73 AMATEUR RADIO

JANUARY 1977
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73

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COVER: The Kenwood TS-700A 2m all mode transceiver. Photo by Ed Crabtree.

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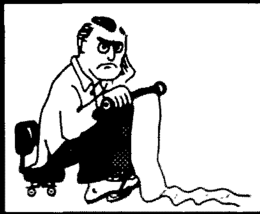

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

Are your club meetings so much fun that at least 75% and often 90% of the club members come to each meeting . . . and you have a tough job getting them to go home after the meeting?

Okay, so a lot of clubs need ideas to get things moving. Before I throw some out on the table for you, I want to make sure that I get feedback. If you have any ideas going for your club that I don't mention, please do all of us a favor and send in a letter telling us about it. If some of my ideas perk things up, let us all know about that, too.

One of the functions of a ham club these days is to help recruit more hams. This means that all members of the club are delegated to do all they can to interest newcomers . . . getting out to CB meetings, giving talks at high schools, seeing that there are posters on the school and electronic firm bulletin boards in the area – and don't forget a poster in every Radio Shack, Lafayette, computer store, or place where CB or ham gear is sold, or where radio parts might be bought.

This process doesn't stop with the sparking of interest. Make sure your club is set to interest these people . . . classes for Novice . . . and then for Technician . . . and General. You might get things started around 7:00 with 20 minutes of code practice, though home practice with code cassettes will be a lot more productive . . . at least 15 minutes per day. Then you want to have a technical talk on fundamentals . . . another 20 minutes should be fine. Don't let these things drag. Start right on time, exactly, and members will be there on time.

Around 7:40 you can have a short business meeting. Have this as well orchestrated as possible . . . reports done quickly by each committee and officer. If there is going to be any argument on any subject, table it until after the meeting and let those interested enough in the subject to stay late and discuss it do that.

By 8:00 you should be ready for the main meeting and brief reports on special interest ham things . . . like what's been doing with DX, SSTV, nets, traffic, ATV, repeaters, the club training classes, etc. It wouldn't hurt to have a report on the content of the ham magazines, with one member reporting on each publication. I am always astounded to find some clubs where only a small percentage of the members are even aware of the material we have been publishing in *73* . . . I know there is little communication within that club. An amateur not getting *73* is losing a lot . . . the inspiration of the building articles . . . the knowledge of the state of art . . . the fuller picture on what is really happening with the FCC, the ARRL, the ITU, and so forth. And what a shame to miss out on an enormous library of articles on every ham subject. You never know when you are going to get fired up on RTTY, say, and desperately need to get caught up on it . . . so where are your back issues?

Keep the reports fast-paced and try to get to the main speaker by 8:30 (let him know your schedule so he won't have to sit through the business meeting if he is a visitor). Who can you get? Well, the club members with special interests are your first line . . . an SSTV demo and discussion . . . RTTY, microcomputers, DX talk . . . you know who your special people are. Going outside the club, you can tap ham manufacturers . . . they will go a long way to bring their latest product and talk about it.

How about DXpeditioners? They have interesting movies or slides and will get your club fired up for its own DXpedition (which isn't all that impossible, by the way). A local ham dealer will be glad to tell you of the problems and joys (which are few) of his business . . . and answer questions. Don't forget the contest fanatics, or the certificate hunters.

By 9:30 you should be ready for doughnuts and coffee or cider for about 15 minutes, then back to another short meeting to discuss club projects such as Field Day, emergency net plans, contest plans, special events. After that you can get to the tabled discussions until members start getting ready to go home. It is most helpful to try to put as much of the business which might drag on into a committee and keep away from whole club discussions. Oddly enough, members get all involved with very small matters (what color to paint the clubhouse) and argue for hours . . . seemingly enjoying themselves. But then they don't show up at any more meetings.

It's nice to leave a little time for members to lie to each other and (in general) talk at the end of the meeting. Those in a rush can get home – others can talk. Kick the last of them out by 11:00 . . . if they want to talk more they can go to a local pizza joint or something. This makes a nice windup for the evening.

Some clubs organize a dinner before the meeting at a nearby restaurant in the reasonable category. This is fun for those who enjoy having more of an opportunity to talk. If you get this going by 6:00, most fellows will be able to either make a short stop at home on the way or else go right from work.

Oh, and don't forget to have any members who get a new piece of ham gear bring it in and tell about it.

HOW TO TREAT SPEAKERS

If a speaker is coming in from any distance or is a special person of some sort, it wouldn't hurt to ask him out to dinner with a few members of the club before the meeting. This will give him a chance to get to know a little more about any special interests of the club – ask questions – and give enough information for a decent introduction.

Speakers should, in most cases, have their expenses of coming to the meeting reimbursed – particularly if it is a big deal for them. If you are flying them in, you'll meet them at the airport and red carpet things.

Many manufacturers will go to amazing lengths to help you out if you only contact them. I know that Ed Clegg has driven or flown hundreds of miles to talk with clubs, and many other ham manufacturers will do the same.

GETTING PUBLICITY

If you go to all the trouble to get in a really special speaker, you don't want a meeting with a couple dozen dozing members – you want to fill your room. Just passing the word over the repeater won't do it. Your club should have someone in charge of publicity . . . preferably someone who knows how to make posters, either with magic markers or via silk screen. Be sure that you have posters well ahead of time on every possible bulletin board . . . and club members should be able to tackle this. Supermarket bulletin boards, high schools, colleges, every Radio Shack within driving distance, Lafayette stores, CB watering holes, parts stores, ham stores, shopping malls . . . etc.

Posters are only the first step. News releases to the local papers and broadcasting media can help, too. Next you want to be sure the info is in the club newsletter . . . on the repeater a lot . . . on any low band nets . . . then try

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LETTERS

REFUNDED IN FULL

Re Trigger Electronics: 8 years ago I was the proud owner of a Novice ticket and wanted to assemble a commercially-made CW xmtr for my shack. Trigger had the kit I wanted for sale and I innocently sent off the money. What arrived, however, was *not* the kit advertised, but the same rig, fully assembled, and *used.*

I was extremely disappointed and fired off a letter to Trigger. After several additional letters and having received no satisfaction from Trigger, I told them in a final letter that it was either my money back or I would send their ad (in *QST*) from which I ordered the kit, together with their sales slip and a letter of explanation to the ARRL, requesting that the League arbitrate the matter.

This prompted Trigger to refund my money in full.

I no longer subscribe to *QST* and don't know if Trigger still places ads in that monthly, but the moral seems to be: If Trigger is playing a number on you, hit 'em where they advertise!

D. Nevin WA1KLB
Northfield VT

73 is forwarding all Trigger complaints to the Illinois Attorney General for action. – Wayne.

IL VS TRIGGER

This office has on file material relating to complaints made concerning Trigger Electronics. This letter is to inform you of the status of our case against Trigger.

An amended complaint was filed against Trigger on October 8, 1976. In addition to an injunction against further advertising by and against continuing in business, we are seeking the appointment of a receiver to marshall such assets as the owner, Mr. Irael Treger, may still have, which would then be paid out *pro rata* to all persons who have complaints on file with this office.

It will be some time before the case will go to trial and, of course, we can promise no favorable results. Please be patient, however, since we hope for progress in this case soon.

Finally, I would appreciate it very much if those of you who have filed complaints would do the following:

1. If you have moved since your complaint was filed, please inform me of your new address.

2. If Mr. Treger has made refunds to you or shipped merchandise ordered by you, please inform me so we can present up-to-date files to the court when the time comes.

Thank you very much for your cooperation.

Jonathan T. McPhee
Consumer Fraud Division
Attorney General
State of Illinois
134 N. La Salle St.
Chicago IL 60602

BAIT AND SWITCH

Yesterday I called Moory Electronics Company in DeWitt, Arkansas, in response to an ad on page 174 of the October *QST*. They had a number of specials listed, including one for a "demo Ham-2 rotor – $99." When I asked about it, the young lady who answered the phone informed me that it had been sold long ago and probably had left their place of business even before their first ad came out about it. However, they could supply a new unit for only $129.95 if I would place an order. The young lady I talked with further admitted that the ad was intentionally left in because it attracted lots of attention and got them in touch with many hams who might otherwise call a competitor. I did not buy anything from this company. This type of advertising is illegal in Colorado and is known as bait and switch. It consists of advertising some product at a low price and then when a prospective buyer shows up, the salesman informs him that the store either had only one of a kind in stock and that one was sold or that the advertised item is inferior in some way and should not be considered; HOWEVER, for only a few dollars more we have . . .

This incident and stories of problems that other hams have in regard to Trigger Electronics lead me to believe that we need protection from the mail order business. By we, I mean not only the prospective buyer, but the legitimate dealers who are trying their best to make a living and give fair and honest deals, too. Some possible solutions come to mind.

1. All amateur radio magazines should refuse commercial concerns advertising space in the classified sections of their magazines.

2. All commercial concerns advertising in a magazine should have to file an affidavit that they do indeed have a reasonable number of the advertised special in stock to meet reasonable demands. One of a kind specials should be discouraged, especially if they are likely to be sold out before the magazine reaches its readers.

3. We have groups of hams working as official observers, intruder watch, etc. Perhaps one more group could be formed for consumer protection. They could arbitrate legitimate differences between buyers and vendors and report unfair practices to each publication. Then each editor would have the option of stopping the unfair advertising practice.

There are probably other solutions and ways to handle this unfortunate situation and I would like to see them discussed. I would hope that there would be input from both prospective buyers and the merchants who make their living through pages of amateur radio publications.

Royal R. Maxwell WA0QFY
Craig CO

NT7HEL

How do you have fun and gain rare status at the same time? Get a Special Events License! For our Helldorado Days Celebration of 15-16-17 October, I was issued NT7HEL. In 33 hours of operation, two friends – Dale AD7RDG and Don AD7NEQ – and I made exactly 1001 contacts. It was almost a continuous pile-up! I made the mistake (?) of turning the beam west to pick up a KH6 on 15 meters and half the hams in Japan jumped us. We worked 90 in one hour and 5 minutes of the heaviest pile-up I've ever seen. We had to break them down into individual prefixes: JA1, JD1, JG1, JH1, JI1, JJ1, etc.

Now the fun is over and the cards have started to come in. And I'm learning. When I gave out QSL information I requested an SASE since this is all coming out of my pocket and I could see a thousand 13¢ stamps coming out of the budget. Out of 192 cards received so far, 25 failed to provide an SASE. Those go to the bottom of the pile.

An even bigger surprise has to do with the time a contact was made. I thought that Universal time was universally used. NOT SO! 7 cards didn't show any time. To the bottom of the pile with them. 42 cards either used local time or used Universal incorrectly. There must be more time zones in the USA than I thought, because some of the abbreviations haven't been figured out yet. What's PMEDT? Some contacts for the evening hours show the correct time but the previous day – failure to advance the day when 2400 UTC passes. You ought to put together a short article on the use of UTC and urge everyone who works over time zone lines to use it. I'd do it myself but I'll be on the road for the next four weeks.

It really was a ball and I'm looking forward to the next one. If you could use an article on the operation of a Special Events station, let me know and I'll knock it out when I get settled down again.

Rod Hallen AA7NEV
Tombstone AZ

P.S. I'm a stamp collector, so envelopes with commemorative stamps are always processed first. Some QSL cards are very hard to decipher. The cards that have the boxes to fill in on the front are the easiest to read. Some of the cards with the report on the back don't leave much room to write, which makes it hard for the recipient to read. Also annoying is having the call on one side and the report on the other. Little things, but they add up when you have a lot of cards to process. I'm much more in sympathy with QSL managers and DX stations. I'm going to redesign my own card and get some printed soon.

MORE YASME

This is a report on the successful YASME DXpedition by Lloyd and Iris Colvin operating on St. Thomas, US Virgin Islands as W6KG/AJ3.

Including operation in the phone portion of the CQ-WW-DX Contest, some 6,800 QSOs were made. Operation was from 8 October through 31 October 1976. QSOs were made with radio amateurs in 125 different countries. Conditions were better than normal and it appears that the sunspot cycle must indeed be on the upswing. For example, WAC was made on 7 MHz on 18 October in 3 hours and 50 minutes. Stations worked were 4X4GD, VK1RM, G3ZDW, W2PN, PY1NEW and CN8AD. On 27 October, WAC was made on 14 MHz in 60 minutes. Stations worked were ZS1XR, OE1UZ, VK2QL, UI8IZ, W1BFT and PY1EUM.

Lloyd Colvin W6KG
Iris Colvin W6QL
Beef Island

THE OPPOSITION

In one of your recent columns, you asked for some input from your readers on the constant argument of ICs, computers, etc., vs the more traditional ham equipment and activities. I think enough of your magazine and your viewpoint to tender my reply.

I must side with the opposition. I'm still struggling along with my WN callsign, and 15 wpm seems to be an impossible dream. To read articles on keyers capable of 60 wpm, rotator brakes, etc., just turns me off. And though your magazine is by far the best I've seen regarding articles for amateurs who are either Novices or new Generals, I don't like the trend I see toward more and more of the esoteric.

Maybe I am expecting too much, but what I need is help in the basics: How do I put out a readable signal when I am a renter (no beam antennas on the roof, no 250 foot long antenna wires out of the window), using the only equipment available to me (a transmitter no one else has ever even heard of, a Globe DSB-100, and an Allied receiver that more or less works, sometimes, I think, maybe?), and when I must compete with $2000 rigs that put out more Watts than my rig could generate in the destruct mode? And I can't help but feel that many other hams find themselves in the same fix. Those of us in this fix don't need articles on a super wide band antenna built at reasonable cost (who says $100-$200 is reasonable?), when that antenna requires 300 square feet of unobstructed land. What we need is an article on how to make do with a homemade 30' vertical that is standing in the middle of my tomato garden, the only spot open for it. Loading, swr, radiation pattern . . . ? I don't have any idea, and really don't care, because it is all I have, and it has to make do. But why won't someone tell me how to make it work better? Every antenna article I've ever read, in *73, QST, Ham Radio, Antenna Handbook*, etc., starts off on the unstated premise that the interested ham has unlimited funds and ½ of Kansas at his disposal to play with. But it just isn't so!!

Regarding the argument about ICs . . . yes, I agree they are the thing of the future. As surely as transistors pushed out tubes, ICs will soon be the *only* thing. I'm sort of sorry to see them go, but it will happen nonetheless. But granting this, that ICs are here to stay, does it follow then that every application of ICs should be of interest to hams? I refer, of course, to computers, microcomputers, microprocessors or whatever. To my mind, this entire field of computers is separate and distinct from ham radio — perhaps related and perhaps useful, but distinct nonetheless. I respect your interest in the magic boxes, but it isn't for me and I rather resent its intrusion into a ham magazine, except if it is directly applicable to ham radio.

Along this latter line, let me tell you one more peeve I have. Your magazine (and many others as well) keeps showing articles on computers that can call CQ, answer calls, log the entry, dump the contact if it's a duplicate and in general handle the entire contact except for a few blanks the operator must fill in, such as RST reports. My question is this: What is ham radio all about? Where is the dedicated amateur, twisting dials, fighting QRM, and sharing contacts with other people? If I want to have a computer do my contacting for me, I pick up my telephone. My ham gear is for fun, people-type fun, not machines. Sure, the computer is more efficient, but is it ham radio? I personally hope not. This is one of those situations where progress may be at too great a price, a price paid in the loss of personal contact, personal exchange, and loss of a great heritage of people dealing with people.

I'm sorry I rambled on, Wayne, but as I said at the outset, your magazine means something special to me, and I felt it worth the effort in writing all of this to you.

Keep on pushing for hams and ham radio. Your voice calling in the wilderness will be heard; such voices always are, eventually.

John P. Cranston, MO WN2DYU
Corning NY

P.S. Along the same lines, why is it that amateur gear is so expensive? The units are mass produced, are not especially complex, and yet are offered at prices that are virtually unreachable. An antenna made up of $10.00 worth of aluminum, a few dollars of hardware, and based on no exotic research, is marketed for 50+ dollars. Transceivers are outrageous, accessories untouchable! Who is playing whom for the sucker here? How about a voice for the ham who doesn't have a multi-hundred dollar budget for his hobby, crying for a good but simple and inexpensive unit, without all the frills and gadgets, but functionally sound (I for one am still quite happy reading dials, and can really see them as well as I can see LEDs glowing their pretty $$$)? Thanks again.

Ham gear expensive? Hmmm. There are several reasons, and perhaps this will be of interest. First, let's take a quickie back through memory lane to 35 years ago. I ran across the invoice the other day for my T-125 tube — $12.50! To put that into perspective, I was working a 45 hour week at the time and making $40 as chief engineer of a broadcast station. That 125 Watt tube cost about one third of a week's pay. The crummiest receiver available, the Hallicrafters Sky Buddy, was about $20 — half a week's pay . . . and it was pretty poor. How much does the chief engineer of a 1000 Watt broadcast station get today? Probably over $300 a week, so you compare value of ham gear then with now. Okay, now as to how the figures mount up. First comes the matter of the cost of designing and prototyping the circuit — then the mechanical parts which have to be made specially — have you priced cabinets recently? The manufacturer has to count in the cost of parts, of following up on the parts orders and trying to get delivery, of storage space and inventory control of parts, of testing and returning bum parts, of phone calls and letters trying to get replacements for bum parts, of salaries for the people to do all of this, of getting PC boards made, of checking them on delivery, of assembling the equipment, testing it, having the package designed and made specially for the equipment, packing it, writing the instruction books, having them published, writing the advertising, the cost of ads (which is not insignificant), answering letters from customers, writing and publishing specification sheets and booklets, overhead of the building, heating, telephone, payroll taxes, management costs, banking costs, Master Charge commissions, 25-40% extra for the dealers, 10% for the manufacturer's representative, maybe a little profit for the manufacturer, shipping costs of everything involved, costs of repairs and the records and bookkeeping involved, support of an accounting firm and their dependents, support of at least one lawyer and his firm, his telephone, etc. It mounts up. Did I mention the costs of attending conventions? Only mighty rough competition keeps the costs of ham gear from going out of sight — the fact is it takes a very tight-fisted firm to compete and no one that I know of is getting rich. — Wayne.

MORE OPPOSITION

In one issue — or two — of *73*, you asked for opinions on the I/O portion of *73*.

I have approximately every copy of *73, CQ* and *QST* for the past 23 years. I have dropped *CQ* as of 2 years ago; I will drop *73* whenever the subscription expires. I like the radio portion — always have — but the I/O section I consider a poor "filler." It takes the place of ads of amateur radio gear — and articles.

I am not against learning something new as you implied to anyone beefing against this crap — but simply confine my interests in solid state to communications items. I would enjoy advertisements much more. As it is, most advertisement is for I/O parts and associated trash — very little radio! Why claim a "radio magazine" when over 60% is totally unrelated electronics? Along with the change of size and format, why not change the title to reflect what it really contains? It isn't amateur radio!

N. P. Walker W5GOS
Midland TX

CQ 11m?

To: Federal Communications Commission
CB and Amateur Department
Rule Change Section
Washington DC 20554

Re: Petition to Change Rules and Regulations. Proposed rule and regulation change permitting amateur use of the 11 meter CB band and other CB bands; requiring amateurs to abide by all CB rules and regulations; permitting the use of amateur station callsign, rather than the CB callsign.

Dear Sirs:

This is to request a change of rules and regulations permitting the use of the 11 meter CB band and other CB bands by amateur station licensees, subject to all CB rules and regulations. The only change would be the use of the amateur station callsign rather than a CB station call. Rules for obtaining a CB license, in this instance, would not be pertinent, since license was obtained in an amateur manner. Amateurs, when operating in the CB bands, would be considered CBers as far as International Treaty or the like. All classes, Novice through Extra, would be affected. Commercial use of the amateur callsign in this instance would not be prohibited.

Discussion *PRO* change of rules:

1. Amateurs will act as "goodwill ambassadors" possibly encouraging a certain portion of CB operators to become hams. This would be a positive effort to aid the FCC in the control of the "CB problem." Hams are on the "FCC side" and are of positive help and aid.

2. Change of Rules and Regulations would pose no problem in implementation and cause no additional government cost for administration.

3. Approximately 280,000 less CB callsigns would be necessary to be issued by the FCC — a saving in government operating cost. (There are approximately 280,000 hams.)

4. In keeping with the stated FCC policy of "deregulating hams."

5. Historically the 11 meter band was a ham band — such a return is feasible.

Discussion *CON* change of rules:

1. I can't think of any disadvantages or con — the change of rules and regulations is positive and constructive.

Please acknowledge my petition — then let me know your decision.

John K. Lassig K5GFV/W5IOV
2025 Bingle Road
Houston TX 77055

LOW PRIORITY

Another childhood illusion shattered — namely that if you get ripped off via the mails that Big Daddy will make it all better.

About one year ago Environmental Products went down the drain. They had an excellent newsletter that I had subscribed to. One of the surviving principals offered through the mails to keep the newsletter going. I sent money and got nothing in return. After a decent interval of waiting (some six months), I entered a formal protest with the proper postal authorities.

My notification of the ripoff went to the Postal Inspector in charge out in Denver CO. One grand hell of a time later, this gentleman finally notified me that a United States district attorney had investigated the firm and had "declined to prosecute." I was further advised that I could write to a Mr. John R. McKown in Colorado, who had indicated that he would stand good for the loss. To date nothing has been heard further on the matter.

Perhaps if you were a large company who had access to a legal staff to

press the matter of why a mail ripoff is allowed to go unprosecuted, you might stand a chance of making recovery. As a lone individual, it seems that Uncle Sam really does not care. If you do not pay your taxes, that is one thing . . . if you look for some service for your tax money, evidently that is a matter of a much lower priority.

Allan S. Joffe W3KBM
Dresher PA

THE HFers

Lots of activity on 11 meters out here — both in and out of the band. Most any evening I can find 6 or more QSOs between 27.255 and 27.500, on SSB mostly. Heard one fellow brag about his new $850 imported SSB rig on 27.400 — didn't seem to know he was illegal as all get out. Several times I have found SSB QSOs in the low end of ten meters. All I can do is tune up and call CQ on CW — seems to discourage them for several days. Is there any way to talk to them within the law? I think they would be happy to start classes somewhere if they could without any hassle or someone putting them down. I think we who communicate by radio need a "common band" where anyone can operate regardless of license class — maybe our ham tickets could be made to include some operation on 11 meters. If these people sat in on a net once or twice they would see that a ham ticket is worth its weight and a very desirable thing to have.

That's all for now. My pen still can't spell but I keep trying.

John E. Winter WB6EUK
Garden Grove CA

KUDOS—HEATH

We hear a lot about dirty deals hams get from the different dealers. No doubt they get comments which reflect the abuse felt by those who resent it the most, but we are taking for granted the good treatment received from the majority of the dealers. A case in point is as follows: On March 15, 1976, I ordered an HW-101 from Heath and did not get around to putting it together for four months. About six weeks ago I got out the kit and started to put it together, since I was unable to previously due to college work.

I found at first that the mode switch was defective as it had one of the wiper contacts missing. Having an assortment of switches, I robbed one of its contact and restored the switch, but wrote Heath about a new switch so I wouldn't have to worry about it later. In less than 10 days a new switch arrived, no charge. Then I found a bad carrier oscillator crystal which they also promptly replaced; in fact, it was removed from one of their working units (a prototype, probably) so I wouldn't have to suffer a six week delay when ordering a single unit from their supplier!

I've built the SB-102, SB-200, Heath wattmeters, scopes, tunnel dippers, transistor checkers, etc., and outside of one other bad transistor, they've been 100% good. Then to receive replacement parts after the warranty period has expired is uncommon and laudatory.

I also commend them on sticking with the amateur fraternity when other manufacturers have moved to some specialized part of communications which provides a quicker cash profit.

So when it comes time to relieve the pressure that has been building up in some little bank account somewhere, we should remember those who've stuck with us and provided good service through the years. When other manufacturers and dealers begin to realize that good service attracts good customers, perhaps the practice will spread. It should be encouraged!

Now . . . how much was the HW-104? Hmmm!

Robert B. Lunsford, Jr. WB5QGI
Killeen TX

REFLECTIONS

Thanks for your article, "Exploding The Power Myth," in December, 1976 of *73*.

For approximately a quarter of a century, off and on, I have studied and restudied reflected power. It has always bugged me, as I have never been able to grasp how power can be reflected backwards. As the articles I was studying came from such reliable sources as the ARRL and college textbooks, I felt I was lacking in mentality and ready to turn in my EE degree and Mensa pin. When *QST* carried a lengthy series of 3 articles on this subject about a year ago, you know I was upset when I was confused once again.

However, I do believe that you, through *73*, have started to set the record straight . . . there is no such thing as reflected power. I hope the ARRL corrects its publications.

William Richrath K9IEN
Elmhurst IL

APPLES 'n ORANGES

Thanks for forwarding me a copy of the *HR* article of August, 1976 by W2DU which talks of coaxial dipole antennas and mentions my *73* article of June, 1973. I don't subscribe to *HR* because it often seems to be just an outlet for frustrated theorists who can't publish in *QST*.

The need for W2DU's ungentlemanly and inaccurate footnote escapes me. He tries to sound very professional but he is comparing apples and oranges. My *73* article was mainly a practical construction article of 2½ pages (old, small page size) while he presents a rambling 14 page (new, large page size) mathematical exposé which concludes that the advantages many amateurs found in practice for the coaxial dipole configuration are not theoretically supportable. His statement that I said 50 Ohm transmission line "must" be used is incorrect. I said one should use 50 Ohm line because of constructional convenience.

He clouds a possibly better understanding of the antenna systems we use — which any open-minded amateur would welcome — with arrogant insult to other amateurs who have experimented in the antenna field. I am surprised the editor of *HR* would accept such material.

John Schultz W2EEY/K3EZ
73 Magazine Staff

AWE AND RHAPSODY

I well remember evenings and weekends spent in awe and rhapsody over many a back issue of *73*, some going back to 1960 and 1961, when they were 37¢ (two for 73¢!). The excitement was heightened all the more by the undergraduate pressure of hard study, nagging me that I should be doing something else . . .

But those days were vividly recalled as I paged through the histories, biographies, and thought-provoking fictions in your November '76 issue. Back came some of the previous stories I'd seen on the wildly imaginative but forgotten genius Tesla — aided by that wonderful high-voltage explosion of sparks in the photograph. Perhaps the best service Harry Goldman did for both Tesla and myself was the extensive bibliography attached to the article. I'm glad *73* hasn't let this man's energies go loose in history and has kept up with his founding work on ac electricity.

Then there's Ken Cole's marvelous account of his experiences in WW II. If there was an award given for the best amateur radio magazine article of the year, "Paolo" should win it. Cole's style kept up the haunting mistiness of the whole adventure, while the photos drove home the realistic tensions of the war. Human interaction, across "enemy" lines, an interest in radio as a hobby, and history all very well interwoven into a readable, believable account.

Rexford and Emelie Matlack's research on "The Quiet Spy" came through well as the story unravelled — newspaper clippings and photos from old magazines added to the realism. I think this kind of work is not a sick kind of return to the nostalgic "good old days," but rather a service to younger hams who can begin to appreciate the obvious richness and diversity of service (and fun) the hobby provides.

And along those lines, Howard Burgess' notes on pioneer efforts directly related to amateur radio seem to pull all these human interest/historical stories into the present: What can we, as experimenters, do *now* with our knowledge and inherent bent for fooling around without strict recourse to the sometimes stifling methods of science? After all, it's usually the amateur generation who break from the past and make new discoveries — if you need a source of these freer minds, look at the work being done in microprocessor control of repeaters or RTTY stations. "Who, Me? A Pioneer?" invites some serious thinking on everyone's part to say yes when all others shrink away from a problem and think you're crazy.

All this and the bodily resurrection of Hank Olson's S-38 too! The best thing to do with that beloved excuse for a receiver is to dump it into the bay or the harbor, depending if you're still in San Francisco or near Boston.

An excellent magazine, Wayne.

Rick Ferranti WA6NCX/1
Cambridge MA

P.S. Was that really you on .52 a couple of weeks ago, mobiling on the way to Tufts Radio? I moved out to this area a month ago for the even more dreaded occupation of graduate school, and found Tufts Radio to be an excellent and friendly place to spend my rapidly dwindling cash. As you may suspect, I have another article in preparation to help alleviate that situation!

Yep, 't was me . . . and thanks for the nice letter. — Wayne.

JAMMING

Congratulations on a fine magazine. Really enjoy your articles over *QST*; they are well-written and easy to understand.

Please find enclosed my check to cover my subscription and a tape.

I only have one complaint. I was listening around 3960 the other night and heard something that made me sick. K6GBG was in QSO with a friend and some jerk jammed him unmercifully. I am wondering what has happened to ham radio. I haven't yet seen a rig without a knob to change the frequency.

If you hams are as proud of your ticket as I am of mine, you will abolish this kind of activity on our bands (the jammer wouldn't even give his call letters).

Thanks again for a fine mag and a great hobby.

G. D. Ross WB7EBA
Medford OR

THE GREEN PHILOSOPHY

Here is my 3 year renewal to *73 Magazine*. At 18 dollars it is a real bargain.

Here also are a few comments that may be of interest to you. I must reluctantly say that *73 Magazine* is probably about the best of all the ham and "popular" types of electronics magazines. I wish I could say the same for its publisher. I often get the

feeling that *73* has, and perhaps always was, more of a personal journal than a vehicle for other hams than yourself, though it is that, too — even if not entirely intended that way. It's sort of a soapbox for you, on which to vent your feelings, espouse causes and screech at the top of your lungs on anything and everything that catches your attention and/or fancy.

As long as I'm at truth saying, I may as well add that there are times that you sound pretty much like a NUT! At other times you are a genuine All American Ham Hero. I've been in ham radio long enough to have followed your career from the start at *CQ Magazine*. You are, to say the least, unpredictable and ruthless to a large degree. You have had failures along the road but all have led to your current success, which is very probably the envy of many others who might have dreamed of doing the same that you have done, or, at least, in being in the same lofty position you now hold. You are much like that childhood poem: "When she was good she was very, very good; When she was bad she was horrid."

The big plus on your side is that you have made *73* the best all around ham magazine. So I am going to stick to *73* and let my subscriptions to all the others, including *QST*, drop. *QST* once was a marvelous publication, with the best in everything that the ham, or prospective ham, might ever want. The latest in construction — at all levels of advancement. A great sense of humor, especially in those once delightful "Strays." Unfortunately, the humor, as well as the quality of interesting articles, has pretty well disappeared. The pages of *QST* are filled with bland trivia that takes a great effort to justify in the minds of the average Mr. Ordinary Ham, like me. As for *Ham Radio*, it's OK, but I like *73* better. So for economic reasons I am discontinuing that publication. As for *CQ Magazine*, *the less said the better*. *Popular Electronics* and *Radio-Electronics* cater almost entirely to CB now, so they, too, will have to be discontinued.

I'm truly sorry to hear that you are eliminating most of the computer articles from *73*, in favor of starting up another publication, *Kilobaud*, in which they will all appear. Looks like I will have to do without them for the above stated economic reasons. $15 for that new magazine, plus the cost of *73*, is more than I can afford. So it will be *73* only from now on, much as I regret having to say that. And for the same reason I will be giving up *Byte Magazine*. There you have it. I am sure that my words reflect somewhat the same thoughts many other readers of *73* have about you and about *73*.

Mack O. Santer W2ZPW
Brooklyn NY

All of us were surprised to hear from you that we are eliminating computer articles from 73. As far as being a nut is concerned . . . that's okay with me . . . unless you can show me some sane person who has accomplished anything of real benefit to the world. My basic goal is to bring as much fun as possible to as many people as possible . . . and use this as a way to perhaps move the world ahead just a notch or two as a by-product. My dais is open for business. I use it to express my ideas, but I'm willing to step down for anyone with a piece to write, whether I agree or not. As far as I know, 73 has the only open pages for such matters. — Wayne.

PLEASE—NO AGC!

First, I'll bite again for another of your "rags" (3rd one).

We have cussed and discussed items before. Know you won't remember, but I wouldn't either in your place (too many to remember all).

I will get around to making copies of the USN code tapes I have one of these days. Too much going on here *all* the time. Please redo your code tapes on a machine without agc. The pumping is bothersome.

Add to your Ham Help column: We (The Wiregrass Amateur Radio Club) sponsor amateur classes via George Wallace Junior College. Novice classes run 10 to 12 weeks twice a year, starting September and March. General classes start in September and run 9 months if needed.

This is the way to operate such classes. The college takes care of everything except the actual teaching. The $10 fee keeps out the mildly curious. So far, after 3 Novice classes and 1 General, we have over 30 new hams in this area. Almost an exact double over 1½ years ago. Most of them are ex-CBers. We make sure the local CB crowd knows about the classes. Don't knock them — get them to join.

Roy Dancy
Dothan AL

CROSSED WIRES

I have just finished reading the letters portion of your magazine and was especially interested in the fellow who was giving up ham radio because of snobbishness.

I would like to advise him that I think he is misconstruing snobbishness with successful endeavors. I feel that when he visits some ham, most of whom are fair to well off, he is overwhelmed by the settings and the elaborate equipment, casts himself into an inferiority complex and cannot recover.

The amateur fraternity is on a fairly high plane and while most well-off amateurs do their best to make themselves understood, the evidence of comfortable living is self-evident and cannot be denied. Again, I consider this to be the underlying factor and it makes the newcomer of limited means very self-conscious. It cannot be helped and I know how he feels, for it is somewhat disconcerting to visit and see a lot of gear that goes to a sum of $5000.00 or better.

Maybe some hams puff up, but I am sure that it is pride more than aloofness, and I say that it is something that they earned. So, again, I think that the fellow that wrote in about snobbishness has some of his wires crossed. I know that I, for one, am overwhelmed by some of the new gear that some of my friends have, but I do not begrudge them; I only envy them and try to do better myself.

So that is my answer and I hope that maybe we can salvage this fellow.

Jack Golden WA2YPW
Portville NY

THE GOLDEN HELMET

As an editor, you should know better than to generalize in your statements. As a ham, you don't seem to be very knowledgeable regarding license classification.

You remind me of the Monsignor of an Irish parish who was very perturbed because one of his parishioners was baptized in a Polish church. I do suppose that a difference between 5 and 13 words per minute does emphasize a great intellectual difference in an individual whose cranial capacity seems to greatly exceed the capacity therein.

As a Technician, I couldn't care less regarding the phone part of the 10 meter band. As an amateur, I suggest that you read the amateur's code, parts one and four.

You remind me of the painting by Rembrandt, "The Man in the Golden Helmet," the old warrior dressed in a gilded uniform with only the memories of the past shutting out those of the future. The Technicians have committed much to the prestige of amateur radio, i.e., the 2 meter halo, TVI filters and many others.

Ham radio, because of attitudes like yours and your snobbish caste set, has taken a back seat to CB and has all but vanquished ham supply stores with fully stocked shelves. Fortunately there are still hams with a sense of human values who strive to build up and encourage the art rather than tear it down with their envy. Your name typifies your character.

John B. Swiencicki K2KMU
Parsippany-Troy Hills NJ

Right on. — Wayne.

A FREE RIDE?

Nearly every issue of *73* has at least one complaint about the code requirement (for amateur licenses) in the letters to the editor column. They remind me very much of the sort of complaints we get from students wanting to be relieved of graduation requirements (I teach at U of Ill.). They want to be relieved of the responsibility for language or math or science courses (the "hard ones"), but they still want a degree labeled "Liberal Arts." Their complaints invariably come down to the fact that they consider the courses difficult and want a free ride. Of course, they rationalize their objections by arguing that the courses are not "relevant." More often than not, these objections come from students too narrow to see beyond their immediate wants.

The principal justification for the amateur radio service is that it is a public service. The FCC study guides even indicate that one purpose of amateur radio is to provide a corps of qualified operators for the military and civilian communications systems in times of war. That — obviously — means operators qualified to use the Morse code, because that mode, more than any other, provides reliable communications at low power levels. Note that *all* the military services still use Morse trained operators. A ten Watt "Angry 109" can do yeoman service on CW in conditions that would put most phone stations out of service. Morse code is far from being, as one complaining letter argued, an outdated mode of communication. It works when others will not. I might also point out that most of our public service traffic nets are on CW and that MARS conducts many such nets.

It also is not true, as Wayne Green once argued, that few amateurs still use CW. If he would bother to come down on the CW bands, he would know that they are as crowded as the phone bands, but that most CW operators run 200 Watts or less. The CW bands tend to be a refuge for those operators who want to communicate, but who lack the money to buy the linear needed to compete on the phone bands. They're willing to work just a little harder than those at the top end of the band.

I find it interesting that so many who consider themselves bright enough to pass the electronic written are willing to admit that they cannot learn the alphabet. That is not a high price for the privilege of being an amateur radio operator. It may be a reasonable minimum. As a professor of economics once put it, "The cheaper a product, the less it is likely to be respected, and the more it is likely to be abused."

David G. Boyd WA9GBW
Collinsville IL

MORE WARC

The following are some of my personal observations. On September 29, 1976, a meeting was held between representatives of the CRTPB (Canadian Radio Television Planning Board) and DOC in Ottawa, for the purpose of discussing proposals of how to rearrange the frequency spectrum between 406 and 960 MHz. The submissions of this and further meetings will be used as a guide by the

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Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Let's call this the "putting one's money where one's mouth is" department. For months now I have been telling you all to go forth and try to get your local CBers interested in becoming amateurs, getting them into training programs, inviting them to radio club meetings, offering to speak at CB "breaks," etc. Well, if you are going to try to meet some of the local CBers in your area, there is really only one place to meet them: on their band, their home territory – 11 meters itself. Why not? Eleven meter radios, the 23 channel variety, have been tumbling in price ever since the Commission announced that, as of January, CB would be expanded to 40 channels. In fact, the radio I purchased from one of the local department stores cost me under sixty dollars including slide-in lock mount and antenna with trunk lip mount and coax. I saw it advertised on TV one evening and ran out to purchase one before they were all gone. As it was, I had to wait for the next shipment as the demand was so great. The line at the counter stretched to the door, and this was a chain department store with many such locations. It would not surprise me to learn that this sale alone added over ten or twenty thousand new operators to 11 meters.

Anyhow, after unpacking the radio, I hooked it up to my allband long wire to see if I could hear anything. Hear anything? It was probably 100 deep on every channel other than 9, which is reserved as an emergency channel. Yet, in some uncanny way, a way that I still find hard to understand, people were actually having conversations and enjoying themselves. Squeaks, squawks and heterodynes everywhere, yet QSOs were going on – people interacting with people – very informal and a lot of obvious friendship. Everyone had a "handle," a pseudonym for personal identity, but what was surprising was that all but a few were using callsigns. When someone didn't use his legal callsign, he or she was "jumped upon" by many others. Hmmmmm . . . could it be that CB was changing? Could it be that average "Joe American" was now taking CB over from the hobbyist DXer and that, handles aside, CB was finally growing into what it was intended from its inception? Let's listen a while longer. An actual language barrier existed. I was finding it hard to understand a lot of what was being said; CB has its own "special language" much the same way that amateur radio has. Since I always believe that one should listen before engaging a PTT button, I took my own advice, sat back and garnered the necessary education.

Over the weekend I installed the locking slide mount and antenna on my '66 Galaxie, which in itself was no easy task, this being my favorite of our two autos even though it's older. I already had two such mounts for the two and 220 transceivers, a Motorola control head and a tone-pad to work around. Luckily, the CB radio was small and fit well just above the gas pedal . . . on the dashboard, that is, between the two meter radio and the Motorola speaker. A vacant spot was found on the rear fender of the driver's side and the lip mount discarded in favor of the regular 3/8" snap-in blind mount and adapter for the ASP type thread. Tuning the antenna took about 15 seconds using a Heath VSWR bridge to make the check that found the approximate midband VSWR at 1.2 to 1 and rising to 1.6 to 1 at either end (channels 1 and 23 respectively).

Can't tell you how strange I felt during my first 11 meter contact. It took a while to get used to the lack of formality, besides which I had no handle other than my name and callsign KKU4645. The strange feeling was short-lived though. By and large, the people one finds on CB are like the neighbors next door. Heck, in many cases, they *are* the neighbors next door. With few exceptions, the people I have met on CB have gone out of their way to make me feel at home with them. At first I kept my interest in amateur radio low profile . . . just being one of the guys . . . one of the voices on the radio. This didn't last. I became involved in many a contact with CBers talking about "moving up" (no pun intended) to amateur radio with specific interest in two meters and FM repeater operation. You have no idea of the impression it makes on a radio-oriented non-amateur to hear a demonstration of the coverage of a good FM repeater. Eyes light up . . . I have seen it happen! So far, the CBers I have met out here in LA who want to get their amateur licenses have no interest in CW, and cannot understand the need for it when all they want to do is talk. Many would be hams right now if not for that obstacle.

So far, in the few weeks that I have spent meeting the members of our local Citizens Radio community, I have been quite impressed by the dedication of many of them. Sure, they have their problems – jamming, malicious interference and, unfortunately, a bit of profanity on the part of a few "channel hogs." Basically, they suffer many of the same problems we face in amateur radio, only down on 11 meters the problems are greater due to the greater number of radios in use, the greater number of users of the spectrum, and therefore the chance for a greater number of "flaky" people to be part of the service. Simple math . . . the more individuals, the more chance for problems to show up. Interestingly, though, it seems that self-policing is starting to develop within the service, at least where I live; those who break the rules of CB etiquette are dealt with by their peers.

As things develop, and as I gather more information, I will pass it along. However, I am convinced that CB radio and its users are the best resource we have to tap for the growth of the amateur service. Many, not all, but many, CBers would like to get an amateur ticket if only amateurs would get off their "high horse" and offer a needed helping hand to those asking for it. It hurts when I hear about CB people going to local hams for assistance in that direction only to be met with a look of indignation and "get lost, who needs you" attitude. Put yourself in the other guy's place . . . how would you feel?

Oh yes, my lack of handle was also short-lived. While checking out the CB radio, I enlisted the aid of a fellow amateur, Charlie WB6SKM, who also possesses a CB radio. Charlie promptly christened me "The *73* Man" . . . well, what else?

While getting a CB radio as I did and taking amateur radio to the CBer was one way, there are other ways of getting the interested CBer to take the next step. A recent, well-publicized event here in Los Angeles was another way. Take an excellent producer-director team like Lenore (W6NAZ) and Bob (W6VGQ) Jensen. Add a well-known and talented emcee such as KTLA-TV personality Johnny Grant WB6MJV, an expert audio engineer like Bill Orenstein KH6IAF/6 with extremely fine equipment, and a bit of help from KHJ radio's Jim Davis WB0SQP/6 to set up and handle audio. Continue with an introduction using Dave Bell's new film, "Moving Up To Amateur Radio," which in itself has the ability to captivate an audience. Include a number of experts on different aspects of amateur radio

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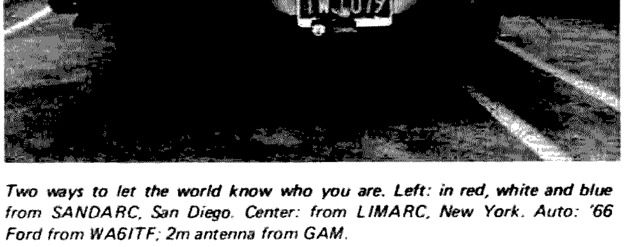
Left to right: Johnny Grant WB6MJV, host of KTLA-TV's "Gallery" show, Lee Goldberg WA6AVP, Mary Stocksdale WA6LUC. (Photo by Bob Goldberg WB6OFO)



Two ways to let the world know who you are. Left: in red, white and blue from SANDARC, San Diego. Center: from LIMARC, New York. Auto: '66 Ford from WA6ITF; 2m antenna from GAM.

BE MY GUEST

visiting views from around the globe

The Largest FCC Raid Ever

Federal marshals and FCC agents raided 19 locations in the Baltimore-Washington area early on the morning of October 27. Confiscated was over 65 thousand dollars worth of equipment used by outlaw SSB CBers. (See "In Pursuit of the HFers," Holiday '76 *73*.) It was the largest single raid in FCC history and capped a lengthy investigation by the Baltimore office in conjunction with the Laurel MD monitoring station. Similar investigations are ongoing across the country, according to FCC sources.

Among those charged with illegal operations were two Novice class amateurs and an alleged ringleader of Maryland CB SSBers. The agents, armed with search and seizure warrants, confiscated extensive membership lists giving call numbers and full names and addresses of the entire Maryland chapter. An FCC spokesman told *73* he expected some further investigations to grow from the lucky find. Station records taken in the raids are being scrutinized in an effort to identify every individual who may be involved and where equipment was purchased.

As illustrated by the accompanying photographs, amateur equipment made up the bulk of the FCC raids. Confiscated were a half dozen linear amplifiers, Heath and Yaesu transceivers, frequency counters, remote vfos, VHF HTs, beams and rotors, along with several ingenious CB rigs. One unit was reportedly set up like an ordinary CB rig with a frequency counter slung underneath. But when you switched on the ANL, the counter would indicate frequencies between 10 and 11 meters, and the delta tune became a vfo!

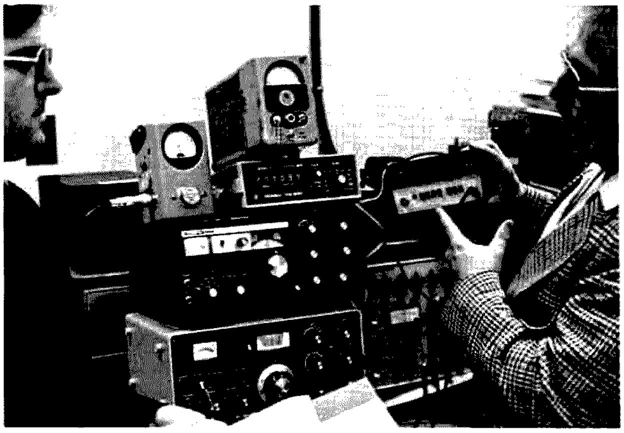
The FCC in Baltimore is conducting an inventory of all the equipment and taking technical measurements to determine exact frequency range and output. Serial numbers are being checked through local authorities to determine if any of the gear was stolen. (Amateurs in the Baltimore-Washington area who are missing gear would be wise to contact FCC Baltimore.)

All 19 CBers raided face federal charges carrying penalties of $500 dollars per day, per offense, and one year in prison and a $10,000 fine for the unlicensed use of CB or amateur radio equipment. Federal judges will decide what happens to all that equipment; it could go towards fines, be declared contraband, or end up on a government surplus list. In any case, it seems likely some of the equipment could go to charitable organizations, and show up on 20 meter SSB in the hands of a missonary, handling phone patches.

Incidentally, it was not the work of hams that led the FCC to the outlaws . . . instead it was the old Tennessee Valley Indians, plus what one FCC official termed massive interference to business radio, and local, state and Federal government radio users. Those are the same tracks that have led FCC teams to SSB outlaws in other parts of the country . . . and the same tracks that are being followed somewhere else as you read this, where would-be hams are taking the easy way onto the air.

Warren Elly WA1GUD
Associate Editor

A room full of confiscated equipment. Robert Mroz, Engineer in Charge, FCC Baltimore (left), and Assistant Engineer in Charge Donald Bogert (right), in the midst of their cache.



Some of the gear undergoing testing; note power output of 80 Watts and frequency of 27.9099 MHz.

Some of the modified CB gear confiscated in Baltimore-Washington. Note the external switching arrangements which allow out-of-band operation.

Dead Within A Decade?

Part 97 of the FCC Rules and Regulations has been changed so much in recent years that most amateurs are not completely familiar with existing requirements. Even those of us who teach licensing courses have trouble keeping up to date with the latest changes. It is my opinion that very few of the recent changes will benefit amateur radio and that many of them will harm our service. Simply stated, I do not believe amateur radio is strengthened by weakening the rules and regulations under which we function.

It has long been obvious to most of us that the FCC does not intend to clean up the mess they have allowed to develop on the old 11 meter band. It appears to me that the FCC is hoping to alleviate some of the present CB problem by easing as many CB people as possible into amateur radio.

I believe our ARRL has been duped into helping the FCC clean up part of the CB mess. I can understand the League supporting a program to produce more amateurs; this is reasonable. However, I find it very difficult to believe that our League cannot see the danger to our amateur radio service. Listen to CB and make up your own mind how "beneficial" these people will be to amateur radio.

I have taught amateur licensing courses every year since 1948. I have had as many as 1,000 students at a time. I have had an increasing percentage of CB people in my courses since 1957 and the current percentage is usually about 30%. It has always been my experience that students with CB background are the least likely to stick it out and earn an amateur license; their dropout rate is about double over the rest of the group. Fortunately, we have had many ex-CB operators develop into extremely good amateurs who are a credit to the amateur radio service. Unfortunately, most of them have been unable or unwilling to shake their bad CB habits and this is bad for amateur radio. It has also been my observation that very few CB people are seriously interested in becoming amateur radio operators. The objectives, backgrounds, and philosophies of amateur radio and CB are radically different.

I do not believe we need to greatly increase the American amateur radio population to safeguard our frequencies at the 1979 World Administrative Radio Conference (WARC). Amateur radio has realized its most significant gains at times when we had very few amateurs. To the best of my knowledge, all WARC position papers were required to be submitted in mid 1976, so any upsurge in the American amateur population (between mid 1976 and the 1979 WARC) will not appear in those papers. Common sense further discredits the present "safety in numbers" approach. Basically, each country has an equal voice at WARC. This means that a country with hundreds of thousands of amateurs has the same voting strength as one with only a handful of amateurs. Since our country has one of the largest amateur populations in the world, it appears reasonable to me that the major objective should be to increase the numbers of amateurs in other countries. Our voting power at WARC will not increase one iota if we double or triple the number of amateurs in our country; please don't be gullible enough to believe otherwise.

My thoughts on this matter are summarized in this paragraph and I hope you will take the time to arrive at your own decision. I am opposed to recent FCC changes which I believe will seriously degrade our amateur radio service. I believe that FCC deregulation of amateur radio can lead to disaster. I do not believe the CB mess will be significantly reduced even if many of them are absorbed into amateur radio. I think the CB mess must be dealt with on its own by the FCC and that Congress should fund the FCC to do this major job. I am firmly convinced that converting any significant number of CB people to amateur radio will degrade our amateur radio service. I do not believe that a large influx of new amateurs is necessarily beneficial to amateur radio; it certainly cannot replace continuing quality performance of existing amateurs serving the public need.

If the present trends continue, I have no doubt that the amateur radio service (as we presently know it) will be dead within a decade. I hope this does not happen because I believe the amateur radio service is of great value to all the peoples of the world. If I did not believe this, I would not spend 20-30 hours per week helping new amateurs get started.

If you decide that our amateur radio service is in danger, please take action to eliminate the problems. I believe it helps to send ideas to the FCC, Senators, Representatives, House/Senate Communication Subcommittees, ITU/IARU, and ARRL. I have been writing for years and I would greatly appreciate some support. I do not believe it is too late to save our American amateur radio service, but it appears obvious to me that it will die if most amateurs fail to wake up and take action. We are communicators; let's pass the word before it is too late!!

Bob Welsh W6DDB
Burbank CA

Reprinted from the LERC Amateur Radio Club Bulletin, *November '76.*

Is There Life On Mars?

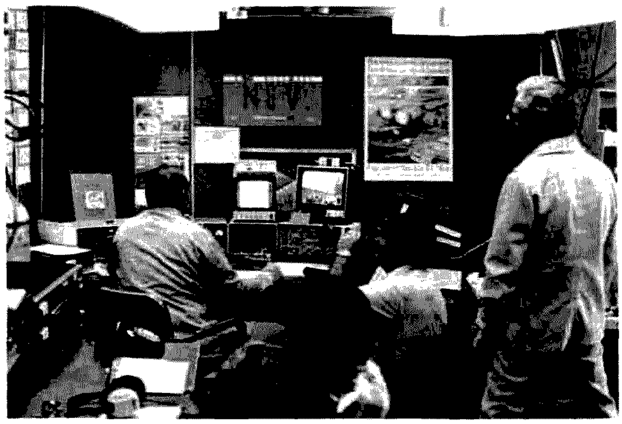
A special event call is issued by the Federal Communications Commission to commemorate some particular event or activity. N6V was such a call, issued on the occasion of the Viking mission to Mars. The significance of the Viking mission (to softland a spacecraft on another planet) warranted an equally significant callsign. N6V was the first modern day 1 x 1 call issued by the FCC to an amateur radio station. The Jet Propulsion Laboratory Amateur Radio Club, W6VIO, is proud to be its owner. We owe many thanks to the Commission for honoring our request.

N6V is the third in a line of commemorative calls issued to the JPL Amateur Radio Club. WP6JPL was for the Apollo 16 mission, and WS6MVM was for the Mariner Venus Mercury mission (Mariner 10). Over the period from June to November, 1976, N6V became one of the most significant special events ever to be undertaken by a single group of amateurs. The operation united our club more than ever before because a real team effort was required in order to build a completely new station from scratch, and then operate N6V over a five month period.

When the JPL Radio Club undertook this activity, we anticipated an event of a size comparable to our previous special events, 2000 to 3000 contacts. It soon became apparent that we had a tiger by the tail, and would have to work 10,000 or more stations to satisfy the tiger's hunger. Our existing station would not be able to handle the load because of small quarters, high electrical noise, limited antenna possibilities, and poor location (in a canyon two miles north of the Pasadena Rose Bowl). The club's long-term goal of a new trailer facility in a better location was now given a deadline for completion . . . June 18, 1976, the planned first day for N6V, which coincided with the orbit insertion rocket motor burn (45 minutes worth) for Viking I. Dick K6SVP was assigned as facility manager. The time was now March.

Final site plans were drawn and submitted by Glenn K6GHJ to the laboratory facility engineering people in May for approval, a surplus tower was obtained from the newly formed Goldstone Radio Club, WB6MXU, surplus RG254 hardline coax (7/8 inch diameter) was found in storage, a TH6DXX 6 element beam and Ham II rotor were purchased, and the race was on. Mr. Murphy reared his head by having the first spool of RG254 coax delivered Friday afternoon to the trailer location at the *bottom* of the rough, brush-covered, rattlesnake-infested hill on which the antennas were to be located some 650 feet up from the trailer. The work party, including five of the JPL Explorer Scouts working on the lab sponsored Project Sunfire for Pitcairn Island, was already scheduled for Saturday morning. There was no time to transport the spool of coax (which weighed several hundred pounds and was five feet in diameter) to the top of the hill, so we gallantly began pulling the coax *up* the hill. Without a doubt, 650 feet of RG254 gets very heavy, especially in the hot sun. The next run of hardline waited until the spool was transported to the top of the hill so we could pull the coax *down*. A second spool of coax was obtained in July and two additional runs of hardline were added. All went smoothly this time, until the wooden spool holding the coax disintegrated on the spool stands. The only solution was to unroll the entire spool by removing all the remaining spool wood and carefully unrolling the entire 1700 feet of coax along the ground. We could then pull the line down the hill.

Tower installation began six days before the deadline. Again, Murphy! Would you believe that when we met the fellow supplying our guy wires



Roy Neal K6DUE oversees NBC "Today" show filming.

KABC newsman interviewing Jim Lumsden WA6MYG.

All N6V transmissions were not SSTV. Here Bob Brodkin WA6TBH works CW under the watchful eye of the Viking project's biology man insignia.

and crimp sleeves at the top of the hill, and he went to open the trunk of his car, Murphy made the key not work? No amount of banging or twisting would open that trunk. Finally, we discovered that two identical cars had been parked side by side down below and that he had put the supplies in the right car, but driven off in the wrong car with the right ignition key! That wasn't the last of Murphy. He decided that one of the tower guy anchors would have to be set in solid rock! By the time we finished we had placed on top of that hill, aside from the 71 foot tower and tribander, a 2 meter collinear, an inverted vee for 40 and 80, and a 40 through 10 meter vertical.

In spite of it all, N6V went on the air at 1300Z, June 18, 1976, for the first operating period of five days. The basic plan was to operate for a total of forty days, divided into four periods coinciding with the four major mission events: Viking I orbit insertion, Viking I landing, Viking II orbit insertion, and Viking II landing.

The first period of five days netted 2250 contacts toward the goal of 10,000 and gave us the confidence that N6V would achieve its goal. We were very pleased at this initial achievement, since the station was manned almost entirely during non-working hours. Because we were a bit late getting the publicity out to some of the publications and missed the June issue, we were met with a bit of amazement and uncertainty as to the legitimacy of the call, but word spread pretty fast. Most worked modes were 20 CW, 20 SSB, and 2 FM, accounting for about 85% of the total contacts. The lowest count was 2 FM CW with one contact (what a surprise that contact was). Other bands and modes were worked, but seemed to be worked out pretty fast. Admittedly, our ears were not very good on 40 and 80 meters, mostly because those antennas for the first period were fed through 700 feet of RG9 coax with the consequent signal losses.

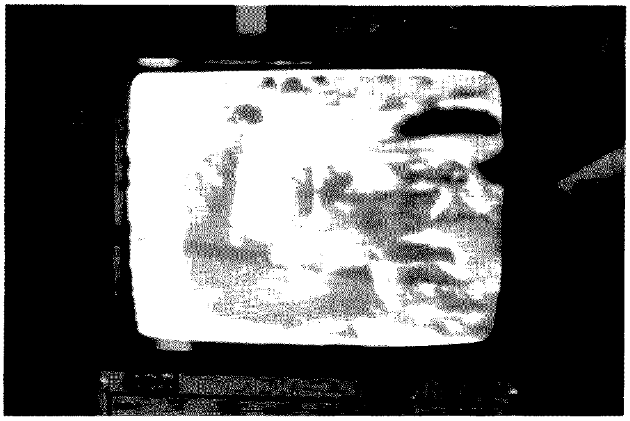
One of the biggest surprises while working 2 meters was being linked to the Kingman AZ 146.16/76 repeater some 600 miles away through a remote link on 146.52 simplex. Most of us were totally unaware that such a link existed. The next surprise was to hear that the entire link was controlled by Jerry WB6NQE while sitting on a diving board at Huntington Beach! Later connections into the remote link put us into locations like Las Vegas NV, El Paso TX, Santa Barbara CA and other points over the mountains north of us. Tremendous! Another highlight of two meters was to contact Bill Pickering, retired JPL Director and ex-Z28L, while visiting the shack. He was put in contact with the giant Goldstone 64 meter (210 feet diameter) antenna control station console which was being manned by one of the Goldstone Radio Club members. The link to the High Desert was made possible through WR6ALH, Rosemend CA, and WR6AFX, Table Mountain CA.

The reception that N6V received on the repeaters was tremendous and much appreciated. In most cases, N6V operation on repeaters was minimized during commuting hours. Initially, we had only two simplex and four repeater crystals; however, we soon realized that proper coverage of 2 meters required a synthesizer, which the club quickly purchased. It was like adding a new band, because we could now work all repeaters that we could reach, as well as other simplex frequencies. The Ensenada Radio Club, XE2BC, met us on one of the now available frequencies on sked one evening and we worked most of the guys in the Ensenada Club.

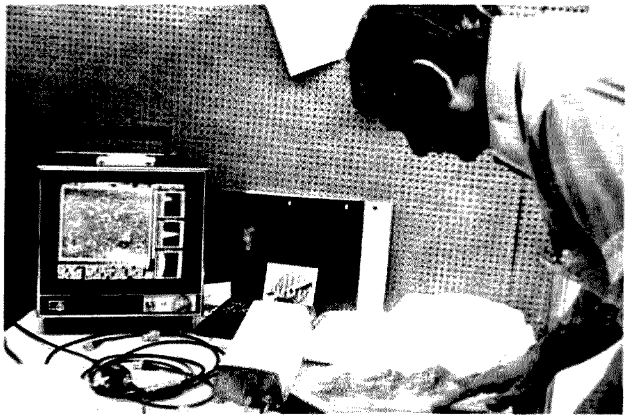
Novice response was, at first, one of bewilderment and disbelief. A three character call? That just did not fit the pattern! Frequently, the return call after a CQ would be to WN6NBV (N6V end to end, almost). As word got around, things got easier and the response got better. Ralph WB6YMF put in many hours at the Novice key.

The most fortuitous station worked early in the event was Mel W6VLH, who asked if we would be on SSTV. Our answer was negative, that no one in our club had the equipment. A couple of days later, we received a call from Robot asking what equipment we needed for SSTV operation and if they could loan it to us! Thus began one of the most wanted SSTV operations in the world. Jim WA6MYJ and Stan K6YYQ operated most of the SSTV (since the equipment was on loan we were sensitive as to its use). Pictures of Mars from both the Viking Orbiter and Lander were aired over N6V, occasionally into areas where there was little or no news coverage of the mission. A most memorable QSO was: "N6V de CZ2O. What are those pictures you are sending? They look like the surface of Mars!" "CZ2O de N6V. That's what they are!" We felt good that the pictures were recognizable. We are grateful to the JPL Public Information Office for providing us with the high quality photographs for our transmissions. We also had a direct video feed to the shack which allowed us to monitor and transmit some of the photos "live" from Mars as they were received here on Earth and processed by the computers. Jose YV5FBL, Caracas, Venezuela, was late to a ham club meeting when the XYL said that the Mars pictures were more important. Besides, he said the rest of the club would not believe him unless he had tapes to prove it. At least one ham, Bill W1PFA, was able to have his Polaroid photo of our transmissions published in the local newspaper, and then sent us a clipping. Bruce VK3VF sent impressive photos of a couple of pictures he received and also submitted to the newspaper. VE3AXC arranged to have TV news coverage live while receiving SSTV. Our local KABC-TV news team covered our operation in the Los Angeles area. Bob WBØJGJ got a story in his local Des Moines IA paper, which was picked up by the AP wire service, and culminated in many local TV news stories filmed in individual local towns (we haven't received all the video tapes yet) and also in a 5 minute report by Roy Neal K6DUE on the NBC "Today" show. As far as we could ascertain, that was the first time a film had been made from both ends of a QSO at the same time. That Roy's always thinking, but what a problem! We had to pick a station in one of several major cities in the US, establish a schedule with him, guarantee a contact at 8:00 am our time, all in less than 24 hours, so that Roy could schedule film crews in separate cities for the following day. Frank WB5SAG was our choice, and the filming was *1000%* successful. We're not sure who was flying higher — Frank or his patients (Frank is an anesthesiologist in Houston TX).

One contact, KC4AAB/M Reg 2 off the coast of South America, expressed more than the usual interest in the Viking mission progress during one of the SSTV operating periods. It turned out that the ship was an icebreaker on its way back from Antarctica with



The famous Mars ledge with a B or number 8 as it appeared from the Viking lander's camera prior to SSTV transmission.



The selection of hard copy pictures for SSTV transmission . . . here, Stan Brokl K6YYQ works near a picture coming from Mars.

several Viking project biologists on board. They had heard no news of Viking's success and were most appreciative of the information heard and vowed that before the next trip out they would have SSTV on board.

The station at N6V was not yet equipped for working OSCAR, so Skip W6PAJ came to the rescue with his mobile setup for working the satellites. Murphy caused an aluminum plate in the roadway to tilt and lodge under his van chassis as he drove by, literally launching all the equipment from the seats onto the floor. Remarkably, all equipment worked afterward. The only other problem encountered while working OSCAR was the high received noise level so that many stations returning Skip's CQ could not be heard. Several stations did get through, however, and we were very pleased that Skip braved the hill to set up on the mesa above JPL a few feet from the rattlesnakes (they *were* heard).

QRP was occasionally exercised, with George K6YGN braving the QRM most of the time. A 5/9 signal from Hawaii on 2½ Watts and 5/8 from the east coast on 1 Watt are not bad reports.

QSLing finally got underway about a month late when we received the cards from the printer (not entirely his fault) and we began filling the SASEs (first as promised). The hardest QSLs to deal with were those that included the SASE and a note saying, "Please send me the QSL card for contacting N6V." No time, date, band, or callsign! At the time we received that card, we had over 6000 entries in the logbook. Another QSL was a bit better; he at least included his callsign. Because we hope to QSL 100%, they will both receive their cards, just a bit later than hoped for. We received cards from several SWLers, and even one from an experimenter who copied SSTV. "Please QSL to W6VIO, Whiskey Six Viking In Orbit" became a catch phrase.

The effort involved in conducting an event the size of N6V is more than significant; it is major, as Jim WA6MYG found out. When volunteering to head the activity one year ago, the magnitude of N6V was not even dreamed of. Although painful (literally) at times to many who participated, the event was very successful, very satisfying, and enabled the JPLARC to realize one of its long term goals . . . a new station. Many friends were made both within and outside the club. This event will be remembered as a unique experience for many years.

Did it seem like a clique running N6V? All who came and participated became a part of the "clique." The list below cannot possibly cover all contributions of every individual; N6V was a team effort and everyone helped in many areas: Jim Lumsden WA6MYJ, N6V Activity Chairman; Dick Piety K6SVP, Facility Manager & Operator; Stan Brokl K6YYQ, Facility & Operator; Ralph West WB6YMF, Facility & Operator; Chuck Weir W6UM, Equipment & Operator; Norm Chalfin K6PGX, Photographer & Operator; Merril Burnett K6BER, QSL Manager; Glenn Berry K6GHJ, Facility; George Williamson K6YGN, Operator, QRP; Jack Patzold KDT6574, Facility & Operator; Warren Dowler KNX8341, Operator; Skip Reyman W6PAJ, OSCAR, Gordon Crawford WB6DRH, Publicity; Jim Longthorn WA6KPW, Operator; Rich Ward WA6VOG, Operator; Merv MacMedan W6IUV, Operator; Bob Brodkin WA6TBH, Operator; Bob Biswell W6MZR, Operator; Stan Sanders WB6MPM, Operator; Joe Berry WA6FCE, Operator; Stan Hench WB6JMP, QSL Design; Bill Carpenter WA6QZY, Video Feed; Waldo Brown W6QWC, Video Feed; Jay Holladay W6EJJ, Trustee.

Beating the Hamburglar

If crime statistics prove correct, nearly all of us can expect to have that prized mobile rig forcibly removed sometime in the near future. It can happen in a parking lot, your own driveway, the service station, or right outside on club meeting night.

The best way to be sure that you don't become a victim of Midnight Electronics Supply is to remove the rig and all markings that indicate the presence of radio equipment. This may also include the extremely unpalatable task of returning those callsign plates to your local registry.

The dyed-in-the-wool mobile operator realizes that no matter how many precautions are taken, it's often next to impossible to completely hide the fact that gear is contained within. So here are a few dos and don'ts for hams that just might keep the cost of the hobby within reasonable bounds.

Do keep your bill of sale in a safe place at home, not in the car.

Do engrave your driver's license number and state on both the inside and outside of the rig.

Do install a quick disconnect system. When leaving the car, take the rig with you or place it in the trunk. Out of sight, out of mind.

Do make sure that you have adequate insurance coverage for your gear. The insurance situation is worth an article by itself. Remember that even though you have homeowners or comprehensive auto theft coverage, there may be exclusions on radio gear as well as high deductible and depreciation clauses.

Don't try to hide the rig with a jacket or blanket. It only arouses curiosity.

Don't leave the car unlocked. Although it sounds like a silly statement, the vast majority of ripoffs happen through the car being inadvertently or purposely left unlocked. Most insurance companies won't pay claims unless there is proof of forced entry.

Don't try to booby-trap your gear. Not only is there a chance that you or a loved one might be injured, but you face the possibility of a lawsuit for assault. (Don't laugh, it really does happen.) For example, if a kid sees your booby-trapped 2 meter rig and goes for it thinking it's CB, WHAMMO! His family can nail you under laws governing what's called an "attractive nuisance." Juries are known to be sympathetic to the kid in these cases and you could be out a few years' pay in one fell swoop.

If, despite the above precautions, you still become victim of the ripoff, here are a few steps to follow:

1. Make sure you really suffered a loss. The gear could be sitting back on the kitchen table or hidden away in the shack. This can be *extremely* embarrassing.
2. Call the local police. Tell them what happened, what was taken, and the identification markings on it. If an item marked with your driver's license

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Looking West

from page 10

OSCAR. Give all this enough prepublicity and you have the makings of an entertaining evening to present to the general public and particularly the Citizens Service operators of the area. This was exactly what was done the evening of September 15, 1976, when the San Fernando Valley Radio Club, in cooperation with the ARRL, sponsored the first "Wide Wonderful World of Amateur Radio" evening subtitled "Everything you always wanted to know about amateur radio but were afraid to ask."

Johnny was at his best that evening, keeping things moving right along, while at the same time being truly entertaining. It was obvious that for him the evening was a labor of love. The pitch of the program was kept high, moving from topic to topic, explaining in progression the many diverse aspects of amateur radio and the people therein. There were demonstrations of slow scan TV, repeaters and autopatch, talks on RTTY and public service. In all, the entire gamut of what amateur radio is all about was covered in this fast-paced two hour presentation. It took a lot of planning, a lot of giving on the part of those involved and, most of all, a feeling on the part of all that what was being done would indeed benefit amateur radio. In the end, somewhere between two and three hundred local residents, many of them CBers, got a bit of insight into the world of the radio amateur and what an amateur could do within the scope of his interest. In all, it was an evening that epitomized the real amateur radio and on a fairly large scale shared it with the non-amateur.

If I had to pick one moment of that evening to call a highlight, I suspect it would be the story told by Lee Goldberg WA6AVP explaining how, for her, amateur radio was the therapy needed to aid in recovery from a serious illness. She told how, in the process, she went from non-amateur to Advanced class in a very short time span. These were moments that held everyone spellbound. Lee's story is one of beauty and dedication, and is an inspiration to set one's sights toward higher goals. Working hand in hand with her husband Bob WB6OFO, Lee not only conquered the after-effects of a serious stroke, but in the process has come to symbolize the important part that amateur radio can play in avenues never explored. Lee is not only a credit to her own personal initiative to conquer an obstacle put in her path, but is also an opener of new horizons for others to seek. She has given a very special new meaning to amateur radio.

If you have been thinking about trying such an event, but have feared that it might fail, fear not! This first was indeed a success and hopefully more such evenings will follow with other members of the amateur community emulating what was begun one warm September evening in Los Angeles. The first "Wide Wonderful World of Amateur Radio" evening will long be remembered by all who attended. Who knows, it may even get us a few new amateurs, and that would be the crowning glory. Yes, we were lucky to have a talented professional crew to start off this type of event, but it's nothing that any amateur radio club cannot emulate on either a larger or smaller scale, with or without the professionals. All it really takes is caring a bit as to whether there will be any amateur radio after the 1979 WARC Geneva conference. Those within our amateur community will pick up the ball and carry it. Is that someone you?

A REPEATER FOR ALL SEASONS

We have repeaters dedicated to many diverse aspects of our hobby/service. There are emergency calling systems dedicated to RACES and AREC type operation, autopatch systems whose prime purpose in life seems to be letting the XYL know that you are pulling into the driveway, club repeaters that, open or closed, are intended to act as an intercom between members of a given radio club and, lest we forget, the good old standby, the simple rag chew type of open system available day and night for anyone to use as long as they operate within the scope of their license privilege. Did I say anyone? Pardon my blunder. Well, though many a system professes to be open to all, in many cases one group does not always get a warm welcome. What group? Why, the "youngster," of course. You know, that group still in school, ages 15 or so and younger, who happen to hold amateur licenses but find it quite hard to develop the same type of lasting friendships on repeater systems that we in the next generation up seem to take for granted.

Admittedly, there is an interest difference between the generations, but must there also be a different set of standards imposed on the younger ham? Must they be relegated to 40 CW when they too have a need, and indeed, by the fact that they have passed the same test as you and I, a *right* to share the same spectrum? And that includes repeaters! At long last someone is about to put into operation a repeater system that will have one specific purpose for its existence: to give the younger generation of amateur with an interest in VHF and repeaters a place to converse with his peers. In a nutshell, that's the avowed prime purpose of WR6AKG and its father, Keith Glispie WA6TFD.

Keith, not that long out of school himself, noted that while virtually every special interest group had a repeater and a format upon which to interact, the younger generation of amateurs in Los Angeles had no such forum. As Keith tells me, about a year or so ago the whole idea began to take shape. Why not a repeater for this group? More specifically, why not a repeater that was designed to serve the need for school amateur radio clubs all over Los Angeles and surrounding environs, as well as their individual members? What a showplace to use as a tool to convince the public school CB operator that a whole new world exists in amateur radio. Not long ago, when the callsign WR6AKG arrived in the mail and a Pye Communications FM-50 high band repeater became available. Keith's dream began to become more of a reality.

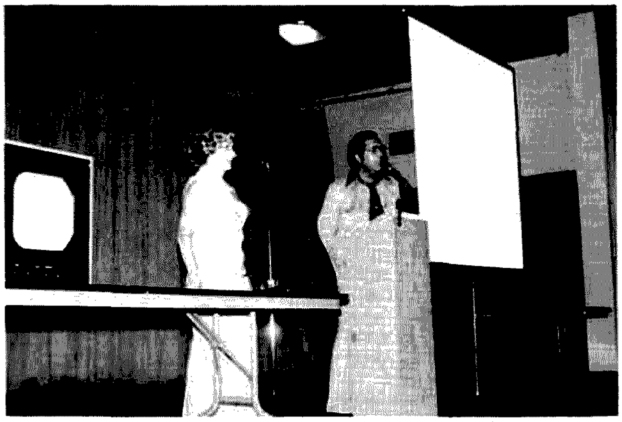
As word of Keith's plan began to leak out, it began to have a rather positive effect on many members of the local FM community, including SCRA's Bob Thornberg WB6JPI, who quickly assigned Jim Hendershot WA6VQP of the Technical Committee to handle the coordination for this system and at least try to expedite the matter. With virtually every two meter channel now coordinated and in use, finding a channel for this project would not be easy, but it is not an impossible task. In fact, since it might be of interest to readers, we will be following the SCRA coordination of WR6AKG starting in this issue to show you exactly how the SCRA operates — sort of two stories in one.

About four weeks ago, after making the decision to put up WR6AKG, Keith contacted the SCRA and told them briefly of his intent. By return mail, he received an "RFC" (Request For Coordination) form that he filled out and returned to the SCRA. Normally, such a request would be placed before a meeting of the Technical Committee for action, but in this case certain parameters of the proposed repeater system called for special consideration on the part of the SCRA. Therefore, Bob directed Jim to look at all aspects of the matter, consider the parameters under which the system as proposed will operate, compare this with the environmental impact that such a system will have on any co- or adjacent channel users, and from this make a recommendation to the Technical Committee as to where on two meters to put WR6AKG.

Very shortly, Jim will have to report back to Bob and the rest of the Two Meter Technical Committee (SCRA has a separate 220 Technical Committee). If they agree with Jim's findings, then Keith will be issued a 90 day "Test Sanction," during which he will place WR6AKG on the air. While it's in operation, he will work with his adjacent channel users, co-channel users, if any, and the SCRA Technical Committee to solve any and all problems that might arise due to this system's establishment. During this time, Keith, like any other test sanctionee, will be obliged to file written reports with the SCRA Two Meter Technical Committee; any co-channel or adjacent channel users will also be given a chance to file any information they feel pertinent about the effects that the new repeater is having on their already existing system. From this myriad of information, the SCRA will make a final decision as to whether AKG will remain where now sanctioned permanently, be moved to a new assignment or perhaps moved to 220, or should no possible final "home" be possible, be requested to cease operation. As this all progresses, we will keep you informed. This, though, is what good competent technical frequency coordination is all about. Not just finding an "open slot" in which to put another system, but rather taking into account all aspects of the proposed new system, its effect on already established systems, the effects of surrounding terrain, the effect that the users of any new system will have on existing systems adjacent to it, and many other parameters that could fill an entire column. These are just a few of the items that Jim is currently investigating in his attempt to find a home on two for WR6AKG. How successful will Jim be? We will continue this next month.

Finally, a few comments of my own about the past two columns

Continued on page 183



The beautiful story of amateur radio as a therapeutic tool described by the person who used it as such — Lee Goldberg WA6AVP, with OM Bob WB6OFO.

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

ARRL VHF SWEEPSTAKES
Starts: 1400 Your Local Time
Saturday, January 1
Ends: 2400 Your Local Time
Sunday, January 2

Complete rules for the 29th VHF Sweepstakes can be found in the December issue of *QST* (please check for any last minute changes in the rules). Briefly, the rules are as follows:

All amateurs operating on or above 50 MHz are invited to participate. Contacts between stations in different time zones can be counted only when the contest period is in progress in both zones. Foreign stations may only work stations in ARRL sections. Crossband work and retransmitted signals (repeaters) are not allowed. Contacts with aircraft mobiles cannot count for section multipliers.

EXCHANGE:

QSO number, precedence (A = less than 50 Watts input power), your call, CK = last 2 digits of year first licensed, ARRL section or country.

SCORING:

Score one point for each exchange sent and each received (max. 2 points per QSO). Each section counts as a multiplier only once regardless of band and no more than one foreign country may be claimed as a section multiplier. Yukon-NWT counts as a separate multiplier. Final score is the total number of QSO points times the total number of sections plus 10.

LOGS:

Official logs may be obtained from ARRL. Send contest logs and summary sheet to: ARRL, 225 Main Street, Newington CT 06111.

QRP – WINTER – CONTEST
Starts: 1500 GMT
Saturday, January 15
Ends: 1500 GMT
Sunday, January 16

The contest is organized by the DL Activity Group – CW. Work 15 hours maximum during the 24 hour contest period, with no more than two pause periods. Select up to 5 bands from 160 to 10 meters. General call is "CQ QRP TEST." A station is not handicapped if CO/VXO control *and* VFO control are used on the same band or the input power of a commercial rig is reduced to below 2.5 Watts. QRO stations – same rules, but work only QRP stations and sign as ". . ./QRO"; scoring is the same.

EXCHANGE:

RST, QSO number, and input (1 to 9). Add "x" if transmitter is CO or VXO-controlled. Example: 579 005/8x.

SCORING:

QSOs with all stations are valid unless running QRO; then only QSOs with QRP stations count. Contacts with your own country count 1 point, own continent = 2 points, DX = 3 points, and score 3 additional points for a QSO with another QRP station (4-6 points). Score additional handicaps as follows: 1 handicap point for each station using below 3.5 Watts input or crystal controlled transmitter. Maximum handicap is 4 for any QSO. Both stations multiply QSO points times the handicap points plus one (QSO points x 5 maximum) to find total QSO points for that contact. Multipliers are as follows: own continent = 1, DX = 2 points per band and country according to the latest DXCC list, but call areas in JA, PY, VE, VK, W and ZS count extra. Final score is total QSO points (including handicap points) times the total multiplier.

LOGS:

Send entry including a "mini-log" to: Hartmut Weber DJ7ST, D-3201 Holle, Kleine Ohe 5, Fed. Rep. of Germany. Logs should be sent no later than February 15, 1977.

CLASSIC RADIO EXCHANGE
Starts: 1800 GMT
Sunday, January 30
Ends: 0100 GMT Monday, January 31

Formerly "Nostalgia Radio Exchange," the contest is sponsored by the Southeast Amateur Radio Club, K8EMY, and is open to all. A classic radio is any equipment built since 1945 but at least 10 years old, an advantage but not a requirement in the Exchange. Object is to restore, operate, and enjoy older equipment with like-minded hams. General call is "CQ CX" on CW and "CQ Exchange" on phone; no AM phone below 21 MHz. The same station may be worked on each mode on each band.

EXCHANGE:

Name, RST, state, province or country, transmitter type (send PA tube if home brew, i.e., "6L6"), and any other interesting pleasantries.

FREQUENCIES:

CW – up 60 kHz from low ends.

Phone – 3910, 7280, 14280, 21380, 28580.

Novice – 3720, 7120, 21120, 28120.

SCORING:

Add the numbers of different transmitters, states/provinces/countries for each band. Multiply by total number of QSOs and then multiply that total by Classic Multiplier: total years old of your transmitter and receiver (if transceiver, multiply years by 2). Different equipment combinations may be used; figure scores separately for each and combine for total score.

ENTRIES:

Send logs, comments, pictures, etc., to: Stu Stephens W8KAJ, 2386 Queenston Rd., Cleveland Heights OH 44118. Certificates will be awarded for highest score, longest DX, most equipment combinations, oldest equipment, and "unusual achievements."

NEW HAMPSHIRE QSO PARTY
2000Z February 12 –
0500Z February 13
1400Z February 13 –
0200Z February 14

The New Hampshire QSO Party, sponsored by the Concord Brasspounders, Inc., W1OC, is held to promote the Worked New Hampshire Award. Operating periods are 2000Z Feb. 12 to 0500Z Feb. 13, and 1400Z Feb. 13 to 0200Z Feb. 14. Stations may be worked once per band per mode. New Hampshire stations may work each other. NH stations send RS(T) and county. Out-of-state stations send RS(T), ARRL section or country. NH stations score 1 point per QSO times the number of ARRL sections plus countries plus NH counties. Others score 5 points per NH QSO times the number of NH counties.

FREQUENCIES:

CW – 1810, 3555, 7055, 14055, 21055, 28130.

Phone – 1820, 3935, 3975, 7235, 14280, 21380, 28575.

Novice – 3730, 7130, 21130, 28130.

VHF – 50.115, 145.015, FM simplex (no repeaters).

AWARDS:

Top scorer in each NH county, and top scorer in each state, province, and country (50 points minimum). Additional certificate available for confirmation of all 10 NH counties. Send logs, summary and check sheets to: Concord Brasspounders, Inc., C. Halloway, 9 Via Tranquilla, Concord NH 03301. Mailing deadline is March 14, 1977. Include business size SASE for results and/or award.

QRP AMATEUR RADIO CLUB INTERNATIONAL INC.
1977 ANNUAL APRIL QSO PARTY
Starts: 2000 GMT Saturday, April 2, 1977
Ends: 0200 GMT Monday, April 4, 1977

This contest is open to all amateurs and all are eligible for the awards.

EXCHANGES:

Members: RST/RS. State/province/country, QRP number. Non-member: RST/RS. State/province/country, power.

SCORING:

Stations can be worked once per band for QSO and multiplier credits. Each member QSO counts 3 points. Non-member QSO 2 points. Stations other than W/VE count as 4 points.

MULTIPLIERS:

More than 100 Watts input power – x1; 25-100 Watts input power – x1.5; 5-25 Watts input power – x2.0; 1-5 Watts input power – x3.0; less than 1 Watt power – x5.0.

Score equals QSO points x total number states/province/countries PEP band x power multiplier.

FREQUENCIES:

CW: 3540, 7040, 14065, 21040, 28040.

SSB: 3855, 7260, 14260, 28600.

Novice: 3720, 7120, 21120, 28040.

All freqs plus or minus 5 kHz or so to dodge QRM.

CALENDAR

Jan 1 - 2	ARRL VHF Sweepstakes
Jan 15 - 16	QRP – Winter – Contest
Jan 30 - 31	Classic Radio Exchange
Feb 5 - 6	ARRL DX Contest – Phone
Feb 5 - 13	ARRL Novice Roundup
Feb 19 - 20	ARRL DX Contest – CW
Feb 19 - 20	YLRL YL-OM Contest – Phone
Mar 5 - 6	ARRL DX Contest – Phone
Mar 5 - 6	YLRL YL-OM Contest – CW
Mar 19 - 20	ARRL DX Contest – CW
Mar 26 - 27	CQ Worldwide WPX SSB Contest
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest – CW
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest – Phone
July 2 - 3	QRP – Summer – Contest
Aug 20 - 21	NJ QSO Party

Note: ARRL contest dates are tentative, as they were not officially announced at the time of this writing (check *QST* for the exact dates).

Also, don't forget to send early for ARRL logs and entry applications for DX and Novice Roundup contests.

RESULTS

RESULTS OF 1976 NJ QSO PARTY

First Place Winners – NJ Counties		
Atlantic	WB2RJJ/2	660
Bergen	AB2RJJ/2	150
Burlington	WA2AWO	6847
Camden	WB2REI	6954
Cape May	AB2RJJ/2	325
Cumberland	WA2CZA	784
Essex	AB2RJJ/2	144
Gloucester	W2FBF	2886
Hudson	AB2JVN	17524
Hunterdon	W2TND	5436
Mercer	W2ZQ	31289
Middlesex	WA2NPP	62578
Monmouth	WA2WDT	546
Morris	WB2RKK	56508
Ocean	WB2FRH	2050
Passaic	AA2BSU	6594
Salem	AB2RJJ/2	240
Somerset	WA2WJY	24070
Sussex	W2FCL/2	6848
Union	W2EME	10865
Warren	WA2DUV/2	10950
Out of State Winners		
CT	WA1WEM	2898
NH	WA1YUK	1026
ME	WA1NKE/1	420
ENY	AC2WSS	168
NLI	WB2PYM	3444
WNY	W2NCI	940
MDC	WB2JYM/3	1617
EPA	K3UEI	3087
GA	AD4BAI	322
KY	W4KFB	88
NC	AC4OMW	1292
NFLA	WA4BTC	490
TENN	AB4WHE	494
VA	WA4JIY	900
WI	KP4EMN	144
LA	W5WG	1343
NM	WA5YTX	403
STEX	W5BWM	420
LA	WB6IOQ	325
ORG	KØGJD/B	896
SF	AC6ZT	1254
SV	AC6KYA	560
MI	WA8WWS	540
IL	WA9MGY	2014
IN	WA9ABI	20
WI	AB9NME	705
CO	ADØQIX	496
IA	WØPRY	1218
NE	WØEKB	48
MAR	VO1KE	322
ONT	VE3EJK	2160
DX	ZL2HE	4

METHOD OF CALLING:

Call: CQ CQ CQ QRP DE (callsign).

AWARDS:

Certificates to the highest scoring station in each state, province or country. Other places will be given depending on activity. One certificate for the station showing three "skip" contacts using the lowest power.

LOGS:

Send full log data, including your full name, address and bands used, plus equipment, antennas, and power used. Entrants desiring results please enclose a #10 SASE to receive result sheet. Logs must be received by May 30, 1977 to QUALIFY. Send all logs and data to: E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

THE MELVIN JONES 77 CONTEST

SPONSORSHIP:

The contest was instituted by Santos Lions Club Ponta da Praia. It will be supervised by the sub-directory of Labre of Santos and the CW Praiano Group. It will be held every year during the second weekend of January for CW and during the third weekend of the same month for SSB.

AIMS:

The contest intends to provide contact among the largest possible number of ham operators all over the world and to proportionate the International Interchange among Lion ham operators.

PERIOD:

CW section – Beginning Saturday 8-01-77 – 00:00 GMT = 21:00 hours Brazilia time 7-01-77, to Sunday 9-01-77 – 24:00 GMT = 21:00 hours Brazilia time 9-01-77.

SSB section – Beginning Saturday 15-01-77 – 00:00 = 21:00 hours Brazilia time to Sunday 16-01-77 – 24:00 GMT = 21:00 hours Brazilia time.

Single operator stations can only operate 30 hours out of the 48 hours of the contest. The minimum obligatory 18 hours of the QRT in the contest can be divided up into 4 periods at any moment during the course of the contest and must be clearly pointed out in the logs. The multi-operator stations may operate 48 hours.

BANDS:

The contest activity will be in the 3.5, 7, 14, 21 and 28 MHz bands.

COMPETITION TYPES:

a) Single operator, any band; b) Singe operator, just one band; c) Multi-operator, any band.

MESSAGES:

For Brazil, the CW bands will be constituted of the RST followed by the States abbreviation, and for foreign stations only RST. Example: PT 2 JB 559/DF – DJ 2 MN 599 – ZS 1 WA 599. CALL: CQ Contest Melvin Jones.

For Brazil, SSB will be constituted of the RS followed by the States abbreviation, and for foreign stations only RS. Example: PY 2 LB 59 GO – PY 2 BOR 59 SP – W 2 PV 59 – LU 1 BB 59. CALL: CQ Contest Melvin Jones.

POINTS:

a) QSOs with stations of different continents shall count 3 points in the bands at 14 and 2 MHz and 6 points in the 3.5, 7 and 28 MHz bands.

b) QSOs with stations in the same continent shall count 1 point in the band of 14 and 21 MHz and 2 points in the 3.5, 7 and 28 MHz bands.

c) Contacts between stations in the same continent are allowed but shall count only 1 point.

MULTIPLIERS:

All the Brazilian States and Territories and all countries worked will be counted only once; even if worked in different bands they will be multiplied by the total number points.

AWARDS:

a) The ham operator who attains the greatest number of points in the world on CW will be granted the International President Lions Club Trophy, and the one who gets the greatest number of points on SSB will be granted the District L-16 Governador Trophy together with special diploma for each mode: CW or SSB.

b) A trophy will be granted to all those who get the most points on each continent. To second place, we will give a medallion containing the Santos Ponta da Praia Lions Club inscription. Diplomas will be awarded for each mode of operation: CW or SSB.

c) The Brazilian ham operator who gets the greatest number of points on each mode will be granted the Santos Lions Club Ponta da Praia Trophy. The second place will be given the Lions Medallion.

d) The country which gets the greatest number of points among all participant countries will be granted permanent possession of the Melvin Jones Trophy.

DIPLOMAS:

a) Every ham operator classified in the first and second places in each country and also Brazilian States and Territories will be granted a special diploma mentioning the classification.

b) The other foreign and Brazilian ham operators taking part in the contest will receive a diploma of participation once they get a minimum of 500 points or 50 contacts.

c) All radio receivers from all over the world including the Brazilians who send their reports mentioning bilateral contacts will be granted special diplomas. For that a number of 25 contact reports is required.

REPORTS:

a) The time must be indicated in GMT (= Brazilian time plus 3 hours). The periods of 18 hours (minimum) of QRT must be clearly indicated in the log.

b) Use one log sheet for each band.

c) All the participants must attach to their log a QSL card addressed to Santos Lions Club Ponta da Praia.

d) A summary must be sent postmarked no later than 30 days after the contest. They must be sent to: Ham Operator Contest Commission, Santos Lions Club Ponta da Praia, P.O. Box 11, 11100 Santos SP Brazil.

DISQUALIFICATION:

Violation of the ham operator regulations, non-ethical conduct, QSOs in duplicate in the same band and non-participant prefix can cause a loss of points. The acts and decisions of the Contest Commission will be decisive.

INTERNATIONAL SHORT WAVE LEAGUE

If you work a fair amount of DX and try to QSL most, you may be interested in the International Short Wave League, 1 Grove Road, Lydney, Glos, GL15 5JE, England. Besides the monthly newsletter giving DX operating notes, contests, awards, etc., you also get full use of their two-way QSL bureau. Their bureau does not require SASEs and incoming QSLs are mailed at regular intervals. The membership fee for US hams is $10 per year. The ISWL also provides a translation service, a correspondence bureau and a large selection of awards:

Century Club – For confirmed 100 countries; stickers each additional 25.

Heard All Continents – Veri-

fied contact with 10 stations in each of the 6 continents.

Heard All States – Verified contact with 48 continental US states.

Commonwealth Award – Verified contact with 50 different countries within the British Commonwealth of Nations.

European Award – Verified contact with 50 different countries within continent of Europe.

Pacific Ocean Award – Verified contact with 45 different countries which have at least a part of their coastline on or in the Pacific Ocean.

Zone Award – For working 25, 50, and 75 ITU zones.

5 Band DX CC Award – For working 100 countries on 5 bands.

MARAC AWARDS

Any hams interested in county hunting or information on the Mobile Amateur Radio Awards Club (MARAC) should send a large SASE with 3 first class stamps to Bertha Eggert WA4BMC, P.O. Box 6811, Southboro Station, Lake Worth FL 33405. Or, try listening to one of the county hunter nets on 14337 (from 1300 GMT daily), 3943 (from 0100 GMT daily), 7237 occasionally, or the CW county hunter nets on Wednesday evenings 2300 GMT on 7055, Saturdays at 1400 and 2000 GMT on 14070, and Sundays at 1430 GMT on 7055. More information on CW county hunting can be obtained from K1ZFO who publishes a monthly newsletter for $2.40 per year. The awards available from MARAC include:

Cliff Corne Jr. K9EAB Memorial Award – For working holders of the USA-CA All Counties Award; in classes of Basic = 10, C = 25, B = 50, A = 75, AA = 100. Basic award $1.00, seals for SASE.

Associate Award – For working charter, regular, or associate members of MARAC for a total of 100 points for the basic award with seals for 250, 500 and 1000 points. Regular members count 2 points each and associates count 1 point each. Fee: $1.00.

M-50-M Award – For working mobiles in all 50 states; original award for 48 states, seals for 49 and 50. Special seal for working all states mobile to mobile. Fee: $1.00.

YL Mobile Award – Work 5 or more YL mobiles in a total of 50 different counties. Seals for 100, 200, and 500 counties. Plaque for 1000. Fee: $1.00.

MARAC DX Mobile Award – For working 25 DX counties while operating mobile. Seals for 50 and 75 counties; plaque for 100. Fee: $1.00.

MARAC Last County Award – First category: Basic award for any station giving last county to finish a particular state. Seals for second, third, and fourth times. Same county and state may be given in each instance. Send application and mobile reply card signed by recipient stating facts for verification. Award can be repeated. Basic fee: $1.00. Second category: Basic award and plaque to any station giving last county to finish ALL states. Fee: $7.50.

Merit Award – Free to any amateur upon recommendation of any MARAC member for outstanding service to amateur radio.

Worked All Counties USA Second Time – For working all counties in the USA a second time!

MARAC Mobile Award – Category 1: To any mobile for giving out at least one county in each of 15 states; seals for 25, 35, and 45 states: plaques for 48, 49 or 50. Category 2: To any station for working the same mobile one time in 15 states; seals for 25, 35, and 45; plaques for 48, 49, and 50. Category 3: To any mobile for giving out 100 different counties; seals for 250, 500 and 1000; plaques for 1500, 2000, 2500, 3000, and 3075. Category 4: To any station for working same mobile in 100 different counties; seals for 250, 500, and 1000; plaques for 1500 2000, 2500, 3000, and 3075.

All award applications should be addressed to: MARAC Awards Chairman, 602 Jefferson St., Lee's Summit MO 64063. Further information can be obtained from WA4BMC as noted earlier.

NC COUNTY AWARD

Basic award $1.00; additional awards for SASE. Classes: D = 30; C = 54; B = 75; A = 100. Send GCR list of stations worked and confirmed to: Alamance Amateur Radio Club Inc., P.O. Box 503, Graham NC 27253.

JUMPING OFF PLACE AWARD

Honoring Independence MO Award; free of charge for working Independence MO stations for points. 5 points total needed. WBØAEW, WBØGYR and WØQWS count 2 points each; others are 1 point each. Apply to Jerry Dowell WBØGYR, 14412 37th St., Independence MO 64055. No date, time or mode limitations.

THE MAPLE LEAF AWARD

Available to both amateurs and SWLs, the award consists of 2 parts – a flag parchment diploma and a Canadian Maple Leaf Flag lapel pin. The award is for working (or hearing) and confirming Canadian amateur radio prefixes. QSLs must be in your possession. A GCR (certified list) must accompany your application. QSLs should not be sent unless requested. Classes: 1. 30 or more different Canadian prefixes; 2. 25 different Canadian prefixes; 3. 15 different Canadian prefixes.

A special plaque award will be issued free of charge to any radio amateur who works and confirms 50 or more different Canadian prefixes. All contacts for all classes must be made after January 1, 1965. Send application, GCR, and 10 IRCs or $1.50 (or equiv.) to the awards custodian: Mr. Garry V. Hammond, Geography Department, L.D.S.S., 155 Maitland Ave., S. Listowel, Ontario, Canada N4W 2M4.

Prefixes can come from: CF, CG, CH, CI, CY, CZ, VA, VB, VC, VD, VE, VF, VG, VO, VY, XJ, XK, XL, XM, XN, XO, 38, 3C and any later ITU assigned callsigns.

CHN MOBILE ACHIEVEMENT AWARD

Issued in 3 different categories: 1. For working mobiles in counties of any one state; 2. For mobiles giving out counties of any one state; 3. For working same mobile in counties of any one state.

BONANZA – The applicant gets award for working same mobile and the mobile gets award free as gift of applicant for giving out counties to same station.

Classes: A = all counties of a state: B = 2/3; C = 1/3.

RESULTS

HOWDY DAY CONTEST WINNERS

WA6WZN	82	YLRL Member
LX1TL	61	NON-YLRL Member
W2GLB	78	
WA1UJV	75	
DJ1TE	74	
DJ1EIC	73	
K4RNS	59	
HBØARC	59	
WB4PXN	57	
DK5TT	53	
DJØEK	42	
WA4ORK	33	
DK2KD	30	
WB4FYU	29	
WBØJFF	27	
DF2KG	27	
WA2VIE	23	
PY1IFI	23	
F5RC	21	
PAØHIL	19	
WA2DMK	15	
WA2RXO	8	

For confirmation only – DL3LS and DK1HH

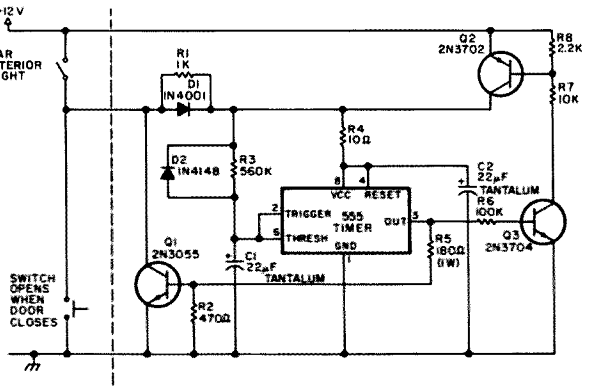
RESULTS

RESULTS OF 1976 PACC CONTEST

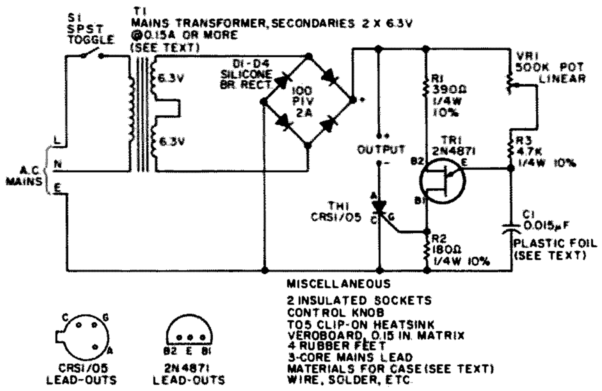
Top Country Winners, Single-Op		SM6EUZ	2646
DK8AX	2400	SP3GCT	5670
DM3NKF	7321	UA3QAQ	11718
EA4BV	1440	UA2FBI	5376
EA8IR	957	UA9JAA	2250
F2VO	1176	UB5ZBB	9996
G3VTT	2100	UC2BA	1035
GI3JEX	3480	UJ8JAS	1836
GM3MZV	6942	UL7GAA	1221
GW4DOO	1320	UM8NNN	561
HAØIG	1620	UO5AP	2880
HA5KHD	8670	UP2BAR	10080
HB9QA	1728	UQ2GCN	9765
I3DUU	1710	YO2QY	1710
JA6BSM	570	YU3TJA	3300
LZ2RF	10170	ZS6CS	2223
OE1TKW	720	9H4G	384
OH6UW	1620	*USA – Winners*	
OK2BLG	9801	AC3ARK	351
ON6NL	3417	AC1OPJ	150
OZ4LX	351	WB5IAL	105

Circuits²

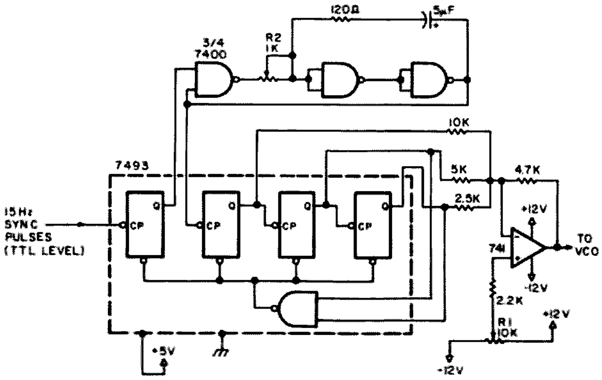
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice.



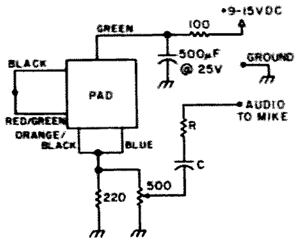
This time delay circuit is easily adaptable to turning off an alarm system and resetting it after a preset period. The values shown will keep the load activated for about 10 seconds, but can be adjusted for values up to many hours. Reprinted from LIMARC Log.

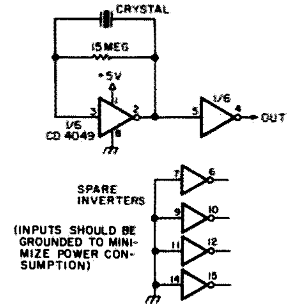


This circuit enables you to use a 12 V dc motor off the ac power line. The motor must be rated at 1 Amp or less. Reprinted from Radio & Electronics Constructor.



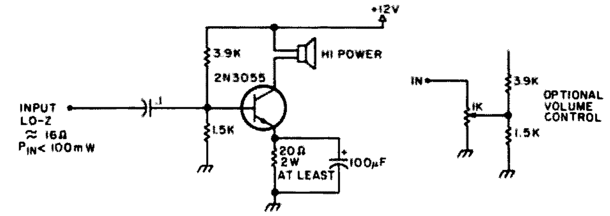
A grey scale generator for SSTV. Connect the output to the VCO of the camera. Gives 2300 Hz, 2100 Hz, 1900 Hz, 1700 Hz, and 1500 Hz. R1 is level adjust on the entire waveform. R2 sets the oscillator frequency to about 75 Hz. Thanks to Roger Peckham WA7SBH.



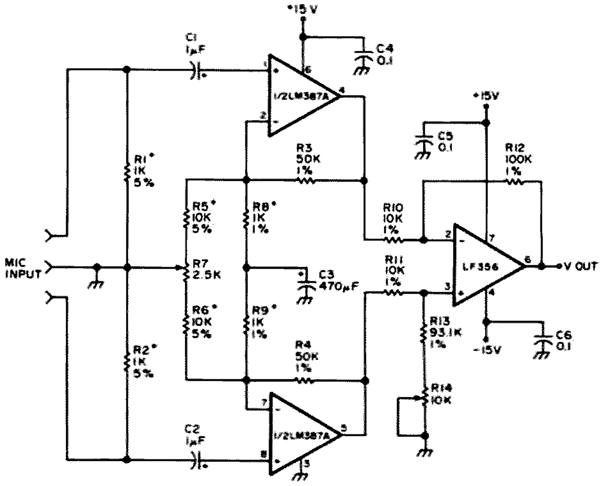


Touchtone pad circuit for finicky repeaters. R will be 100k to 4 megs, depending on the mike circuit. Select a value that doesn't distort mike audio but gives enough deviation from pad. C is .1 uF electrolytic. Use 10 uF for carbon mikes. Reprinted from SCRAMSGRAM.

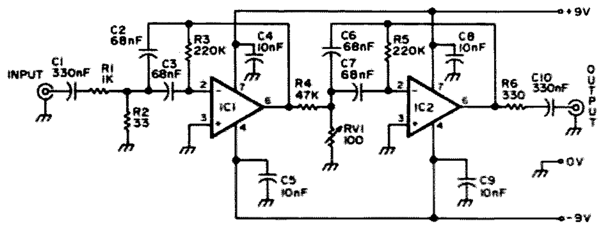
This very simple clock oscillator uses only three components. It's usable to 5 MHz and draws less than 10 mA. Four spare inverters are available for use elsewhere in the circuit. Thanks to Bruce Brown WB4YTU/WA9GVK.



This simple audio follower stage adds punch to low power radios and tape recorders. It will provide 5 to 7 Watts output with a 750 mW input. The optional volume control is for fixed volume sources. Be sure to use a hefty speaker, as most speakers will blow out. Thanks to Steve Uhrig WA3SWS.



This low noise balanced mike preamp uses the ability of op amps to amplify differential signals while rejecting common mode ones, thus eliminating the transformer and its inherent susceptibility to hum pickup. Reprinted from Audio Handbook, *National Semiconductor.*



An active CW filter that can use a variety of ICs, including the 741, 748, and 301A series. The first stage is fixed-tuned. The second can be set the same, or slightly offset to provide double humped bandpass. Reprinted from Radio ZS.

Novice Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.

Q. What is a simple solution to low vfo drive on 10 meters?

A. A vfo will not always work simply by unplugging a crystal and replacing it with a vfo. Here are some of the reasons for this. The output impedance of the vfo must be proper for the oscillator circuit used in the rig. You cannot drive a rig on 10 meters with an 80 or 160 meter vfo output, even though 7 MHz crystal for 10 meters is used. There must be enough rf output from the vfo for proper drive on 10 meters.

Most crystal oscillators have a high impedance input. If the vfo output is low impedance, there may be trouble. Changing from low- to high-Z requires another tuned circuit or redesigning the oscillator. Generally, if the vfo has low-Z output and the right oscillator a high-Z input, simply link-couple a resonant parallel-tuned circuit to the vfo, with the tuned circuit going to the oscillator.

Although it is possible to obtain 10 meter drive with 80 or 160 meter vfo output leads, it is easier to use a crystal frequency.

By adding a buffer-amplifier stage, increased drive may be obtained, although low rf output from a vfo is sometimes unavoidable. Increasing voltages to the vfo will not, in most cases, do a bit of good. Sometimes the impedance transformation will yield the additional rf voltage needed.

When using coax to couple the vfo to the rig, be sure it is the correct impedance. If a capacitor is used in series with the coax at the vfo end, disconnect it and try link coupling on the output coil to the rig. This will help if the input of the rig is low impedance.

Q. Is there a simple way of switching a pi-network for two-band operation?

A. This principle can be applied to any two adjacent bands; however, the circuit illustrates the constants for operation on 7 and 14 MHz bands. The effective inductance is 4 uH and the capacitance is 620 pF with the control switch, SW, set at the 7 MHz position. At 14 MHz the inductance and capacitance are reduced to 2 uH and 310 pF respectively.

Q. Is there a circuit diagram for a 1000 Hz af oscillator which can also double as a 100 kHz crystal calibrator? It must be transistorized and compatible for use with an SSB transceiver.

A. Suggest you use 5% resistors (½ W) if available, in the circuit. The output of the af oscillator can be switched into the "mike" position of the rig, as shown in the figure.

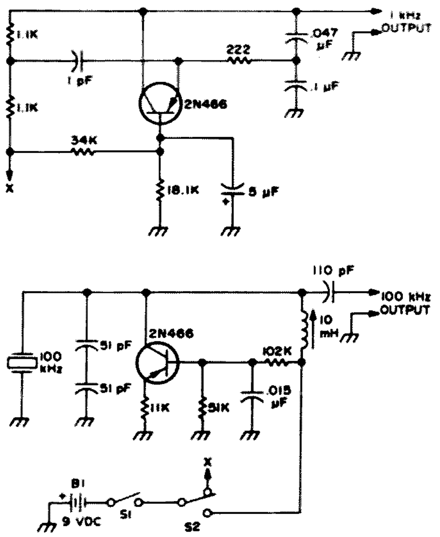
Q. What can cause backlash in a gear-driven tuning system, and how can it be corrected?

A. Anti-backlash gears in receivers sometimes become unwound or springs pop out of place due to shock in handling. To correct it, set the bandspread pointer at zero on the logging scale (have the bandspread capacitor fully meshed). In one model receiver, the white-metal gear should be set so that its long setscrew is 1/8 in. from the stop pin (this long setscrew serves as a stop on the other end of the tuning range). With the bandspread tuning mechanism in this position, loosen the setscrews and slide the white metal gear out of mesh. Wind the free brass gear one tooth and reengage the white metal gear. Other methods use a pair of spring-loaded gears whose wedge action takes up free play between meshing gear teeth.

To set the general coverage, the same procedure may be used; however, set the general coverage pointer at 100 on the logging scale. Final check of proper positioning of the dial vs tuning capacitor should be made on a known frequency like a local BC station.

Q. Any suggestions for checking erratic S-meter action in a receiver?

A. First check the S-meter tube. Then check each of the resistors in the circuit, especially the carbon controls. Clean them with an aerosol cleaner. Dirt and tarnish can be the cause of erratic action. Check the AVC switch contacts for proper contact, too – apply contact cleaner.



Q. When a beam is mounted on a high tower, how can you determine whether or not the transmission line (coax) becomes disconnected from the beam?

A. Simply check the final loading control. Also, use a grid dip meter. In most cases you will find that the antenna won't load as it did before. If a pi-network is used, you will find that the final loading control setting for a particular band will be way off – even for a partial load.

Q. What is a product detector?

A. Some receivers actually contain two detectors – a standard diode for AM reception plus a second circuit designed for CW and SSB reception. In such configurations, the second detector is referred to as a product detector – actually just another name for a converter-like circuit with a built-in bfo.

Many feel that the product detector exhibits limited or no improvement over the standard diode arrangement. Others – particularly the dyed-in-the-wool sidebanders – claim it provides significantly increased intelligibility characteristics.

Q. When operating, isn't a Q-multiplier supposed to act as a good, sharp crystal filter? Also, what causes squeal when its external controls are manipulated?

A. The majority of Q-multipliers installed in commercial ham receivers provide for internal adjustment. Usually, the adjusting control is set just below the threshold of oscillation. The Q-multiplier will not usually cause a "ringing" effect similar to that experienced when phasing a crystal filter.

For proper nulling or notching action, Q-multiplier controls must be carefully adjusted in vernier steps. A squeal indicates improper internal adjustment.

Q. How much difference is there in the velocity factor between coaxial and open-wire lines?

A. The velocity factor is a ratio of the actual wave velocity along a transmission line to the wave velocity in the air or free space. It varies from .65 to .85 with solid dielectric coax. Open-wire line's velocity factor is between .95 and .98.

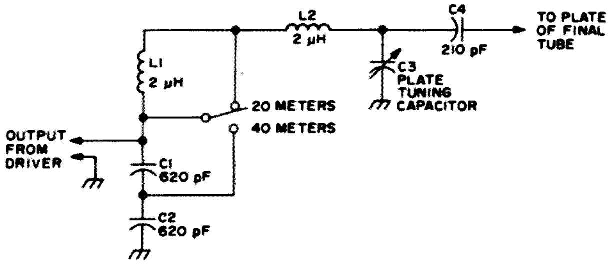
Q. Can the 6146B be used to any advantage in a transmitter designed to use the 6146?

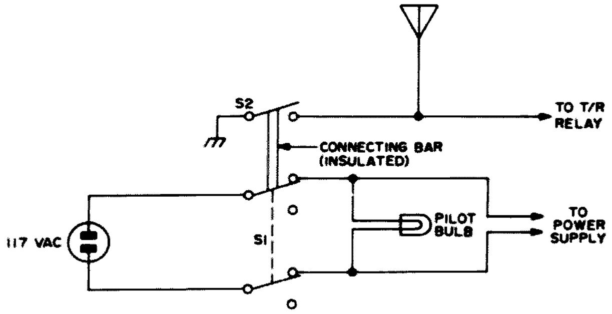
A. Yes, the 6146B is a direct replacement for the 6146, and – if power is available – the change is worthwhile. The 6146B is a better tube than the old 6146 and does give more rf power output.

Q. What circuit can be used to automatically ground an antenna when the main power switch is open?

A. See the figure. SW1 is a DPST switch which feeds 115 V ac to the

Continued on page 27





D. W. Ishmael WA6VVL
1118 Paularino Ave.
Costa Mesa CA 92626

SSTV Test Generator

-- invaluable diagnostic tool

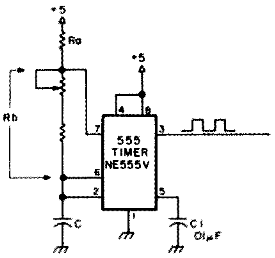
Probably the biggest obstacle facing amateurs building their own SSTV monitor is finding a stable slow scan signal source to properly adjust the monitor circuitry. This is especially true if the reader decides to design his own monitor or deviates from an existing design. The monitor itself generally cannot be used as a test unit because all the circuitry has to be adjusted and operating properly before anything can be viewed on the monitor's CRT.

This article describes an SSTV pattern generator which produces a continuous, high quality, 4x4 checkerboard SSTV signal which can be used with a triggered sweep oscilloscope to follow the slow scan signal through the monitor circuitry. The generator can be used to improve the design of an existing SSTV monitor or as a diagnostic tool to repair one.

The pattern generator described in this article is an adaptation of the circuit designed by Bert Kelley K4EEU.[1] NE555V timers are used as astable oscillators in place of the crystal oscillators, and the digital logic has been modified to produce a 4x4 checkerboard pattern.

After reading Bert Kelley's article on building a slow scan TV test generator, I didn't appreciate the need for such an instrument until seriously designing and building my own monitors; now I am convinced that anyone undertaking such an adventure should have a similar instrument.

The "front end" of my monitor at the present time contains circuitry from WB9LVI,[2] W6MXV[3] and myself. It is more or less the same route that WA9MFF took with his monitor,[4] a conglomerate of designs. Breadboarding the circuitry was relatively easy, but finding a stable signal source proved to be the biggest problem. I was able to use an audio oscillator to initially adjust the limiter, pulse counting discriminator, video amplifier, and sync separator, but fine tuning them for maximum performance was impossible using this method. A cassette recorder was used for a time, but was unsatisfactory from my standpoint as the video content was constantly changing, as was the video quality (I didn't have an opportunity to use a tape recorded by an SSTV manufacturer so I can't comment on them as an SSTV signal source). Remembering K4EEU's article, I resurrected it from my SSTV files, building the generator described in this article.



$$\text{frequency of oscillation} = \frac{1.44}{(Ra + 2\,Rb)\,C}$$

$$\text{duty cycle} = \frac{Rb}{Ra + Rb} \leqslant 50\%$$

Fig. 1. 555 timer connected as an astable oscillator. C1 is recommended by the manufacturer.

1200, 1500, and 2400 Hz Reference Oscillators

The primary attraction of the K4EEU generator is its inherent stability, accuracy, and lack of adjustments provided by three crystal controlled reference oscillators. I felt, however, that the stability of 555 timers was adequate for most SSTV alignment applications and designed my generator accordingly.

Several dozen Signetics NE555V timers manufactured over a two year period were tested over a temperature range of 25°C-55°C in an oil bath to determine their temperature coefficients (tempcos) and, therefore, their suitability as reference oscillators when operated in the astable mode. A test fixture was constructed so that only the NE555V was placed in the oil bath and not the external timing components. Fig. 1 shows a 555 timer connected as an astable oscillator. The tempcos of the NE555V timers measured .045% to .07% per degree centigrade (/°C). After the tempcos of the 555s were

determined, a number of different timing components were included in the oil bath to check the overall oscillator tempcos. Best performance was obtained using precision wirewound resistors and metallized polycarbonate film capacitors with oscillator tempcos measuring .05% to .08%/°C. The worst performance was obtained using carbon resistors and disc ceramic capacitors with oscillator tempcos exceeding .3%/°C.

As a compromise between performance and parts availability, I used RN55/60C (50 ppm) metal film resistors, cermet 15 turn trimpots, and metallized polyester capacitors. Using these components, oscillator tempcos did not exceed .1%/°C, which corresponds to 1.2 Hz/°C for the 1200 Hz sync oscillator, 1.5 Hz/°C for the 1500 Hz black oscillator, and 2.4 Hz/°C for the 2400 Hz white oscillator.

Circuit Description

Referring to the schematic, U1, U2, and U3 are 555 timers used as 2400 Hz, 1500 Hz, and 1200 Hz reference oscillators. The component values specified in the parts list have been selected so that the oscillator frequencies can be adjusted ±16-19% from nominal to allow for normal component variations. To improve the oscillator's ability to be set, R2, R5 and R8 can be changed to 2k and R4, R7, and R10 trimmed (selected) for the correct frequency. There is nothing critical about the values specified and they can be changed as required, but keep the duty cycle in the 47-49% range. Table 1 provides nominal values of Rb for preferred values of C when Ra equals 1k. Nominal values include 1/2 the value of the series trimpot selected. The outputs of U1, U2, and U3 are brought out to pins C, B, and A.

U4 is a TTL 7410 three input positive NAND gate. U4A and U4B alternately

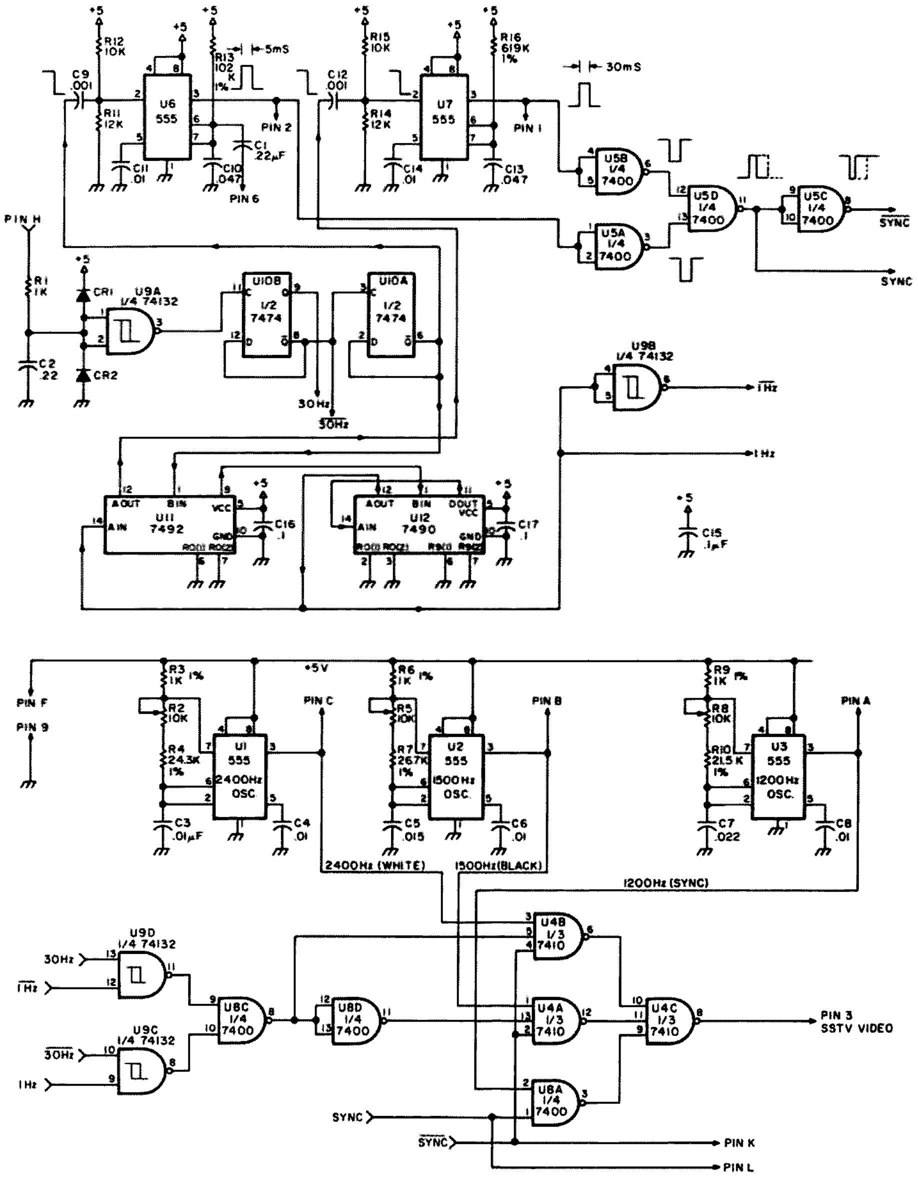


Fig 2. Schematic, SSTV pattern generator.

gate the 1500 Hz black and 2400 Hz white oscillators to the input of U4C, except when inhibited by the $\overline{\text{SYNC}}$ signal from U5C. During the time that U4A and U4B are inhibited by $\overline{\text{SYNC}}$, U8A is enabled by the SYNC signal from U5D, gating the 1200 Hz sync oscillator to the input of U4C. U4C is used as a three input inverter, its output, the SSTV video output, brought out to pin 3.

U5 is a TTL 7400 quadruple 2 input positive NAND gate used as a sync adder, combining the 5 ms horizontal and 30 ms vertical sync pulses from U6 and U7. The outputs from U5D and U5C (SYNC, $\overline{\text{SYNC}}$) are brought out on pins L and K.

U6 and U7 are 555 timers used as 30 ms vertical and 5 ms horizontal sync generators. U6 is triggered from the negative edge of U10A (15 Hz) and U7 is triggered from the negative edge of U11 (1/8 Hz). Pin 6 may be externally grounded to increase the horizontal sync pulse width from 5 ms to 30 ms. This provides a 30 ms wide sync pulse at a 15 Hz rate for easily adjusting the monitor's vertical sync separator. The outputs from U6 and U7 are brought out on pins 2 and 1.

U8 is a TTL 7400 quadruple 2 input positive NAND gate. U8C combines the output of U9C and U9D and, in conjunction with inverter U8D, alternately enables/disables gates U4A and U4B. U8B is not used.

U9 is a 74132 quadruple 2 input positive NAND Schmitt trigger. U9A squares the 60 Hz ac input pin H providing fast output rising/fall times, the positive edge triggering the first dual-D FF U10B. U9B is used as an inverter for the 1 Hz output of U12.

	1200 Hz	1500 Hz	2400 Hz
.01 uF	59.5k	47.5k	29.5k
.015 uF	39.5k	31.5k	19.5k
.022 uF	26.8k	21.32k	13.14k
.033 uF	17.68k	14.04k	8.59k
.047 uF	12.27k	9.71k	5.88k
.068 uF	8.32k	6.56k	3.91k

Table 1. This chart provides nominal values of Rb for preferred values of C when Ra = 1k. Nominal values include ½ the value of the series trimpot selected.

1	Vertical Sync Pulse, 30 ms wide
2	Horizontal Sync Pulse, 5 ms wide
3	SSTV Video
6	Contact closure to ground increases the width of the horizontal sync pulse from 5 ms to 30 ms.
9	Ground
A	1200 Hz
B	1500 Hz
C	2400 Hz
F	Power in, +5V ±.25 @ 150 mA
H	6.3-12.6 Vrms ac @ 6-12 mA
K	$\overline{\text{Sync}}$ (combined horizontal/vertical)
L	Sync (combined horizontal/vertical)

Table 2. Pattern generator pin assignments.

Opposite phases of the 30 Hz output from U10B and 1 Hz output from U12 are connected to U9C and U9D, which alternately gate the 1500 Hz and 2400 Hz oscillators every 30 picture lines and 16.67 ms producing a 4x4 checkboard pattern.

U10 is a TTL 7474 dual-D type positive edge triggered FF triggered by the positive edge of U9A. U10A and U10B divide the 60 Hz output from U9A by four, producing the 15 Hz SSTV horizontal scanning frequency. The negative edge of U10A triggers the 5 ms horizontal sync generator U6 and U11. Both phases of U10B (30 Hz, $\overline{30\text{ Hz}}$) are connected to the inputs of U9C and U9D.

U11 is a TTL 7492 divide by twelve counter and U12 is a TTL 7490 decade counter connected to divide the 15 Hz horizontal scanning frequency by 120, generating a 30 ms vertical sync pulse at the end of 120 lines or 8 seconds. Each counter contains a ÷2 element combined with a ÷5 element (7490) and a ÷6 element (7492). The schematic is not typical of two cascaded counters as they are cascaded as follows: 7492 – ÷6, 7490 – ÷5, 7490 – ÷2, and 7492 – ÷2. This connection provides the vertical scanning logic which produces the symmetrical 4x4 checkerboard pattern when combined with the horizontal logic in U9C and U9D. (In truth, the 4x4 checkerboard pattern is not symmetrical as displayed on a monitor, as 5 ms of the leading edge is blanked by the horizontal sync pulse; that is, the 1500 Hz and 2400 Hz oscillators are overridden by the 1200 Hz sync oscillators during the horizontal and vertical sync pulses.)

Construction: Printed Circuit Board

The components are mounted on a double-sided 5½" x 3" glass-epoxy circuit board fabricated to fit a standard 10 pin card edge connector with .156" spacing. I prefer not designing double-sided circuitry because of the problems encountered making them at home and the increased costs involved, but the artwork density using twelve ICs made it impossible for me to design single-sided circuitry which fit a 5½" x 3" circuit board. The artworks were prepared at home using commercially available artwork aids,[5] taped 2:1, and photographically reduced at a local photo shop. Using direct positive photoresist coated boards available from the Vector-Electronic Co. (CU70/45WE-2RN, 7 x 4½", 1/16" double-sided glass-epoxy), the boards were exposed, developed, and etched following the instructions that came with the boards. After cutting and drilling (#65 drill for IC pads, #60 drill for others), I tin plated the finished boards with Shipley LT-25 chemical plating solution.[6] After assembly, the component side is top soldered as required and jumpers soldered top and bottom in the three feed-through holes.

Adjustment

Obviously the easiest way to set the 1200 Hz, 1500 Hz, and 2400 Hz reference oscillators is with a frequency counter, and the values specified in the parts list should allow you to adjust the oscillators without re-selecting R4, R7, or R10. If a frequency counter is not available, the oscillators can be set with a triggered scope with a *calibrated* timebase. Set the timebase to .1 ms/div, internal trigger and adjust the 1200 Hz oscillator for a width of .83 ms, the 1500 Hz oscillator for a width of .67 ms, and the 2400 Hz oscillator for a width of .417 ms. Switch to line trigger and readjust the oscillators for a stable waveform (i.e., a waveform which is not slowly drifting from right to left or left to right across the screen). This adjusts the oscillators against the 20th harmonic (1200 Hz), 25th harmonic (1500 Hz), and 40th harmonic (2400 Hz) of the 60 Hz power line and is accurate within .1% provided your timebase is calibrated, as it is very easy to adjust the oscillators against the wrong harmonic.

Operation

The pattern generator requires +5 V ±.25 @ 150 mA and 6.3-12.6 Vrms ac, and the supply illustrated in Fig. 3 satisfies the power supply requirements for the generator.

Syncing the scope on the positive edge of the horizontal sync pulse will be adequate for most troubleshooting/design, and a few

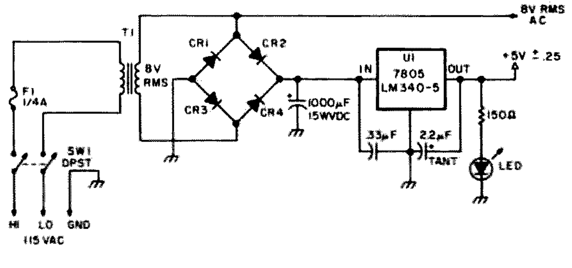


Fig. 3. This power supply satisfies the requirements for the pattern generator, but since the generator only requires 150 mA @ +5 V, it can easily be borrowed from an existing supply.

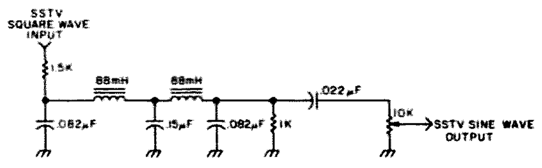


Fig. 4. This low pass audio filter used by K4EEU requires no power supplies.

Parts List

C1, 2	.22 uF ±10% 250 V
C3, 4, 6, 8, 11, 14	.01 uF ±10% 250 V
C5	.015 uF ±10% 250 V
C7	.022 uF ±10% 250 V
C9, 12	.001 uF disc ceramic
C10, 13	.047 uF ±10% 250 V
C15, 16, 17	.1 uF ±10% 250 V
Note: With the exception of C9 and C12, all caps are metallized polyester Mepco/Electra Series C280AE/A or equivalent (.4" lead spacing).	
CR1, 2	1N914 or equivalent silicon
R1	1k ±10% carbon
R2, 5, 8	10k ±10% 89PR 15 turn cermet trimpots;
R3, 6, 9	1k ±1% RN55/60C 50 ppm metal film
R4	24.3k RN55/60C 50 ppm metal film
R7	26.7k RN55/60C 50 ppm metal film
R10	21.5k RN55/60C 50 ppm metal film
R11, 14	12k ±10% ½ Watt carbon
R12, 15	10k ±10% ½ Watt carbon
R13	102k ±1% RN55/60D 100 ppm metal film
R16	619k ±1% RN55/60D 100 ppm metal film
U1, 2, 3, 6, 7	NE555V IC Timer
U4	7410 triple 3 input positive NAND gate
U5, 8	7400 quadruple 2 input positive NAND gate
U9	74132 quadruple 2 input positive NAND Schmitt trigger
U10	7474 dual-D type positive edge triggered FF
U11	7492 divide by twelve counter
U12	7490 decade counter

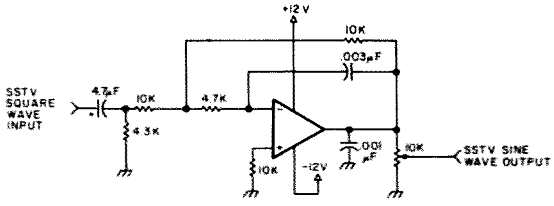


Fig. 5. WØLMD low pass audio filter.

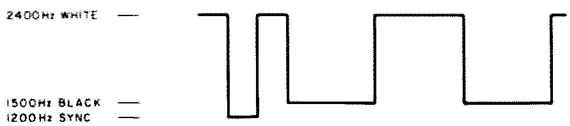


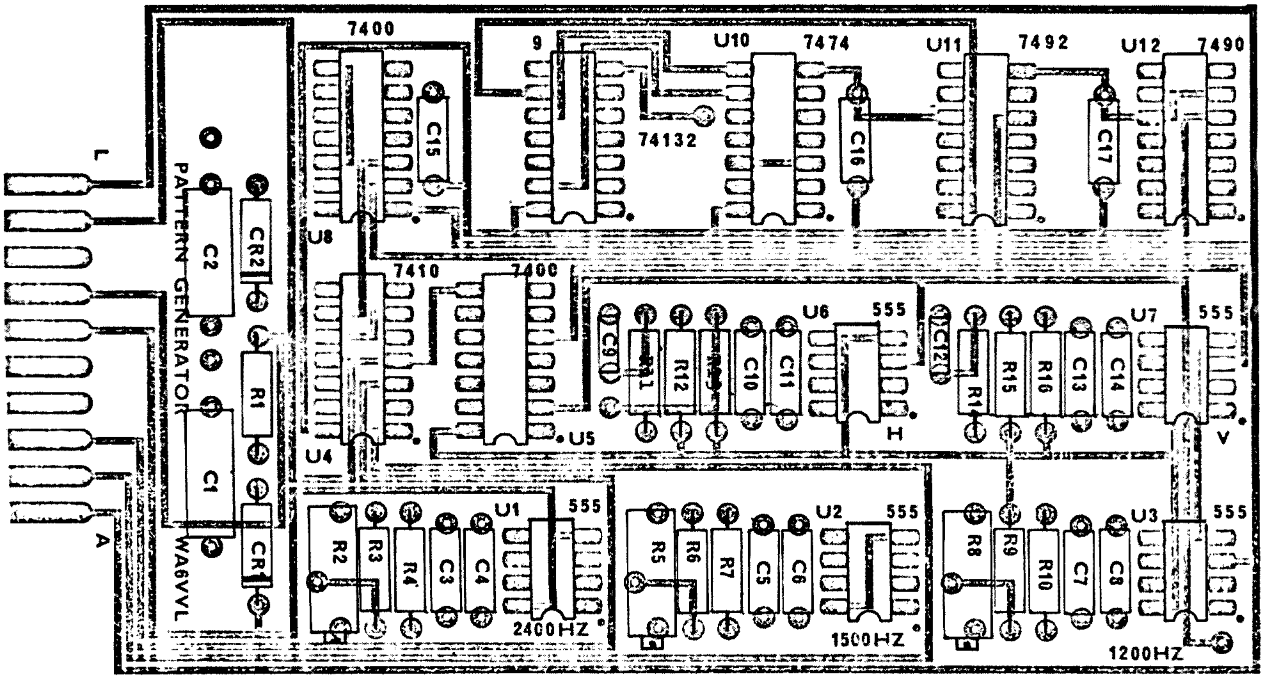
Fig. 6. Output of the WB9LVI low pass filter.

evenings spent with *73*'s *SSTV Handbook* should provide sufficient information to repair an ailing monitor with the generator. The 1200 Hz output can be used to tune the sync circuitry, and the 2400 Hz output can be used to adjust the discriminator. The horizontal and vertical sync pulses may be used as horizontal and vertical discharge pulses to drive the triggered deflection circuitry, and the checkerboard pattern can be used to optimize the gain(s) of the low pass filter for a square wave response with just enough overshoot (ringing) to enhance picture detail. The video output can be attenuated with a potentiometer to determine the minimum input for limiting, determined by limiter gain. Fig. 6 is the output of the WB9LVI low pass butterworth filter with the generator connected, and Fig. 7 illustrates the checkerboard pattern as displayed by the monitor.

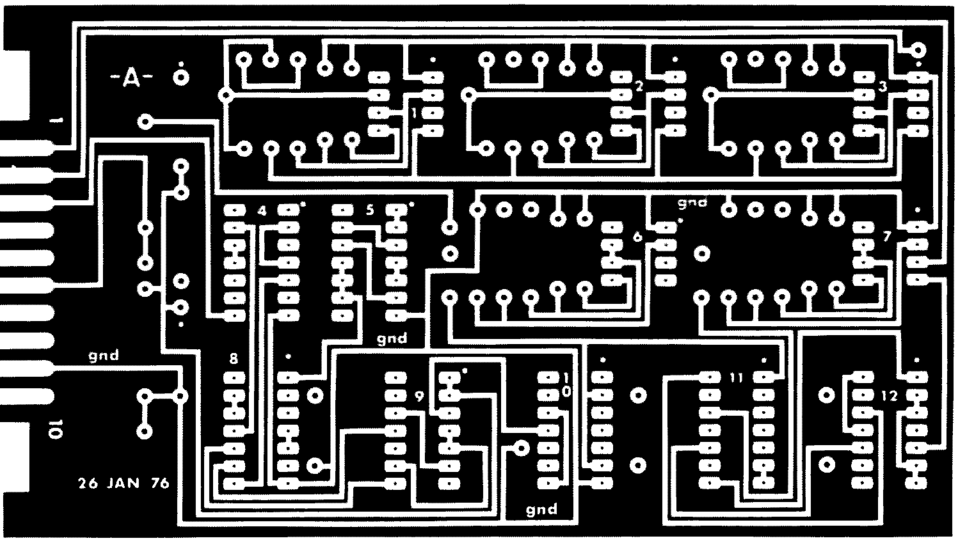
Although designed primarily for tuneup, calibration and repair, the generator can also be used for transmission by using the low pass audio filter used by K4EEU, shown in Fig. 4, to convert the square wave video to sine waves. I prefer this filter because it requires no power supplies, but an alternative is the filter used by WØLMD in several of his designs,[7,8] shown in Fig. 5.

Conclusion

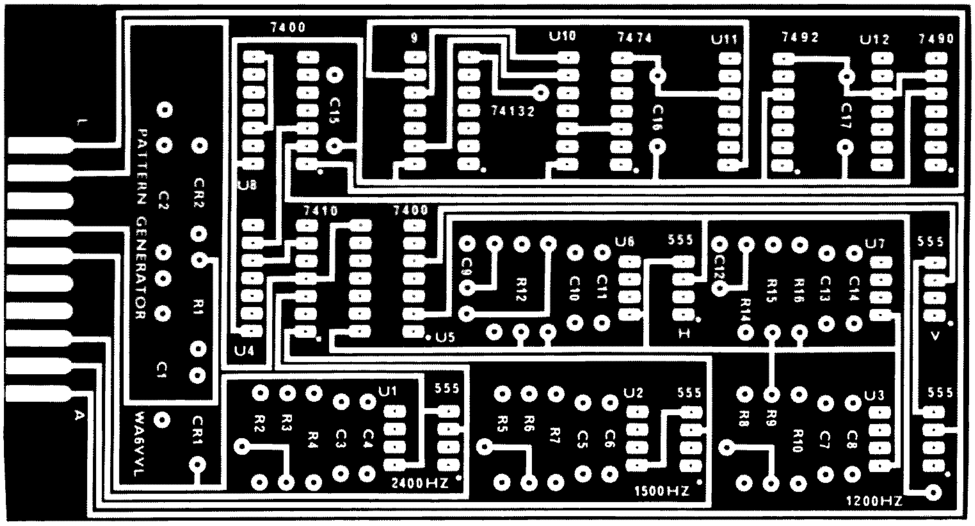
Compared to the cost of an SSTV monitor, the pattern generator represents a modest investment. Like K4EEU, once the completed generator was connected to my monitor, I wondered how I survived without it, and am now convinced that anyone who wants to roll their own monitor should have a similar unit. I'll be the first to admit



Component layout.



PC layouts.



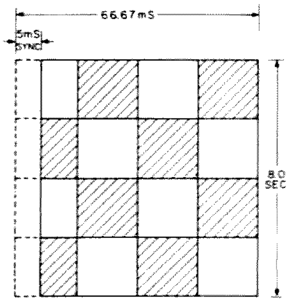


Fig. 7. Checkerboard pattern as displayed by the monitor. The pattern appears to be unsymmetrical because the leading edge is blanked by the 5 ms horizontal sync pulse.

that a monitor can be constructed and aligned without it, but it should save countless hours of work should a snag develop. ■

References

[1] Bert Kelley K4EEU, "Slow Scan TV Test Generator," *Ham Radio*, July 1973, pages 6-14.

[2] Dr. George R. Steber WB9LVI, "Slow Scan To Fast Scan TV Converter," *QST*, May 1975, pages 28-36, 46.

[3] Michael Tallent W6MXV, "The W6MXV Hi-Performance Magnetic Deflection SSTV Monitor," *Slow Scan Television Handbook*, a *73* publication.

[4] Larry Pryor WA9MFF, "Homebrew this SSTV Monitor," *73*, June 1975, pages 22-30.

[5] W. H. Brady Co., 727 W. Glendale Ave., Milwaukee, Wis., 53201; Bishop Graphics, Inc., North Hollywood, Calif., 91605.

[6] Shipley Co. Inc., 2300 Washington Str., Newton, Mass., 02162.

[7] Dr. Robert Suding WØLMD, "An SSTV Keyboard," *CQ*, September 1974, pages 20-26, 79-80.

[8] Dr. Robert Suding WØLMD, "SSTV Scan Converter," *73*, August 1974, pages 73-84.

Additional References

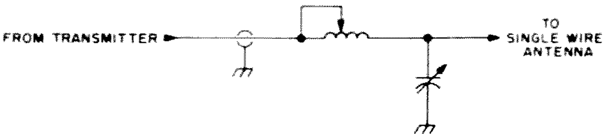
Slow Scan Television Handbook, a *73* publication.

"Applications of Linear Integrated Circuits," Eugene R. Hnatek, Chapter 7, *The Integrated Circuit Timer*, pages 421-454.

Designing with TTL Integrated Circuits, Texas Instruments Electronic Series, edited by R. L. Morris and J. R. Miller.

The TTL Data Book for Design Engineers, Texas Instruments Inc.

Novice Q&A



from page 21

power circuits, and SW2 is a SPST that does the antenna grounding.

Q. Using a trap antenna, erratic loading readings are obtained when it rains. What could be the cause of this?

A. The trap may be leaking. Also, there may be water entering the coax. With a good high-range ohmmeter (at the transmission line end), check the antenna — both when the weather is wet and when it is dry. A low reading when wet will indicate moisture is the problem. Disconnect and check the coax; then recheck the antenna itself with the coax disconnected.

Q. In an attempt to make a 10 meter transistorized converter work with a BC transistor radio, AM broadcast signals are received after the converter is connected to the BC set's antenna coil. Any suggestions?

A. If the antenna coil is not shielded, you will continue to pick up BC signals. Shield the coil and connect it via a coaxial cable to the output of your converter by placing a .0022 uF capacitor in series with the cable's center lead. Ground the coax shield to the BC set chassis.

Q. How can a long wire antenna be matched to a transceiver without an elaborate or heavy antenna tuner, when used away from home?

A. Any single wire antenna can be matched to the low impedance of your transceiver with the circuit shown. A surplus coil and a capacitor of 200-365 pF may be used. Using an swr meter, adjust the rotatable coil and capacitor for proper matching and maximum transmitter output. This circuit may also be used for mobile operation.

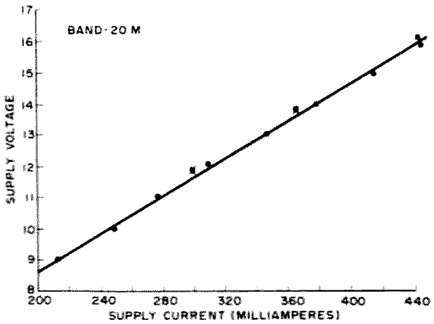


Fig. 1. Supply voltage vs. supply current.

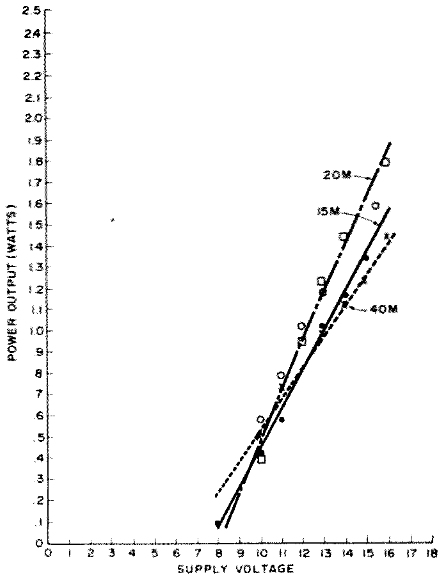


Fig. 2. Power output vs. supply voltage.

How Does Your Rig Perform?

- - an example using the HW-7

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Some time ago I spent two weeks in Hawaii, enjoying the sun, surf and QRP operation/KH6 using the Heathkit Model HW-7 transceiver. I used two "twin lead" folded dipoles about 15 feet high and batteries for power which were recharged during the day using solar energy. The performance on twenty and forty meters was excellent: ZL1, JA∅, JA1, LA1, UA∅, KL7, VE5-6-7, W4-5-6-8-9-∅ – all with good (S3-S8) signal reports. My log shows that nearly 50% of the stations called replied.

After returning to the mainland, I wondered about the truth of "2 Watts" and decided to measure the performance characteristics of the HW-7 transmitter. The object of this article is to present the experimental test data that I obtained with my HW-7 so that other amateurs will have more knowledge about their HW-7 and how to use it for optimum performance.

Fig. 1 shows the measured input current as a function of the applied voltage. This data was taken with the transmitter adjusted for maximum power out on twenty meters. The results are linear over the voltage range from 8-16 V. Below 8 V the unit does not always oscillate and the output waveform is very distorted.

Fig. 2 shows the measured power output of the transmitter as a function of supply voltage for the three operating bands. The frequencies used were 7.05 MHz, 14.10 MHz and 21.15 MHz. The

power was determined from the measurement of the peak-to-peak voltage across a 50 Ohm, non-inductive load.

$$P = \frac{(E_{pp} \times 0.50 \times 0.707)^2}{R}$$

The peak-to-peak output voltage was measured with a Textronics Model 546 oscilloscope.

Fig. 2 shows that the power outputs on 40 meters and 15 meters are essentially the same, while the 20 meter output is considerably higher. The Heathkit manual claims that the power input varies from 3 to 2 W with increasing frequency, implying a corresponding decrease in power output. I cannot explain this apparent discrepancy between the test and published data.

As with the power input, the power output increases linearly with supply voltage. For battery operation, this characteristic is fortunate because it results in a gradual, rather than sudden, drop in output power as the battery discharges. However, the need for well charged batteries is apparent: A 2 V drop from 12 to 10 V reduces the power output by 50%.

With the power input and power output established, the next question concerned the optimum load for the transmitter. The specifications prescribe a 50 Ohm, unbalanced load. To measure the effect of load resistance on power output, a series of non-inductive, resistive loads was applied to the transmitter and the power output was measured. Fig. 3 shows the results of these measurements.

From this data it appears that the transmitter is optimally matched to a 62 Ohm load, but the difference between 62 and 50 Ohms is negligible. This data was taken on 20 meters with a 12 V supply.

In actual practice, antenna loads seen by a transmitter are seldom resistive, and usually show either inductive or capacitive reactance as well as resistance. To measure the effects of reactance on power output, various inductive and capacitive elements were placed in series with a 50 Ohm, non-inductive, resistive load. The power output was measured across the resistor.

Fig. 4 shows the power output as a function of the reactance of the load for the three bands. The power output is essentially constant for up to 10 Ohms of either capacitive or inductive reactance and drops rapidly with increasing reactance.

The range of reactance variation is limited by the variable capacitor. Since the impedance seen by a transmitter can vary over a wide range of values with antenna design, and transmission can vary over a wide range of values with antenna design and transmission line length, one should be very careful to provide the transmitter with a resistive load. With increasing reactance the "relative power" meter reads higher and higher, even off scale. The peak reading still corresponds to the peak power output, but the relative reading is valid only for non-inductive, resistive loads.

The HW-7 has a reputation for creating TVI, and mine is no exception. As far as I know, the interference is limited to TV sets in close proximity to the transmitter, but considering the DX achieved with less than 3 W, the interference range might

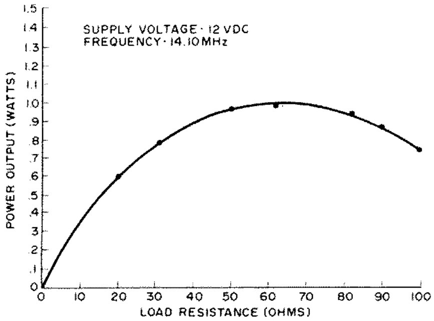

Fig. 3. Power output vs. load resistance.

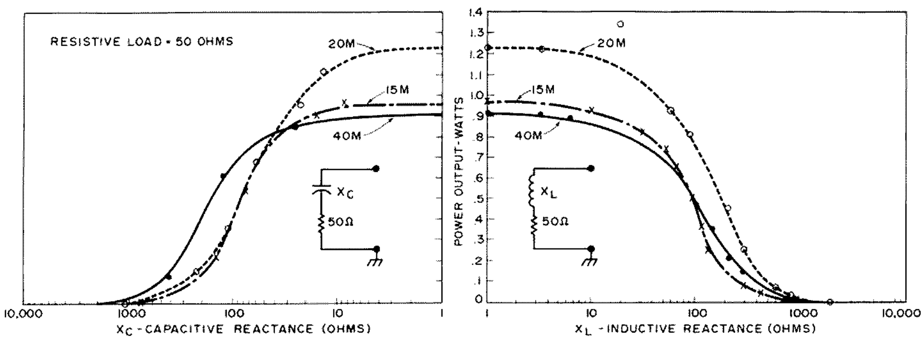

Fig. 4. Power output vs. inductive and capacitive reactance.

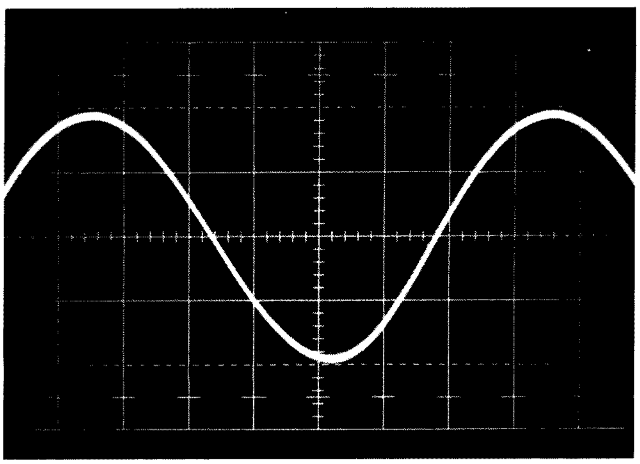

Fig. 5. Output waveform, 7.1 MHz.

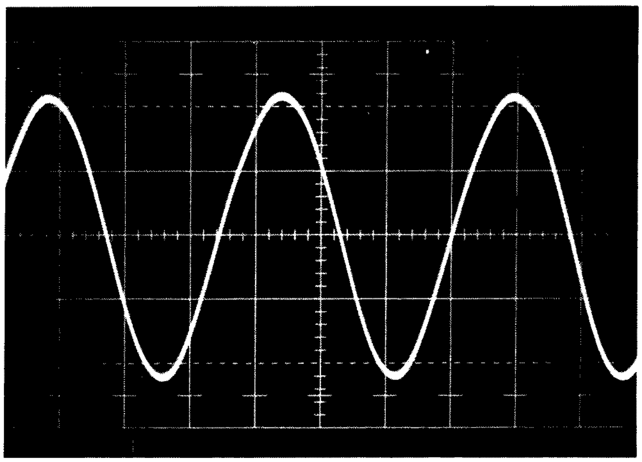

Fig. 6. Output waveform, 14.1 MHz.

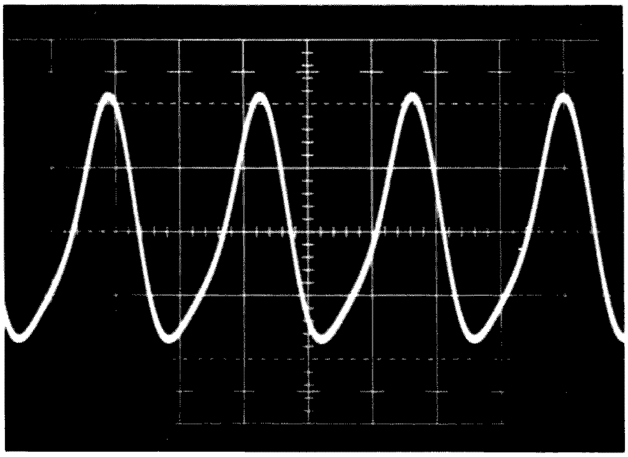

Fig. 7. Output waveform, 21.1 MHz.

be quite large.

The output waveforms of the transmitter were measured, using the 546 oscilloscope. This data is shown in Figs. 5, 6 and 7. Each of these photos shows the output waveform measured at peak power. For all three bands, this waveform is sinusoidal with little or no harmonic content. Figs. 9, 10, and 11 show the power output at the same frequencies

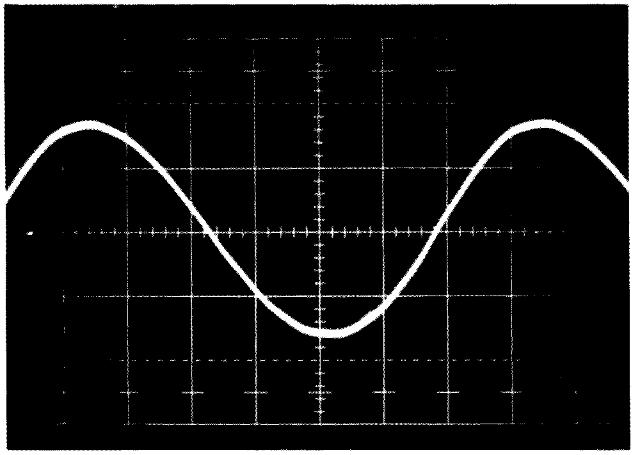

Fig. 9. 7.1 MHz de-tuned.

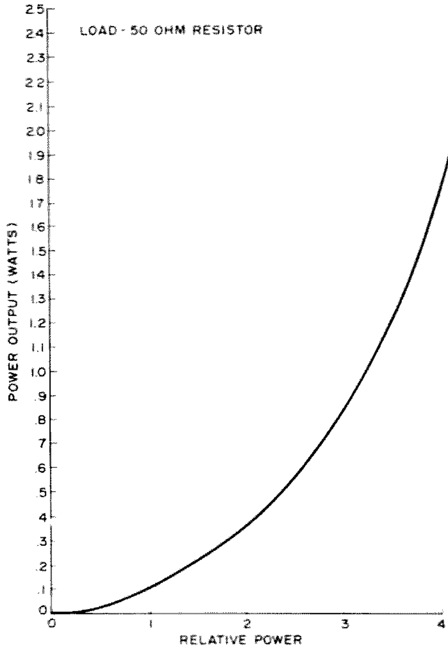

Fig. 8. Calibration curve, power output vs. relative power.

but with the leading capacitor turned slightly off peak relative power indication. Here the harmonic content becomes high, particularly on 15 and 20 meters, although the power output is not markedly decreased. This effect of de-tuning on harmonic content is more pronounced when de-tuned on the high frequency side of the relative power peak.

Fig. 8 shows a calibration curve of the relative power meter to yield absolute power output as a function of meter reading. This curve, however, is only valid for the 50 Ohm resistive load supplied with the kit.

The measured and on-the-air performance of the HW-7 transmitter shows that it is fine for QRP operation. The only possible problem areas are matching of the unit to a non-resistive load with the resultant misleading relative power indication, and that careful power peaking is required to minimize TVI. ■

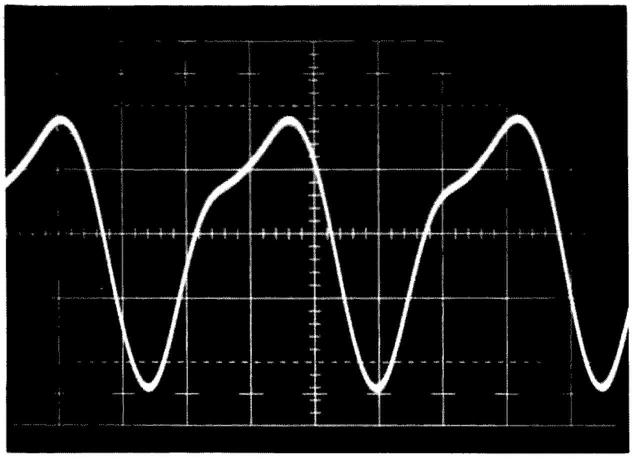

Fig. 10. 14.1 MHz de-tuned.

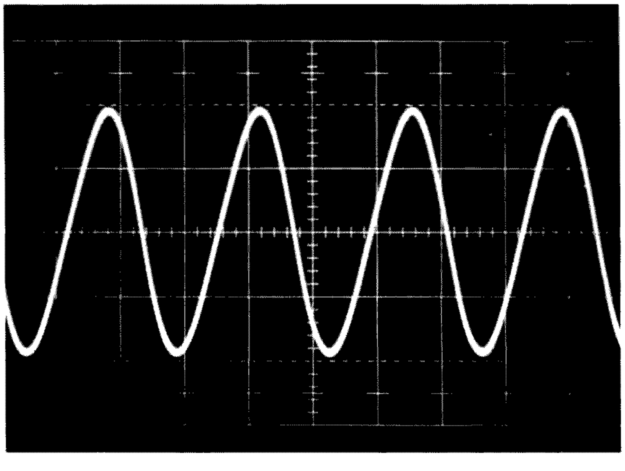

Fig. 11. 21.1 MHz de-tuned.

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Art and the PC Board

-- new uses for copperclad boards

Traditionally, printed circuits have been an aid in the mass production of electronic devices such as radios, TVs, telephones, etc. However, there is no reason to restrict the use of PC materials to traditional applications.

As the photographs show, they may be used for front panels, decorative plaques, and name tags. The more intricate patterns are most conveniently done by means of a photographic process, one that may be done at home. Fig. 4 and the top of Fig. 3 are two examples of this.

The wall plaques and transmitter front panel require a minimum of materials. Double-sided board is easier to get than single-sided for many reasons. It is also the best for this use as the back side will readily take solder.

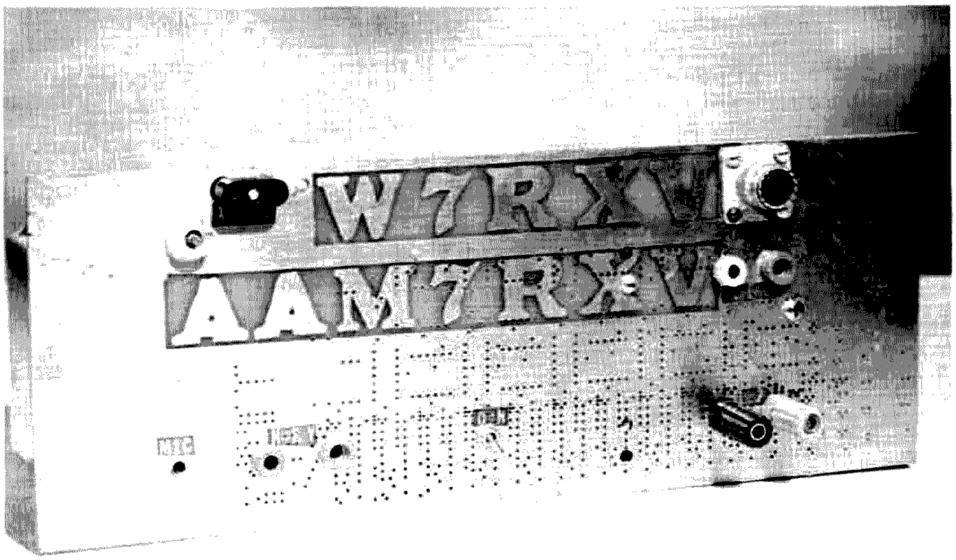


Fig. 1. ¾" letters.

Etch resist or laundry marking pens and paper masking tape are used to keep the etching solution where it belongs. The laundry markers are available for about 1/2 to 1/3 the price of the etch resist pens. (Sanford's "Rub-A-Dub" proved to be insoluble in water and ferric chloride.)

The dry transfer or press-on type of decals also work quite nicely as may be seen in Figs. 1 and 5. (Figs. 3, 4, 5 are essentially life-size.)

The results shown in the lower portion of Fig. 3 are what gave rise to the use of stencils for the plaques. I never did get along too well with a triangle and tee square.

If you have been paying attention, then by now you should have on hand the following items: triangle, tee square, ferric chloride, laundry markers, masking tape, copperclad, steel wool, stencils, and a tall pitcher of lemonade.

So as to preclude two trips to the store, the photo chemicals may be picked up too. Kodak's KPR system has proved to be quite reliable. The information that came with it seemed to be lacking in detail. More about that method later.

As anyone who has worked with printed boards can tell you, cleanliness is next to impossible, but absolutely essential.

The side of the board with the smallest number of nicks and scratches should be scrubbed with steel wool. After it glistens, apply several drops of rubbing alcohol and wipe dry with a paper towel. Surprise, surprise, you thought the board *was* clean!

Lay the board face down on a clean paper towel and apply a nice smooth bubble free coating of masking tape to the back side. If the board is wider than the tape, then overlap the edge of the tape.

Make sure the tape is securely down against the board.

If a combination of decals and stenciled letters is going to be applied, the stencil should be used first. Take your time and fill in the stencil with plenty of ink. Any slop-over may be corrected with a razor blade or better yet, an X-acto type of blade. A large error may be cleaned up with rubbing alcohol.

Follow the manufacturer's ideas with the decals. Try to avoid rubbing the center area of closed letters. The gum that is transferred in the process may act as a resist. If that does happen it may be corrected during the etching by carefully scratching the area with a thin pointed instrument. The board should be rinsed off with cool water before trying this correction.

The borders are made by applying masking tape. Where they overlap at the corners, put down a good layer of ink first.

A little freehand artwork is used to fill in the letters and avoid the broken appearance normally associated with stencils.

The photographic process is somewhat more involved, and somewhat more expensive. If a large number of the same thing is going to be made, then the higher cost might be warranted. Club projects that require a lot of boards would be one example. There would almost certainly be enough materials left over for the processing of a few call letter tie clips, etc. Fig. 4 is an example of this. The upper part of Fig. 3 shows what can be done to dress up the drab looking company-issue type of formica name tag. Two alligator clips are soldered on the back.

The boards are cleaned as above and handled with rubber gloves. Fingerprints and similar contamination must be avoided. The boards are coated with the etch resist by means of a medicine dropper. (This is done under yellow "bug" lighting.) Apply an excess of solution and flow it around the surface by tilting the board. The board is held vertically and the extra solution is drained off. Don't keep them vertical too long.

Place the boards in a preheated oven for 10 to 15 minutes. Oven temperature is 150-180° F. Remember, the boards are sensitive to light before they come out. Although this pre-bake may be skipped, it gets dry boards ready for exposure in about 20 minutes, instead of 24 hours. Your pattern is more likely to stay with you during high temperature processing, too.

Exposure time was 8 minutes at 24 inches with a BEP lamp. This is a 300 Watt photoflood. First-hand information of sunlight exposure time is not available due to the fact that there wasn't any sunlight available between the hours of midnight and 6 am when these items were made. Daylight exposure time should be about 2 minutes though.

The exposed board is dropped face up into the developer for 60 seconds. An aluminum cake pan with a

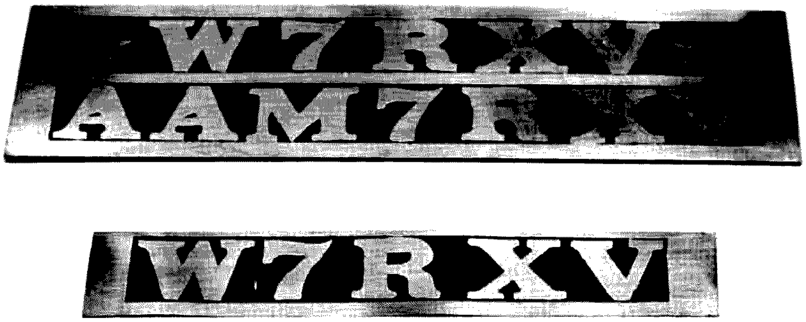


Fig. 2. 1" letters.

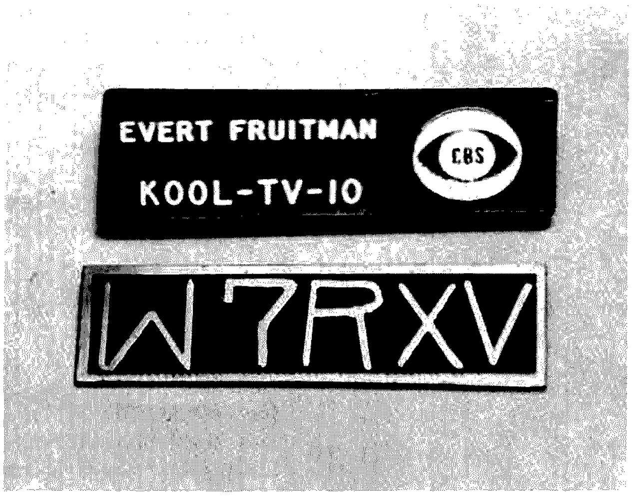


Fig. 3. Just about actual size name and call tags.

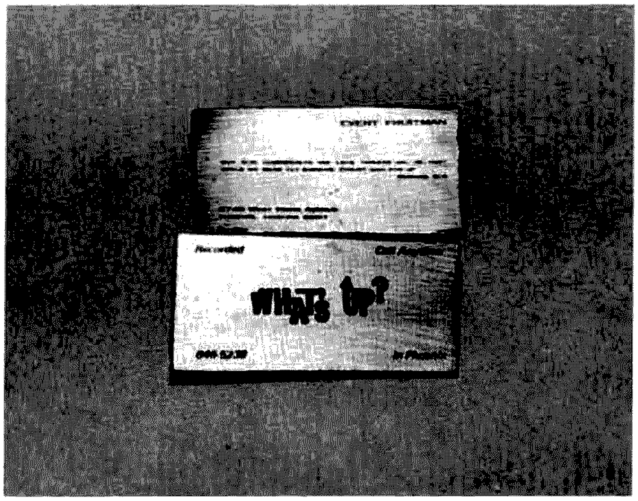


Fig. 4. Note fine resolution of photo process.

Fig. 5. Almost actual size.

sliding cover helps keep the odor to a relatively low level. Gently agitate the solution during the development. Immediately after developing, the board is given a cool running water rinse. A gentle stream of water should be directed at the surface for several seconds. A faint pattern may be visible as it dries.

The boards may be etched at this time, but it is better if they get a post bake for about 10 minutes at 180° F. This may be done in normal room lighting.

The developer may be reused. Several ounces of developer may be poured into a small can with a tight fitting lid and used until it starts looking a bit dirty. Not the most scientific method for determining the end point, but quite practical.

The smallest available quantity of resist is a quart. That will do many boards. The developer comes in gallon cans. Generally speaking, the photo stores can tell you who handles the KPR series of chemicals or can order them for you.

There are some canned spray photoresists at some of the radio stores. We tried some of the canned variety but they didn't seem to work too well. Either they had been sitting on the store shelf too long (and in the Arizona heat that may not take too long either), or the chemistry needed to be worked out better.

After the boards have been etched and dried, they may be cleaned with steel wool. There are spray lacquers that make a nice durable coat. For best results, give them a 10 minute bake at about 180° F. A coating of the YF's clear fingernail polish does wonders for the smaller items such as the name tags, tie clips, etc. The tape is removed from the back and alligator clips, safety pins, etc., may be soldered in place.

It might be in order to give some details about the etching process. There are many fine comprehensive articles on the subject, but this isn't going to be one of them.

Everyone seems to have his own favorite method and etchant. We like ferric chloride. It is readily available and almost harmless. It does stain hands and clothing, the latter on a permanent basis. Wear old clothes and rubber gloves. Drug stores have some types for as little as 50¢ a pair. They also carry the stencils.

The etching may be done in plastic or glass containers. DO NOT let the ferric chloride come in contact with aluminum!

One of the popular methods uses heatproof glassware, and the solution is kept heated during etching. Infrared lamps aimed from above, or a very gentle fire underneath, is one way it is done. The dish is slowly rocked during the process. The board is face up.

We took some old plastic bleach bottles and cut the top off just about in line with the center of the handle. The solution is poured into the bottle and this is placed in a pan of hot water. The heat may be left on during the process. If the boards are too long to go all the way into the solution, then use enough solution to cover at least half of the board. It is lifted up and down or used to stir the brew until etching is done. If the board is a long one, then turn it over and finish it off. This was done with the transmitter front panel and plaques shown in Figs. 1 and 2. The 1 and 2 quart size bottles are the most convenient to use for this. The boards may be rinsed off with water and examined anytime during the etching process.

The top of the bottle makes a nice funnel for pouring the used etchant back into its container when the job is completed.

It takes about 5-10 minutes with fresh warm etchant to etch the average board. If it isn't convenient to agitate the thing while it's etching, it will take quite a bit longer to finish cutting it. But it will cut.

If you don't feel like adding some fancy decorations to the shack, Fig. 6 shows that copperclad may be used as an easily machined and inexpensive and decorative material. ■

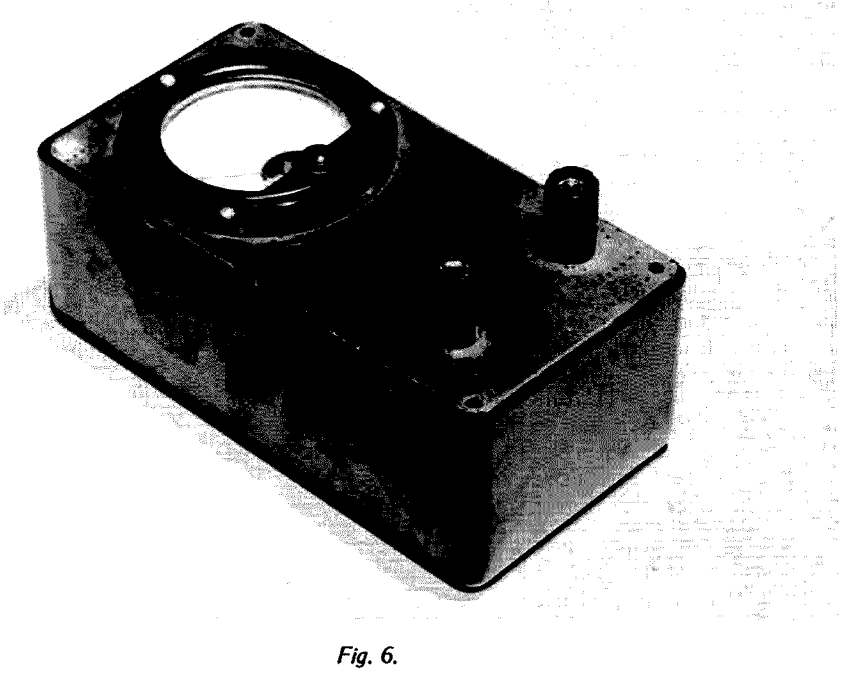


Fig. 6.

Don Jenkins WA6OAZ
PO Box 3313
Riverside CA 92509

The "New" 88 Channel IC-22

- - add two switches and flip

By now, I'm sure you have heard at least three tales of how to get more frequencies out of your Icom IC-22S. Well, hang on! Here comes one I think you will like.

Icom supplies a chart for programming the diode matrix of the 22S. It was from this chart I discovered you can get at least 88 channels by simply adding two small switches and programming it in a logical manner. The modification should cover over 95% of the repeaters in the United States as well as

FREQUENCY VS. DIODE PLACEMENT

		Frequency	Total "N"	D-7	D-6	D-5	D-4	D-3	D-2	+30 kHz B D-1	+15 kHz A D-0
1 –		146.010	108		x	x		x	x		
	A	146.025	109		x	x		x	x		x
	B	146.040	110		x	x		x	x	x	
	A + B	146.055	111		x	x		x	x	x	x
2 –		146.070	112		x	x	x				
	A	146.085	113		x	x	x				x
	B	146.100	114		x	x	x			x	
	A + B	146.115	115		x	x	x			x	x
3 –		146.130	116		x	x	x		x		
	A	146.145	117		x	x	x		x		x
	B	146.160	118		x	x	x		x	x	
	A + B	146.175	119		x	x	x		x	x	x
4 –		146.190	120		x	x	x	x			
	A	146.205	121		x	x	x	x			x
	B	146.220	122		x	x	x	x		x	
	A + B	146.235	123		x	x	x	x		x	x
5 –		146.250	124		x	x	x	x	x		
	A	146.265	125		x	x	x	x	x		x
	B	146.280	126		x	x	x	x	x	x	
	A + B	146.295	127		x	x	x	x	x	x	x
6 –		146.310	128	x							
	A	146.325	129	x							x
	B	146.340	130	x						x	
	A + B	146.355	131	x						x	x
7 –		146.370	132	x					x		
	A	146.385	133	x					x		x
	B	146.400	134	x					x	x	
	A + B	146.415	135	x					x	x	x
19 –		146.430	136	x				x			
	A	146.445	137	x				x			x
	B	146.460	138	x				x		x	
	A + B	146.475	139	x				x		x	x
20 –		146.490	140	x				x	x		
	A	146.505	141	x				x	x		x
	B	146.520	142	x				x	x	x	
	A + B	146.535	143	x				x	x	x	x
21 –		146.550	144	x			x				
	A	146.565	145	x			x				x
	B	146.580	146	x			x			x	
	A + B	146.595	147	x			x			x	x
		146.610	148	x			x		x		
		146.625	149	x			x		x		x
		146.640	150	x			x		x	x	
		146.655	151	x			x		x	x	x
		146.670	152	x			x	x			
		146.685	153	x			x	x			x
		146.700	154	x			x	x		x	
		146.715	155	x			x	x		x	x
		146.730	156	x			x	x	x		
		146.745	157	x			x	x	x		x
		146.760	158	x			x	x	x	x	
		146.775	159	x			x	x	x	x	x
		146.790	160	x		x					
		146.805	161	x		x					x
		146.820	162	x		x				x	
		146.835	163	x		x				x	x
		146.850	164	x		x			x		
		146.865	165	x		x			x		x
		146.880	166	x		x			x	x	
		146.895	167	x		x			x	x	x
22 –		146.910	168	x		x		x			
	A	146.925	169	x		x		x			x
	B	146.940	170	x		x		x		x	
	A + B	146.955	171	x		x		x		x	x
8 –		146.970	172	x		x		x	x		
	A	146.985	173	x		x		x	x		x
	B	147.000	174	x		x		x	x	x	
	A + B	147.015	175	x		x		x	x	x	x
9 –		147.030	176	x		x	x				
	A	147.045	177	x		x	x				x
	B	147.060	178	x		x	x			x	
	A + B	147.075	179	x		x	x			x	x
10 –		147.090	180	x		x	x		x		
	A	147.105	181	x		x	x		x		x
	B	147 120	182	x		x	x		x	x	
	A + B	147.135	183	x		x	x		x	x	x
11 –		147.150	184	x		x	x	x			
	A	147.165	185	x		x	x	x			x
	B	147.180	186	x		x	x	x		x	
	A + B	147.195	187	x		x	x	x		x	x
12 –		147.210	188	x		x	x	x	x		
	A	147.225	189	x		x	x	x	x		x
	B	147.240	190	x		x	x	x	x	x	
	A + B	147.255	191	x		x	x	x	x	x	x
13 –		147.270	192	x	x						
	A	147.285	193	x	x						x
	B	147.300	194	x	x					x	
	A + B	147.315	195	x	x					x	x
14 –		147.330	196	x	x				x		
	A	147.345	197	x	x				x		x
	B	147.360	198	x	x				x	x	
	A + B	147.375	199	x	x				x	x	x
15 –		147.390	200	x	x			x			
	A	147.405	201	x	x			x			x
	B	147.420	202	x	x			x		x	
	A + B	147.435	203	x	x			x		x	x
16 –		147.450	204	x	x			x	x		
	A	147.465	205	x	x			x	x		x
	B	147.480	206	x	x			x	x	x	
	A + B	147.495	207	x	x			x	x	x	x
17 –		147.510	208	x	x		x				
	A	147.525	209	x	x		x				x
	B	147.540	210	x	x		x			x	
	A + B	147.555	211	x	x		x			x	x
18 –		147.570	212	x	x		x		x		
	A	147.585	213	x	x		x		x		x
	B	147.600	214	x	x		x		x	x	
	A + B	147.615	215	x	x		x		x	x	x
		147.630	216	x	x		x	x			
		147.645	217	x	x		x	x			x
		147.660	218	x	x		x	x		x	
		147.675	219	x	x		x	x		x	x
		147.690	220	x	x		x	x	x		
		147.705	221	x	x		x	x	x		x
		147.720	222	x	x		x	x	x	x	
		147.735	223	x	x		x	x	x	x	x
		147.750	224	x	x	x					
		147.765	225	x	x	x					x
		147.780	226	x	x	x				x	
		147.795	227	x	x	x				x	x
		147.810	228	x	x	x			x		
		147.825	229	x	x	x			x		x
		147.840	230	x	x	x			x	x	
		147.855	231	x	x	x			x	x	x
		147.870	232	x	x	x		x			
		147.885	233	x	x	x		x			x
		147.900	234	x	x	x		x		x	
		147.915	235	x	x	x		x		x	x
		147.930	236	x	x	x		x	x		
		147.945	237	x	x	x		x	x		x
		147.960	238	x	x	x		x	x	x	
		147.975	239	x	x	x		x	x	x	x
		147.990	240	x	x	x	x				

14 standard simplex frequencies.

You start out by programming the radio for the 22 "base" frequencies. Icom pre-programs the first five channels; these must be reprogrammed.

You then add two small switches to the radio, to add +15 kHz, +30 kHz or both, for +45 kHz, to the base frequencies. I marked these switches "A" and "B", so (for example) channel 5AB (both A & B on) would be 146.25/85 +45 kHz, or 146.295/895. The switches can be installed almost anywhere on the radio. I added mine to the upper cover.

The common of both switches is wired to +9 volts from the matrix board. Switch "A" (+15 kHz) is wired in series with a diode (1N4148) to any hole in the top column of the matrix board marked 1 (DØ), opposite the channel numbers at the bottom of the board. These holes at the top of the board are all common to one another on the back side of the board.

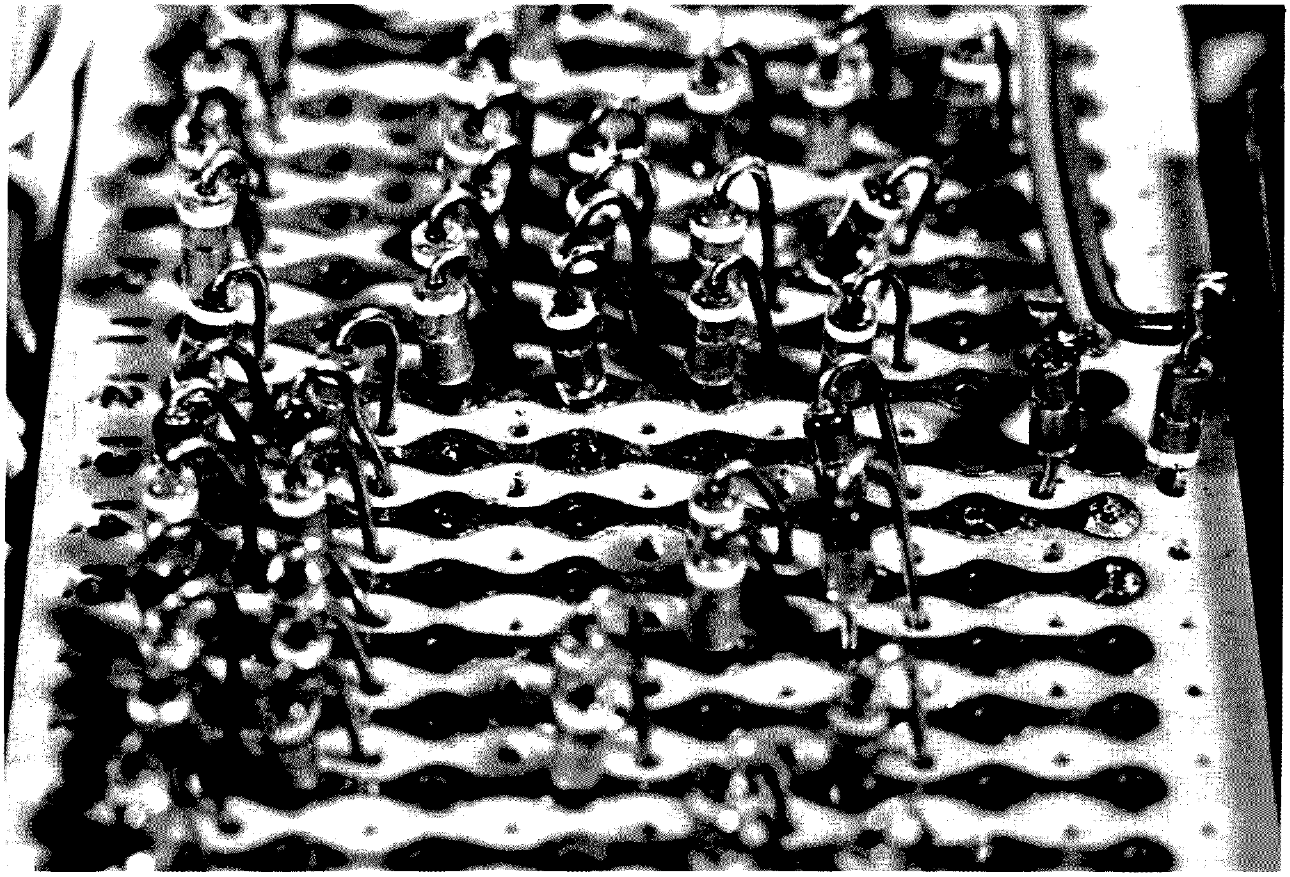
The second switch (+30 kHz) is wired to any hole in the second row from the top. The diodes in both cases are inserted with the banded end through the board, and then soldered to the back side of the board. Next, solder the wires from the switches to the tops of the diodes and you're ready to go!

This modification does produce one interesting operating characteristic. If either switch "A" or "B" is on, and you pass an unprogrammed channel, the Icom 22S will "lock" onto this blank channel until released by momentarily switching off power.

Just think, you've quadrupled the capacity of your 22S for the cost of two switches! Not bad at all.■

Chan. #	(base) program radio for	A & B off	base +15 kHz A on	base +30 kHz B on	base +45 kHz A & B on
1	146.01	01/61	025/625	04/64	055/655
2	146.07	07/67	085/685	10/70	115/715
3	146.13	13/73	145/745	16/76	175/775
4	146.19	19/79	205/805	22/82	235/885
5	146.25	25/85	265/865	28/88	295/895
6	146.31	31/91	325/925	34/94	355/955
7	146.37	37/97	385/985	40/40	415/415
8	146.97	97/97	985/985	7.60/00	7.615/015
9	147.03	63/03	645/045	66/06	675/075
10	147.09	69/09	705/105	72/12	735/135
11	147.15	75/15	765/165	78/18	795/195
12	147.21	81/21	825/225	84/24	855/255
13	147.27	87/27	885/285	90/30	915/315
14	147.33	93/33	945/345	96/36	975/375
15	147.39	99/39	405/405	42/42	435/435
16	147.45	45/45	465/465	48/48	495/495
17	147.51	51/51	525/525	54/54	555/555
18	147.57	57/57	585/585	60/60	615/615
19	146.43	43/43	445/445	46/46	475/475
20	146.49	49/49	505/505	52/52	535/535
21	146.55	55/55	565/565	58/58	595/595
22	146.91	91/91	925/925	94/94	955/955

Any of the above frequencies can be reversed with the duplex a/b switch on the radio.



Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Jan)	Time (GMT)	Longitude of Eq. Crossing °W
19264	1	0124:02	079.5	A	9739	1	0149:40	079.4
19276	2	0023:57	064.5	B	9751	2	0049:00	064.3
19289	3	0118:53	078.3	A	9764	3	0143:18	077.8
19301	4	0018:49	063.3	B	9776	4	0042:38	062.7
19314	5	0113:45	077.0	A	9789	5	0136:55	076.3
19326	6	0013:41	062.0	B	9801	6	0036:16	061.1
19339	7	0108:36	075.8	A	9814	7	0130:33	074.7
19351	8	0008:32	060.8	B	9826	8	0029:53	059.5
19364	9	0103:28	074.5	A	9839	9	0124:10	073.1
19376	10	0003:24	059.5	B	9851	10	0023:31	058.0
19389	11	0058:20	073'3	A	9864	11	0117:48	071.5
19402	12	0153:15	087.0	B	9876	12	0017:08	056.4
19414	13	0053:11	072.0	A	9889	13	0111:26	070.0
19427	14	0148:07	085.8	B	9901	14	0010:46	054.8
19439	15	0048.03	070.8	A	9914	15	0105:03	068.4
19452	16	0142:59	084.5	B	9926	16	0004:24	053.2
19464	17	0042:55	069.5	A	9939	17	0058:41	066.8
19477	18	0137:50	083.3	B	9952	18	0152:58	080.4
19489	19	0037:46	068.3	A	9964	19	0052:18	065.2
19502	20	0132:42	082.0	B	9977	20	0146:36	078.8
19514	21	0032:38	067.0	A	9989	21	0045:56	063.6
19527	22	0127:34	080.8	B	10002	22	0140:13	077.2
19539	23	0027:30	065.8	A	10014	23	0039:34	062.1
19552	24	0122:25	079.5	B	10027	24	0133:51	075.6
19564	25	0022:21	064.5	A	10039	25	0033:11	060.5
19577	26	0117:17	078.3	B	10052	26	0127:28	074.1
19589	27	0017:13	063.3	A	10064	27	0026:49	058.9
19602	28	0112:09	077.0	B	10077	28	0121:06	072.5
19614	29	0012:05	062.0	A	10089A	29	0020:26	057.3
19627	30	0107:00	075.8	B	10102	30	0114:44	070.9
19639	31	0006:56	060.8	A	10114	31	0014:04	055.8

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.85-145.95 MHz; Output 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

OSCAR 7 is turned off every Wednesday to conserve power. All mode B orbits that fall on GMT Mondays are designated QRP. A limit of ten Watts ERP is recommended, with a 100 Watt limit at all other times. Higher power will drain the OSCAR batteries at an accelerated rate.

AMSAT

During the months of January and February 1977, a number of normally OFF Wednesday orbits of AMSAT-OSCAR 6 will be turned ON for a special QRP Test. The 2 to 10 meter transponder of AO-6 will be turned on for as many ascending and descending node passes as possible on the following dates: January 5, January 19, February 2 and February 16, 1977. Stations participating in this QRP Test should run no more than *TEN WATTS Effective Radiated Power* and should indicate so during their transmissions. All other stations are asked not to transmit in the AO-6 uplink passband of 145.900 to 146.000 MHz during the test. The Wednesdays chosen for the tests fall on odd days of the year which also happen to be Mode-AX days for the AMSAT-OSCAR 7 satellite. Since the orbits of the AO-6 and AO-7 begin to overlap in January and February, it has been decided that AO-7 be switched to Mode-BX for these tests in order to avoid confusion which might result if both satellites' 2 to 10 transponders were on at the same time. The 70 cm to 2 meter transponder of AO-7 should *NOT* be used during Wednesday AO-6 QRP Tests or any other Wednesday unless so scheduled by AMSAT.

All orbits of all AMSAT-OSCAR 7 Mode-B Mondays from now until further notice will be on for QRP purposes only. Stations using the 70 cm to 2 meter transponder on these days should run no more than *10 WATTS ERP*. All Mode-B users are strongly urged to use as far below the maximum recommended 100 Watts ERP as possible to help to keep the AO-7 battery voltage above the point at which the low voltage sensors switch the transponder into Mode-D, the battery recharge mode.

LAUNCH DATE FOR PHASE III SATELLITE ANNOUNCED

AMSAT has been notified by the European Space Agency (ESA) that the Phase III satellite will be accepted as a secondary payload on test flight number 2 scheduled for launch in December, 1979. The Phase III satellite, now under development by AMSAT, will contain an onboard microprocessor that will allow the satellite to control itself. The highly elliptical orbit chosen will allow amateurs to have dependable satellite communications for up to eleven hours at a time.

Funding for the Phase III spacecraft is especially critical, as AMSAT will have to purchase and assemble the one square meter of solar cells, $30,000. The funding required for Phase III will probably be $150,000.

To meet these needs, a number of fund-raising projects will be initiated. For instance, it has been suggested that we ask AMSAT members to sponsor a solar cell in the satellite.

We have noticed an increase in memberships and donations when satellite articles appear in the major magazines. Thus, one of the fund-raising projects will be to run a dozen satellite articles as a group in *73*, coinciding with the launch of A-O-D.

This was done in July, 1975, and we found the effort to be worthwhile. Several pages of pictures, text and a membership/donation form will be made available by the magazine for AMSAT to publicize the Phase III project.

To be successful, we will need articles on many subjects: DX, antennas, awards, telemetry analysis, beginners' articles, A-O-D, microprocessor applications and operating aids. Joe Kasser G3ZCZ/W3 and I are willing to provide pictures, typing and editorial support if necessary. For simplicity, we ask that the articles be submitted as a package by me around February 28, 1977. Authors will be paid directly from *73 Magazine*. In addition, some of the articles will be published in the AMSAT Newsletter.

So that I will know how the project is going and what subjects Joe and I will need to add, I would appreciate a QSL card stating your willingness to help and your subject area.

Gary Tater W3HUC
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Ellicott City MD 21043

FCC

In an Order released October 13, 1976, the Commission announced it had amended Section 2.302 of its Rules effective November 2, 1976 to permit the issuance, subject to availability, of specific 1 x 2 callsigns in the Amateur Radio Service (that is, callsigns consisting of one letter, one digit, and two letters) with suffixes beginning with the letter "X" to eligible applicants holding amateur Extra class operator licenses. In its Order, the Commission stated that, pursuant to its First Report and Order in Docket 20092, 58 FCC 2d 1272 (1976), it wished to make as many 1 x 2 callsigns as possible available to amateur Extra class licensees.

The Commission has now determined that 1 x 2 callsigns prefixed with the letter "N" will be available to eligible amateur Extra class applicants beginning November 2, 1976. Callsigns beginning with the letter "N" are presently allocated to the Amateur Radio Service, and this action does not, therefore, require a rule amendment. Eligible amateur Extra class applicants wishing to obtain specific 1 x 2 callsigns prefixed by the letter "N" may apply under the provisions of Section 97.51 of the Commission's Rules on or after November 2, 1976. Amateur Extra class licensees first licensed as amateurs twenty-five or more years ago and amateur Extra class licensees who obtained their amateur Extra class licenses on or prior to November 22, 1967 could apply for specific 1 x 2 callsigns on November 2, 1976. Extra class licensees who obtained their amateur Extra class licenses on or before July 2, 1974 may apply for specific 1 x 2 callsigns on January 1, 1977, and amateur Extra class licensees who obtained their amateur Extra class licenses on or before July 1, 1976 may apply for specific 1 x 2 callsigns on April 1, 1977. All amateur Extra class licensees are eligible to apply for available 1 x 2 callsigns on July 1, 1977.

A No Hands Telephone Dialer

- - mobile accessory using a ROM

Donald R. McEwan WA1PNG
46 West Shore Road
Holbrook MA 02343

Here is a gadget that should appeal to the two meter FM fraternity. Living near metropolitan Boston where there are 7 autopatch repeaters, one gets many opportunities to call the police and fire departments both for oneself and to assist other amateurs.

Several months ago, while still a newcomer to two meters, I heard a phone number being dialed very rapidly. I waited until the patch was finished then asked the other amateur what he had used. It turned out to be a card dialer. I thought, "Why couldn't this be done electronically?" A card dialer is a mechanical kluge, big, bulky and requiring shuffling through cards which may be easily mutilated or lost. This autodialer may be used in motion after a little practice with binary coded decimal numbers.

Theory of Operation

The heart of this autodialer is two 256 x 4 read only memories which are addressed in parallel. A binary coded decimal address of 0 through 15 is selected by switches marked 8, 4, 2, 1. For example, if you wished to dial phone number seven in your list of numbers you would set switches 4, 2 and 1 in the up position, just a simple matter of addition. 0 is all switches down and 15 is all switches up; 8 plus 4 plus 2 plus 1 is equal to 15. 0 through 15 equals 16 addresses. After your number is set, the start switch is pressed setting pin 3 of the RS flop U1 low, which resets the binary counter U2 to the count of zero, thereby permitting U1 pin 11 to go high starting the clock U5. When the start switch is released, the next rising edge of the clock will produce a binary count of one on U2 and, at the same time, a low to enable the read only memories is produced at U1 pin 8. The binary counter is allowed to count to eight; on the rising edge of the nine

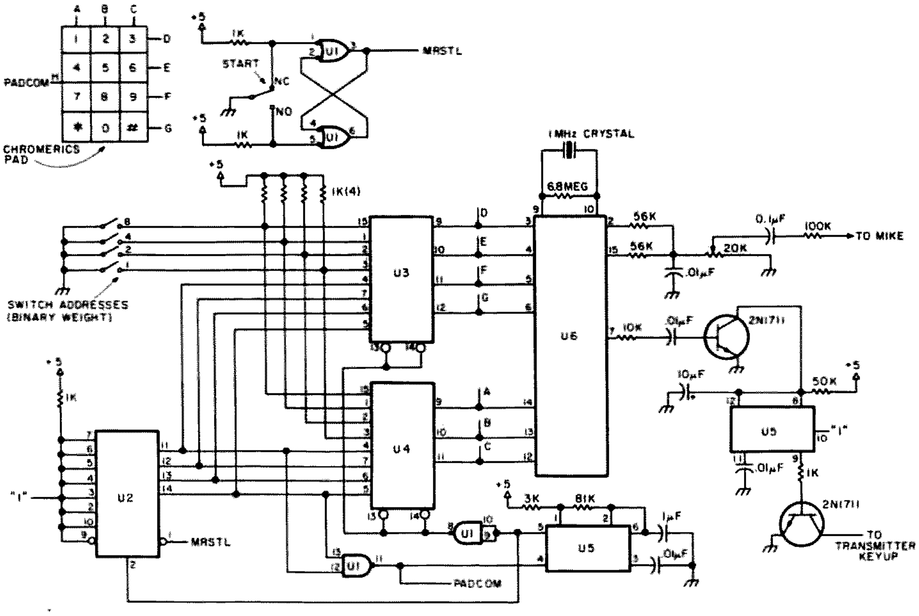


Fig. 1. U1 – 7400; U2 – 74161; U3, U4 – 256 x 4 ROM; U5 – NE556; U6 – MC14410P.

count, pins 12 and 13 of U1 will both be high, giving a low on U1 pin 11, shutting down the clock which will remain stopped until the next time the start button is depressed.

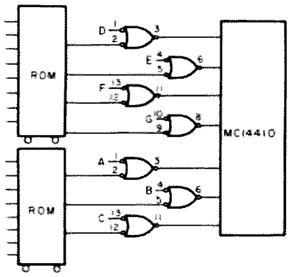
Supposing we assume that you have selected the seventh phone number appearing on your list; the address of the ROMs before accessing the start button would be 01110000. On the first count after starting, it becomes 01110001, then 01110010 for the second count, 01110011 for the third and so on.

The MC14410 takes active lows in a 2 out of 7 code. For example, the digit 1 is a low on pins 3 and 14. See Table 1.

Let's take a phone number and see how we can program the ROMs. Assuming that the first phone number which will be address 0 is 963-1234, we can write a truth table as in Table 2.

Since the binary counter always starts at zero, we don't want anything on the

Fig. 2. Necessary if TTL output ROMs are used. Added gates are 7408 ICs (2 required).



ROM outputs; also, if your phone number is a seven digit number, the same thing will be true on the count of 8. This autodialer will take either 7 or 8 digit phone numbers.

When the clock is stopped by virtue of a low being on U1 pin 11, this output can be used to enable the TT pad for repeater access or for phone numbers that don't appear in memory. It is not recommended that access numbers be stored in memory unless your favorite autopatch repeater uses Ma Bell cup-core tone decoders, as the clock is running at ten cycles per second, i.e., a seven digit phone number takes only 0.7 seconds to complete. The phase locked loop decoders that most repeaters use are not fast enough to respond to this speed. Once you have brought up the patch and are talking to Ma Bell's lines, you are only limited to the phone company decoders which will accept pulses of 40 milliseconds on time and 60 milliseconds off time, so if you wished, the speed of this autodialer could be increased a smidge.

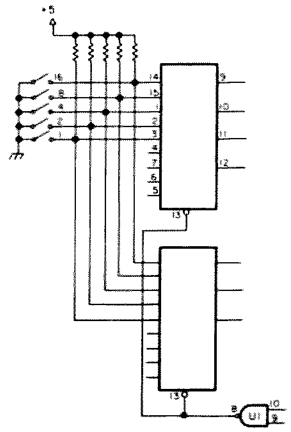
The MC14410 has a high going signal at pin 7 every time a number is selected. This is used to fire ½ of a 556 in a one shot configuration to turn on your rig, thus making it unnecessary to key your mike button when using the autodialer.

The 0.1 uF capacitor in series with the 100k resistor coming off of the wiper arm of the pot will interface with high impedance input rigs such as the Regency HR2B. Other types with low input impedances or rigs that use a lot of audio processing, such as the Icom IC-230, may require selection of other values.

The South Shore Repeater Association of Scituate, Mass. is offering this autodialer in a partial kit form consisting of an epoxy PC board and two ROMs pre-programmed to 16 phone numbers of your choosing. For further information, drop me an SASE.

For those of you who wish to roll your own, a few words of caution. The ROMs must satisfy the following conditions: (1) be enabled by a low on the chip select; (2) when disabled, all outputs must go high; (3) have tri-state or open collector outputs; (4) if open, collector outputs must be pulled up by 1k resistors. A good bet would be the Signetics 82S129 being sold by S. D. Sales Co., Dallas, Texas, for $2.95. I used the Harris HPROM-1024. TTL ROMs could be used but then you would have to OR the ROM outputs and the TT keyboard (see Fig. 2).

Fig. 3. 32 phone number version. Good choice for 512 x 4 ROM is MM16306.



A 32 phone number dialer may be built using 512 x 4 ROMs. This requires the addition of one more switch and one more pull-up resistor which would have a number weight of 16 (see Fig. 3). ■

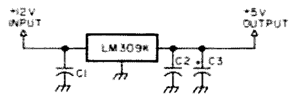


Fig. 4. Regulator. C1, C2 — 0.1 uF 25 V; C3 — 100 uF 15 V electrolytic.

Digit	3	4	5	6	14	13	12 (MC14410 pins)
1	0	1	1	1	0	1	1
2	0	1	1	1	1	0	1
3	0	1	1	1	1	1	0
4	1	0	1	1	0	1	1
5	1	0	1	1	1	0	1
6	1	0	1	1	1	1	0
7	1	1	0	1	0	1	1
8	1	1	0	1	1	0	1
9	1	1	0	1	1	1	0
*	1	1	1	0	0	1	1
0	1	1	1	0	1	0	1
#	1	1	1	0	1	1	0

Table 1.

(Switch add.) 8 4 2 1	Counter add.	(ROM outputs) D E F G	A B C	Phone nr.
0 0 0 0	0 0 0 0	1 1 1 1	1 1 1	–
0 0 0 0	0 0 0 1	1 1 0 1	1 1 0	9
0 0 0 0	0 0 1 0	0 1 1 1	1 1 0	3
0 0 0 0	0 0 1 1	1 0 1 1	1 1 0	6
0 0 0 0	0 1 0 0	0 1 1 1	0 1 1	1
0 0 0 0	0 1 0 1	0 1 1 1	1 0 1	2
0 0 0 0	0 1 1 0	0 1 1 1	1 1 0	3
0 0 0 0	0 1 1 1	1 0 1 1	0 1 1	4
0 0 0 0	1 0 0 0	1 1 1 1	1 1 1	–

Table 2.

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What's the Best Antenna for 160?

-- the inverted vee compromise

The downfall of potential 160 meter operators is most usually the antenna system. For some unexplainable reason, many persons who would operate the 1.8 MHz band apparently believe, perhaps due to the frequency, that any antenna made to load will produce satisfactory results. Satisfactory results are different to different folks, but if 160 is to be enjoyed to its potential, haphazard antennas are not the medium.

It is not the intent of this article to debate 1.8 MHz antenna type merits. That discussion has been underway for decades. Anyone who has operated 160 meters has his opinion, likely biased towards his particular use of the band.

There simply is no "best" antenna for all situations, but taking into consideration expense, ease of construction, and the ability to produce all-around performance, whether it be local or DX communication, the inverted vee dipole is probably the best compromise. Full-sized quarter wave verticals are popular with the DX crowd, but 160 meter pioneer W1BB leads them all with nearly 130 countries worked on an inverted vee.

In my general geographic location, three operators spent this past winter actively chasing DX and comparing results. Two stations were inverted vee equipped, the third had a full-sized quarter wave vertical. Letters from and on-air communication with DX stations throughout the world were interesting. The quarter wave vertical station ranked, on the average, slightly better for signal consistency compared to the inverted vees, but under certain conditions and over certain paths, the inverted vees took honors. An interesting comment came from a European, who said, "When the band is marginal, your quarter wave competitor may be copyable when you aren't, but when the band is open, your inverted vee is louder." Is this mixing and reinforcement of polarization? Possibly. You can find on 160 some unusual propagation and path quirks not found on any other amateur band. In the long run, the vagaries of propagation are the great equalizer so long as the antenna performs at the best possible efficiency.

If you have a tower topped with a high frequency tri or mono-band beam, can lay an adequate ground screen radial system (and I am not certain what is "adequate"), and wish low angle DX radiation, then by all means use the tower shunt fed as well-described in one or more previous articles.[1] A 3/8 wave inverted L type antenna is an excellent performer, provided it too is operated against a good radial system. The short, commercially available, base or center loaded 20 to 30 foot verticals are poor performers even used with a good radial system. Should you not want or be able to install a radial system, the inverted vee is likely the best all-around compromise 160 meter antenna, giving hours of enjoyable stateside contacts and doing a respectable DX job when the skip is long.

The inverted vee, however, is not to be constructed and installed in a haphazard manner. Set aside a Saturday afternoon and do it properly. To assist, here are a number of suggestions and tips that will ensure a well-performing installation.

1. Use number 14 or larger copperclad steel wire for the dipole.
2. The center insulator should be a 1:1 balun like the Palomar, which covers 160 meters, or the like. Be certain the balun selected does cover 160 meters. Many do not, have a low frequency cutoff around 3 MHz, and will not work at 1.8 MHz.
3. Cut the antenna length using the standard half wave dipole formula of 468/f(MHz) or 257 feet, 10 inches at 1.815 MHz.
4. Prepare the center balun/insulator and dipole wires according to the manufacturer's instructions.
5. On the dipole far ends, use 6 to 12 inch insulators similar to those made by Hy-Gain. Do NOT use "egg" type insulators.
6. Do not solder the dipole far ends after securing through the insulators. The antenna will have to be trimmed to resonance. The wires will be soldered after resonance determination.
7. Erect the center (apex) insulator/balun as high as possible. It should be a minimum of 95 feet high to obtain a between-leg apex angle of 90°. A 50 foot height will give an apex angle of 120° and is the *maximum* angle at which the inverted vee will exhibit low angle vertical radiation. A 90° to 100° angle is highly recommended, but with less than 90°, signal cancellation and severe loss of antenna efficiency will result. These figures place the antenna ends approximately 200 feet apart and at ground level. It is desirable to have the antenna ends elevated ten or more feet, if height capabilities per-

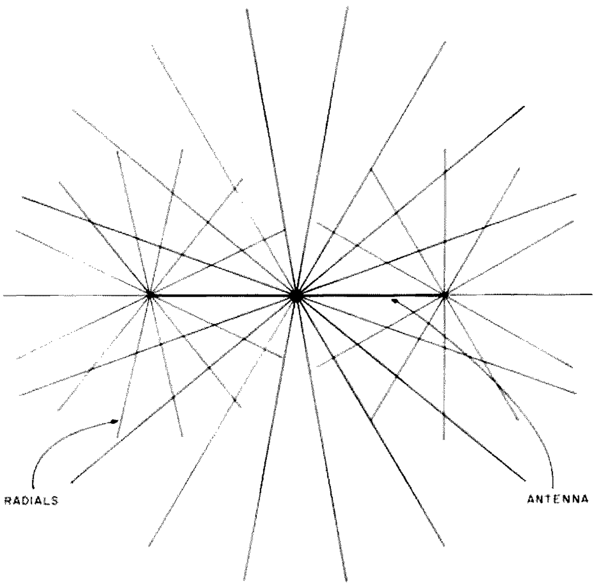

Fig. 1. Proposed ground screen radial system for 160 meter inverted vee (top view).

mit. It is also desirable to run the legs in a straight line, not folding them back upon themselves, but this may be necessary to fit the antenna into available space.

8. If the antenna center is to be supported by a metal mast or tower, it is recommended the center of the antenna be hung 3 or more feet off the support to minimize coupling. It is assumed any guy lines are broken with insulators into non-resonant lengths. Install the antenna as clearly as possible from guy lines.

9. The feed impedance of an inverted dipole is approximately 50 Ohms. The antenna may be fed with any popular 50 Ohm coaxial cable. At this frequency and amateur-allowed power levels of up to one kilowatt, there is nothing gained in using expensive RG-8 type cable. The much less expensive RG-58 type cable has very low loss and more than sufficient power handling capability at 1.8 MHz.

10. It is highly recommended that the feedline be made an *electrical* half wavelength or multiple thereof. A half wave length of foam dielectric coax, at 1.815 MHz, is 219 feet, 6 inches; solid dielectric coax has a length of 178 feet, 11 inches at the same frequency. These feedline lengths are calculated for 1.815 MHz. Should you elect operation in other available portions of the band, as shall be discussed briefly later, in addition to adjusting the dipole length, feedline length will need to be changed. Use these formulas for the calculation of an electrical half wavelength:

Foam

$$\frac{492}{f(\mathrm{MHz})} \times 0.81 = \text{length}$$

Solid

$$\frac{492}{f(\mathrm{MHz})} \times 0.66 = \text{length}$$

Any excess cable between the antenna and transmitter may be coiled, taped and placed out of the way.

11. Tuning the antenna may be accomplished through use of a reflectometer (swr bridge) or wattmeter having forward and reverse scales. Be certain the instrument is accurate at 160 meters. Many commonly available swr and wattmeters cut off around 3 MHz and are *entirely* inaccurate at 1.8 MHz. The least expensive swr meter having reasonable accuracy at 160 meters that I know of is the Swan SWR-3 at $10.95.

12. There are but two places to accurately measure swr: at the antenna feedpoint or along the feedline at the electrical half wave points. If you cut your feedline as described, you may do your measurements at the transmitter. Otherwise, if you want accuracy, measure at the antenna feedpoint. This may not be physically convenient, but a tuned antenna is our goal.

13. Initial swr measurements will most likely indicate the antenna is too long. This is expected due to a number of factors involving an inverted vee antenna. The antenna will need to be trimmed on *each* leg from 2 to 5 percent. Initial trimming may be up to 6 inches. Recheck the swr, trim again as necessary, but in smaller increments of 2 inches per leg.

14. Do not put absolute faith in an swr meter. If you have two, try both, being prepared to believe the one which shows the *highest swr*. Erratic readings, indication of reflected power varying under key-down conditions, may be diode saturation in the swr meter (use only as much transmitter power as needed for full scale forward reading), a faulty balun, or the like. If you are using an antenna tuner and it becomes warm or if you have difficulty loading the transmitter, suspect a problem in the antenna system that warrants immediate attention.

15. In practice you may not be able to obtain a 1:1 swr at the desired frequency. Trim for minimum swr, remembering that a 1.5:1 swr represents only 6.25% loss and a 2:1 but 11%. With the feedline cut as suggested, an swr of less than 1.5:1 is easily obtainable.

16. Inverted vee straight dipoles typically have a very narrow operating bandwidth rarely exceeding 25 kHz at the 2:1 swr points. Some additional bandwidth is possible using a folded dipole in the inverted vee configuration. Antenna and feedline lengths remain as previously described except the center balun/insulator will be a 4:1, such as a Palomar.

17. Observed radiation patterns of acute angle inverted vees suggest maximum radiation off the antenna *ends*, not broadside. Two inverted vees at right angles to one another are suggested for maximum coverage of all compass points. On certain paths, startling signal strength differences of 10 to 15 dB are not uncommon.

18. A remote-powered changeover relay may be used at the feedpoint for feedline switching between antennas. This saves the cost of one feedline but adds the cost of the relay and possibility of its failure some cold winter night. Separate feedlines are suggested.

19. Don't neglect waterproofing of connections. PL-259 connectors are not waterproof. Spray with several coats of a Krylon-type spray, wrap with good quality electrical tape and spray again.

Speculative Ground Screen Option

While I have not experimented with a ground screen radial system beneath an inverted vee, my speculation is that it may be worthwhile, particularly in locations having poor soil conductivity. Ground losses at 160 meters can cause severe absorbing of transmitted power. The suggestion would include bonding 20 to 40 radial wires to the tower base, the radial wires being .40 to .50 wavelengths long evenly spaced and fanned around the tower like spokes of a wheel. At the dipole ends and directly beneath them, a six foot or longer ground rod may be driven into the earth and bonded to it, another 20 to 40 radials each being .12 to .25 wavelengths long evenly spaced and fanned. Electrically it is not necessary to bury the radial wires.

Before undertaking the complete radial installation, try the first 4 radials directly

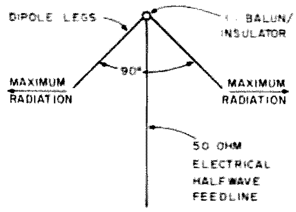

Fig. 2.

beneath the antenna center, spaced 90°. Place two radials directly beneath the antenna legs. I would anticipate a change in the antenna's resonant frequency which may be an indication the radial system would be worthwhile. Carefully controlled before and after signal strength measurements with the cooperation of a nearby colleague may provide meaningful information.

An inexpensive source of ground screen radial wire is the so-called electric fence wire available from Montgomery Wards, Sears Roebuck or most farm supply stores.

The Gentleman's Band

The 160 meter band is not an amateur band per se, but a shared band in which U.S. amateurs are permitted operation on a non-interference to LORAN navigational services basis. As protection to the LORAN service, the 160 meter band is segmented by frequency allocation and transmitter input power is related to geographic location. Traditionally popular segments of the band in the U.S. are 1.800 to 1.825 and 1.975 to 2.000 MHz. Over the years there has evolved a gentleman's agreement on usage. This agreement says that 1.800 to 1.810 is reserved for CW only, and 1.810 to 1.825 is for voice communication, although FCC regulation allows mixing of modes by not specifying CW and voice subbands. There is little U.S. CW activity elsewhere in the 160 meter band with the exception of Hawaiian stations operating between 1.995 and 2.000 MHz.

Furthermore, as relates to DXing, the gentleman's agreement says no U.S. or Canadian station may use 1.825 to 1.830 for transmitting, to allow foreign stations a segment in which to operate without being obliterated by VEs and Ws. This is the "DX Window." The agreement has worked quite well over the years with few exceptions. Five kilohertz of a 200 kilohertz band, or 2½ percent, is not too much to ask for those desiring to work international DX and as a courtesy to our foreign friends. Those who honor the agreement are commended, those who do not are respectively requested to be considerate.

If your 160 meter interest is DXing, your operation will likely be confined to 1.800 to 1.825, keeping in mind not to spill sidebands into the DX window by operating too close to 1.825 or 1.830.

If your interest is rag chewing and developing long-term friendships for which 160 is particularly noteworthy, you will likely wish to operate in those segments of the band allocated to your geographic location while keeping clear of frequencies around 1.900 where LORAN interference is fierce. This winter past saw much sideband activity moving into the 20 to 30 kHz above 1.830 and above 1.975 for QRM-free contacts. If these frequencies higher in the band are your choice, the previously given antenna and feedline formulas need to be recalculated.

Before operating 160 meters, be sure to check FCC regulations concerning power and frequency allocation for your area. The ARRL Operating Aid S-15A contains all necessary particulars. ■

Reference

[1] W5RTQ, "Shunt Feeding Towers . . .," *QST*, pg. 22, October, 1975.

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Ten Meters: Dead or Alive?

- - a user's report

During the month of June, 1974, after twenty years of hamming, I was mighty close to pulling the big switch on all low band operations and contemplating 2 meter FM. Exchanging signal reports and the usual trivia no longer interested me. Nor was I going to continue the bothersome task of trying to pry QSL cards from Lower Outer Magnolia. No siree, 2 meter FM here I come!

By chance, I decided to go on ten meters, before selling all of my low band gear. It was sixteen years since I had been active on my old favorite band, during the peak of one of the highest sunspot cycles on record. Those were the days, my friend.

A strange thing happened that fateful evening. The band was open on a North-South path and the 4 call area was coming through loud and clear. Who said ten was dead? I heard multitudes of stations calling CQ ten-ten. It sounded like a group of newly licensed hams with cases of nervous jitters. Hence, the stuttering. Using my old Heath HR20, HX20 receiver and transmitter along with an inverted vee cut for 20 meters, I loaded up on ten with an swr of umpteen to one. I answered a CQ from a station in Birmingham, Alabama who had his friend on frequency with him.

We exchanged the usual trivia and then it happened.

"What's your Ten-Ten number? Do you have the Yodar Kritch?" he asked. I offered him my Social Security number instead, if he was interested, but I did not know what a Ten-Ten number was. As for the Yodar Itch or something, I told him I did not have it and asked if it was catching.

"Do you have a sweetheart," he replied?

"No!" I said. "I am happily married."

His friend broke in and asked if I was a liar. "It's all the truth," I said. 2 meters here I come, the quicker the better, I thought. Let me see what 2 FM holds forth. "To each his own," I mumbled.

I was getting ready to sign off when he said, "Wait, old man, and let me explain. To promote activity on ten during the lull of the current sunspot cycle, a group in California organized a net with chapters in many of the larger cities. Some foreign countries are also forming chapters and appointing their own chapter heads. The main body is called The Ten-Ten International Net of Southern California. All you have to do is collect 10 different Ten-Ten numbers if you are in the USA and 5 if you are out of the USA. You send the log information only, no QSLs needed, to the manager in charge of your call area along with a nominal fee," he went on to explain. "You will get your own Ten-Ten number along with a certificate, suitable for framing, plus quarterly newsletters. We are all having a ball and at the same time keeping ten alive and saving our band from being taken over by the CBers," he raved.

He explained that many of the chapters issue their own certificates for working a certain amount of their certificate holders. The Yodar Kritch is the name of a certificate issued by the Maryland, Washington D. C. chapter. In fact, its chapter head is Jim Hart WA3NCQ, so they also issue The SweetHART certificate for working five members. The LIARS stands for the Long Island Amateur Radio Service, a chapter serving the New York City, New Jersey metropolitan area. You can get more information by signing into their Thursday evening net on 28.620 MHz at 8 pm local time.

I apologized for my ignorance and asked just how many are now involved in this new aspect of amateur radio and isn't it pretty expensive? "We are well over the 9000 mark," he replied, "and the certificates are no more than one dollar. In fact, some are free. You don't have to go certificate-hunting if you're not interested, just collect Ten-Ten numbers. Bars, plaques and awards are issued for reaching different plateaus of achievements. Worked All States Ten-Ten awards are even issued. For this one you do need QSL confirmations. You can become a VIP in the Ten-Ten organization by collecting 500 numbers. 1000 different contacts qualify you for a plaque award. You can work up to these levels by submitting a list of each 100 you work, for which you receive a bar."

"Sounds mighty complicated," I said. "Did you hire a private secretary to do your paperwork?"

"On the contrary," he shot back, "it's pretty simple if you can keep an up-to-date card file and use a separate log for ten. It's like an eternal contest, worked on at your own pace. You will find us to be a group of very friendly chaps, all willing to help. None of the hanky-panky that you hear on some of the other bands."

"To each his own," I replied. "2m FM here I come! What is your Ten-Ten number? Just for my log, you understand."

As you have probably guessed, over two years have passed and I never did get on 2m FM. Two months after that fateful evening, I was already hooked with my own Ten-Ten number of 9732. I have collected many numbers since and have had the most enjoyable contacts in my twenty-two years of hamming. Over 13,000 numbers have been issued and it shows no sign of stopping. For twenty years I could have been considered a certificate haters club member. Today, I am the holder of many unique certificates issued by the Ten-Ten chapters. They would have to be seen to be appreciated. One of the certificates, The Raggedy Ann and Andy, is issued by Worth Gruelle K4VM. Worth, a renowned artist, the son of Johnny Gruelle who invented and originated the characters, issues the certificate in memoriam to his father. The different certificates issued now number over 50. They are too numerous to mention and many hold interesting stories behind their origina-

tion.

Propagationwise, ten meters appears to be the twilight zone of HF and VHF characteristics. It's fascinating to observe the effects of backscatter and tropospheric bending. Sporadic E propagation found on ten seldom appears on fifteen meters. It is a rarity on six and will reach a maximum of maybe 70 MHz. Freak conditions, at times, will cause it to appear higher.

Ten meter beacons are being transmitted from almost all continents of the globe as a guide to conditions. This is evidence enough to show the increasingly wide interest being shown on this band.

It is ironical to hear so many newcomers to this band comment that they haven't been on ten for years. They thought it was dead. Many skip contacts are being made and at times when fifteen and twenty are dead. True enough, if no one went on, it would appear to be dead. How surprised many would be if they tuned their receivers to ten.

Antennas need not be cumbersome. When conditions permit, many long haul contacts can be made much easier on this band with simpler antennas and lower power then is needed on the other lower frequency bands. QRM problems appear less frequently due to the huge frequency spread.

I want to thank Mike WA4BNU and Ron WB4ASV both of Birmingham, Alabama, the home of the All American Cities chapter, for taking the time to initiate me into Ten-Tenning. My appreciation also goes to the Long Island Amateur Radio Service (LIARS) and its chapter heads past and present, Rich WB2MAN, Jack W2KDI, and all of their officers and members for their dedication to keep ten alive, along with many others who all share in using ten and enjoying it. ■

New Products

HEATHKIT HW-2036 SYNTHESIZED 2 METER TRANSCEIVER

Do you do a slow burn every time your old buddy comes on the air and brags about his brand new synthesized rig? Does he rub in the fact that what he paid for it roughly equals a month's pay for you? Do you get the old here-we-go-again feeling every time a new repeater comes on in your area and you spring for a new set of rocks? Well, there's a solution. For $269.95 you can get yourself a fully synthesized 2 meter rig with specs and features equaling radios that cost over twice as much.

I'm talking about the *new* Heathkit 2036. I have to stress the word new since in all probability many operators will remember what happened in 1975 with the 2026. To refresh your memory, the 2026 had a spur problem which was difficult to correct without a spectrum analyzer, something you just don't find in every shack. Heath, however, set things right by doing something that is extremely rare in the merchandising business — they took back the rigs, refunded money in full, and went back to the old drawing board.

After a year of redesigning, the successor has arrived. The HW-2036 has solved the problems. Heath says the spurs are now down 70 dB within 20 MHz of the carrier and their spectrum analyzer photos back this up. So it seems that now we can operate without worrying that every repeater within range will be set off.

The HW-2036 has the solid look and feel that hams have come to expect from Heath amateur equipment. The unit weighs 6½ pounds and features the usual turquoise blue finish. The folks at Heath have provided the multi-packaging of their kits with a large number of parts. Six sub-packs keep all those little parts well separated until they are needed. The manual hefts out at 160 pages and is in keeping with the Heath tradition of step by step crystal-clear directions. A separate fold-out section contains all the pictorials so they can be conveniently mounted over the work area for easy perusal.

The HW-2036 is definitely not a quickly-assembled one evening kit. There's a large number of parts and quite a few steps to assembly. Five circuit boards are involved. They're interconnected with a pre-assembled wiring harness. Access to the boards for the big step of alignment is excellent. There are eight sections involved for a total of nearly 100 alignment steps. For this, you need a VTVM or high-impedance VOM, as well as a receiver that tunes WWV. Even better, use a frequency counter that reaches 150 MHz. Although the steps are quite time-consuming, alignment isn't a terribly complicated procedure. Any 2 MHz segment of the 2 meter band can be selected.

On a weekend trip, I worked a number of repeaters in the New England area. Just about everyone I talked with commented on the clean and crisp audio output. Remarks like, "It must be a Heath" were common. The rig features a 10 Watt output, which was adequate for all but the fringe areas. I'm a bit spoiled anyway since my old rig ran 45 Watts. My impression is that one can get along just fine without an external amplifier, considering the proliferation of repeaters.

The economy-size illuminated meter is a joy to use. It shows both received signal strength and relative rf output. A bright green LED situated next to the meter pops on to show there is a signal being received.

A red LED labeled "Synth Lock" lets you know when the synthesizer is not locked to frequency. If you don't notice it and the unlocked condition lasts for more than one-half second, the transmitter is automatically disabled by a safety circuit to insure that you won't accidentally operate outside the band. Another fail-safe built into the HW-2036 disables the transmitter if you dial above 147.995 or below 144.00. If you're into MARS or CAP, don't despair, since this can be defeated by the simple act of removing a jumper on one of the circuit boards.

I found it helpful to put a small hooded light over the channel selector switches so I could more easily set them at night.

Heath told me that they had been having a few complaints about audio with the HW-202. Checking into them, they found that some customers had put non-standard mikes on the units. To eliminate this problem on the HW-2036, they made the mike non-detachable.

I've always wondered why Heath mikes are white. On a dark New Hampshire night, I found out. Having no mike clip on the dashboard, I have to lay the mike on the dark colored upholstery. This requires a good deal of groping. With the shiny white mike, my problem was solved.

The HW-2036 can be ordered with either the standard mike for $269.95 or with Heath's Micoder featuring a built-in Touchtone pad for $299.95. That's a savings of 20 bucks over the Micoder alone.

Adding to the list of built-in features is a subaudible tone encoder. Three switchable tones can be set during alignment in the 70-200 Hz range.

A logical accessory for the HW-2036 is the HWA-2036-3 power supply. Selling for $32.95, this easy one-evening project supplies 13.8 V dc at up to 2.7 Amps. It features 1% regulation and 0.1% ripple.

For those who are interested in specs, here are a few for the HW-2036. The receiver sensitivity is 0.5 uV for 12 dB SINAD, which comes out to 15 dB of quieting. Audio output is typically two Watts. I-f rejection is greater than -80 dB. while trying various repeaters, I found a very noticeable birdie at 147.00 MHz. While puzzling about this problem, an early-morning call from Heath shed light on what happened. It seems the first production run of the HW-2036 had a bum FET in the synthesizer board which resulted in that birdie. No units with this were shipped to customers. Heath assured me that the inclusion of the correct part would eliminate the birdie problem completely.

The transmitter is capable of taking a 100% duty cycle into an infinite VSWR. Offset crystals are supplied for plus and minus 600 kHz with provision for one extra. Current consumption is 700 mA on receive and 2.6 Amps on transmit.

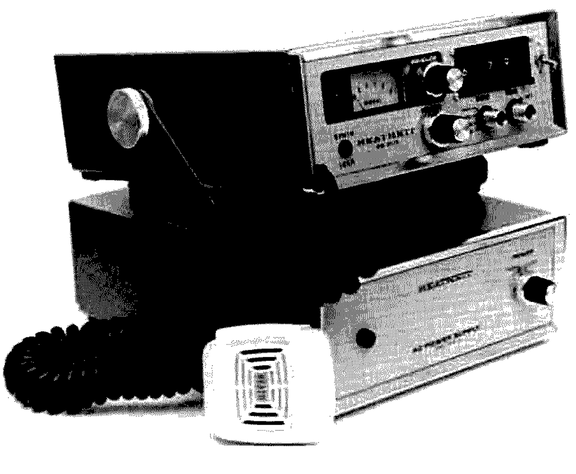
The HW-2036 is a pleasure to build and to use. You'll have to look pretty far to find all these features for a price of $269.95. It's by far the lowest cost synthesized 2 meter rig on the market and is sure to find an immediate niche. If you want to stop collecting rocks and the piggy bank isn't full enough for one of the big ones, this is sure to be the rig for you. *Heath Company, Benton Harbor MI 49022.*

Stan Miastkowski WA1UMV
Associate Editor

THE VHF ENGINEERING SYN II SYNTHESIZER

VHF Engineering of Binghamton NY has announced their new SYN II synthesizer, a high quality synthesizer designed for use into virtually all two meter rigs available on the market today.

The VHF Engineering SYN II synthesizer is designed to operate over a frequency range of 140 to 149.995 MHz in 5 kHz steps, and is compatible with two meter equipment that uses transmit crystals in the 6, 8, 12, or 18 MHz range and receive crystals in the 15 or 45 MHz range. The SYN II synthesizer may be used with either FM or phase modulated transmitters and may be operated with either mobile or base transceivers. The SYN II synthesizer features unique i-f programming which permits the unit to be used with receivers having i-fs in the range of 100 kHz to 30 MHz. Detailed programming instructions are given in the construction manual so that the builder may select the standard 10.7 MHz i-f or any other i-f frequency in the permissible range. This feature permits use of the SYN II with older commercial equipment as well as currently available two meter units. Standard repeater offsets of +600 kHz, -600 kHz are provided along with 3 user selectable offsets in 100 kHz steps. This feature permits the user to operate standard repeaters



as well as repeaters with unique offsets. A modification kit is available for MARS and CAP offsets.

The VHF Engineering SYN II synthesizer kit consists of high quality epoxy glass circuit boards, computer grade components, thumbwheel switches, stylized cabinet, and a detailed construction manual. The kit is complete and requires no additional components. The price of the kit is $169.95; wired and tested $239.95; programmed to your equipment $249.95. *VHF Engineering, 320 Water St., Binghamton NY 13902.*

THE KLM ECHO 70 432 MHZ SSB/CW TRANSCEIVER

If you have longed to explore the world of 432 MHz, Echo 70 may be the answer. Heretofore, 432 equipment for SSB has been mostly a matter of homebuilt type equipment. Thanks, in part, to the popularity of AMSAT's OSCAR satellite, KLM has filled a void for a reliable compact piece of gear for the OSCAR up-link. The KLM Echo 70 is imported by KLM from Japan where it is known as the "Liner Four Thirty."

If OSCAR is not your bag, then maybe 432 DX will interest you. With those super KLM antennas there should be no problem making sufficient contacts on the band to keep up your interest. We are fortunate in the South Jersey area to be within range of a good deal of activity from the New York-New England area and from across the river in the Philadelphia area.

One can't help but be impressed by the Echo 70; from the time the packaging is removed, it is a physically attractive and sturdy-looking piece of gear with the controls well laid out and convenient to operate. The unit comes complete with a dynamic mike, mounting bracket and dc cord, and is ready for mobile operation as is or can be set up in the shack with the addition of a regulated 12 V dc supply good for about 5 Amps maximum. When used in this manner I would strongly recommend the use of KLM's model 432-16-LB 16 element antenna which sports a gain of 15 dB and is rather compact with its 12 ft. boom length. Be sure to use low loss, jacketed or hard line coax for those extra long runs up the tower. The *VHF Handbook* gives 5 dB attenuation per hundred feet for regular RG-8/U at 420 MHz.

Now let's take a look at how the Echo 70 operates. The unit covers two segments of the band: 432.00 to 432.480 MHz and 435.00 to 435.480 MHz. These ranges are switch selected from the rear panel. Having selected the operating range, the tuning knob on the front panel features a direct readout channel display (similar to an FM rig) which ranges in steps from 432.01 for channel 1 to 432.47 for channel 48, or 435.01 to 435.47, and a VXO control with 20 kHz divisions for total coverage between each channel.

The receiver has an RIT control which can be switched in or out of the circuit for additional excursions of plus or minus 2 kHz from the transmit frequency. An effective noise blanker may be switched in by means of a front panel push-button. Upper or lower sideband is also push-button selected from the front panel. The power, volume and squelch controls are concentrically mounted in the upper right corner of the front panel. An unusual and convenient feature is built in to the front panel when the VXO is in the off position. This feature is called an "Auto Watch," which allows the receiving frequency of each channel to be swept automatically. The auto watcher will not respond to weak signals but will detect, by a beat note, stronger signals within the range of each channel, which after they are detected can be "tweaked in" with the VXO.

Reports of an excellent sounding signal have resulted on both SSB and CW with power output in the ten Watt range, giving excellent coverage with a good antenna. Solid state amplifiers are available should you choose more power.

Although not measured, the receiver sensitivity seems excellent and well within the 0.5 uV for 10 dB s/n claimed by KLM. The quality of the small internal speaker is fine and provides sufficient audio output.

Additional operating controls include a mike gain (accessible from the right side panel) and rear panel controls for SSB-CW, frequency range, key jack, external VFO switch and VFO input jack, a relay switching control and external speaker jack. The mobile mounting bracket doubles as a fine stand for the operating table.

To be fair, any equipment report should include the negative as well as positive factors under review. This is an honestly difficult task but nonetheless a few items were uncovered. My major "gripe" is the oddball CW jack on the rear panel for which KLM did not provide a plug or adapter. For those of you who care to use it (I do not, except for contest work), a VOX circuit would be a handy addition or option.

I think the first sentence in the Echo 70 operating manual is an appropriate closing line for this article. "The unit is the very first 432 MHz band SSB transceiver that has ever been manufactured in the world. Nevertheless, it is a compact and cozy piece of equipment with prominent performance." *KLM Electronics, 17025 Laurel Road, Morgan Hill CA 95037.*

Dan Kernan WA2KOK
Vincentown NJ

VHF ENGINEERING 2M TRANSCEIVER

It started with my desire to build a 2m mobile rig that wouldn't take up much space. After running a converted GE mobile phone rig, which took up most of the storage area in the cab of my pickup, it was obvious that the answer was to go solid state. VHF Engineering seemed a logical choice, since I could mix and match their components and custom design my own system.

A phone call to Tufts Radio in Medford MA brought a 2 meter transmitter strip (TX-144). I decided to start with the transmitter because I wanted to get a look at the way VHF Engineering products went together before I acquired the remaining components for my transceiver. The kit was easy to assemble, with all PC boards well laid out, and a sensible set of instructions. Construction took two evenings, and with a #51 light bulb, talking across town was a snap. With a 19" ground plane the Concord NH repeater, some 30 miles away, yielded good to excellent signal reports. The one Watt transmitter strip proved to be quite a performer, with several stations reporting good audio.

All doubts about VHF Engineering cast aside, it was time to order a receiver. Again a call to Tufts . . . and again prompt service. The RX-144D receiver, like the matching transmitter, was easy to build, and provided almost instant satisfaction. Assembly time was about double, including alignment. The major change in the 144D over previous VHF Engineering 2 meter receivers is the elimination of variable capacitors for alignment purposes. Instead, VHF has switched to slug tuned coils, and the results are encouraging. Aside from the ease of alignment, the coils are bound to last longer. Noise is reduced, since dirt can't get into coils as it can into capacitors . . . plus there's the question of corrosion, since silver plated capacitors are bound to detune after an extended period of all-weather use. Here in New Hampshire, with our wide changes in temperature, it's best not to take any chances, and I'll take coils over capacitors under those conditions anytime.

With receiver and transmitter up and running, the next question was an enclosure. After searching through everything I had around, it became obvious I would have to buy some-

thing. Then VHF Engineering announced production of a cabinet kit, with relay knobs, speakers, volume and squelch controls. I couldn't resist.

Take a look at VHF Engineering's product line and it's easy to see why you can custom design your own rig. Scanning decks, accessory filters, amplifiers, even synthesizers are available. I opted for a 10 channel scanning deck and 1x25 Watt amplifier. In the VHF Engineering case it all fit like a glove. Really nice layout, with lots of room for even the most all-thumbs constructor.

On-the-air operation is actually more fun than building the kits (although I had my doubts while building, since I kept coming up with more accessories). Reports have been most satisfying, and the pride of knowing I not only constructed the gear, but custom designed it as well, doubles the fun.

I've already started work on my 432 rig, and 220 isn't far behind. By the way, if economics is any consideration, my entire 25 Watt 2 meter mobile ended up costing less than $225. Can you beat that? *VHF Engineering, 320 Water Street, Binghamton NY 13901.*

Bob Main W1ZAW
Hillsborough NH

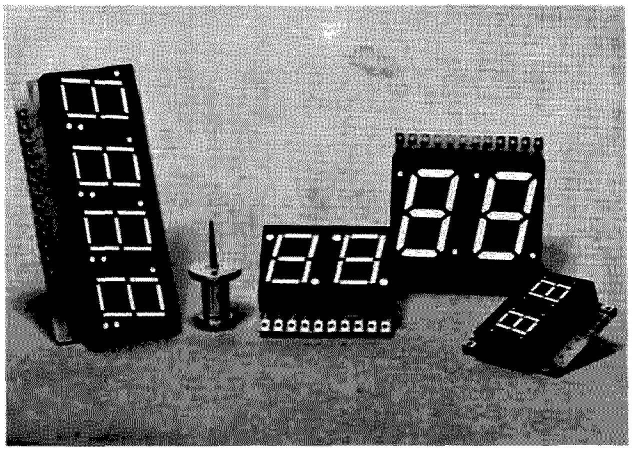
NEW MULTI-DIGIT LED NUMERIC DISPLAYS FROM NATIONAL SEMICONDUCTOR

A new series of light emitting diode display numerics are now being manufactured by National Semiconductor Corporation, according to Bob Santos, Marketing Director for Optoelectronic Products. This series of multi-digit GaAsP reflective displays represents the latest in design advances in 0.3, 0.5 and 0.7 inch formats, Mr. Santos said. "They provide the designer with an effective, easy to implement answer to the need for an inexpensive large numeric display for use in a wide range of applications."

Basically 2 digit and 4 digit displays, the units can be stacked on end for uses that require additional digits. (The 2 digit displays are known as the "NSN" series, and the 4 digit displays are the "NSB" series.) When combined with the options for overflow, polarity and other indications, virtually all display requirements can be satisfied. Both the common anode and common cathode forms are available with direct drive and multiplex versions, providing a great deal of versatility to the designer. Printed circuit board type terminals on the edges of the display are used for electrical contact.

The optical design of this display series creates a distinct, easy to read display with a wide viewing angle, as well as excellent on-off contrast and segment uniformity, making these units suitable for use in test and measurement equipment, consumer products, instrumentation, industrial controls, digital instruments, desk top calculators, clocks, TV channel indicators, and other applications. The series features a typical digit light intensity at 10 mA of 1.6 mcd.

Pricing per digit in lots of 100 pieces is $1.80 for the 0.3 inch, $1.90 for the 0.5 inch, and $2.00 for the 0.7 inch sizes. *National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara CA 95051.*

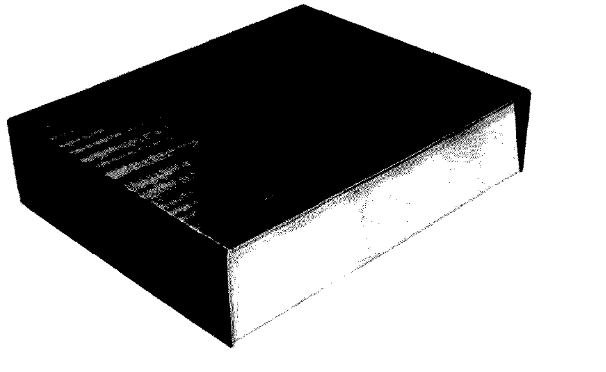


CASES ENHANCE CUSTOM-DESIGNED INSTRUMENTS

A new line of economical enclosures, in two sizes and numerous attractive colors and finishes, gives desk-top instruments an appearance contemporary with sophisticated electronic components and systems. Designated "Cono-Cases" by Vector Electronic Company, the WA series enclosures incorporate a ten degree sloped front panel and an optional smoked plastic facing for behind panel indicators. A recessed rear panel protects input/output connectors.

The enclosures, assembled from two interlinked channels, allow easy access to circuits, accessories and wiring. The lower section forms a chassis integrated with front and rear panels. Elongated holes in the bottom and rear panel provide superior convection cooling. The upper section serves as top and side panels. The WA1 enclosures are 11 inches wide by 8 inches deep by 4 inches high, giving 307 cubic inches of circuit space.

The WA2 enclosures are 14 inches wide by 11 inches deep by 4 inches high, providing a 560 cubic inch working volume. Construction of 0.062 inch (14 gauge) aluminum insures adequate support for transformers, heat sinks and other heavy components.



Cono-Cases are available with clear anodize satin finish, or with blue or walnut grained vinyl on the cover. Other colors available in anodize, vinyl or paint on request.

A full line of circuit boards and packaging accessories supports the enclosure line.

The WA series enclosures are priced from $12.95 to $19.70, depending on model and finish. They are available off-the-shelf from Vector and will be available through the firm's distributors throughout the United States and Canada.

Vector is a major manufacturer of sockets, terminals, connectors, printed circuit boards, card cages, enclosures, and complete packaging systems. *Vector Electronic Company, 12460 Gladstone Avenue, Sylmar CA 91342.*

ENGINEERING SPECIALTIES SYNTHACODER 22

What the heck is a Synthacoder? And why does every Icom 22S owner need one? The answers lie in the design of Icom's new radio, a diode matrix synthesizer which puts an end to crystals forever. (See New Products, Holiday '76 *73*.) Synthacoder is obviously a combination of synthesizer and encoder, and encoding is just what the device does. It makes the 22S a lot more fun to use, but still keeps the price tag low.

Using the Synthacoder, you can put the 22S on any common or 15 kHz simplex or repeater pair with a flick of four thumbwheel switches. Program the 22S for 21 channels of your choice using the diode matrix, and plug the Synthacoder into number 22. A trip into unknown repeater territory becomes a snap, provided your *73 Repeater Atlas* is handy.

Fact is that due to space limitations on the diode matrix, the 22S cannot be programmed for every standard repeater pair. You can cover non-split channels from 146.01 through 146.37 and up from 147.00 to 147.24 MHz before running out of channels, but that leaves five standard pairs unavailable, not to mention simplex and splitter pairs. The solution is obviously an outboard encoder.

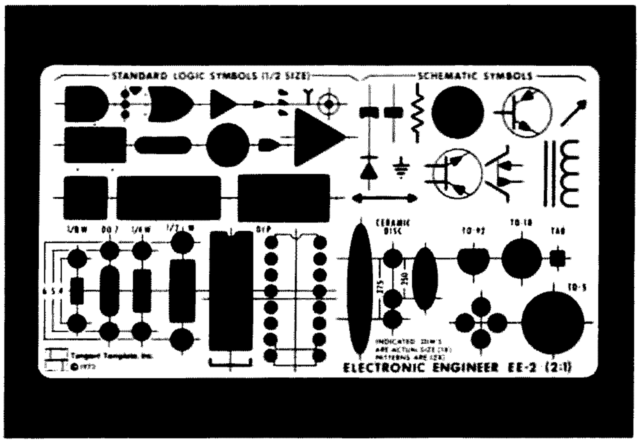
Many folks think they can outboard the 22S with a single ROM or even a few thumbwheel switches. You can, but to figure out what channel you're on takes enough charts and calculations to make the average weekend sports car rallyist cringe.

The Synthacoder allows *direct* readout of frequency, through a complex system using CMOS bipolar logic. The manufacturer won't say much more than that about his design and I suppose his reluctance is understandable. The competition is reportedly fierce to produce devices like the Synthacoder, with more than the 22S in mind. The smart money says Icom's idea will soon be appearing in other rigs, eventually eliminating the need for crystals. If diode matrix synthesizers do become the VHF economy rage, the Synthacoder will have a definite edge on the rest of the pack.

One big reason for Engineering Specialties leadership is price. Complete with wiring harness, hardware and fully assembled, the Synthacoder retails for $74.95. That puts the cost of an outboard programmed IC-22S under $320. Two hundred dollars more would be required just to equal the Icom receiver and super frequency flexibility.

Installation is quite simple, using the 9 pin accessory socket built into the 22S, to bring the Synthacoder's encoding lines into the Icom's diode matrix. Power is supplied by installing two pins in the standard 12 volt socket. (Icom conveniently left the two pins vacant.) The Synthacoder then is easily connected and disconnected from the 22S, and mounted with strips of velcro attached to the Icom mounting bracket. The unit is super compact, with a single PC board, and dimensions of 3¾" wide by 1½" high by 6" deep. It weighs less than 6 ounces and is packaged in a brushed and anodized aluminum case.

Dialing up frequencies with the Synthacoder is easy, although seeing the thumbwheels in the dark is impossible. (Engineering Specialties is working on an illumination kit, but I'm confident most hams will devise some type of lighting system of their own.) Otherwise there isn't a glitch to be found with the unit. It's very easy to count up and down without taking your eyes off the road, because the thumbwheels have a very positive feel.



The Synthacoder will not allow non-15 kHz frequencies, which the Icom will reject anyway. Instead the unit automatically disables the transmitter and turns on a bright red LED warning lamp labeled "Invalid Code" if you hit one of those non-standard frequencies.

Last month, after reviewing the 22S, I was left with the impression I'd be hard pressed to find 22 different channels to program into the Icom's diode matrix. I was wrong. After a trip into the New York City area with the 22S and matching Synthacoder, I vowed never to leave New Hampshire without the encoder. Not one repeater was out of my reach. And I'd successfully avoided the $500 dollar club in trying to put together a flexible, synthesized 2 meter mobile. And with the money I saved it was easy to finance a linear amplifier. *Engineering Specialties, PO Box 2233, 1247 Commercial Avenue, Oxnard CA 93030.*

Warren Elly WA1GUD
Associate Editor

NEW GENAVE VHF TRANSCEIVER

General Aviation Electronics, Inc. (GENAVE) of Indianapolis, Indiana, has introduced a new 25 Watt, high band transceiver. The unit comes in two models – the GMT-125 and the GMT-225.

The GMT-125 is called the "economy workhorse" of the GENAVE line. Modestly priced at $345, the transceiver will operate between 143.9 and 173.4 MHz.

The GMT-125 is a one channel transceiver and includes a 4 pole monolithic crystal filter. The inclusion of the crystal filter means that in most areas there is no adjacent channel interference. An 8 pole monolithic crystal filter is also available for those high density areas. A built-in heat sink enables the unit to operate longer and more effectively. Included with the GMT-125 is a captive microphone.

The GMT-225 is the deluxe 25 Watt model. The transceiver has all of the same fine features as the GMT-125, including a 4 pole monolithic crystal filter and built-in heat sink. The GMT-225 does include the addition of another channel, making it a two channel transceiver, and substitutes a plug-in microphone for the captive microphone. The GMT-225 is priced at $360.

Included with both the GMT-125 and the GMT-225 are microphone, microphone clip, dc power cord and mounting bracket. Weighing only 6 lbs., and operating on 13.75 V dc, the units are easily installed anywhere.

The subaudible tone squelch is one of the most advantageous accessories for the GMT-125 and the GMT-225. The tone squelch allows your receiver to be activated only in response to calls placed within your own system. No distractions by everyone else's transmissions!

Other accessories available for both units include portable power pack (allowing portable operation), external speaker and 12 Watt PA horn.

Also available are antennas for trunk lip mount, magnetic mount, and drill through mount. *General Aviation Electronics, 4141 Kingman Drive, Indianapolis IN 46226.*

THREE FUNCTION TEMPLATE SPEEDS CIRCUIT DESIGN

The Electronics Engineer template incorporates on one template the most commonly used logic, schematic and component layout patterns required for the majority of electronic circuit design applications. Each template includes a complete set of half size logic symbols and basic schematic symbols for preparing circuit diagrams. Component layout patterns include capacitors, resistors, diodes, transistors, ICs and a DIP.

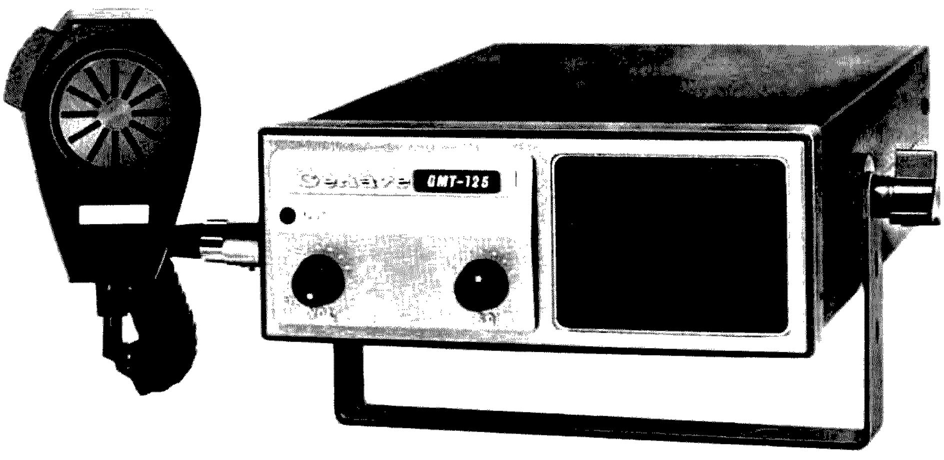
The template is designed expressly for use by electronics engineers, circuit designers, technicians and draftsmen. The Electronics Engineer template is available with 1:1, 2:1 and 4:1 component patterns. EE-1 (1:1), $5.00; EE-2 (2:1), $5.50; and EE-4 (4:1), $7.50. *Tangent Template, Inc., P.O. Box 20704, San Diego CA 92120.*

NEW CATALOG AVAILABLE

Hamtronics, Inc. announces publication of a new catalog, which is available on request. This new edition features a new miniature VHF receiver preamplifier, a receiver multicoupler allowing the use of two receivers on a single antenna, and a low cost FM signal generator. Previous products include VHF and UHF FM receivers and transmitters in kit form and various adapters for use with VHF and UHF equipment, such as scanner adapters, multichannel adapters, and a full line of preamps. This new 16 page catalog is yours in exchange for a self-addressed stamped envelope. *Hamtronics, Inc., 182 Belmont Road, Rochester NY 14612.*

"WIRELESS" CONTROL COAXIAL RELAY

One coaxial feedline can be used for two antennas with Inline Instrument's Type 105 Wide Band Switching System consisting of a coaxial coupler and an SPDT coaxial relay. The coupler causes the coaxial cable to conduct both the rf signal and the energizing voltage to the remote coaxial relay, permitting one of two antennas or other loads to be selected at their source. Power capability is 1250 Watts CW from 1.5 to 60 MHz, 1000 Watts CW from 60 to 100 MHz and 750 Watts CW from 100 to 180 MHz. Other features include: negligible swr and insertion loss, weatherproof construction, no insertion noise, and 10,000,000 switch transfer life expectancy. Use of this system minimizes wind resistance, weathering and maintainance associated with multiple cables. Price is $49.95 (1 system). *Inline Instruments, Inc., Box 473, Hooksett NH 03106.*



Bill Pasternak WA6ITF
14725 Titus St., #4
Panorama City CA 91402

200 lb. Cookie

- - microwave repeater control

Each repeater owner has his own favorite way to control his repeater, be it an on-site system with an on-off switch or the most elaborate of UHF radio systems. In remote control systems, the two most popular today are UHF radio remote and telephone remote. Both have drawbacks in an area like Los Angeles. First, the majority of our repeaters are located atop rather large mountains that can be a toll call away, and calling your system to activate one of your many remote functions can become quite expensive. For that reason, UHF remote control has become very popular out here, because there is a one shot investment and that's it. The drawbacks though, can be twofold. In Los Angeles there is virtually no unused spectrum available on the 450 band and it has been that way for many years. Obtaining a clear spot for a control link can be a job and a half. So, if a system already has an allocation, why change? Security and dependability – these are the key reasons for Burt Weiner K6OQK's decision to install a point-to-point microwave control system from his home in the San Fernando Valley (fondly referred to as "Burt's Pumpkin Patch") to his repeater in the KPFK transmitter site on Mt. Wilson.

For many years Burt has alternately controlled WR6ABE on telco lines and UHF, but has encountered the drawbacks previously discussed. Finally, upon acquiring some microwave equipment, he decided to make the big break from tradition and install the equipment as control for his system. Another reason was the pride he takes in the overall quality of the system itself. To listen on the output and then alternately switch to the input, one will note that many of the repeated signals out of ABE sound much better than its receiver is hearing. A look at the repeater itself will easily explain the reason. While the receiver and transmitter are quite standard early vintage Motorola, the equipment between them is state of the art broadcast quality. Burt, a broadcast engineer by profession, has taken a lot of care with the audio and carefully processes every word the receiver hears before the transmitter gets it. His technological wizardry can make even the raunchiest signal sound fairly passable. Since ABE's site also functions as a remote for the weekly "Mt. Wilson Repeater Assn. Amateur News QST Bulletin" and the audio quality via the telco lines was nothing to brag about (and since he was quite familiar with the improved quality that could be had by feeding the "News Service" to the transmitter via a microwave link), the decision to implement was made.

The accompanying photo taken on Mt. Wilson at the "Pumpkin Patch" tells part of the story. Burt and his compatriots have the ability to make even the hardest job a labor of love . . . you have to love what you are doing to truck a 200 lb. dish up a 5000' plus mountain, install it, and then go home and climb your 70' tower with another 200 lb. dish.

While still in the experimental stages, eventually WR6ABE will be on a full time microwave control system with limitless capabilities. At any rate, it is at least another first for southland open repeaters as far as we know. ■

David J. Brown W9CGI
RR 5, Box 39
Noblesville IN 46060

Weather Satellite Simulator

-- do-it-yourself satellite?

This satellite may never fly, but it does speak exactly the same language as the weather satellites we presently have in orbit. There are a number of articles already available describing monitors for copying these transmissions.[1] Some are complete monitors and others describe how to modify your SSTV monitor to add this feature for a very small fee. These articles also describe the different set of standards used by this service, so I will touch on them only briefly, and only as they apply to this project.

The project is an adapter that goes with another item by Dr. Robert Suding WØLMD in the July 1975 *73 Magazine*, page 98. This article described a generator of accurate audio tones using a crystal timebase, and then TTL ICs to divide down to the required audio. By using a very accurate and reliable (and quite inexpensive) generator like this to feed my adapter, you end up with a gray scale generator for use in setting up SSTV monitors to very accurately decode and display weather pictures.

The standards used by these satellites very briefly are: 1. The transmission to Earth is an FM modulated (approximately 10 kHz deviation) carrier in the 135 MHz region. 2. The FM modulation is a 2400 Hz tone. This 2400 Hz tone is AM modulated giving picture and sync information that is equal to the instantaneous percentage of modulation – 0% is black, 80% is white, and 100% is sync. 3. The sync is sent just before each horizontal line for 12.5 ms (APT-satellite). 4. The horizontal rate is 4 Hz or 1 line every 250 ms (APT). 5. The total picture length or vertical scan is 200 seconds for 800 lines resolution (APT). 6. The aspect ratio is 1:1 just as in SSTV transmissions. The articles describe exact times, days, frequencies, and information required to copy pictures and are highly recommended reading for those intending to try. These standards as they apply to this adapter concern only the horizontal, vertical, and sync information and how they each relate to the percent of modulation and its use here.

Where to Start

I believe someone once said that for rabbit stew you first need a rabbit! In this case that would be to build the WØLMD generator. Other stable sources could be used, but this unit is so versatile it is more than worth the extra effort. One addition is suggested and can be included in the original generator if you choose, by using the 12th position of the rotary switch marked "frequency selector." This would be a good addition even if you don't build the adapter, since it gives you a very good source of 2400 Hz used for the weather satellites. If you have an SSTV monitor, the modifications to make it work in "satellite mode" are so few, and the addition of a 2400 Hz position to the generator so easy, that it seems silly to do without either. Further, the 2400 Hz tone is also very close to the bandpass edge for present SSB filters (2.5 kHz) and should prove useful for things other than satellites.

The modifications required to the WØLMD generator are as follows: 1. Add one more 7430 TTL IC to the parts required, and wire it into the circuit for +5 V and ground just as the other 7430s using pins 14 and 7 respectively. 2. Wire pin 1 to the "frequency selector" rotary switch position "L", the 12th or extra position. 3. Wire pin 8 (output) to pin 11 of the 7430 that has "1200" at pin 1, "2300" at pin 6, etc. This is one of two 7430s just before the 7402, and has +5 V wired to pin 11 in the original generator. 4. The remaining pins decide what frequency causes an output to occur on pin 8 of your added 7430, and are wired to outputs of the three 74193 "countdowns." Pin 2 is wired to "1024", pin 6 of the third 74193. Pin 3 is wired to "256", pin 3 of the third 74193. Pin 4 is wired to "64", pin 6 of the second 74193. Pin 5 is wired to "16", pin 3 of the second 74193. Pins 6, 11, and 12, the remaining input pins, are wired to the +5 V bus. When the "frequency selector" switch is set to position "L", a 2400 Hz output results. This is the extent of the modifications if all you wish is a 2400 Hz source in addition to the original frequencies.

Generating a "Gray Scale" Satellite Picture

By building an additional adapter, the added 2400 Hz tone may be changed into a gray scale generator signal. This requires only a few more TTL ICs, and is quite inexpensive. For setting up a monitor for accurate presentation of the weather pictures it is hard to top, as it provides a gray scale pattern including the 0% black, 80% white, and 100% sync signals mentioned earlier.

Since the adapter requires an unusual clock signal as well as the very accurate 2400 Hz from the WØLMD unit, a complete countdown chain required for the satellite reception and presen-

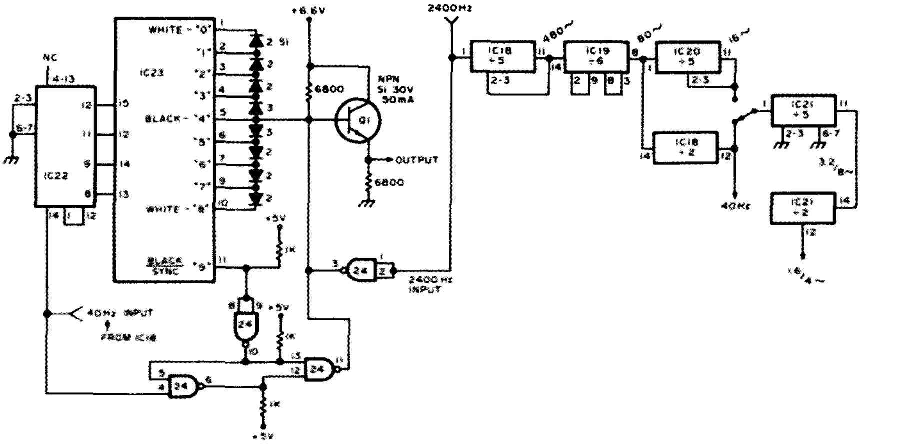


Fig. 1. Q1 emitter: "0" = 0-4.8 V; "1" = 0-3.6 V; "2" = 0-2.4 V; "3" = 0-1.2 V; "4" - 0 V; "5" = 0-1.2 V; "6" = 0-2.4 V; "7" = 0-3.6 V; "8" = 0-4.8 V; "9" = 0 V/0-6.0 V. IC18-22 (7490): pin 5 = +5 V; pin 10 = ground. IC23 (7445): pin 16 = +5 V; pin 8 = ground, IC24 (7403): pin 14 = +5 V; pin 7 = ground.

tation is included as part of the adapter. Build it in its entirety and you have all the timing signals required for your satellite ground station.

The 2400 Hz square wave from the WØLMD unit enters the adapter unit and is sent two ways (see Fig. 1). The first is to the input of the gray scale generator and one pole of a switch that allows straight through operations. The second is to a countdown chain of dividers that ends up providing the basic signals of 1.6 and 4 Hz used for horizontal scanning on each of the satellite's two modes. Included in this slightly different arrangement of dividing is a source of 40 Hz (a 25 ms period). This 40 Hz signal drives the 7490 counter, IC22, which in turn causes IC23, a 7445, decoder's outputs "0" through "9" to go low for a 25 ms period each. If further gating were not used, this would result in an output from Q1 emitter of ten 25 ms long outputs. The 7400, IC24, is added to cut one of these outputs into two 12.5 ms periods. These three ICs are the only ones that really comprise the gray scale generator, and their cost at going rates is approximately: 7490 — .76, 7445 — 1.10, and 7403 — .19, for a total of $2.05. A word may be in order here about the IC numbers since I used IC1 to IC16 for the original WØLMD unit, IC17 for the added 7430 to get 2400 Hz, IC18 to IC21 for the timebase countdown dividers, and then IC22 to IC24 for the gray scale generator. Simple as that.

While the diode arrangement around the IC23 outputs may not be unique, I have not seen it elsewhere; I frequently use it to make up various staircase generators. With the added IC24 gate, these diodes cause a 5 level staircase, first descending, then ascending, for the positions "0" to "8" of the 7445 IC23. The staircase is formed as follows: 1. Position "0" going low through nine diodes (junctions) causes a voltage of approximately 9 times .6 V, or 5.4 V, at the base of Q1. For 25 ms (one clock period) this is as *high* as the base of Q1 can go. Meanwhile, at the output of IC24, pin 3, 2400 Hz transitions are occurring throughout IC23's ten clock periods. This creates or allows 60 cycles of 2400 Hz square waves, 0 to 5.4 V P-P, to occur at the base of Q1. Allowing for the one .6 V drop across Q1 from base to emitter, these 2400 Hz square waves become 0 V to 4.8 V P-P. Assume for a moment a 0 V to 6 V maximum output from Q1, and the 0 V to 4.8 V square wave would represent 80% of that figure; thus we will call position "0" the "white" level.

Without completely repeating all of this, going to position "1" on IC23 causes two less diodes in the IC23 to Q1 path. This means 1.2 V less maximum at the base, or 4.2 V. IC24, pin 3, causes another 60 cycles of 2400 Hz of 0 V to 4.2 V at the base, and 0 V to 3.6 V at Q1 emitter. This is 60% of 6 V or a "gray" shade.

For position "2", two less diodes, 0 V to 3.0 V Q1 base, and 0 V to 2.4 V Q1 emitter for a 40% "gray" shade. Position "3", two less diodes, 0 V to 1.8 V Q1 base, and 0 V to 1.2 V Q1 emitter for a 20% "gray" shade. Position "4", three less diodes (to be certain Q1 goes off), 0 V at Q1 base, Q1 off, 0 V and no 2400 Hz at Q1 emitter for a 0% black. Position "5" is the same as "3" by adding diodes back in. Position "6" is the same as "2", "7" the same as "1", and "8" the same as "0".

Position "9" is somewhat different to allow two features. One, it was desired to retain the same 12.5 ms wide sync as is present from the satellite, such that any time dependent circuits in the monitor would not see an artificially long (25 ms) sync signal. Two, since the period had to be divided in half to get the 12.5 ms sections, it was felt that the second half would be used for sync, thus causing it to occur just before the next horizontal line as in the satellite. Further, the first 12.5 ms section is made a 0% or black signal. This means presented on the screen will be 9½ bars going from white to black to white, and a half bar of black. This allows a bright white to align the left edge of the picture on the screen, and a good hard white to black transition at the right to check your amplifiers, beam switches, etc., for speed and absence of "ringing."

In order to accomplish this section "9" division into two 12.5 ms periods, simple gating is used. IC24 is a quad 2 input gate IC that has uncommitted collector transistors for outputs. While this is not really a requirement at outputs on pins 10 and 6, since they work into more TTL logic, it is necessary for the outputs on pin 3 and 11 for two reasons. The first is a TTL rule regarding the direct connection of two TTL device outputs having com-

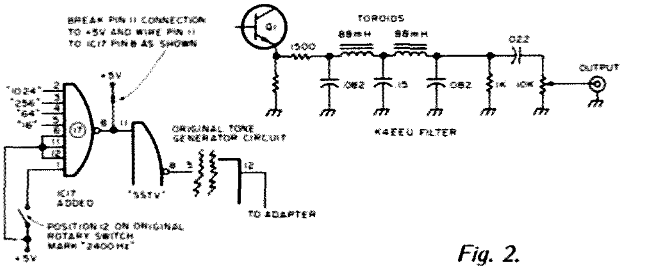


Fig. 2.

mitted outputs – a no-no! Secondly, and more importantly in this case, we want the base of Q1 to go all the way up to 6.6 V when not being acted on by IC23, or IC24 outputs pins 3 or 11.

Following the gating of IC24, the 40 Hz clock rate enters all the time on pin 4. This would cause 12.5 ms high and 12.5 ms low outputs at pin 6 if pin 5 were high, and a steady high at pin 6 when pin 5 is low. Pin 5 is tied to pin 10 of IC24. Pin 10 also ties to pin 13. By putting pins 8 and 9 together, the 8-9-10 gate is used as an inverter. The inputs 8-9 are wired to position "9" of IC23, and thus are high except when IC23 is in position "9". The low that occurs at pin 10 disables both the 4-5-6 and 11-12-13 gates of IC24 by holding at least one input low and, therefore, their outputs at a fixed high.

When position "9" is reached, it is the fall from high to low of the 40 Hz clock signal that causes this, and thus the low portion of the 40 Hz is on pin 4 of IC24. A low from position "9", inverted through the 8-9-10 gate to a high at pin 13 half enables the 11-12-13 gate. A low at pin 4 keeps pin 6 high and also pin 12 high, causing a low at pin 11. This low turns off Q1, and a 0% black is present for 12.5 ms. When the high part of the 40 Hz clock comes along and makes pin 4 high, then pins 6 and 12 go low and pin 11 now goes high. Since the base of Q1 is not held down during this 12.5 ms period by either gate 11-12-13 or IC23, only gate 1-2-3 affects it. As such, 30 cycles of 2400 Hz square waves at 0 V to 6.6 V P-P appear at Q1 base. This is then 0 V to 6.0 V at Q1 emitter, or 100%, namely "sync"!

You should see by now it takes longer to explain the adapter than to build it and get it running combined. Also, it may have occurred to you that any accurate 2400 Hz into the adapter will accomplish the same result. Quite true! I happened to build the WØLMD unit first; I have been having a ball finding out the many uses for it, so I used it here. It is great – and accurate – and it just was not worth the trouble of building another 2400 Hz source whose accuracy I could not trust as much (non-crystal source, etc.).

An SASE will get all the help I can give on the gray scale generator or the new timebase, but questions on the monitor or the articles contained in the references should go to the respective authors, since in those portions of my ground station I only copied their work and mine worked fine the first time. This way they are more apt to be familiar with any problems you are having than I would be. The generator I will take full responsibility for and will try to get you a rapid reply. ■

References

[1] *73 Magazine,* WB8DQT, August 73, p. 45. *73 Magazine,* WB8DQT, Sept. 74, p. 79. *73 Magazine,* WB8DQT, Dec. 74, p. 48. *73 Magazine,* WB8DQT, June 75, p. 128. *73 Magazine,* WA9MFF, June 75, p. 22. *73 Magazine,* WB8DQT, July 75, p. 76. *73 Magazine,* WB8DQT, August 75, p. 45. *73 Magazine* WB8DQT, Oct. 75, p. 60.

Note: While giving the unit adapter its final checks and preparing this article, some additions crept in, and are noted in Fig. 2. The output here is a square wave, as in my previous RTTY and SSTV adapters, and should be run through a like filter. The K4EEU filter used there works just fine and can be used here, so I include it in Fig. 2. Bert's filter appeared in Ham Radio, *July 1973, p. 6, for those who care to see its original use.*

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An Automatic Thermostat

- - saves 10% on your fuel bill

It is common knowledge that heating bills can be reduced by setting the heat lower at night. As a matter of fact, most heating engineers will tell you that a savings of up to 16% can be realized by lowering the nighttime temperature in a home by 10 degrees Fahrenheit for at least 8 hours every day during the winter heating season. While it is very easy to use your index finger to push the thermostat back 10 degrees every night, this manual method does not turn out to be very reliable. Either someone forgets or the attitude of "I'm not getting up in the cold to turn up the heat" seems to prevail. Thus, the use of an automatic "day/night" type of thermostat is a better way to cut down on heat bills. This type of thermostat, however, is usually rather expensive ($50-75) and must be used in place of each thermostat in the house. In a dwelling with multiple zones and multiple thermostats, this can be quite expensive.

This article describes a "day/night" heating control which will automatically turn the heat down at night and back up again in the morning. While this device sounds like a "day/night" thermostat, it is different in that it connects to the 24 V ac electrical system of the furnace and will control all of the thermostats in a typical house. It is easy and economical to build and can be installed quite simply on either a hot water or hot air heating system. It has been designed so that an inexperienced experimenter can build, install, and maintain it.

Principles of Operation

A typical heating system has a circuit diagram similar to the diagrams in Figs. 2 and 3. Note that, in these diagrams, all thermostats have one side connected to a common point or common wire. The entire heating system (except for the control for hot water reservoir) is disabled if the connection between the 24 V ac transformer and this common point is broken. The "day/night" heating control has a 117 V ac relay connected to a cyclic timer. The "normally on" contacts of this relay are used to provide the connection between the transformer and the common point. At night, when it is time to set the heat back, the timer turns on the 117 V ac relay breaking the connection between the thermostats and the transformer disabling the heating system.

When I was building my first unit, I asked a neighbor who was a heating engineer if there was any reason why I should not let the house get as cold as possible during the night. His answer was a definite, "Yes, there's a very good reason." It turns out that a very complex relationship exists between the outside temperature, the day/night setback temperature differential, and the amount of fuel needed to bring the house up to temperature the next day. Because of this relationship, there is an optimum "setback" temperature, which for the average house is about 10 degrees for a maximum savings of 16%. If you exceed this setback temperature by very much, your savings will decline and it is possible to reach the point where you are ultimately using extra fuel rather than saving fuel. For this reason, an additional thermostat was included in the system to provide an overall nighttime temperature for the house. This additional thermostat uses the 24 V ac transformer on the furnace for power and is connected to a 24 V ac relay. This thermostat is set at a temperature which is 10 degrees less than the daytime temperature. When the house temperature falls below this nighttime setting, the thermostat closes, turning the 24 V ac relay on. Since the power leads for the 117 V ac relay go through the normally closed contacts of the 24 V ac relay, the 117 V ac relay will be inactivated and the system will go back to normal. At this point, all of the daytime thermostats take control and call for heat as required. When the temperature rises above the nighttime temperature, the heating system is once again disabled. Note that the nightime thermostat does not turn on all zones automatically but merely puts the heating system back to daytime or normal. This was done to

This project is a perfect opportunity to use your skills to make a few dollars on the side. This easily built thermostat can be sold to friends and neighbors and installed by you. — Ed.

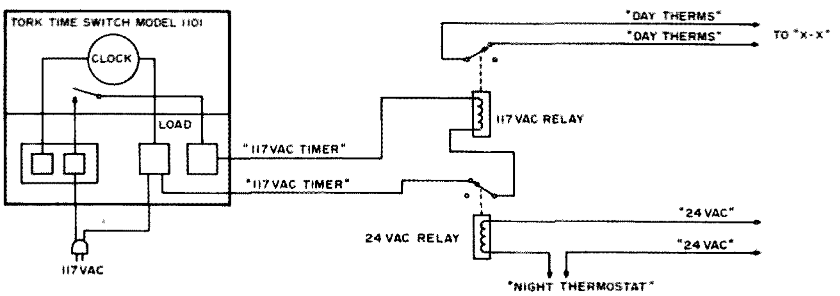

Fig. 1. Day/night furnace control.

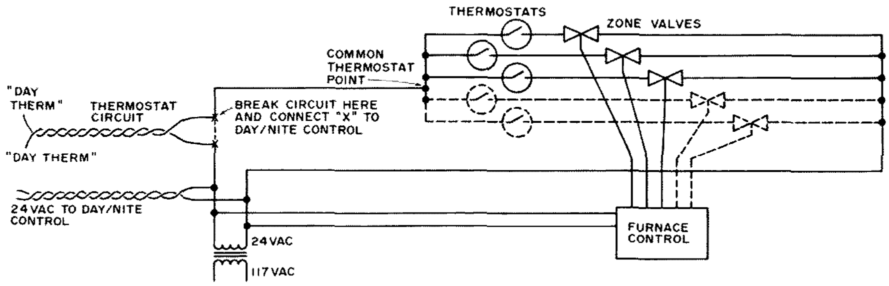

Fig. 2. Typical hot water heating system.

should be made with the appropriate circuits de-energized. Never work on a "live" circuit. When making connections to the 24 V ac transformer, be sure that the circuit to the furnace is turned off. In some cases, it may take two to three minutes for the heat to come on due to inherent delays in the controls for the furnace and the zone valves.

allow a given maximum temperature in a particular zone and to permit a zone to be turned off. If a zone is turned off during the day, it will not be activated at night by this system. I wanted this feature for my own house where the basement zone is off except for rare occasions. If I had used the nighttime thermostat to turn on all zones, I would be wasting heat in the basement.

Construction

Simple, quick construction was one of the design goals of the system since many neighbors expressed interest in this device and contemplated building it for their homes. Reliability was another goal, since few of the neighbors had an electronics background and thus could not troubleshoot the system should a malfunction occur. Consequently, parts were chosen on the basis of ease of construction and reliability, rather than on a minimum cost basis. Those readers with a good junk box and electronics knowledge can improvise and substitute, possibly saving a few dollars here and there.

I might mention that an all solid state version of this unit was built and tested; however, since it was not totally reliable and was expensive to build, it was abandoned. It is difficult to beat the relay in regard to reliability and cost.

A small metal box with dimensions of 3" x 4" x 5" or larger is used to hold the two relays. Top mounting sockets are used for the relays so that it will not be necessary to punch large holes in the box. A small quarter inch electric drill and a screwdriver are the only tools needed for the project. After assembling the unit, both the timer and the control unit are mounted on a wooden board which can be nailed to the cellar wall or any other convenient place. I originally mounted lights on the box, but since they have no real value and add unnecessarily to the cost of the unit, they were omitted in all subsequent units. Hence the circuit has no lights shown.

All connections made inside the box are brought out through a ½" grommet in a ½" hole. Connections should be labeled as shown in Fig. 1, using masking or adhesive tape.

The timer used is a heavy duty industrial timer and is very inexpensive for its quality. If you wish to cut corners, you may substitute the Sears #34H6442, which sells for about $7.00 in their catalogue.

Installation

Install the nighttime thermostat in a central part of the house. Do not mount the thermostat on an outside wall or a wall that gets cold. Use twisted pair, solid thermostat wire or equivalent for the run from the thermostat to the control.

After the control box and timer are mounted on the board, connect the timer and control together as shown. (If you use a timer other than the Tork timer, then connect the 117 V ac timer leads to the terminals marked "load" on the timer.) Plug the timer into an outlet and test the unit as follows: Throw the lever in the timer to "on" and the 117 V ac relay should pull in. Throw the lever to "off" and the relay should drop out. Unplug the timer, cut the wire going from the "common thermostat point" to the transformer, and connect the two ends to the control box leads marked "day therms." Turn on one of the thermostats in your house and the heat should go on. Leave the thermostat on, plug the timer in and turn the lever to "on." The heat should go off. Connect the leads marked "24 V ac" to the 24 V ac transformer and connect the "night therm" leads to your night thermostat. Turn the timer on so that the 117 V ac relay turns on. Turn the nighttime thermostat to ten degrees or so below the actual house temperature. The heat should stay off. Click the night thermostat on. The relays should click and the heat will go on. At this point the system is installed and ready for operation.

Note that all connections

Operation and Use

In our household, the timer is set so that the heat is turned off ½ hour before bedtime and turned on ½ hour before rising. With these settings, our house remains comfortable before going to bed and warms up before rising. In cases where we will be staying up late beyond normal bedtime, we merely turn the nighttime thermostat way up until it "clicks in." This puts the system back to normal without having to change the timer. In this case we turn the thermostat down before retiring and the nighttime system takes control.

It should be noted that when you set the trippers on your timer, the trippers are set to turn "the control on" and "the control off." This corresponds to disabling the thermostats and enabling the thermostats. In cases where no one is at home because of school or work, additional trippers may be added to turn the control on at 8:30 am and off at 4 pm or any other time. By doing this, the heating system would be in "nighttime" mode from 8:30 to 4. In this example, an additional fuel savings would occur for 7½ daytime hours.

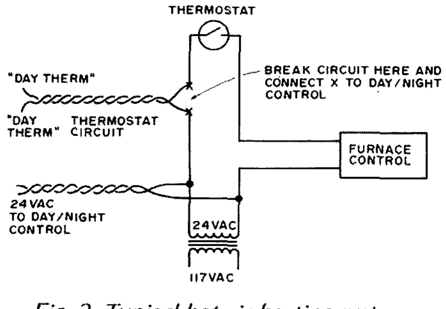

Fig. 3. Typical hot air heating system.

Recommended Parts List

Quantity	Description	Supplier	Approx. Cost
1	120 V ac relay Line Electric Co. Model MKH2A	Hatry's	$6.50
	or		
	HI-G, 115 V ac Model 4SLRP-215	See notes	See notes
1	24 V ac relay Line Electric Co. Model MKH1A	Hatry	
	or		
	HI-G, 26.5 V ac Model 4SLRP-126	See notes	See notes
	Sockets for Line Electric Co. relays – Potter and Brumfield #27E122	Hatry	6.00 (3.00 ea.)
	or		
	HI-G #4SLRP	See notes	See notes
1	Tork Time Switch Model 1101	Graybar	14.00
	or		
	Sears #34H5870	Sears	14.00
	or		
	Sears #34H6442	Sears	7.00
1	Thermostat Sears #42H9235	Sears	14.00
	Thermostat wire as required Sears #42H9151	Sears	1.35/35' roll

Notes to Parts List

Prices given may fluctuate, and do not include shipping and taxes.

The HI-G relays shown as alternates are very high quality hermetically sealed relays. They are recommended if you have means for cutting the two required 1-3/32" holes and don't mind doing a bit of metal work to get them mounted. Write to the manufacturer to get the address of the nearest distributor and the current price.

The Line Electric Co. relays are not hermetically sealed but do have a dust cover.

Distributor addresses: Hatry Electronics, 500 Ledyard St., Hartford CT 06114; Graybar Electric Co., Inc., 231 Newfield Ave., Hartford CT 06105; HI-G Incorporated, Spring St. and Route 75, Windsor Locks CT 06095.

Additional trippers cannot be added to the inexpensive timer noted in the parts list.

This system has been working for several years now and has saved us a real 10% in fuel utilization. We are quite pleased with the system; however, I will admit that it did take a while to get used to it. First of all, the bedroom does get cold at night, which means that we had to learn to sleep with three blankets and a quilt. Second, visiting the "head" in the middle of the night can be a chilling experience. Third, the temperature throughout the house at night is not as uniform as when the system is in normal. This is of little consequence since you should be asleep at this time.

Very obviously, the advantage of this system is fuel savings for the individual homeowner. It would not be unreasonable to save twice the cost of the unit during the first winter. From the savings that our family is seeing right now, we may do considerably better. Aside from the savings experienced in the individual household, this unit could have an impact on nationwide fuel economy if it were used on a national basis. It could help us conserve our scarce national fuel resources. ■

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Mod for the Heath IO-102 Scope

- - faster warm-up

The Heath IO-102 scope kit appears to be one of the "better buys for the money." The 30 mV vertical sensitivity, 80 nanosecond rise time, and 5 MHz frequency response seem to fill the bill. Actually, the vertical response is adequate for viewing 15 MHz or higher signals with sufficient trace height to be usable. Assembly is on four main circuit boards: vertical, horizontal, sweep, and power supply. The finished unit is uncluttered, internal adjustments are no problem, and most components are easily serviced.

Critical power supply voltages are zener regulated, a fact which contributes to the operational stability after warm-up. The power transformer, which is double shielded, and circuit board layout result in a trace like those drawn in textbooks.

The initial alignment and internal adjustments, although not difficult, *must* be performed as directed. An accurate VOM or VTVM is the only equipment needed. During this alignment, one wishes he had a screwdriver with a ten to one drive. However, with a light touch, the desired results can be achieved.

Heath states that vertical drift during warm-up "for the first half hour or so" is to be expected. Experience with two of these units was as follows: From a cold start at 70° F, the trace was completely off the screen for the first ten minutes. After ten minutes, the trace appeared at the top of the CRT and drifted downward for 35 minutes, at which time it stabilized and no further drift was noted over several hours of operation. For someone who turns on the instrument and intends to use it all day, this may not appear as a problem. My use is on an intermittent basis and I found juggling the vertical position control inconvenient. The addition of four simple heat sinks produced two improvements:

1) A usable trace on the screen in 3 to 4 minutes.
2) A completely stable trace, without touching the position control, in 12 to 15 minutes.

Two heat sinks (Fig. 1) were made from 1/8 in. aluminum and attached to the vertical output transistor heat sink tabs as shown. The tops of these sinks, which were bent 90°, may be secured to the CRT shelf with standoff insulators or RTV cement. Two additional heat sinks, 1 in. by 1 in., were attached to the driver transistors with a small wrap-around wire.

Heath incorporates a 1 volt peak to peak calibrating signal at a front panel jack. I personally prefer a square wave calibrating signal and incorporated the circuit shown in Fig. 2. This calibrator provides a clipped sine wave signal of .1 V, 1 V, and 10 V. Three pin jacks were added next to the vertical input ground jack, to bring these signals to the front panel from the circuit which was mounted on the cover of the power supply transformer using existing screws.

All things considered, I feel you will find this instrument a worthwhile addition to your test bench and a pleasure to use. ■

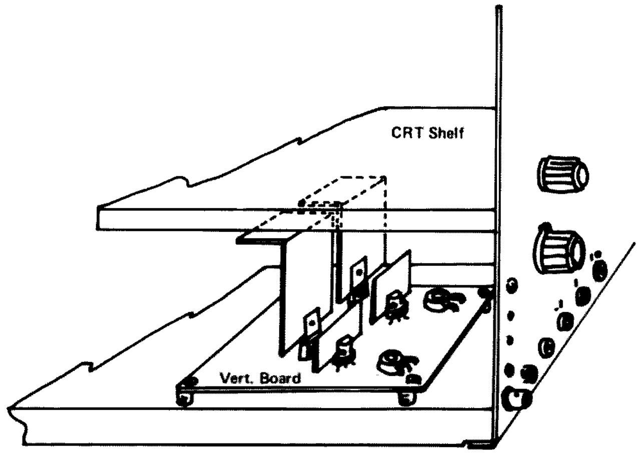

Fig. 1.

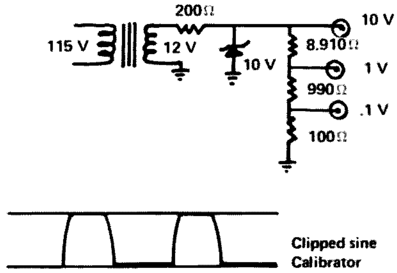

Fig. 2.

by Wayne Green W2NSD/1

I/O EDITORIAL

THE ALTAIR BUS

For some reason there has been a move recently to rename the Altair bus the S-100 bus. Dirty pool.

First, what is a bus? Well, we don't use bus structure much in amateur radio since we have very few common connections between the various modules of radio equipment, but the bus system has evolved for computers. A bus is a set of parallel wires to which the various modules of a system are connected. Most computers use a mother board with rows of connectors on it into which plug the boards which make up the system. All of the terminals on the connectors are connected to the same terminals on every other connector.

In the Altair, a 100 terminal connector is used, with 50 terminals on each side of the PC board. This set of wires carries power to each board, feeds in the signals and takes them out. To save on pin connections, many of the microprocessors use the same wires for feeding data into the chip as out, and this means it is possible to get by with fewer wires in the bus. Some of the bus wires carry handshake signals, etc.

While some hardware people rail out against the Altair bus, making much hay over this difficulty or that, it has become the de facto standard of the microcomputer world . . . partly because it was first . . . partly because its originator, MITS, sold more Altairs than everything else combined . . . and partly because, for all its faults, it is a very efficient and useful bus system . . . and it works.

The Altair bus is used by the Imsai and Polymorphic computers, plus a host of boards for ordinary and specialized functions. A recent estimate put the number of boards so far available for the Altair bus at 100. An even more recent (last week) count placed the number at over 150! I'm sure hoping for a series of articles describing all of the Altair bus compatible boards for publication in *Kilobaud* . . . writers please take note.

My reaction to the move to rename the bus the S-100 is that credit should be given where credit is due and it should be called the Altair bus.

ATLANTA JUNE 18-19

Pencil those dates in and make your reservations for one of the biggest and the best hamfest/computerfests in the country. Dayton is big, for sure, but other than the hamfest, what have you got? Atlanta is worth planning a couple days or so of vaction to correspond with the hamfest, for there are all sorts of fantastic things to do around there.

The 1977 Atlanta Hamfestival will be held at the Atlanta Marriott Hotel in downtown Atlanta . . . there are 1000 rooms available, more than twice what was available last year . . . and the rates will be $18 single and $24 double . . . free parking . . . big flea market area which is inside and air conditioned. Call 800-228-9290 toll free to make your hotel reservations . . . and better not wait too long.

There will be 120 exhibits, fantastic prizes, some of the top speakers in hamdom and computerdom (particularly featuring Ed Roberts, the president of MITS), and probably the best hamfest food you've ever tasted. Get a group together from your club and have a great time. How about a convoy with 2m intercom along the way?

The hamfest will be emphasized on Saturday and the computerfest emphasized on Sunday. This will be your chance to see the very latest in ham gear and meet the manufacturers and major dealers (Tufts Radio will be there again this year) . . . and to see what computers look like in the flesh, with a lot of computer exhibits. If you've been putting off messing with microcomputers, you'll be interested to see 'em in action . . . and get your hands on them to play some games . . . see 'em work RTTY . . . plot OSCAR passes, etc.

Last year I took a little time to see Underground Atlanta, ogle the incredible downtown hotels, and visit nearby Stone Mountain . . . a sort of entertainment and picnic center. There's a lot to see in the area . . . and do . . . and the restaurants . . . wow!

KILOBAUD

A high capacity data channel – *Kilobaud* – and the name of our new magazine, the first issue of which is now out. We were going to call it *Kilobyte*, but decided to duck a lot of legal expenses by changing the name slightly . . . rather spend the money on a better magazine than lawsuits.

The first issue runs 144 pages and is pretty good. It'll be better as we go – we're trying out some new ideas and after a while we'll settle down. Subscriptions are $15 a year – we'll start with the first issue while it lasts.

The hobby computer field is moving rapidly – new microcomputer chips are coming out faster than they can be put into systems. The most important newer chip is the Z-80, which is an advanced 8080A chip and may, despite my reservations about it, soon be the most used hobby computer system microprocessor.

The proliferation of TV games has opened many eyes. It started with one guy in his basement turning out Pong games and now it is sweeping the country, with many big manufacturers in there making hay. Not that Atari, the originator, is doing badly. The next step is one that you could make, if you wanted to. If you visit any of the arcades you'll see that the most popular games, by far, are games using a television screen and some simple controls . . . Tank . . . Red Baron . . . Quick Draw. These all use a Fairchild F8 microprocessor chip and the whole thing is done with a program . . . software! You see where I'm heading?

You have to have your own microcomputer going and build an inexpensive graphics generator . . . then write your own action games for it. When you're done, put the whole works onto one board and package it with the controls so it will play through a color TV set . . . and you'll have the world by the tail. If the public will buy ping pong, they'll go crazy over even better action games. Who's going to do it?

PUBLISHER'S DATA PROCESSING

We've been having a ball getting our own computer system going to handle the subscriptions and other jobs around *73*. We already have six CRT terminals going, trying to keep up with the new subscriptions to *73* and *Kilobaud*, and nine more on order for other data handling such as advertising records, bulk copy order records, inventory, repeater lists, club lists, dealer lists, accounts receivable and payable, billing for subscriptions, an article index, things like that.

Once we have all of the programs running smoothly, we'll be able to sell complete systems completely programmed for running a publishing house. The whole works will cost about as much to own as two office employees and will do the work of about ten or so. It should be popular. It should be about ready for a demo in the first quarter of 1977. If you know any publishers, give us a mention.

GROWTH AT 73

One of the reasons for those recent ads for more help at *73* was to keep up with our growth. You may have noticed that the last three issues have been over 200 pages – this takes a lot of work. In recent weeks we've increased the staff by 50%, doubled our typesetting facility, built a second photo darkroom, put in data processing stations on all four floors, doubled our computer capacity, and gone to two shifts in several departments.

We expect *73* to continue running over 200 pages (we're aiming at 500 pages per month), *Kilobaud* should increase from its present 144 pages to over 200 pages shortly, plus three or four good-sized books per month, a couple dozen newsletters, who knows what in computer program sales through the computer stores, and who knows how many complete computer systems for small publishers – it's quite a project for us to produce all this from our 200-year-old house in New Hampshire . . . but it's fun.

WHAT ARTICLES ARE NEEDED

If you are one of the pioneers of hamming or microcomputing, there are several reasons why you should stop every now and then and document your progress. First of all, there are a lot of fellows who would like to not have to reinvent the wheel. Give the other builders a break and let them know what you've done. Then there is the fact that being published makes you an "expert." You get a little less disrespect from fellow hobbyists. Probably of no interest to you is the payment for your article (we pay the highest, by far, in our fields).

The readers are most eager for any IC projects, digital articles, just about anything to do with computers . . . particularly as applied to amateur radio. Teachers in touch with Novice classes may have some good material to interest newcomers, activities of clubs might be helpful to other clubs, etc. Just about anything in small transmitters or receivers is of interest . . . some of these new ICs make fascinating projects possible.

Perhaps you're more into a book. If you have a book in mind, write up an outline plus a couple sample chapters and get in touch. Any one of a hundred outfits can print a book for you, but you need a publisher with distribution channels set up to sell your book . . . you don't make a lot on a book unless it sells well. There is a big need for well-written books on the fundamentals of all aspects of computers . . . and virtually nothing yet available. The day of self-teaching in this field has just arrived.

HAMFESTS AND COMPUTERFESTS

The two combo hamfest/computerfests that have been run so far have been successful enough to indicate that this is a good way to go. The two hobbies are remarkably parallel, with at least a 25% overlap both ways.

Computer exhibits at hamfests and

Continued on page 88

George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

Go Forth and Multiply!

- - the space age approach

A simple 4 bit multiplication algorithm may be implemented on virtually any microprocessor system by simply placing a table of products in memory and then using the multiplier and multiplicand to form a relative address to point to the desired product in the table. This technique produces a fast multiply and does not require separate hardware in order to implement a multiply instruction. Furthermore, by using the fundamental properties of arithmetic, the 4 bit multiply may be expanded to produce an 8 bit or larger multiply instruction. The disadvantage of this fundamental technique is that a four bit multiplication table will require 256 eight bit memory locations.

The algorithms described in this article (both 4 and 8 bit) may be applied to systems lacking a software multiply or they may be used to replace a slower multiply in systems where a multiply instruction already exists.

As an example of multiplication in the binary system, consider multiplication of the two binary numbers 1001 and 1101:

```
Multiplicand ——►   1001    = 9₁₀
Multiplier ————►  x 1101   = 13₁₀
                   ----
                   1001
Partial     {     0000
Products    {    1001
            {   1001
                -------
Product ——————► 1110101    = 117₁₀
```

Multiplier | Multiplicand

4 BIT ADDRESS	4 BIT PRODUCT [contents of memory]
00 00	0000
00 01	0000
00 10	0000
00 11	0000
01 00	0000
01 01	0001
01 10	0010
01 11	0011
10 00	0000
10 01	0010
10 10	0100
10 11	0110
11 00	0000
11 01	0011
11 10	0110
11 11	1001

Fig. 1. Two bit multiplication table.

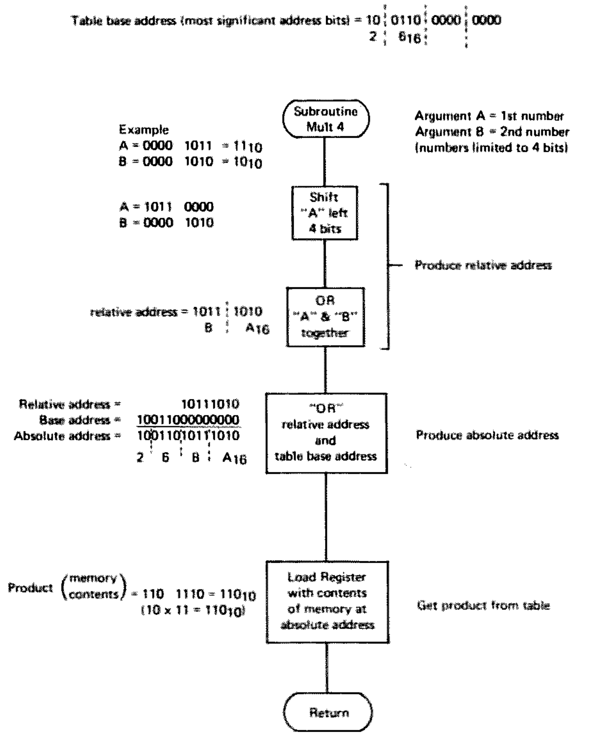

Fig. 2. Four bit multiply algorithm for 8 bit machine. Four bit multiplicand and multiplier must be placed into least significant bits of 8 bit word.

The Multiplication Table

The table of products, or multiplication table, is generated very simply by joining a 4 bit multiplier and a 4 bit multiplicand together to form an 8 bit relative address. The 8 bit relative address points to a memory location that contains the product, or result, of multiplying the 2 four bit numbers together.

As an example, consider the 2 bit multiplication table shown in Fig. 1. If we wished to multiply the binary integers 01 and 10 together, we would join the two numbers together to form a relative address of 0110 or 1001. The data contained at either of these relative addresses is 0010, which is the product of the two numbers (1 x 2 = 2).

Setting Up a 4 Bit Multiplication Table

The 4 bit multiplication table is easily set up by multiplying out each product using all combinations of 4 bit numbers. While this sounds time-consuming, it is not, and only involves 256 multiplications. (Some computer manuals may have this table already worked out.)

The multiplication table may be placed anywhere in memory; however, it is convenient to locate the table on a 256 word boundary (the start of a block of 256 words), so that either a logical operation or an arithmetic instruction may be used to generate the absolute address of the product.

Performing the Multiplication

In order to use the multiplication technique described, it is necessary to write a simple subroutine as shown in Fig. 2. In brief, this subroutine accepts 2 four bit numbers, uses them to form an 8 bit relative address, "ORs" in the base address of the table to form an absolute address, and then loads the product into a register from the table. A very minimal number of instructions are needed to perform the entire process.

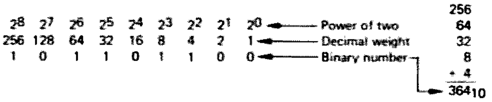

Fig. 3. Powers of two example.

An 8 Bit Multiply

Once the 4 bit multiply has been implemented, the basic properties of arithmetic may be used to generate an algorithm to multiply 2 eight bit or larger integers. To multiply the 2 eight bit numbers A and B together, it is first necessary to break the 8 bit numbers down into 4 bit pieces such that $A = m\ (2^4) + n$ and $B = q\ (2^4) + r$, where m and q are the most significant 4 bit portions of the numbers and n and r are the least significant 4 bit portions of the numbers. (See Fig. 3 for powers of two example, if you're in need of a little "refresh" in this area.)

Examples:

	m	n	
Multiplicand	1 1 0 0	0 1 0 1	$= 197_{10}$
Multiplier	0 1 1 1	0 0 1 0	$= 114_{10}$
	q	r	

$A = m\ (2^4) + n \longrightarrow A = 12\ (16) + 5 \quad = 197_{10}$

$B = q\ (2^4) + r \longrightarrow B = 7\ (16) + 2 \quad = 114_{10}$

$$\begin{array}{rr} & 197_{10} \\ & \times\ 114_{10} \\ \hline \text{Product} \rightarrow & 22458_{10} \end{array}$$

It then follows that:

$$A(B) = [m(2^4) + n]\ [q(2^4) + r]$$

Expanding the above expression produces:

$$A(B) = m(q)\ (2^8) + m(r)\ (2^4) + n\ (q)\ (2^4) + n\ (r)$$

We see that we can generate this multiplication by performing four bit multiplications, followed by a summation of the products. In the case when a power of 2 is associated with the product, the product must be shifted left n bits, where n is the power of two, prior to the summation. A simple subroutine to perform this 8 bit multiplication could be written as shown in Fig. 4.

Conclusion

The 4 bit multiplication algorithm given in this article may easily be implemented on any 8 bit (or larger) microprocessor system with very little difficulty, provided that the system has an 8 bit register in which to store the 8 bit product. The 8 bit multiplication algorithm, however, produces a 16 bit product, a product which is produced by summing four 16 bit product terms. For easy implementation of this algorithm, the microprocessor should have a 16 bit arithmetic register or a 16 bit software add.

The fundamental 4 bit multiplication algorithm described in this article was intended primarily to be implemented by software, such that the multiplication table would be loaded each time the system was loaded. There is no reason, however, why the multiplication table could not be placed in ROM or PROM and made a permanent part of the system.

The algorithms given in this article were not intended to be the last answer to the problem of providing a multiplication instruction for a microprocessor system. They are intended to provide a viable alternate solution to a problem which can be solved in many ways.

If the microprocessor user is running out of CPU cycles and his system is overloaded due to the use of such a software multiply or other software-implemented instructions, then the user should seriously consider adding additional hardware functions to replace these software routines. ■

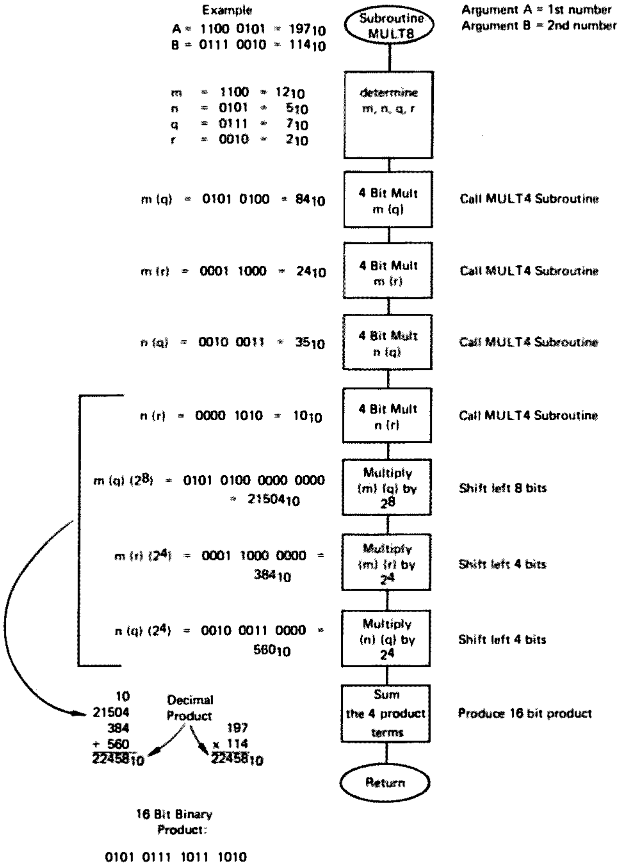

Fig. 4. Eight bit multiply routine (using 4 bit multiply subroutine).

I/O REPORT

by John Craig

Last month I squeezed in a quick mention of the Faire, and this month I'd like to fill in more of the details. Jim Warren (editor of *Dr. Dobb's Journal*) and Bob Reiling (editor of the Bay Area's Homebrew Computer Club *Newsletter*) are putting together a shindig on the West Coast in April. There are expected to be over 200 commercial and home brew exhibits, along with 100 formal and informal seminars, plus two big banquets.

You've all seen how microprocessors have played a big part in recent hamfests. Here's a "computerfest" that ham radio could play a big part in. One of the conference sessions is being planned around "Computers and Amateur Radio" and there's no reason why this couldn't be a good opportunity to get some computer enthusiasts interested in ham radio. We're going to have to show them what can be done when the two hobbies are combined, though.

If you'd be interested in presenting a talk on ham radio, the organizers would like to hear from you. If you've got your home system doing interesting things with (or without) your ham station, and you can cart it all to San Francisco, then you ought to see about getting a "home brewers" booth. (By the way, they are even offering nominal grants-in-aid to help with exhibit transportation costs. Check into it if you need to.) And, not incidentally, the "home brew" booths are free.

Don't get me wrong and get the impression that ham radio is the only thing you should consider (this just seemed like a good place to emphasize it). There are a multitude of other subjects you might be interested in, and I'll mention some of those next month.

The First West Coast Computer Faire, to be held in the San Francisco Civic Auditorium, April 15, 16, and 17, 1977. For further details call or write: Jim Warren, Faire Chairperson, Box 1579, Palo Alto CA 94302, (415) 851-7664 or 323-3111.

DEDICATED CONTROLLER APPLICATIONS

Almost without exception, every single board computer which has been manufactured and marketed was developed for the digital design engineer to use in dedicated controller applications (boards such as MOS Technology's KIM-1, Intel's SBC-80, National's IMP-16, etc.). For several reasons, I don't think it would be such a bad idea for some of the hardware-oriented hobbyists to start looking at the world around them through the eyes of those design engineers. In other words, start looking for the same applications they are.

Let me give you an idea of what I mean. I once heard an interesting story about a microcomputer engineer who had a neighbor who was in the asphalt business. During a conversation over the backyard fence one day, the road builder was relating to his engineer neighbor one of the problems of his business (which was costing him a lot of money). It seems that during the manufacturing of asphalt it is very important to get all moisture out of the sand/gravel mixture prior to beginning the mixing process. This is accomplished by using kerosene burners mounted under a large tumbler containing the sand/gravel mix. The problem was that these burners kept going, and consuming expensive amounts of kerosene, for some time after the mixture was completely dried out. The engineer recognized this as a problem which could be solved by a microcomputer, some sensors, and some valve controllers. He installed moisture sensors within the tumbler (and I'm still having trouble picturing that) and used the computer to monitor the amount of moisture and control the amount of kerosene going into the burners. And, of course, the burners were turned off at precisely the right time, resulting in significant savings in kerosene. As a matter of fact, the designer derived his "fee" from a royalty based on a percentage of the annual savings the new system offered (compared to the old way of doing it).

We've got a couple of things going for us in this area . . . and a couple against us. First of all (in the "against" department), we all need more exposure to the world of analog-to-digital and digital-to-analog conversion techniques. We haven't seen enough articles on the subject (in any magazine) and it's doubtful that there are a great number of people among our ranks with extensive experience in this area. Those that are should get busy and share some of their knowledge through an article or two. I would think a good place to start would be a publication such as National Semiconductor's *TRANSDUCERS Handbook*. (The handbook covers temperature and pressure transducers and application.)

On the plus side, most of the hams who are into computers have sufficient electronics background to pick up the necessary information on A/D and D/A applications and the interfacing to a computer. Also, we're going to be seeing articles on some *very* low cost single board computers in upcoming pages of *73* and *Kilobaud*. Some of these boards can be built for as little as $50 to $100 (quite an improvement over the $250 to $450 range we're normally faced with from the commercial versions). And, one more plus . . . the hobbyist isn't going to have to go through the "trauma" of having to learn how to program his microprocessor. He's already been there!

QUANTITY PURCHASING

A friend of mine is building a low cost 132 column line printer which should have quite an effect on the hobbyist and small business computer market. Just like anyone else attempting a project such as this, he's having his problems getting financial backing for the venture. In the process of putting together a cost analysis package (to show to prospective backers), he ran across some interesting things which are worth sharing with you.

One of his objectives in putting together this package was to itemize each component that goes into the printer and put down the single quantity price, the quantity price (100), and the total cost per unit for that component (based on the number required for each unit). After getting all this information down, he could then very easily add it all up and come up with a cost-per-unit based upon single quantity purchasing versus quantity buying (he knew that one was going to be quite a bit less . . . he just wanted to see how much).

He quite naturally assumed (as did I) that the best way to go about getting the lowest prices for the various components would be through OEM price lists. We were both in for a surprise. Here's an example of what he came up with on integrated circuit prices using a Signetics and National Semiconductor OEM price list:

	1 to 24	100 to 999
Signetics – 7400 DIP	$.51	$.34
National – 7400 DIP	.55	.35
Signetics – 7474 DIP	$.78	$.52
National – 7474 DIP	.88	.54

The above information certainly doesn't contain any earth-shattering news (except to show my friend the slight price difference between the two). But . . . and look out, here comes the good part . . . after getting the whole package together he happened to glance at the James and Godbout ads in *73* and suddenly discovered what low prices really are! Here's the way they stack up with regard to the two ICs picked at random:

Godbout – 7474 DIP	.36
James – 7474 DIP	.32
Godbout – 7400 DIP	$.18
James – 7400 DIP	.16

And those are single quantity prices!! Rather incredible, right? Well, you ain't seen nothin' yet! Both Godbout and James offer a *20%* discount on orders of 100 or more!

Normally I'm pretty level-headed and don't get too excited about such things, but this really intrigued me. Furthermore, it occurred to me that a lot of other people out there in hobbyville and small businessland might make the same mistake (using OEM price lists) when getting ready to manufacture things. Therefore, I decided to do some checking into the situation and find out just what was going on. A phone call to Bill Godbout cleared it all up. Very simply, if you're going to be buying ICs in the hundreds of thousands, such as Godbout and James do, then the manufacturer brings out an entirely different price list than the one my friend had. But the most important point he brought out is that the chips he and James (and most of the other large volume dealers) are selling are full-spec ICs. Your first impression after seeing the large difference in those prices is that the dealers must be selling something other than quality material. Not so.

MISCELLANEOUS

About a year ago I subscribed to *Ham Radio* and *QST* for the express purpose of keeping track of the "competition" and their coverage of the computer hobbyist/microcomputer applications area. Each month when those magazines arrived it became more and more obvious that I had wasted my money. But, I hate to just throw them away . . . after all, there's very likely somebody, somewhere, who would like to have them. I think perhaps they'll be going with me to the next ham swap.

Quite often I have people ask me about the opportunities for getting into computer programming and/or maintenance through the experience they've gained "working" with a hobby system. I wouldn't want to discourage anyone, but I think such an approach would depend an awful lot on the individual and his plan of attack. The idea is not too terribly farfetched, though. I glance through the Sunday *Los Angeles Times* classifieds every now and then to keep track of anything that might have a bearing on the computer hobbyist field. It's interesting to note that I've been seeing more and more ads for microcomputer-experienced personnel. By "more and more," I mean 4, 5, or 6 each Sunday . . . compared to none a year and a half ago.

How to Find a Forgetful Memory

- - diagnostics for a thoughtless computer

Symbolic Address	Location	Machine Code	Mnemonic	Comments
DEBUG	043-200	021	LXI D	Set TW pointer
TWP	201	xxx		to start of block
	202	yyy		to be tested
	203	006	MVI B	Load reg B
TW	204	377 (000)		with test word
	205	353	XCHG	Switch regs D-E & H-L
NEXT	206	160	MOV M,B	Load reg M with TW
	207	353	XCHG	Switch regs D-E & H-L
	210	041	LXI H	Set FW pointer
FWP	211	xxx		to start of block
	212	yyy		to be tested
LOAD	213	175	MOV A,L	Test to make sure
	214	273	CMP E	FW isn't loaded into
	215	302	JNZ	same addr as TW
	216	225	OK	
	217	043		
	220	174	MOV A,H	Still testing to
	221	272	CMP D	make sure FW isn't
	222	312	JZ	loaded into same
	223	227	SKIP	addr as TW
	224	043		
OK	225	066	MVI M	Load reg. M
FW	226	000 (377)		with FW
SKIP	227	043	INX H	Advance FW pointer
	230	174	MOV A,H	Test to see if FW pointer
	231	376	CPI	is at start of next block
NB	232	aaa		Page number of next block
	233	302	JNZ	No, continue loading FW
	234	213	LOAD	
	235	043		
TEST	236	353	XCHG	Switch regs D-E & H-L
	237	176	MOV A,M	Retrieve stored TW
	240	270	CMP B	Has stored TW changed?
	241	304	CNZ	Yes, call ERROR routine
	242	277	ERROR	
	243	043		
	244	043	INX H	Advance TW pointer
	245	174	MOV A,H	Test to see if TW pointer
	246	376	CPI	is at start of next block
NB	247	aaa		Page number of next block
	250	302	JNZ	No, go back and load TW
	251	206	NEXT	into next addr in this block
	252	043		
LOOP	253	076	MVI A	Fetch loop counter value
LCV	254	010		from addr 254
	255	075	DCR A	Decrement LCV
	200-256	312	JZ	LCV=0?
	257	267	DONE	Yes – have tested whole block
	260	043		"LCV" times, so jump to DONE
	261	062	STA	Store the loop counter value
	262	254		in LCV
	263	043		
	264	303	JMP	Make next pass through
	265	200	DEBUG	the program for the
	266	043		present block under test
DONE	267	076	MVI A	Reset the loop counter
	270	010		value
	271	062	STA	Store the loop counter
	272	254	LCV	in LCV
	273	043		
	274	303	JMP	Jump back to
	275	bbb	MONITOR	your MONITOR
	276	ccc		
ERROR	277	305	PUSH B	Save the TW on the stack
	300	114	MOV C,H	Move page number to reg C
	301	315	CALL	Output the page
	302	ddd	OCTOUT	via your octal conversion
	303	eee		and print routine
	304	115	MOV C,L	Move addr to reg C
	305	315	CALL	Output the address
	306	ddd	OCTOUT	
	307	eee		
	310	116	MOV C,M	Move the errant TW to reg C
	311	315	CALL	Output the errant TW
	312	ddd	OCTOUT	
	313	eee		
	314	315	CALL	Output A
	315	fff	CRLF	carriage return and
	316	ggg		line feed
	317	301	POP B	Retrieve TW from the stack
	320	311	RET	Return to main program

Table 1. The improved memory diagnostic program. Note that the programmer must initialize "TWP", "FWP", and "NB" according to the block memory he wishes to test.

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Canada N0M 2V0

In a recent article (*73 Magazine*, Oct., 1976, p. 114), I described a simple memory diagnostic program for 8080-based systems and illustrated its use in troubleshooting 4K memory boards. While that method is effective for localizing gross defects, such as chips which have one or more bits permanently set, more subtle defects may evade detection. For example, after discovering 4 bad chips in 8K of memory, by the simple techniques described in my previous article, I attempted to load and run "SCELBAL" – but to no avail. After many hours of checking and reloading scattered addresses with the correct contents, it dawned on me that when I corrected the contents of some addresses I was sometimes changing the contents of other addresses. What obviously was needed was a more thorough memory "debugging" approach. This article, I believe, brings us one step closer to that end, and "SCELBAL" is now running fine.

The simple methods which I outlined in the previous article employ two basic techniques. One technique takes the value of an address and loads it as a data word into that same address. This is done for all 256 addresses on a page. Next, the values of the addresses are compared with their respective contents. If they are dissimilar, an error printout is produced. For example, if the eighth data bit (bit 7) at address 023 is always set to 1 due to a chip defect, the actual contents of that address will be 223, which would generate an error. However, if bit 0 of address 023 was always set to 1, no error would be detected. Needless to say, this would cause problems in an actual program which required that bit 0 at address 023 be set to 0.

One way that the above problem can be overcome is to use a slightly different approach. Typically, this second technique loads a random number into all ¼K addresses of a page and then sequentially examines the contents of the 256 addresses to see if they still contain the pattern which was loaded into them. If enough random patterns are tried, a bit at some given address which is permanently set will sooner or later be discovered. However, a not uncommon problem is for 2 or more addresses to interact. If addresses 023 and 025 were interacting in such a manner that whatever was loaded into bit 7 at address 025 changed the corresponding bit in address 023, then this second technique would not detect the error by virtue of the fact that the whole page was loaded with the identical data word.

As if the above wasn't trouble enough, programs which check only one page of 256 addresses at a time are unable to detect interactions between 2 or more of the 4 blocks of 256 bits which actually reside on a single 2102 type memory chip.

The program described in this article overcomes the shortcomings listed above,

and when fully implemented provides a potent tool for detecting memory problems. In order to make maximum use of the procedure, I recommend that you read my earlier article in order to understand the functional layout of a typical 4K board of 2102 chips.

About the Program

In my system, the program, which is listed in Table 1, resides on page 043, address 200-320 (octal). Relocation should provide little difficulty once the mechanics of the program are understood.

The program loads a Test Word (TW), either 377 or 000 (octal), into one address in a 1K segment of the board. It then fills the remaining addresses of the 4 pages with a Field Word (FW), either 000 or 377 (the complement of the TW). When the 4 pages have been filled with the FW, the program retrieves the TW which was previously stored in memory and examines it to see if it was altered. If the TW has been altered, an error printout will be produced. If no error has occurred at that address, the next sequential address is loaded with the TW while all other addresses are loaded with the FW. Then the stored TW is once again tested. This process is repeated until each address in the 4 page block has been tested.

The program repeats the above procedure eight times (your option). The reason for repeatedly testing a 4 page block is that the repeated accessing of a particular area in memory will generate additional heat, consequently increasing the chance that marginal chips with thermal defects will be detected.

The programmer then sets up the program to check the next block of 4 pages on a board, until the whole board has been checked. In order to keep the program simple for beginners like myself, I opted to have the programmer initialize each successive 4 page block; obviously the computer could be made to do it, albeit at the cost of making the program more complex and harder to follow. After checking out the whole board, the programmer should change the TW and FW to the values given in brackets in the program, and then test the whole board again. You may encounter a situation where the 377 test word won't be altered by an interaction with a 000 field word, but a 000 TW will be altered by a 377 FW.

020 167 375	020 134 010
020 222 376	020 135 020
021 026 177	023 163 100
022 140 337	023 272 004

Table 2. A typical printout from "DEBUG." Test word for the left-hand column was 377, while the test word for the right-hand column was 000.

Table 2 illustrates a typical printout. Note that the page, address, and incorrect data are outputted. As in the previous program, this program assumes the existence of an octal conversion and print routine ("OCTOUT") which it can call.

A Few Tips

When you are making the test, do it once or twice with the case off the computer when it is relatively cool. Then put the case on and run through the procedure with the computer thoroughly warmed up. I found 4 defective chips with the program when testing cool, and 4 more when testing hot. What really blew my mind was that two of the cool defects showed up only sporadically under the hot condition. Also, this is a time when effective use can be made of the spray-type component coolers. You might also wish to sandwich the memory board(s) between other boards in order to entrap the heat.

I hope you find the present techniques as valuable as I have. Happy troubleshooting. ■

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A Super Log

-- a program for the ham shack computer

Most software articles I'm finding in all the popular magazines are written in software language, which I have a heck of a time understanding. I'm just a radio amateur, not a computer genius. So it takes a little more detailed explanation for me to understand what's going on. However, I have a little business of my own and to help my business I purchased a SWTPC 6800 computer kit. Once I got the machine together, I was most anxious to put it to work for my business. And that's where I gained a little software knowledge. After writing the program for my business, I thought it would be interesting to present the same program, with a few changes, to my fellow hams. So, here it is.

The object of this article is to give you a logkeeping program and to explain how the program works. You may not have a 6800 microprocessor yourself or may want to develop the program for your IMSAI or MITS computer. Or, you may not even have a computer and perhaps just want to know more about software. If you have a Motorola 6800 microprocessor and you are a radio amateur, the program listing at the end of the article is for you. This program does a few unique things and can be modified just like an electronic circuit to best suit your personal needs. First of all, we'll spend some time talking about the basic concept of the computer program and what it is supposed to do so you can have a little better understanding of what's going on. Then we'll talk about the details of the Amateur Computerized Logkeeping Program.

Before we jump right into the meat of the article, I should tell you a few things about the program and how it operates and exactly what it can do for you. To begin with, it's a *Search* program. It will search for data entered in memory, by using the first three characters entered. It's not an alphabetic search; it simply uses the first three characters, which can be alpha, numeric, or anything you want. This is a natural for amateur radio calls since the *last* three letters of any callsign are different for each amateur station. (While indeed it is possible to have a WA7SCB, a K7SCB, a K6SCB, etc., odds are against working a bunch of hams with the same last three letters.) A typical input to the computer might be that shown in the photos. Note the call letters start on one line and the state begins on the other. Thus, the computer can search for the call letters, or the state, or for whatever is on one line. There are also some entry and change programs that allow you to delete entire lines of data, thus removing someone from the logkeeping memory. If your computer has a cassette interface, there is a program to store logs on digital cassettes and read them out on a later date if you need to, to produce hard copy on a teletype or line printer.

The only character that can be accessed directly by the keyboard without punching another button is S. S is the key that tells the program to go into the search routine. The computer will come back with CALL? You then insert the last three letters of the call followed by a period. The period causes the program to start running and the computer searches through memory. Any time your processor comes to a line of information that starts with the three letters that you punched in, it will print them on the screen of the CRT. You then can ask for any other listings that start with those three letters by pushing any other character on the keyboard (preferably line feed — makes for a neater display). Or, you may go back to the main program by punching a Y, telling the computer, "Yes, this is the guy I was looking for." You may *Enter* data by holding down the control button and then punching the letter E. If no more memory positions are available, the computer will come back with FULL (not all of us can afford 64K); if there are memory positions available the com-

```
LOAD ACCUMULATOR "A" (IN HEX)

        LDA A:

            IMMEDIATE - 86 XX (XX is data)
            DIRECT - 96 XX (XX is address 00 XX)
            INDEXED - A6 XX (XX is amount of offset from "index" contents)
            EXTENDED - B6 XX XX (XXXX is full address)
```

Fig. 1. 6800 addressing methods, using "Load Accumulator A" instruction as an example.

The WA7SCB station.

puter will respond with CALL? You then enter the data that you wish to be stored, formatting it as shown in Table 1. (Of course, you may use your own format, but you do need to standardize. This way you'll be able to search for the data again at some later date.) After you have entered all the desired data, press the period. The period then terminates the Enter Routine and the computer sends "*73s". Those of you who do not go along with saying "73s" in its plural form simply change the program to say "73" or "blank" or "thanks" or whatever you want.

The third mode the computer operates in is *Change.* When you push control C, the computer comes back with CALL? You then enter the first three letters and hit a period. The computer searches for the data, then prints out a line of data on the screen. If the line shown is not the one you wish to change, just push line feed, and the computer will search for the next entry in your computerized log that has the same first three letters. As soon as you come to the call letter that is the one that you wish to change, depress Y which activates the CALL? response. Now you can re-enter data. To delete the entry, all you do is enter a space and a period. This is because in the Enter Routine the computer is searching for spaces in memory. If it finds anything but a space at the beginning of a line, it assumes that there is some valid data there and goes to the next line of data in memory. Thus, inserting a space as the first character in a line of data in memory will delete the entire line of data. The next time you use the Enter Routine, the computer will find that space, and your new data will write over the old line in memory.

Obviously, if the computer is looking for spaces in memory, the first thing that we have to do is to stuff spaces in memory. We have a program to do that and it is called *Load Up* (with spaces) routine. You have enough open memory positions to store as much data as your configuration is capable of handling. Of course, you could just put a space in every 32nd character (the beginning of a line in memory).

Any time a wrong character is punched on the keyboard, the computer says "GOOF!" It can say anything else you'd like it to say, but GOOF was convenient and doesn't take much memory.

Programming – General

As I said, I am a radio amateur and not really a computer programmer. In order to make my computer work, I had to first learn what was going on inside. It's simple enough to understand. There are three basic parts to a computer: the I/O, the processor, and the memory. The function of the I/O is pretty simple. It's a way to input and output data from your computer. The function of memory is simple too. It remembers. That's all there is to it! It's the microprocessor that's tricky. The microprocessor is a collection of registers, decoders, timing circuits, and whatever else it takes to perform the functions of decoding information from memory. The microprocessor is a programmable AND gate, OR gate, Adder, Subtractor, Shift Register, etc.

A typical microprocessor has several registers inside it. These registers are used for temporary data storage, manipulating data, shifting bits around timing, decoding, etc. The 6800 is a typical microprocessor with several registers. It has two registers called accumulators (the A accumulator and the B accumulator), which are nothing more than 8-bit data registers. A hexadecimal B6 is the com-

mand to "load Accumulator A." It's called *Load Accumulator A Extended* because it tells the microprocessor there is an address to follow. The 6800 also has some other modes of operation; for example, it's possible to load the A Accumulator from an address specified in another register in the 6800. The other register is called the *Index Register*. The command *Load Accumulator A Indexed* can also contain offset so that you may either add or subtract from the number that is the index register for your memory address. Another mode of loading the accumulator with data is the direct mode. The direct mode is limited because it is only a 2-bit address. Thus, the highest number you can specify is address FF, which amounts to 265 memory positions. There's still another mode of loading the accumulator, the immediate mode. In the immediate mode, the accumulator is loaded with whatever data is in the location "immediately" following the instruction. The accumulator is told to be loaded and then is given a number to be loaded with. Fig. 1 shows the modes of putting data in the accumulator.

Mnemonics are aids to help us remember things. It's pretty tough to remember C6, A6 or B6 but fairly easy to remember Load Accumulator A, or its mnemonic, LDA A. If a person has an *assembler*, a program can be generated using just these mnemonics (i.e., no hexadecimal or octal numbers punched in at all). Typing in STA B SWER would result in storing the B accumulator in a location which has a symbolic name of SWER (somewhere). In our machine-language coding the mnemonics simply serve as memory aids for the instructions (and symbolic names for addresses are not used).

Without some way to talk to it, the computer is a pretty useless device. The read only memory in the SWTP 6800 computer is nifty because the first thing that happens when power is applied is that a Power Up Routine is executed and the computer prints an asterisk (a *prompt* character) on the screen of the CRT or teletype. The SWTP computer then recognizes the commands L, M, P and G. The M command (modify) allows the loading of programs into memory. With the L command you may load the programs from a punched tape, and the P command will cause paper tapes to be punched. The G command starts a program that has been loaded into the computer. The G command makes the computer begin at whatever step has been designated as the beginning step for your particular computer program.


Front view of the home brew terminal.

The Ham Computerized Log: A Blow by Blow Description

The program is written in sections. The first piece is the main routine. This routine is responsible for recognizing various command characters entered at the keyboard. Those are S, Control E and Control C. Any other character entry will get an error message (GOOF!). Other programs include the Enter Routine, which starts at a certain point in memory (specified by you), then checks that point, and every 32 characters beyond, for a space (hexadecimal 20). When it finds a space, it requests your input of data which will then be written on that 32 character line of memory. If the enter program searches beyond your specified memory point and cannot find a space, it concludes memory is full and sends you a "FULL" message.

The Search Routine takes your keyboard entry of three characters and then searches through memory on a bit-by-bit basis beginning at character position 0 and checking every 32 characters thereafter. It will look for the first character that you typed in at character position 0, 32, 64, etc. As soon as the routine finds a match, it skips to the next character and checks that for a match. If there is no match, the routine proceeds to the next 32 character set. If it finds a match it checks the third character and if this matches also, the program assumes this is the correct character combination and prints the entire message.

The Change Program is entered by pressing control C. It does everything the Search Program does except that it jumps back into the Enter Routine once it finds the correct line. You can enter

```
INITIALLY:
     M    A048   ENT SP 00
          A049   ENT SP 0D
          A04A   ENT SP CR
     Press G -computer says "G".
     Press Y -computer says "GOOF!"
     If all is well, computer will checkout OK and is ready to use.


TO USE

    TO ENTER A NAME:
          Press E-computer says "CALL?"
          Type in name-first three letters duplicate, others okay
          to abbreviate.
          At end of entry, hit the period.
          Computer says "*73s."
    TO FIND A NAME:
          Hit S, computer says "CALL?"
          Enter name or first three letters, then a period.
          Computer searches and prints.
               A. If name is correct, hit Y.
               B. If name is wrong, hit SP.
    TO CHANGE AN ENTRY
          First search to insure it's there
          If OK, hit C, computer says "CALL?"
               Enter first three, then a period.
               Enter "Y" or SP.
          Computer gives new name or prints "CALL?"
               Enter changes (delete by SP then hit period)
               Computer says "*7 ."
```

Table 1. Program operating commands.

MAIN ROUTINE

```
             MACHINE  SYMBOLIC
LOCATION     CODE     ADDRESS      MNEMONIC                  COMMENTS
0000         BD                    JSR INEEE                 MIKBUG CHARA IN ROUTINE
                                                             PUTS CHARA IN ACCUM A.
  01         E1
  02         AC
  03         C6                    LDA B    Ctl. "E"         LOAD B WITH CONTROL E
                                                             TO COMPARE WITH 4.
  04         Ø5
  05         11                    CBA                       COMPARE B & A
  06         27                    BEQ                       BRANCH IF EQUAL TO "ENTER"
  07         18
  08         C6                    LDA B "S"
  09         53
  0A         11                    CBA                       COMPARE A WITH "S".
  0B         27                    BEQ                       IF EQUAL GOTO "SEARCH"
  0C         65
  0D         C6                    LDA B Ctl. "C"
  0E         Ø3
  0F         11                    CBA                       COMPARE A WITH "CTLC"
0010         27                    BEQ                       IF EQUAL GOTO "EDIT"
  11         63
  12         CE                    LDX IMM                   Ø160
  13         Ø1
  14         6Ø
  15         FF                    STX                       MESSAGE START LOOK UP,
                                                             AØ4C.
  16         AØ
  17         4C
  18         BD                    JSR "OUTLINE"             COMPUTER SEZ "GOOF!"
  19         ØØ
  1A         AØ
  1B         7E                    JMP TO MAIN BEGIN
  1C         ØØ
  1D         ØØ
  1E         Ø1 }                  STARTING MEM. LOCATION    PRELOADED BY USER. CONTAINS
                                                             ADDRESS WHERE FIRST DATA
                                                             WILL BE LOADED
001F         80 }
```

ENTER ROUTINE

```
0020         FE "ENTER"            LDX WITH STARTING
                                   MEM LOCATION
  21         ØØ
  22         1E
  23         C6 "ANOTHER"          LDA B WITH SPACE
  24         2Ø
  25         A6                    LDA A INDEXED             FIRST CHARA IN MEM.
  26         ØØ
  27         11                    CBA                       COMPARE SP & FIRST CHARA
  28         26                    BNE                       BRANCH NOT EQUAL TO "LOOKY".
  29         23
  2A         BD                    JSR                       JUMP TO "NAME" SUBR
  2B         AØ
  2C         5Ø
  2D         FE                    LDX BACK FROM TEMP.       STORAGE
  2E         ØØ
  2F         7Ø
0030         Ø1
  31         Ø1
  32         Ø1
  33         BD ANOTHER            JSR INEEE                 MIKBUG CHARA IN SUBR.
  34         E1
  35         AC
  36         A7                    STA A INDEX               PUT A IN MEMORY LOCATION
  37         ØØ
  38         C6                    LDA B (.)                 PUT (.) IN B
  39         2E
  3A         11                    CBA                       IS CHARA A (.)?
  3B         27                    BEQ                       BRANCH IF EQUAL "FIN"
  3C         Ø4
  3D         Ø8                    INX
  3E         7E                    JMP BACK "ANOTHER"
  3F         ØØ                                              GET ANOTHER CHARA &
                                                             PUT IN MEM LOCA X.
0040         33
0041         CE "FIN"              LDX WITH MESS START
  42         Ø1
  43         5Ø
  44         FF                    STX IN REGIS              START OF MESSAGE IN AØ4C.
  45         AØ
  46         4C
  47         BD                    JSR "OUTLINE" COMPUTER
                                   SEZ "73's"
  48         ØØ
  49         AØ
  4A         7E                    JMP BACK TO MAIN
  4B         ØØ
  4C         ØØ
  4D         C6 "LOOKY"            STA B 20_16(32_10)        PUT LINE LENGTH IN B
  4E         2Ø
  4F         Ø8 LOOP               INX                       LOOP - INCREMENTS INDEX
                                                             REGISTER 32 TIMES.
0050         5A                    DEC B
  51         2F                    BLE B ≤0?
  52         Ø3
  53         7E                    JMP BACK FOR SUMMORE      TO "LOOP".
  54         ØØ
  55         4F
  56         FF                    STX                       STX IN TEMP.
  57         ØØ
  58         7Ø
  59         C6                    LDA B W                   LAST MEM ADR MSB
  5A         ØF
  5B         B6                    LDA A WITH MSB INDEX REG
  5C         ØØ
  5D         7Ø
  5E         11                    CBA                       LAST MEMORY YET?
  5F         2E                    BGT                       IF YES BRANCH TO "BIG".
0060         Ø3
  61         7E                    JMP BACK AGAIN -
                                   "ANOTHER" LOOK.
  62         ØØ
  63         23
0064         CE BIG                LDX DIR WITH MESS
  65         Ø1
  66         7Ø
  67         FF                    STX                       IN AØ4C FOR MESS START.
  68         AØ
  69         4C
  6A         BD                    JSR OUTLINE COMPUTER
                                   SEZ "FULL"
  6B         ØØ
  6C         AØ
  6D         7E                    JUMP TO MAIN
  6E         ØØ
006F         ØØ
  70         ØØ                    TEMP X STORE
  71         ØØ
0072         7E                    JMP                     } BRIDGE FROM MAIN PGM TO
  73         ØØ                                            } SEARCH SUBR.
  74         CA
A050         FF "NAME"             STX TEMP.                 HOLD X IN TEMP STORAGE.
  51         ØØ
  52         7Ø
  53         CE                    LDX MESS START
  54         Ø1
  55         68
  56         FF                    STX AØ4C                  MESSAGE BEGIN REGIS AØ4C.
  57         AØ
  58         4C
  59         BD                    JSR "OUTMESS"             COMPUTER SEZ "CALL?"
  5A         ØØ
  5B         AØ
A05C         39                    RTS
```

EDIT ROUTINE

```
0075         CE "EDIT"             LDX IM MESS               STARTING MESSAGE ADDRESS.
  76         Ø1
  77         68
  78         FF                    STX MESS                  AØ4C FOR LOOKUP
  79         AØ
  7A         4C
  7B         BD                    JSR OUTLINE COMPUTER
                                   SEZ "CALL"
  7C         ØØ
  7D         AØ
  7E         CE                    LDX IM TEMP LINE START
                                   ADR
  7F         Ø1
0080         4Ø
  81         BD                    JSR INEEE                 MIKBUG CHARA IN ROUTINE
  82         E1
  83         AC
  84         A7                    STA A INX'D               PUTS INPUT CHARA IN BUFFER
  85         ØØ ALDX
  86         C6                    LDA B (.)                 PUT (.) IN ACCUM B
  87         2E
  88         11                    CBA                       COMPARE B AND A
  89         26                    BNE                       NOT EQUAL BRANCH TO "SUMMORE"
  8A         Ø9
  8B         BD                    JSR "SEARCH CHARA"        FINDS MATCHING CHARACTERS
  8C         ØØ
  8D         FØ
  8E         7F                    CLEAR ALDX
  8F         ØØ
0090         85
  91         7E                    JMP TO "ENTER"            ALLOWS DATA ENTRY
  92         ØØ
  93         2A
  94         7C SUMMORE            INC A LDX
  95         ØØ
  96         85
  97         7E                    JMP & LOAD ANOTHER
                                   TO TEMP LINE
  98         ØØ
  99         81
```

OUTLINE SUBROUTINE

```
00A0         FF OUTLINE            STX TEMP                  KEEP CONT OF IND REG IN AØ4E.
  A1         AØ
  A2         4E
  A3         FE                    LDX AØ4C (CHAR START)     GET LINE STARTING
                                                             ADR FROM AØ4C.
  A4         AØ
  A5         4C
  A6         A6 ANOTHER            LDA A X'd                 PUT 1ST CHARA IN ACCUM A.
  A7         ØØ LDAX
  A8         C6                    LDA B (.)
  A9         2E
  AA         11                    CBA                       COMPARE A TO A (.)
  AB         27                    BEQ                       BRANCH IF EQUAL TO CRLF.
  AC         Ø9
  AD         BD                    JSR OUTEEE                MIKBUG CHARA OUT ROUT.
  AE         E1
  AF         D1
00B0         7C                    INCR LDAX
  B1         ØØ
  B2         A7
  B3         7E                    JMP TO                    "ANOTHER"
  B4         ØØ
  B5         A6
  B6         7F CRLF               CLR AX'd
  B7         ØØ
  B8         A7
  B9         86                    LDA A LF                  LOAD ACCUM A WITH LF.
```

the new data, changing whatever data is in the 32 character line of memory.

There are two main subroutines. One is the Search Character Subroutine (this is used by the change program and the search program). The Search Character Subroutine looks for a particular character until it finds a match in memory, then holds the memory location in the index register.

The other is the Outline Subroutine. This one is used in conjunction with a temporary memory position to output various messages to the operator. Once your messages have been entered in a given place in memory, the Outline Subroutine will print them on the screen whenever you call for them.

Terminators for all the routines are periods. When the computer sees a period it will know that is the end of an entry or that it is the end of a line of memory.

Quirks, Problems and General Points of Interest

Let's go to the beginning. The main routine is located at 0000 and goes through 001F. If you are an SWTP purist who is obeying the manual's suggestions, you may want to put the main routine somewhere else. The SWTP books suggest you leave locations 0000-0020 open for future floppy disc interface. It's easy to move the main routine. Also, you may not like the computer recognizing S, CTL

```
  BA      ØA
  BB      BD               JSR OUTEEE            MIKBUG CHARA OUT ROUT.
  BC      E1
  BD      D1
  BE      86               LDA A CR              LOAD ACCUM A WITH CR.
  BF      ØD

00C0      BD               JSR OUTEEE            MIKBUG CHARA OUT ROUT.
  C1      E1
  C2      D1
  C3      FE               LDX TEMP              PUT ORIGINAL DATA BACK
                                                 IN INDEX REG.
  C4      AØ
  C5      4E
  C6      39               RTS
```

SEARCH ROUTINE

```
00CA      CE SEARCH        LDX MESS START        STARTING MESSAGE ADDRESS.
  CB      Ø1
  CC      68
  CD      FF               STX START REG         PUT START MESS IN AØ4C.
  CE      AØ
  CF      4C

  D0      BD               JSR OUTLINE COMPUTER
                           SEZ "CALL?"
  D1      ØØ
  D2      AØ
  D3      CE               LDX TEMP LINE         LOAD INDEX REGIS WITH
                                                 FIRST BUFFER ADDRESS.
  D4      Ø1
  D5      4Ø
  D6      BD GET ANOTHER   JSR INEEE             MIKBUG CHARACTER IN.
  D7      E1
  D8      AC
  D9      A7               STA A INX             STORE CHARA IN BUFFER.

  DA      ØØ AX'D
  DB      C6               LDA B (.)             PUT (.) IN ACCUM B.
  DC      2E
  DD      11               CBA                   COMPARE A WITH (.).
  DE      26               BNE                   BRANCH NOT EQUAL "ANOTHER"
  DF      Ø9

00E0      BD               JSR CHARA             SEARCH FOR CHARACTER SUBROUT.
  E1      ØØ
  E2      FØ
  E3      7F               CLR AX'D
  E4      ØØ
  E5      DA
  E6      7E               JMP--MAIN
  E7      ØØ
  E8      ØØ
  E9      7C ANOTHER       INCR AX'D

  EA      ØØ
  EB      DA
  EC      7E               JUMP--GET ANOTHER
  ED      ØØ
  EE      D6
```

SEARCH CHARACTER SUBROUTINE

```
00F0      FE CHARA         LDX 1st MEM CHARA     FIRST MEMORY DATA STORAGE
                                                 ADDRESS.
  F1      ØØ
  F2      1E
  F3      Ø1               NOP
  F4      F6               LDA B 1st CHARA IN
                           TEMP LINE
  F5      Ø1
  F6      4Ø
  F7      A6               LDA A INX 0           A HAS 1ST MEM DATA.
  F8      ØØ
  F9      11               CBA                   ARE MEM CHARA AND ENTERED
                                                 DATA SAME?
  FA      26               BNE                   NO: TO "20"
  FB      1F
  FC      F6               LDA B 2nd CHARA IN
                           TEMP LINE
  FD      Ø1
  FE      41
00FF      A6               LDA A INX 1           2ND CHARA MEM.

0100      Ø1
  01      11               CBA                   2ND CHARA COMPARE?
  02      26               BNE                   NO: TO "20"
  03      17
  04      F6               LDA B 3rd CHARA
                           TEMP LINE
  05      Ø1
  06      42
0107      A6               LDA A INX 2           3RD CHARA COMPARE?
0108      Ø2
  09      11               CBA                   3RD CHARA COMPARE?

  0A      26               BNE                   NO: TO "20".
  0B      ØF
  0C      FF               STX IN TEMP LINE      YES PUT STARTING
                                                 ADDRESS IN AØ4C.
  0D      AØ
  0E      4C
  0F      BD               JSR "OUTLINE" COMPUTER
                           PRINTS FROM MEMORY

0110      ØØ
  11      AØ
  12      BD               JSR INEEE             MIKBUG IN CHARA.
  13      E1
  14      AC

0115      C6               LDA B "Y"
  16      59
  17      11               CBA                   IS IN CHARA Y (YES)?
  18      26               BNE                   NO: "20"
  19      Ø1

  1A      39               OR RTN TO MAIN RTN IF OK
011B      C6 "20"          LDA B WITH 32_10      GO TO NEXT STARTING
                                                 MEM LOCATION. PUT 32_10
                                                 IN ACCUM B.
  1C      2Ø
  1D      Ø8 LOOK AGAIN    INX
  1E      5A               DEC B
  1F      2F               BLE                   COUNTDOWN DONE? TO "HERE"

  20      Ø3
  21      7E               JMP BACK--LOOK AGAIN
  22      Ø1
  23      1D
  24      FF HERE          STX TEMP
  25      Ø1
  26      3E
  27      C6               LDA B WITH 07_16      (OR HIGHEST NUMBER OF
                                                 SEARCH).
  28      1Ø
  29      B6               LDA A WITH MSB OF X REG

  2A      Ø1
  2B      3E
  2C      11               CBA                   HIGHEST LEVEL REACHED?
  2D      2E               BGT                   YES, TO "DONE".
  2E      Ø3
  2F      7E               JMP BACK LOOK ANOTHER
                           CHARA

0130      ØØ
  31      F4
  32      CE DONE          LDX WITH MESS START
  33      Ø1
  34      5A
  35      FF               STX MESS
  36      AØ
  37      4C
  38      BD               JSR OUTLINE SEZ "NO!"
  39      ØØ

  3A      AØ
  3B      39               RTS    7E
  3C      Ø1               DF
  3D      Ø1               8A
  3E      3F               TEMP STORAGE
```

MISCELLANEOUS

```
0140 }    Write in Chara
014F }    Stor

0150      ØA
  51      ØA
  52      ØD
  53      2A
  54      37    *73s
  55      33
  56      27
  57      53
  58      2E
  59      2E

015A      ØA
  5B      ØD
  5C      4E    NO!
  5D      4F
  5E      21
  5F      2E

0160      ØA
  61      ØD
  62      47
  63      4F    GOOF!
  64      4F
  65      46
  66      21
  67      2E

0168      ØA
  69      ØD
  6A      43    CALL?
  6B      41
  6C      4C
  6D      4C
  6E      3F

0170      ØA
  71      ØD
  72      46
  73      55    FULL.
  74      4C
  75      4C
  76      2E

001E }    Starting mem ADR. (0180)
001F }
```

0180	0280	
01A0	02A0	
01C0	02C0	Etc. Through
01E0	02E0	Ø7EØ........
0200	0300	
0220	0320	
0240	0340	
0260	0360	

LOCATIONS WHERE A LINE OF STORAGE BEGINS

LOAD UP (WITH SPACES) ROUTINE

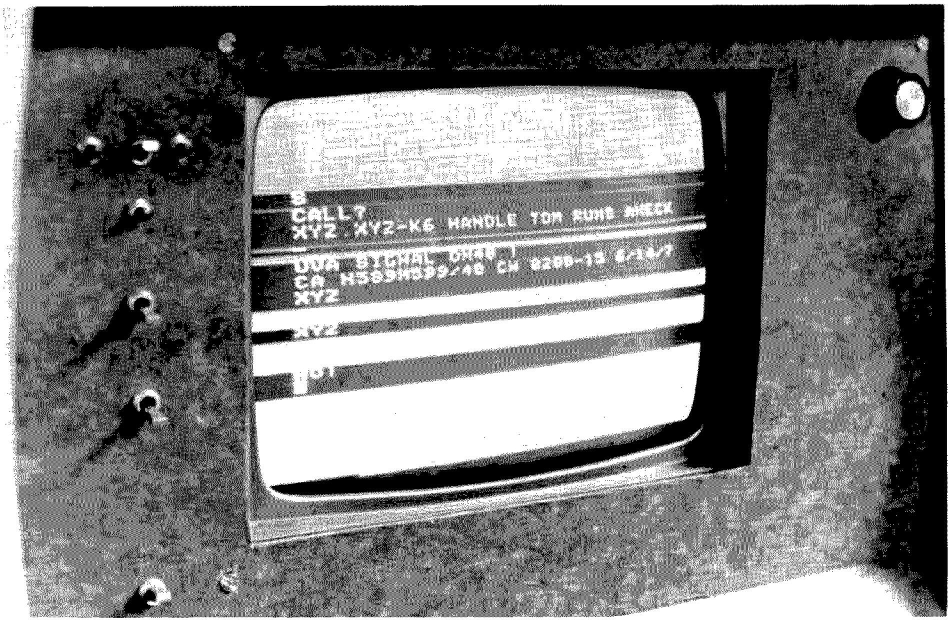
```
0180      CE
   1      Ø1
   2      93
   3      86
   4      2Ø
0185      A7
   6      ØØ
   7      8C CPX
   8      Ø1
  09      91
  0A      27
  0B      Ø4
  0C      Ø8 INX
  0D      7E JMP
  0E      Ø1
  0F      85
0190      3F
0191 }    Last Memory Address to have sp
0192 }
0193      1st sp loaded here & through adr loaded in Ø191
```

E, and period, so you can use whatever codes you wish (see 0004, 08 and 0E). Note that 001E contains the starting memory location. Should you decide to store your log info in some other part of memory (maybe the last 4K, or so), you mustn't forget to change this address.

The enter program at 0020 looks for spaces to find an empty spot. You don't need to use spaces; it's just that I liked 'em. You can put just about anything in 0024. Note, too, I went to a little subroutine at A050 in the middle of my program. I added these steps after the entire program was written and wouldn't work. You could put these steps right in the program, or at some other location.

Also, location 0059 loads accumulator B with the most significant bytes of the last memory location you are using (mine was 0FFF until I recently added memory). Don't forget to make 005A fit your system.

Here is an interesting point concerning the EDIT Routine (0075). With this jewel you *have* to change something. That's why you should search to make sure what you want to change is really in the computer, because if the computer says "NO!" in EDIT Routine, it means there are no more lines of data starting with the characters you entered. The problem is that you will then be writing over the message that says



Searching for a call in memory.

Searching by state, and then retrieving information on a station worked in that state.

"NO." Don't panic when this happens. Just type "LF/CR/NO!." The period will terminate the edit routine and eliminate this problem. This will probably only happen once; after that you'll learn to search before you change!

The search routine starts at 00CA. It is pretty straightforward. An interesting point is that it has an upper memory limit, too. This is the address of the highest memory position you want to search for. My upper address is 0FFF (add one = 0100). So, the most significant byte 01 is put in the Search Routine at 0028.

Finally, one last point: In the Miscellaneous section, note the memory storage allocations. Temporary data (the three characters you want to search for) are located at 0140 through 014F, and all fixed messages start at 0150. Normally this causes no problems, but if some overzealous person gets to your computer and decides to figure it out alone, he or she may type in over 16 characters instead of the three needed, probably figuring the computer will find it faster that way. Of course when 16 characters are exceeded, the entries will start writing over all your nifty messages. If you find some rather weird messages coming out of your machine, check and see — chances are your friend wrote the Gettysburg Address for you . . . all over your program! ■

I/O EDITORIAL

from page 72

conventions have been drawing the biggest crowds, so we know that a large percentage of hams are definitely interested in computers. The articles in the *73* I/O section reflect this interest and have helped develop it. Computer firms exhibiting at hamfests have been most enthusiastic about the response . . . and the sales of equipment.

Not as much is known about ham exhibits at computerfests, but there is a marked increase in getting ham licenses by computer hobbyists. They are well aware that a great many of the recent applications for computers have been in ham-oriented applications . . . and they are greatly enthused over the prospects of being able to interface their system with another over the air. You'll see a lot of this happening as more and more repeater systems get geared up for this.

Computerfests and hamfests pull about the same size crowds since there are about as many computer hobbyists as amateurs in the country. But, while amateur radio is growing at about 11%, computerists are growing at about 100% per year . . . it may turn out that a major source of new hams will be via the computer hobby instead of CB. All the more reason to tie hamfests and computerfests together.

If your club is figuring on a hamfest, you could do worse than get our package of information on the hobby computer field . . . it's $50 and you get a list of about 300 hobby computer clubs, over 500 manufacturers and dealers (for prizes and exhibit booth sales), newsletter publishers and magazine editors. You'll also get instructions on how to get PR in this field. The list is on gummed labels, ready to use.

If you have anything big planned, you might call me and see if we can coordinate. I might be able to help set up your speaking program with top computer talent and even help sell a few booths, too. There is only so much of me to go around, so it's got to be good-sized.

Short On Memory?

- - build this 2K board for your 6800

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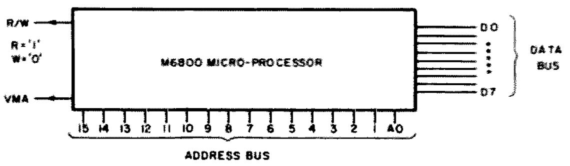


Fig. 1. M6800 control lines used by the memory interface. Read/write line (R/W) controls flow of data on 8 bit bidirectional data bus. The valid memory address line (VMA), when HI, allows the interface to respond to the 16 bit address on the address bus. Each address line, when HI, represents a power of two in the binary numbering system. For example, if lines A0, A2, and A10 are HI, the address sent to the interface is equal to $(2^0 = 1 + 2^2 = 4 + 2^{10} = 1024)$ *or* 1029_{10}.

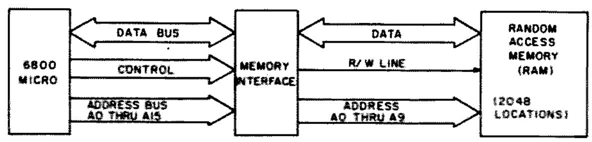


Fig. 2. Information flow between micro, interface and memory. Note that only address lines A0-A9 go to memory, as the interface uses remaining lines to decode valid memory addresses.

Medical science tells us that only a tiny fraction of the human brain's capacity is used during an individual's lifetime. This excess memory capacity is unfortunately not a feature of the average home microcomputer system, a fact which usually causes the experimenter to seek additional "brain power" almost as soon as the new micro kit or prototype is finished and running. Most of the commercially supplied micro kits provide only minimum memory, usually 1024 bytes (1K) or less. It is in this memory that the user's application programs and language processors (such as BASIC) must reside.

A typical amateur radio application for a microprocessor system is the control of a RTTY station. The micro can be programmed to send CQs, answer calls automatically, detect speed changes, etc. However, it becomes immediately obvious to the operator of the station that more memory than is supplied with most micro kits is required to handle even the simplest functions, such as sending a list of station equipment. For example, the single message:

CQ CQ FROM WB2ZCF – "JOHN"

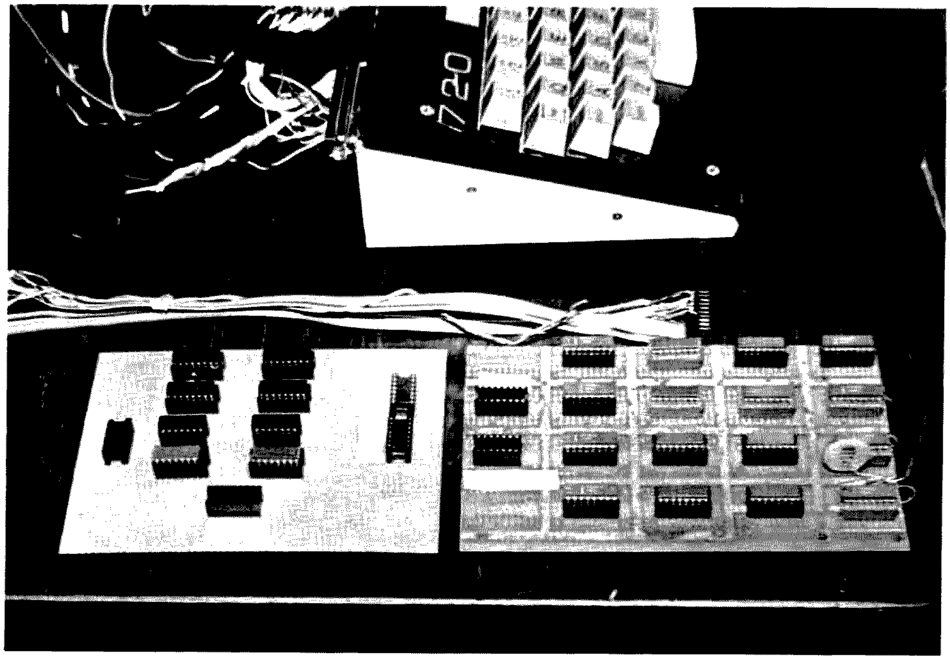
takes about 33 characters, including shift functions. Taking into account that the machine code to control the system occupies the same memory, it becomes obvious that, when stored in memory, even a short list of equipment, when added to other operator comments, rapidly eats up critical space. Think about some of those other functions that can be controlled by a micro, and you will be ready to consider adding memory capacity to your micro system. There are two ways of making your micro smarter – buying a commercial 2K or 4K board and sliding it into your system or, in the best ham tradition, home brewing a memory system for your setup.

This article describes the latter approach – a complete do-it-yourself 2K memory system for a Motorola 6800 type microprocessor, including interface and memory board. The design uses popular (and inexpensive) 2102 static memory chips, and the interface design may be modified to support other microprocessors. All parts used in this project are readily available from *73* advertisers.[1] I have attempted to present in logical order the background required to understand the project, the design criteria, pitfalls, actual construction and logic analysis, and, finally, the debug techniques used in bringing up the add-on memory. Hopefully, this will encourage those of you who need additional memory for your systems to consider building it yourselves.

The Background – or, the Microprocessor's Nervous System

The Motorola M6800 microprocessor is capable of

supporting up to 65,536* bytes of random access memory. The single byte accessed during a machine cycle is selected by 16 address lines. Each address line may be viewed as a digit (1 or 0) in the binary system; therefore, the unique memory address generated by the micro is really a binary number in the range of 0-65,535 (see Fig. 1). The data to be read or written by the micro is transferred over eight data lines, or the data bus. The memory is directed to read or write by a single line, the R/W line. If the 6800 places a 1 (TTL HI) on the R/W line, the memory sends the single byte of data (whose address was presented on the 16 line address bus) to the micro over the data bus. A 0 on the R/W line causes a memory write to occur; the data on the data bus is written into memory. One control line, called VMA (Valid Memory Address), is a 1 if the micro really wants to access memory. These lines, the address, data bus, R/W, and VMA, must be used to coordinate data flow between the micro and our planned add-on memory. The logic required to do this is called an *interface*. We will build a simple interface to control our new memory (see Fig. 2). Since all micros do not have a VMA line or its equivalent, the design of the interface includes a method of removing the VMA function.



Completed memory interface (left) and 2K memory board (right) using 16 type 2102-1 RAM chips. Note ribbon cable (rear) used in system interconnection. The interface is constructed on perfboard, using wire-wrapped connections. The memory is built on a scrap piece of PC board with etched power leads.

Interface Design — Controlling the Data Flow

The interface has three primary functions. The first and most important function is to determine that the address on the address bus is really intended for our memory. You may wonder how an address could possibly be invalid — until you realize that when adding a 2K memory to a system capable of addressing 65K, some means must be employed to "channel" addresses to the area where memory really exists. This process is called address decode and is a concept common to any memory design. There are address decoding techniques that could make our 2K add-on respond to any 2K range of addresses within the allowable 65K, but for simplicity we will place our memory in the range of 0-2047. The actual process of address decode is simple in practice, requiring only a couple of packages in my design.

Recalling that the data bus in the 6800 is bidirectional, we need some method of making the memory correctly receive and transmit data over a common bus when commanded by the R/W line. This, the second feature of the interface, is accomplished by using *three-state* logic. This logic has the familiar 1 and 0 TTL output levels, as well as an "open circuit" state. Thus, upon command, a gate with three-state output capability may appear to be an open circuit to any other device on the same line. This allows us to parallel (OR-TIE) many gates to the same bus, with only one actually driving the bus at a given time. The design presented here uses three-state logic to drive the data bus. On a memory read cycle, the gates driving the bus are turned on (or enabled) by the R/W line, allowing memory data to flow from the 2102s to the microprocessor. On a write cycle, the gates previously enabled are driven into the open circuit mode, allowing data to flow into the memory (see Fig. 3). The final function of the interface is to buffer the address, data, and control lines. Most MOS microprocessors such as the 6800 can drive only one TTL load per line; thus it is most important not to overload the micro. The interface uses 7400 gates between all micro lines and interface logic. Using the NAND gate as a buffer causes the signal to be inverted, a useful characteristic in some parts of the interface.

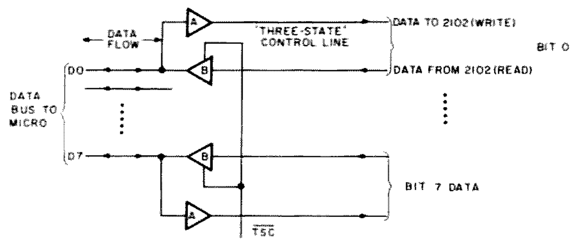
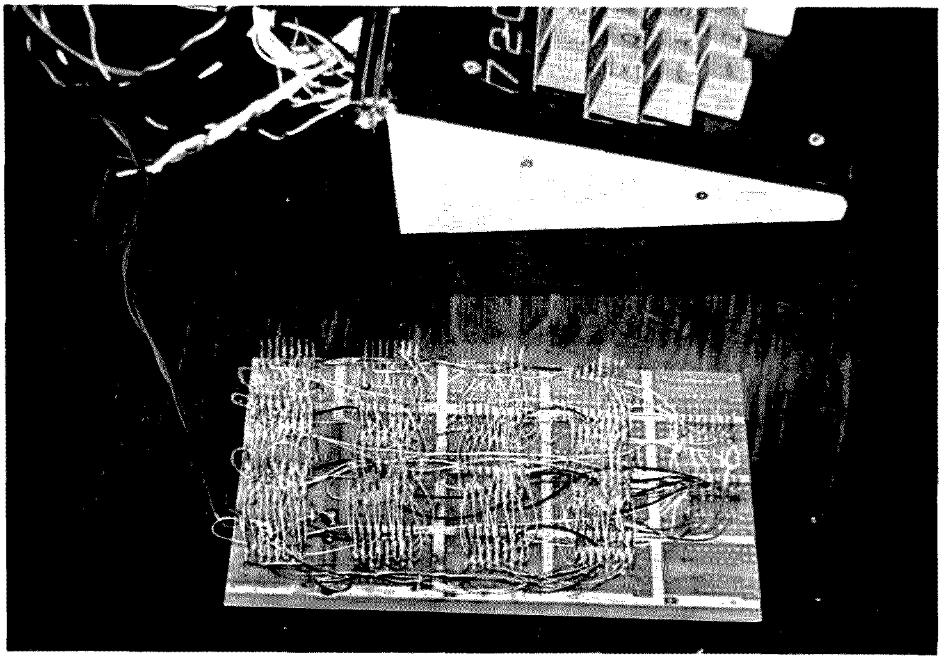


Fig. 3. Three-state logic allows devices to be paralleled on the bidirectional data bus. During a memory write cycle, the TSC line is HI, allowing data to pass from the data bus through device A into memory. The B devices are forced into an open circuit condition, thus not affecting data flow. On a read cycle, a LO on the TSC line turns on device B, allowing data passage from memory to the data bus. Device A, although always enabled, is not affected by read data passing through it, as the 2102 memory's write line is off during a read cycle.

*All numbers are base 10 unless otherwise indicated.



Underside of the 2K memory showing wire-wrap construction. The four distinct "waves" of wire-wrap indicate the number of parallel connections between memory chips. Refer to Fig. 5 for memory schematic.

Some Pitfalls – Be Ye Wary!

One desirable feature of the M6800 microprocessor system can be a possible problem when adding memory. Input and output operations, as well as some system features, use actual memory addresses to initiate and control special functions. For example, micro systems using the MIKBUG® monitor program (such as the SWTP 6800) use locations from $A000_{16}$ – $A07F_{16}$ for system storage, and some locations around 8000_{16} are used for I/O control. These locations must not be overlapped by add-on memory. My system also restricts the use of the upper few memory locations, as they are reserved for system use in a special Read-Only Memory. The point of all this is to be careful where add-on memory is located using address decode techniques. Overlapping system locations can and will cause difficult debugging sessions once the system is running.

Good digital construction practices must be used when working with memory systems. No "software" problem is harder to find than one caused by a hardware glitch. Noise is a problem in systems with add-on memories, as the new memory is seldom on the same board as the original. Liberal doses of power supply bypassing are a must – I used 0.2 uF capacitors in parallel with 0.01 uF ones to bypass power leads. The interface and memory boards are wire-wrapped, but all IC power connections are soldered to the wire-wrap stakes, using #18 bus wire. Interconnection lead length is not critical; mine are 9" between microprocessor and interface and about the same between memory and interface.

The Interface – Linking Micro and Memory

The interface is represented in Fig. 4. All connections between the micro, memory, and interface are made using standard 14 and 16 pin wire-wrap sockets. The cables are ribbon cable with IC header connectors used as plugs. The interface functions as follows: Address decode is accomplished in part by keying on the A10 address line to determine if the address is in the range of $0\text{-}1023_{10}$ (Bank 0) or 1024-2047 (Bank 1). Line A10 allows us to select the bank to be accessed, as described below. The 2102 type RAM is formatted 1024 bits by one bit wide; thus it takes eight RAMs, each contributing a single bit, to make up one memory bank consisting of 1024 bytes (8 bits to a byte). It takes 10 address lines to resolve an address in the range of 1024 bytes; therefore, lines A0-A9 are connected to each 2102. A given bank of eight RAMs is enabled or selected by bringing the enable pin (pin 13) low. The eight enable lines of each bank are in parallel to select eight RAMs at once. Since our memory is to respond only to addresses in the range of $0\text{-}2047_{10}$, all other addresses must be "locked out" by our address decode logic, which works as follows: Any address outside the allowable range will have one address line between A11 and A15 activated. IC1 and IC2A invert and buffer the incoming address lines and pass the resulting five signals to IC3, a 7430 eight-input NAND gate. This gate produces a TTL HI output if any of the eight input lines goes LO, a condition caused by one of the inverted address lines containing an invalid (HI) address. If all five of the address lines in question are LO, the output of the 7430 is LO; this signal, called $\overline{\text{ENAB}}$ (ENABLE), will allow the

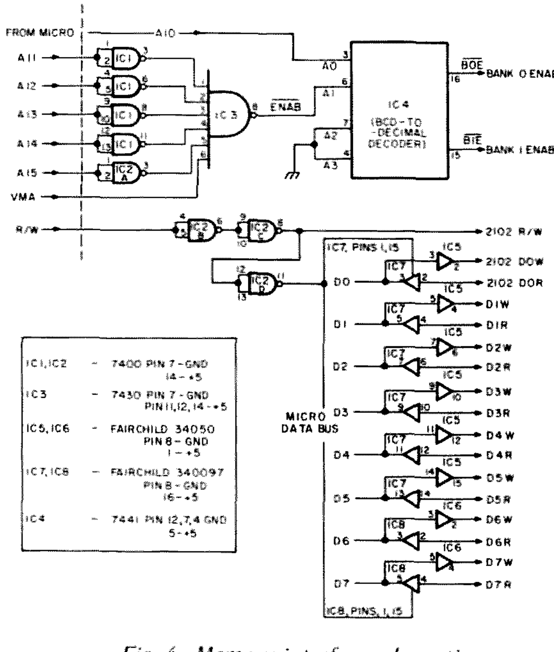


Fig. 4. Memory interface schematic.

memory bank selected to respond to the memory access. Note that the VMA line is also connected to IC3. Recall that VMA is HI if the micro really wants a memory access. A LO on VMA disables the memory exactly as an invalid memory address would.

If your micro does not have a VMA line, tie IC3, pin 6, to Vcc along with pins 11 and 12 (the unused inputs). The above process satisfies the address decode function described earlier. Now, recall that our 2K memory is actually two banks of 1K, each bank having an enable line formed by interconnecting the 2102 enable lines. We must now select the bank desired, as well as using the ENAB signal formed by the decode process. The key to bank selection is based on the fact that line A10 is LO when addresses 0-1023 are referenced, and HI when addresses 1024-2047 are referenced. This fact allows the easy selection of Bank 0 or Bank 1, if the ENAB signal is active. IC4 is a "data decoder" chip, which provides a unique LO output based upon four input signals. For example, if input lines 10-13 contain data "LO LO LO LO," the first of ten output lines will be LO. If the input data is "HI LO LO LO," the second output line will be LO; the first returns to a HI state. The remaining input-output correspondence is not used in this design. Since we only desire to monitor one input line (A10), we connect it to IC4 pin 3. Then, when A10 goes LO, IC4 pin 16 goes LO, thus enabling Bank 0. If A10 goes HI, IC4 pin 15 goes LO, selecting Bank 1. Our ENAB signal is fed to the second IC4 input, pin 6. If ENAB goes HI (invalid address), both of the outputs that enable our banks go HI, effectively disabling the entire memory system. It may be seen that the unused inputs and outputs of the data selector IC4 could be used in more elaborate memory systems. (Refer to the *Fairchild TTL Data Book* for a detailed explanation of the 7441 data selector.)

So far we have determined that the address presented to the interface is valid and the correct bank has been selected. All that remains is to control the 2102 read/write function as well as the three-state data bus drivers. The R/W signal is buffered and inverted by IC2B. This output is re-inverted by IC2C and fed to the 2102 read/write lines to direct data flow within the memory chips. This signal is inverted and used to drive the three-state control lines of IC7 and IC8, the data bus drivers. The additional inversion is required as an active LO signal enables the bus drivers, while a HI signal causes the 2102 chips to output data (read cycle). Finally, note that each 2102 receives address lines A0-A9, as described earlier. The interface board was wire-wrapped on a standard perfboard (see photo). The memory and interface could have been constructed on a single board, eliminating some interconnections, but I chose to make the interface separate as I had a 2K memory board left over from a former project. The choice is left to the reader.

The Memory — Lots of Bytes For a Few Bucks

The 2102 RAM device is an economical choice for memory systems under 8K. Eight of the chips are required for each 1K byte of memory. When constructing a memory board, for each 1K bank, tie address lines A0-A9, the CE lines, the R/W lines, and the DATA IN, DATA OUT lines to form five memory buses. As banks are formed, all buses are tied *except* the CE bus, which is used to select banks. Refer to Fig. 5 for details. The memory may be constructed on perfboard and wire-wrapped, but be sure to provide heavy power lines, as described earlier. Commercial memory boards may be used with the home brew interface if the builder so desires.[2] If this approach is taken, be sure that no address decoding is done on the commercial board, or an address conflict will occur.

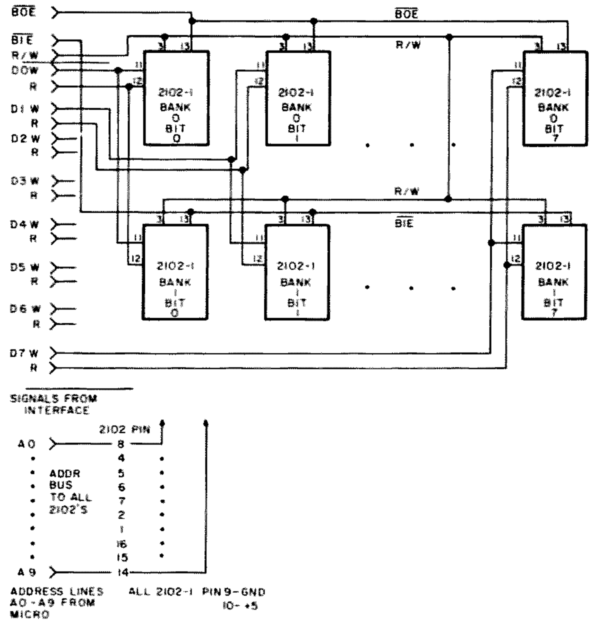


Fig. 5. 2K memory consisting of two banks of 1K each. Note that the A0-A9 address bus goes to all 16 2102-1 RAMs, as does the R/W line. The eight enable pins of Bank 0 tied to B0E from the interface (pin 13). All enable lines from Bank 1 go to B1E. Finally, the D0W and D0R lines go to pins 11 and 12 respectively on Bank 0, bit 0, and Bank 1, bit 0. This pattern of interconnections follows for the remaining D-W, R pairs.

And Finally — Testing

Once the interface has been developed and a memory constructed, the system may be connected to the microprocessor board. Connect all buses as indicated in Fig. 6. Five volt power (Vcc) for the interface can probably be borrowed from the micro, as the drain is under 60 mA. However, 2K of 2102 RAM requires upwards of 700 mA, dictating a separate supply unless the main supply has the beef. Remember to tie all ground leads if using more than one 5 V source. In some cases it is necessary to remove existing memory chips from the micro board if they conflict with the add-on memory. For example, my Motorola MEK prototype board had several 128 byte RAMs in low memory that would have conflicted, so I popped them out and used them in another system.

After making all interconnections and checking for obvious shorts, etc., apply power and check for smoke — aargh! If all looks good, insert the ICs, reapply power, and then attempt to read a new location. Many 6800 systems use the Motorola MIKBUG® monitor, which enables the user to execute an "M" command to examine memory. A random pattern should be present. Now attempt to rewrite the location, checking for correct data. Systems with front panel switches, such as the MITS 680, can be checked by manually reading/writing new locations. Next, check the location following the last one supported by the add-on (2048 in this system). It should be zero, indicating

The "Big Three" Motorola MEK 6800 microprocessor evaluation board (left) provides computing power for RTTY system. The memory interface and memory board providing add-on memory capability are alongside. The converted television set in the background provides temporary display capability, while using a Model 19 (not shown) for hard copy. The Sanders 720 ASCII terminal may also be used "on-line" with software ASCII/Baudot conversion.

correct address decode. Also, try locations that are 2K multiples of the add-on, such as 4096, etc. They, too, should be zero. If all is OK so far, load and execute a program — better yet, write that new application! Don't get lost in all that new memory.

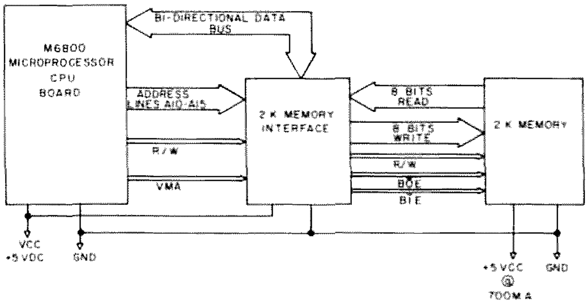


Fig. 6. System interconnections.

In Case of Problems — Don't Break the Board

The most likely problem area is in the address decode logic. If locations read/write erratically, check for address overlap with existing memory or I/O devices. If two devices answer an access request, an error is sure to result. Look for *patterns* in errors — if a single bit of multiple bytes is set or off continuously, check for memory board data line wiring errors. Repetitive errors are easy to isolate due to the fact that so many elements are tied together. Don't discount the possibility of a bad 2102. They are MOS devices, capable of being zapped by static charges during installation. Handle them with care. DO NOT attempt to use old 2102 devices without the "-1" suffix. These are 1000 ns devices and much too slow to be used with 6800 and 8080 systems, especially considering the propagation delays introduced by the interface. Use 2102-1 (500 ns) devices, available from several *73* advertisers.[1]

And Finally . . .

After adding a couple of K to your system, applications should suggest themselves at every turn. In order to run BASIC or other language processors, at least 8K will be required. Hopefully, having built the simple 2K system, you will be encouraged to tackle a larger memory system using some of the suggested techniques. A future article will discuss the use of dynamic RAM devices in large memory systems, should you exhaust your 2102 space. Until then, however, *good luck* and *good programming.* ■

References

[1] Bill Godbout Electronics, Box 2355, Oakland Airport CA 94614. James, 1021 Howard Ave., San Carlos CA 94070.

[2] Dutronics, Box 9160, Stockton CA 95208. Morrow's Micro-Stuff, Box 6194, Albany CA 94706.

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Mansfield MA 02048

A Software Replacement for the Muffin Fan

-- IC cooling program

One of the most fundamental and oft-forgotten principles of electronic tinkering is that of semiconductor heat generation. Whether that tinkering involves a new design, or modification of an existing design, heat calculations are usually a must. I've presented here a simple and straightforward method of heat calculations, designed to take the "black magic" aura away. Also included, for the individual with access to a computer, is a lazy man's program (called Pele) which performs all the calculations with ease.

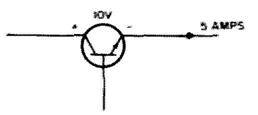


Fig. 1. 2NXXX pass transistor dissipating 5 Watts of power.

For this discussion, I will consider only transistors in the examples given. Obviously, the same method can be applied to diodes and ICs and, in fact, the last example using the Pele program was based on a voltage regulator IC. It should also be pointed out that this is only one method of calculating heat generation and there are other equally good procedures.

The first question I usually have regarding a semiconductor is, "How much power can I pour into the little devil without blowing its brains out?" If I were not wise in the ways of the world, I might take the following approach (for a dc application): look up the maximum current and voltage ratings, and let it go at that. For example: I am planning to use a 2NXXX as a pass transistor in a power supply. The maximum ratings (taken from an actual data sheet) are 70 volts maximum collector to emitter voltage and .7 Amps maximum collector current (I_C). Since I am conservative by nature, I plan to drop only 10 volts across the pass element and pull .5 Amps through it. Therefore, I am dissipating 5 Watts in the device, in the form of heat. This might seem reasonable, since the device is advertised as a 5 Watt transistor. Do I really know what I am doing? Let's see. Fig. 1 indicates the situation we are about to analyze.

Analysis Procedure

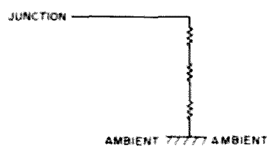
Step 1. Draw a thermal resistance sketch of the device and its surroundings. Assume a heat sink will be used. Each thermal resistance (Θ) can be indicated by the symbol for a resistor. See Fig. 2.

Step 2. Next add to the diagram the following (from data sheet):

Θ_{JA} – the junction to air thermal resistance (°C/W).

Θ_{JC} – the junction to case

Fig. 2. Step 1: Thermal resistance sketch.



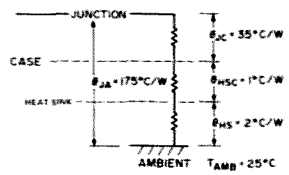


Fig. 3. Step 2: Thermal resistance sketch.

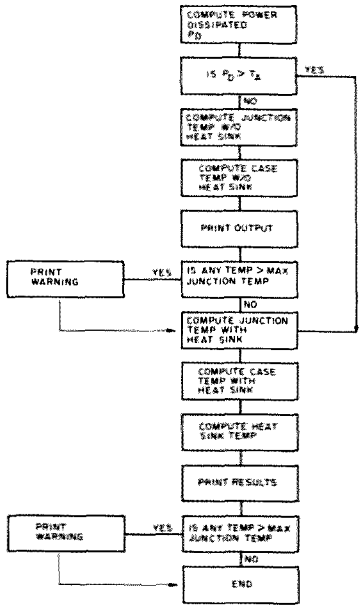


Fig. 4. Flowchart used to generate Pele.

```
PELE

      SEMICONDUCTOR   HEAT   DISSIPATION   PROGRAM

IF SERIAL DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 1
IF IMMED. DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 2
IF DIRECT DATA ENTRY (NO QUESTIONS) IS DESIRED, TYPE 3
? 1


WHAT IS THE MINIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE
SUBJECTED TO , IN DEGREES C
? -3
WHAT IS THE MAXIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE
SUBJECTED TO, IN DEGREES C
? 101.2
WHAT IS THE MAXIMUM ALLOWABLE JUNCTION TEMERATURE,IN
DEGREES C --- IF UNKNOWN, TYPE 200
? 200
WHAT IS THE MAXIMUM ALLOWABLE POWER DISSIPATION,IN WATTS AT
25 DEGREES C, AMBIENT
? 2.4
WHAT IS THE JUNCTION TO AIR THERMAL RESISTANCE,IN DEGREES C
PER WATT
? 62
WHAT IS THE JUNCTION TO CASE THERMAL RESISTANCE,IN DEGREES C
PER WATT
? 17
WHAT IS THE THERMAL RESISTANCE OF THE SIL PAD
OR HEAT SINK COMPOUND,IN DEGREES C --- IF UNKNOWN , TYPE 1
? 1
WHAT IS THE THERMAL RESISTANCE OF THE HEAT SINK,IN DEGREES C
PER WATT
? 10
WHAT IS THE VOLTAGE DROP (WORST CASE) ACROSS THE DEVICE,
IN VOLTS
? 20
WHAT IS THE CURRENT (WORST CASE) THROUGH THE DEVICE,IN AMPS

? .1


DEVICE CAN BE USED WITHOUT HEAT SINK


            DEVICE TEMPERATURES WITHOUT  A HEAT SINK

AMBIENT TEMP.       -3.0 C              25.0 C              101.2 C

JUNCTION TEMP.     121.0 C             149.0 C              225.2 C
CASE TEMP.          87.0 C             115.0 C              191.2 C

**WARNING**MAX. JUNCTION TEMP. EXCEEDED--WILL DESTRUCT
THIS MUST BE A LOUSY DESIGN

            DEVICE TEMPERATURES WITH A HEAT SINK

AMBIENT TEMP.       -3.0 C              25.0 C              101.2 C

JUNCTION TEMP.      53.0 C              81.0 C              157.2 C
CASE TEMP.          19.0 C              47.0 C              123.2 C
HEAT SINK TEMP.     17.0 C              45.0 C              121.2 C

PROCESSING     1 UNITS
```

Fig. 5. Actual problem using Pele.

thermal resistance (°C/W).

Θ_{HSC} – the heat sink compound (or silicon washer) thermal resistance (°C/W); if unknown, specify 1°.

Θ_{HS} – the heat sink thermal resistance (°C/W); mnemonic of Θ_{SA} also used instead of Θ_{HS}.

T_{AMB} – the ambient temperature (°C).

Note that with the exception of the last parameter all units are the same, i.e., degrees C per Watt (°C/W). This is the standard unit of thermal resistance. See Fig. 3.

Step 3. Multiply the total power dissipated (in Watts) in the device by Θ_{JA}. This will tell us how hot the junction will become (*above* ambient) without a heat sink. For our example, $P_D \times \Theta_{JA}$ = 5 W x 175°C/Watt = 875°C above ambient = 900°C. That is pretty warm, and it looks like I *didn't* know what I was doing; the maximum junction temperature as listed on the data sheet is 200°C. What happened to the 5 W advertisement? If I had read the fine print, I would have noticed that this 5 W rating applied only at case temperature (T_C) up to 25°C. If I

```
PELE

35 PRINT '       SEMICONDUCTOR   HEAT   DISSIPATION   PROGRAM'
36 PRINT
37 PRINT
40 PRINT 'IF SERIAL DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 1'
41 PRINT 'IF IMMED. DATA ENTRY (WITH TEXT QUESTIONS) IS DESIRED, TYPE 2'
42 PRINT 'IF DIRECT DATA ENTRY (NO QUESTIONS) IS DESIRED, TYPE 3'
43 INPUT Z
44 IF Z=3 GO TO 197
53 PRINT
54 PRINT
100 PRINT 'WHAT IS THE MINIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE'
101 PRINT 'SUBJECTED TO , IN DEGREES C'
102 IF Z=2 GO TO 115
110 INPUT A
115 PRINT 'WHAT IS THE MAXIMUM AMBIENT TEMPERATURE THE DEVICE WILL BE'
116 PRINT 'SUBJECTED TO, IN DEGREES C'
117 IF Z=2 GO TO 125
120 INPUT B
125 PRINT 'WHAT IS THE MAXIMUM ALLOWABLE JUNCTION TEMERATURE,IN'
126 PRINT 'DEGREES C --- IF UNKNOWN, TYPE 200'
127 IF Z=2 GO TO 130
128 INPUT C
130 PRINT 'WHAT IS THE MAXIMUM ALLOWABLE POWER DISSIPATION,IN WATTS AT'
131 PRINT '25 DEGREES C, AMBIENT'
132 IF Z=2 GO TO 140
135 INPUT D
140 PRINT 'WHAT IS THE JUNCTION TO AIR THERMAL RESISTANCE,IN DEGREES C'
141 PRINT 'PER WATT'
142 IF Z=2 GO TO 150
145 INPUT E
150 PRINT 'WHAT IS THE JUNCTION TO CASE THERMAL RESISTANCE,IN DEGREES C'
151 PRINT 'PER WATT'
152 IF Z=2 GO TO 160
155 INPUT F
160 PRINT 'WHAT IS THE THERMAL RESISTANCE OF THE SIL PAD'
161 PRINT 'OR HEAT SINK COMPOUND,IN DEGREES C --- IF UNKNOWN , TYPE 1'
162 IF Z=2 GO TO 170
165 INPUT G
170 PRINT 'WHAT IS THE THERMAL RESISTANCE OF THE HEAT SINK,IN DEGREES C'
171 PRINT 'PER WATT'
172 IF Z=2 GO TO 180
175 INPUT H
180 PRINT 'WHAT IS THE VOLTAGE DROP (WORST CASE) ACROSS THE DEVICE,'
181 PRINT  'IN VOLTS'
182 IF Z=2 GO TO 190
185 INPUT J
190 PRINT 'WHAT IS THE CURRENT (WORST CASE) THROUGH THE DEVICE,IN AMPS'
191 PRINT
192 IF Z=2 GO TO 196
195 INPUT K
196 IF Z=1 GO TO 200
197 INPUT A,B,C,D,E,F,G,H,J,K
198 REM  COMPUTE THE POWER DISSIPATED-- MULTIPLY J*K
200 X=J*K
209 REM  IF POWER DISSIPATED IS GREATER THAN D , HEAT SINK IS NECESSARY
210 IF X>D GO TO 500
212 REM  COMPUTE THE FREE AIR JUNCTION TEMPERATURES AT THE 3
213 REM  DIFFERANT TEMPERATURES
220 J1=(E*X)+A
230 J2=(E*X)+25
240 J3=(E*X)+B
245 REM COMPUTE FREE AIR CASE TEMPERATURES
250 C1=J1-(F*X)
260 C2=J2-(F*X)
270 C3=J3-(F*X)
277 PRINT
278 PRINT
279 PRINT
280 PRINT 'DEVICE CAN BE USED WITHOUT HEAT SINK'
290 PRINT
300 PRINT
304 PRINT
310 PRINT '          DEVICE TEMPERATURES WITHOUT  A HEAT SINK'
313 PRINT
314 PRINT
315 PRINT USING 316 A,B
316 :AMBIENT TEMP.       ###.# C             25.0 C             ###.# C
317 PRINT
320 PRINT USING 330 J1,J2,J3
330 :JUNCTION TEMP.      ###.# C             ###.# C            ###.# C
340 PRINT USING 350 C1,C2,C3
350 :CASE TEMP.          ###.# C             ###.# C            ###.# C
351 REM  TEST FOR EXCEEDED JUNCTION TEMPERATURE AT 3 TEMPS
352 IF J1>C GO TO 440
353 IF J2>C OO TO 440
354 IF J3>C GO TO 440
355 GO TO 500
440 PRINT
441 PRINT '**WARNING**MAX. JUNCTION TEMP. EXCEEDED--WILL DESTRUCT'
442 PRINT 'THIS MUST BE A LOUSY DESIGN'
445 REM COMPUTE JUNCTION TEMPERATURES WITH A HEAT SINK AT THE 3 TEMPERAT
URES
500 J4=(F+G+H)*X+A
510 J5=(F+G+H)*X+25
520 J6=(F+G+H)*X+B
525 REM COMPUTE CASE TEMPS. WITH A HEAT SINK AT THE 3 TEMPERATURES
530 C4=J4-(F*X)
540 C5=J5-(F*X)
550 C6=J6-(F*X)
555 REM COMPUTE HEAT SINK TEMPERATURES AT THE 3 VARIOUS TEMPERATURES
560 H1=C4-(G*X)
570 H2=C5-(G*X)
580 H3=C6-(G*X)
590 PRINT
591 PRINT
595 PRINT '          DEVICE TEMPERATURES WITH A HEAT SINK'
596 PRINT
597 PRINT
598 PRINT USING 599 A,B
599 :AMBIENT TEMP.       ###.# C             25.0 C             ###.# C
600 PRINT
601 PRINT USING 610 J4,J5,J6
610 :JUNCTION TEMP.      ###.# C             ###.# C            ###.# C
620 PRINT USING 630 C4,C5,C6
630 :CASE TEMP.          ###.# C             ###.# C            ###.# C
640 PRINT USING 650 H1,H2,H3
650 :HEAT SINK TEMP.     ###.# C             ###.# C            ###.# C
651 REM TEST FOR EXCEEDED JUNCTION TEMP. AT THE 3 TEMPS.
652 IF J4>C GO TO 680
653 IF J5>C GO TO 680
654 IF J6>C GO TO 680
655 GO TO 700
680 PRINT
681 PRINT '**WARNING**MAX. JUNCTION TEMP. EXCEEDED--WILL DESTRUCT'
682 PRINT 'THIS MUST BE A LOUSY DESIGN'
700 END
```

Fig. 6. The Pele program.

cooled the case with an infinite heat sink, like liquid nitrogen, I might get away with it.

Step 4. To find the case temperature without a heat sink, subtract the quantity ($P_D \times \Theta_{JC}$) from the previously calculated junction temperature. For our example:

Case Temp. = 900°C − ($P_D \times \Theta_{JC}$)
= 900°C − (5 W × 35°C/W)
= 900°C − 175°C
= 725°C

So now we have found that without using a heat sink, 5 Watts of power will heat up the junction of the transistor to 900°C and the case to 725°C. In other words, that 2NXXX will be vaporized!

Calculations with a Heat Sink

Step 5. How much will a heat sink help? To find out, add up the individual thermal resistances on the right side of Fig. 3 ($\Theta_{JC} + \Theta_{HSC} + \Theta_{HS}$) and then multiply by P_D. In our case: 5 W × 38°C/W = 190°C above ambient = 215°C junction temperature. This is a lot closer, but still above the specification for maximum junction temperature.

Step 6. Find the case temperature in much the same way as before. Subtract the quantity ($P_D \times \Theta_{JC}$) from the junction temperature:

Case Temp. =
215°C − 175°C = 40°C

Step 7. Calculate the temperature of the heat sink by subtracting the quantity ($P_D \times \Theta_{HSC}$) from the case temperature.

Heat Sink Temp. =
40 − (5 W × 1°C/W) = 35°C

This is an interesting fact, because it shows that while the heat sink is relatively cool (35°C), the junction is very hot. (Remember that the next time you think your calibrated fingertip is telling you something about how hot a device is getting.)

Step 8. Relax. In my case I shall ponder the acquisition of a new device. Let's summarize:

2NXXX Transistor
(dissipating 5 W)

	25°C Ambient
Without Heat Sink	
Junction Temp.	900°C
Case Temp.	725°C
With Heat Sink	
Junction Temp.	215°C
Case Temp.	40°C
Heat Sink Temp.	35°C

For this example, a 25°C ambient was assumed. Naturally the highest operating ambient should be chosen for this value.

Sometimes a specification is given for power dissipation at 25°C with no heat sink. In this case (T_a), the free air dissipation was 1 Watt (this would have told me right away I could not use the device at all without a heat sink, because I was dissipating 5 W).

A flowchart of the foregoing method is given in Fig. 4. This flowchart was also used to generate a program in BASIC on a 370 computer.

The Program

The Pele program can input data in any one of three ways: (1) after each text question; (2) after all the text questions; or (3) directly, without text questions. Pele then calculates the junction and case temperatures without a heat sink and also the junction, case and heat sink temperatures when a heat sink is used. It does both of these at three different ambient temperatures with 25°C ambient as the center line value. If the power dissipated at 25°C (P_D) exceeds T_a, Pele will only print out the "with heat sink" temperatures. If the junction temperatures exceed the maximum inputted value, Pele will print out a caustic remark. An actual problem which was run using Pele is shown in Fig. 5. The Pele program is listed in Fig. 6.

Finally, why name a program after a soccer player? Didn't you know? Pele is the Hawaiian God of Fire. ■

1,000 WPM Morse Code Typer

-- for the bionic brass pounder

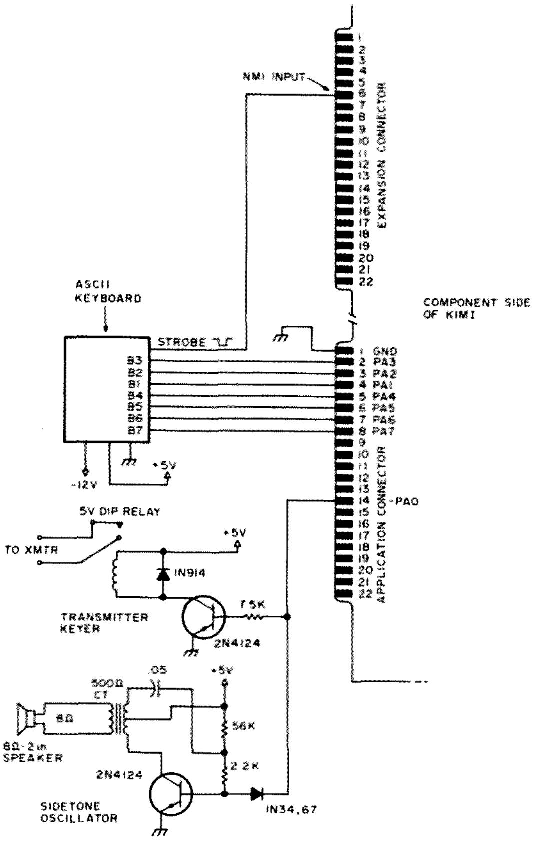


Fig. 1. Schematic for Morse code keyboard hardware. The A I/O port on the KIM is used as a parallel data link for the ASCII keyboard and as a serial output for the Morse code. This serial output can be used to switch a sidetone oscillator and/or a CW transmitter.

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Up until the recent microprocessor boom, a project such as a Morse keyboard presented a formidable design, construction, and debugging project even for the well-versed hobbyist. The program presented here is a much easier software approach to this hardware problem using the KIM-I microcomputer by MOS Technology. The principles used to design this program are suited for other systems equipped with a programmable, read-write interval timer.

The KIM-I is equipped with such a timing device embedded within the architecture of its MCS6530 peripheral interface chip. This addressable timer is used extensively to define the timing of dots, dashes, spaces, spaces between letters, and spaces between words under program control. Reading and writing into the timer is just like an R/W operation in RAM memory.

The features of the software package are as follows:

1. Variable code speed from 9 to over 1,000 words per minute (for those of you who are bionic brass pounders).
2. 256 character First In, First Out (FIFO) buffer memory for typing ahead capability. The third page of RAM (0300-03FF) is used for this buffer storage.
3. Configuration software (I/O assignments and initializing) is provided for instant "GO" upon loading, or power turn on, if the user decides to use PROM for the program storage.
4. The program resides in a field of 256 bytes, which lends itself well to unexpanded systems (i.e., using just the memory available on the KIM-I board).
5. Excellent learning tool for self-instruction in Morse code.

The folowing guidelines were used for Morse code character synthesis: DOT = 1(t); DASH = 3(t); SPACE = 1(t); Space between letters = 3(t); Space between words = 7(t).

The interval timer on the KIM defines the basic time period, (t), under program control for character timing. The duration of this interval has been measured to be about 1.08 milliseconds, multiplied by XX_{hex}:

$(t) = 1.08$ milliseconds x (XX_{hex})

XX is any hex value from 01 to 7F.

The timing interval (t) ranges from 1.08 ms to 138.4 ms. The program fetches the code speed byte from 17BE in the KIM RAM. Before program execution is begun, the pro-

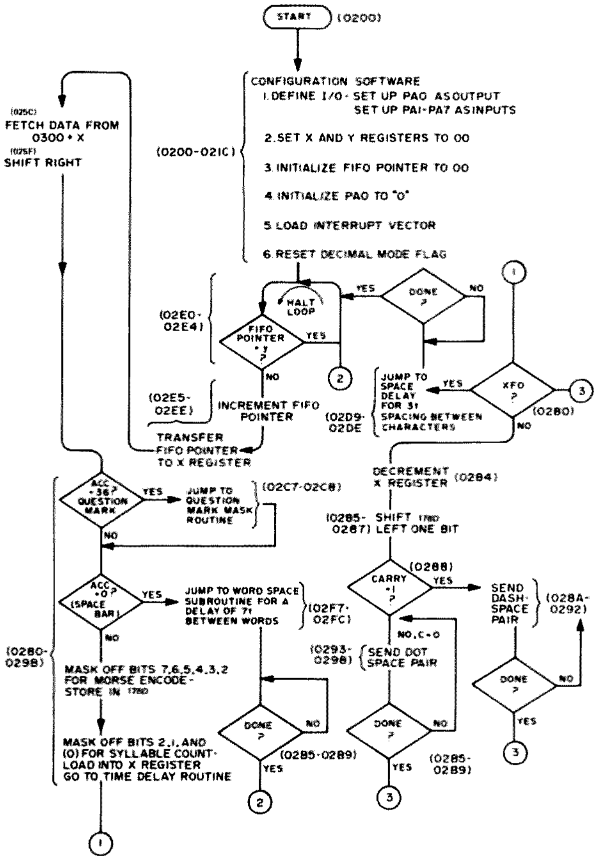

Fig. 2. Program flow chart for Morse code keyboard with FIFO buffer.

grammer must load the code speed byte into 17BE by hand using the hex keyboard on the KIM.

A value of $1A_{hex}$ in location 17BE yields a code speed of approximately 43 words per minute. A 20 wpm rate can be programmed by entering 37_{hex} in 17BE. 7F will correspond to 9 wpm.

The Morse characters are synthesized in dot-space or dash-space pairs. The completed character is followed by a delay of 2(t) to provide a total spacing of 3(t) so that individual letters are easily discernible. This spacing is added automatically by the program, and does not use valuable FIFO memory space. One depression of the SPACE bar on the ASCII keyboard provides a word spacing of 7(t).

Character Loading

The software has an interrupt routine that loads each key depression into successive memory locations in the FIFO buffer. This loading process occurs at any time during program execution, so that the operator is synchronously independent of the system. The interrupt routine for loading keyboard data occupies addresses 02CC-02D7. Each keyboard stroke is stored in successive memory locations beginning with 0300. The keyboard STROBE pulse is used to trigger the non-maskable interrupt (NMI) input of the KIM to signal the microprocessor that data is available for storage and processing. Thus, the Morse code keyboard is an interrupt driven device. (NOTE: Please observe the polarity of the STROBE pulse out of your ASCII keyboard. The NMI input of the KIM is normally high; if the STROBE pulse out of your keyboard is normally low, then you will have to invert it. I did this with my keyboard by using the $\overline{Q}$ output of the STROBE one shot.)

Character Fetch

Upon completion of stepping through the configuration software, the program jumps to location 02E0. If no data has been entered into the FIFO, the program enters a HALT loop by branching between 02E0 and 02E3. When data is loaded into the FIFO via the ASCII keyboard, the Y register is incremented to a value greater than the FIFO pointer in address 17BF. When these two registers are not equal, the character fetch from the FIFO begins and continues until the FIFO pointer has incremented up to the value contained in the Y register. The Y register points how far into the FIFO the last character was entered, while the FIFO pointer designates the next character to be fetched and processed. When the FIFO pointer in 17BF increments up to the value in the Y register, the machine has finally caught up to the operator, and the program reenters the HALT loop.

From ASCII to Morse

The conversion of ASCII into Morse code begins at 025C when a byte is fetched from the FIFO. Since PA∅ (bit zero of the A I/O port) is used as an output, the ASCII entry ports have been shifted up one bit from PA∅. This has the net effect of shifting the incoming data one bit to the left, even before the computer has asked to receive it. To compensate for this, the LSR instruction at 025F restores the identity of the parallel ASCII data by shifting it right one place.

As an example, assume that the ASCII code for C is in the accumulator after the LSR instruction execution. The ASCII code for C is 100 0011 or 43_{hex}. This value is transferred to the X register, then the accumulator is loaded with data at the calculated address of 0200 + 43 or 0243 as indexed by the X register. 0243 is in the LETTERS "lookup" table portion of the program. You will note that the contents of this address is $A4_{hex}$ or $1010\ 0100_2$. The encoding information is contained within this binary string.

Within this encoding byte are:

1. The type of syllable to be synthesized: dash-space or dot-space.
2. The number of syllables that will be synthesized to make that Morse code character. A syllable defined herein is either a dot-space or a dash-space pair.

The separation of these "subcodes" is performed by using the AND instruction in conjunction with a masking byte that will extract the information we need to execute the process.

To get the information in the first six significant bits from 1010 0100, this byte is ANDed with FC_{hex} or 1111 1100.

Case I:

1010 0100 (A4)
1111 1100 (FC)
1010 0100 RESULT

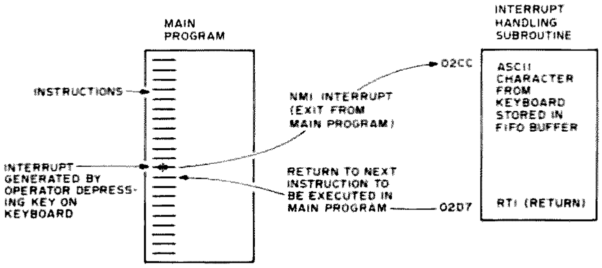

Fig. 3. Software block diagram of interrupt operation.

Program listing.

```
0200  A9  LDA, imm      Start.
0201  01
0202  8D  STA, abs      Set PA0 as output, PA1 through PA7 as inputs.
0203  01
0204  17
0205  A9  LDA, imm
0206  00
0207  AA  TAX           Clear X and Y registers, initialize PA0,
0208  A8  TAY           and FIFO pointer (17BF).
0209  8D  STA, abs
020A  00
020B  17
020C  8D  STA, abs
020D  BF
020E  17
020F  A9  LDA, imm
0210  CC
0211  8D  STA, abs      Load low byte of NMI vector, CC, in 17FA.
0212  FA
0213  17
0214  A9  LDA, imm
0215  02
0216  8D  STA, abs      Load high byte of NMI vector in 17FB.
0217  FB
0218  17
0219  D8  CLD
021A  4C  JMP           Jump to FIFO Buffer Fetch routine at 02E0.
021B  E0
021C  02
021D
021E
021F
0220  00  SP            "Space bar" encode.
0221  8A  TXA
0222  48  PHA
0223  A2  LDX, imm      Load X with 06 for 7(t) word spacing.
0224  06
0225  4C  JMP           Jump to time delay routine.
0226  AE
0227  02
0228  4C  JMP           Jump to word spacing routine group at 02F7.
0229  F7
022A  02
022B
022C  CE  COMMA         Comma encode byte. Look up value for (,) key.
022D  16  SK            SK encode byte. Look up value for (=) key.
022E  56  PERIOD        Period encode byte. Look up value for (.) key.
022F  36  QUESTION      Question mark encode. Look up value for (?) key.
0230  FD  '0'  - - - - -
0231  7D  '1'  . - - - -
0232  3D  '2'  . . - - -
0233  1D  '3'  . . . - -
0234  0D  '4'  . . . . -     NUMBERS lookup table.
0235  05  '5'  . . . . .
0236  85  '6'  - . . . .
0237  C5  '7'  - - . . .
0238  E5  '8'  - - - . .
0239  F5  '9'  - - - - .
023A  55  :    . - . - .     AR encode byte. Look up value for (:) key.
023B  95  ;    - . . - .     DN encode byte. Look up value for (;) key.
023C
023D
```

```
023E
023F
0240
0241  42  A  . -
0242  84  B  - . . .
0243  A4  C  - . - .
0244  83  D  - . .
0245  01  E  .
0246  24  F  . . - .
0247  C3  G  - . .
0248  04  H  . . . .
0249  02  I  . .
024A  74  J  . - - -        LETTERS lookup table.
024B  A3  K  - . -
024C  44  L  . - . .
024D  C2  M  - -
024E  82  N  - .
024F  E3  O  - - -
0250  64  P  . - - .
0251  D4  Q  - - . -
0252  43  R  . - .
0253  03  S  . . .
0254  81  T  -
0255  23  U  . . -
0256  14  V  . . . -
0257  63  W  . - -
0258  94  X  - . . -
0259  84  Y  - . - -
025A  C4  Z  - - . .
025B
025C  BD  LDA, x abs    Fetch next character from FIFO buffer.
025D  00
025E  03
025F  4A  LSR           Shift fetched data one bit to the right to preserve
0260  18  CLC           identity of the ASCII character.
0261  AA  TAX
0262  BD  LDA, x abs    Fetch Morse encoding info from the lookup table
0263  00                as defined by 0200 + X.
0264  02
0265  8D  STA, abs      Store lookup value in 17BC.
0266  BC
0267  17
0268  C9  CMP, imm      Check if fetched data from FIFO is an ASCII code
0269  36                for the QUESTION MARK.
026A  F0  BEQ           Branch to QUESTION MARK masking routine at
026B  58                02C7 if accumulator = 36.
026C  C9  CMP, imm      Check if fetched data from FIFO is an ASCII code
026D  00                for the space bar.
026E  F0  BEQ           If space bar, branch to 0228 for JMP to 02F7.
026F  B8
0270  29  AND, imm      Extract syllable subcode.
0271  FC
0272  8D  STA, abs      Store syllable subcode in 17BD.
0273  BD
0274  17
0275  AD  LDA, abs      Fetch lookup value from 17BC.
0276  BC
0277  17
0278  29  AND, imm      Extract # of syllables to be generated, and load into
0279  07                X register.
027A  AA  TAX
027B  4C  JMP           JMP to 0280 to avoid the lookup value for DEL key.
027C  80
027D  02
027E
027F  8D  'DEL' (-----) BT encode byte. Look up value for (DEL) key.
0280  E0  CPX, imm
```

The first four significant bits are: 1, 0, 1 and 0. The 1s represent dashes and the 0s represent dots. The order in which dots and dashes will be sent from the computer is dictated by the arithmetic shift left (ASL) instruction. The ASL instruction shifts bit 7 to the left, into the carry bit, and zeros into bit 0. Thus the result of the first shift is:

(C)	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
1	0	1	0	0	1	0	0	0

Since the carry flag (C) is a 1, a dash-space pair will be sent. One more ASL will yield:

(C)	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
0	1	0	0	1	0	0	0	0

Since the carry flag (C) this time around is a 0, a dot-space pair will be cranked out.

The process continues until all of the syllables have been synthesized. The number of times that an ASL instruction will occur in the course of sending a complete Morse code character is determined by the three least significant bits, B_2, B_1 and B_0. Isolating these bits is done by ANDing the encode byte A4 with 07 as follows:

Case II:

```
1010 0100 (A4)
0000 0111 (07)
0000 0100 RESULT
```

The result of Case II is transferred to the X register. The X register is decremented for each (ASL) shift. When X has been decremented to 00_{hex}, a complete character has been processed. In this case, four (4) syllables are sent to synthesize the letter "C" (– · – ·).

All letters, numbers, punctuation and abbreviations are processed in this manner. When X has been decremented to 00_{hex}, the program branches to a subroutine that adds two extra timing intervals, 2(t), to the last syllable so that letter spacing is 3(t). This subroutine is located at 02F0-02F6.

Syllable timing and spacing are done by subroutine groups that funnel the program through one central time delay loop, 02AE-02C6, for maximum coding efficiency.

Special Keys

Provisions have been made for "lookup" table values for generating abbreviations and the punctuation marks used most frequently by hams.

1. The colon (:) key is coded to produce AR.
2. The semicolon (;) key is coded to produce DN.
3. The equals (=) key is coded to produce SK.

```
0281  00
0282  F0   BEQ        If X = 0, complete character was sent. Branch
0283  55              to 02D9 to insert 3(t) spacing between letters.
0284  CA   DEX
0285  0E   ASL, abs
0286  8D              Shift 17BD one bit to the left and monitor the
0287  17              status of the carry bit.
0288  90   BCC        If carry (C) is 0, send dot-space pair.
0289  09
028A  20   JSR
028B  A0
028C  02              DASH-SPACE subroutine group, 028A-0292.
028D  20   JSR
028E  A7
028F  02
0290  4C   JMP
0291  80
0292  02
0293  20   JSR
0294  A7
0295  02
0296  20   JSR        DOT-SPACE subroutine group, 0293-0298.
0297  A7
0298  02
0299  4C   JMP
029A  80
029B  02
029C
029D
029E
029F
02A0  8A   TXA        Save X on stack.
02A1  48   PHA
02A2  A2   LDX, imm   Load with 03 for delay of 3(t) for DASH.
02A3  03
02A4  4C   JMP        JMP to delay routine at 02AB.
02A5  AB
02A6  02
02A7  8A   TXA        Save X on stack.
02A8  48   PHA
02A9  A2   LDX, imm   Load X with 01 for delay of 1(t).
02AA  01
02AB  EE   INC, abs   Toggle PAØ.
02AC  00
02AD  17
02AE  CA   DEX
02AF  AD   LDA, abs   Load code speed byte into timer.
02B0  BE
02B1  17
02B2  8D   STA, abs
02B3  07
02B4  17
02B5  CD   CMP, abs   Watch timer for count passed 00.
02B6  07
02B7  17
02B8  30   BMI        If timer has timed out, branch to check if additional
02B9  03              time periods are to be done.
02BA  4C   JMP        Jump back to recompare timer output.
02BB  85
02BC  02
02BD  E0   CPX, imm   Check X for additional delays to be done.
02BE  00
02BF  F0   BEQ        If X = 0, interval timing is complete.
02C0  03
02C1  4C   JMP        JMP back to reload timer.
02C2  AE
02C3  02
```

```
02C4  68   PLA
02C5  AA   TAX        Restore X to pre-subroutine value.
02C6  60   RTS        Return from subroutine.
02C7  29   AND, imm
02C8  F8
02C9  4C   JMP
02CA  72
02CB  02
02CC  8A   TXA        Save X on stack.
02CD  48   PHA
02CE  AD   LDA, abs
02CF  00
02D0  17              Fetch data from the keyboard, and load it into
02D1  99   STA, y abs the FIFO buffer, in location 0300 + Y.
02D2  00
02D3  03
02D4  68   PLA        Restore X to pre-interrupt value.
02D5  AA   TAX
02D6  C8   INY
02D7  40   RTI
02D8
02D9  20   JSR        Jump to LETTERS space, 3(t), delay routine.
02DA  F0
02DB  02
02DC  4C   JMP        JMP to FIFO FETCH routine at 02E0.
02DD  E0
02DE  02
02DF
02E0  CC   CPY, abs
02E1  BF
02E2  17
02E3  F0   BEQ        HALT if last character in FIFO was processed
02E4  FB              when Y equals contents of 17BF.
02E5  AD   LDA, abs
02E6  BF
02E7  17
02E8  AA   TAX
02E9  EE   INC, abs
02EA  BF
02EB  17
02EC  4C   JMP        JMP to fetch next character from FIFO.
02ED  5C
02EE  02
02EF
02F0  8A   TXA
02F1  48   PHA        Save X on stack.
02F2  A2   LDX, imm
02F3  02              Load X with 02 for a total space time delay
02F4  4C   JMP        of 3(t) between letters.
02F5  AE
02F6  02
02F7  20   JSR        JMP to word space, 7(t), time delay at 0221.
02F8  21
02F9  02
02FA  4C   JMP        JMP to FIFO FETCH.
02FB  E0
02FC  02
02FD
02FE
02FF

PROGRAM BUFFERS
17BF   FIFO pointer.
17BE   Code speed byte.
17BD   Syllable encode storage, the ASL is performed on this location.
17BC   Lookup value buffer storage.
```

4. The DEL key is coded to produce BT.
5. The period (.), comma (,), and the question mark (?) keys have been coded to produce their respective Morse code equivalents.

Operating Hints

In the interest of minimizing program listing requirements, the LETTERS lookup table, 0240-025A, was designed around the uppercase alphabet characters. The lower case alphas have been omitted for two reasons:

1. There is no distinction between upper and lower case letters in Morse code.
2. About 99.9% of existing software is written in upper case, and most teletypes, terminals, and ASCII keyboards that don't have the upper/lower case feature are coded for the upper case letters. Shift and lower case characters are not permitted.

The first step in the start-up is loading the program. Since the listing is quite lengthy, loading the program by using the hex keyboard each time the power is turned on is somewhat of a pain in the ASCII. I suggest that after you have checked your data entries, you take advantage of the audio tape dump program and hardware that is already on the KIM, so that you will have it permanently stored. Loading the computer from the cassette takes about 40 seconds for this particular program.

During the loading operation, the sidetone oscillator and transmitter switch will be enabled. A toggle switch, in series with the speaker to temporarily disconnect it until the system is configured by the software, is recommended.

Before you pass GO, be sure that you load the code speed byte in location 17BE. Use values less than or equal to 7F. In order to change the code speed after you have the program running, you will have to stop the program and load 17BE from the hex keyboard.

Since the KIM is a relatively new machine with little software support, you may have to move the program buffers, 17BC-17BF, to some other locations in the RAM memory space as new hardware and software are introduced and marketed. I chose to use those locations because they reside in the 64 byte RAM in the 6530 interface chip. This still leaves pages 00 and 01 free for expanding the program within the confines of my unexpanded system. ■

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It Works! The First Time!

-- the Seals Electronics memory board

It all started while I was looking through the June issue of *73* and came upon an ad for an 8K memory board. This particular ad made me realize that if the claims of the manufacturer were true, this board would be a very nice addition to my computer system.

Upon investigation of the manufacturer of this particular board (Seals Electronics) at the local computer club, I heard a very strange rumor. That is, that it was possible to obtain this 8K static memory board in only 10 days from the date that the order was received. I was quite sure that it was actually 100 days, but the temptation was more than I could resist. On June 16th I placed my order.

As soon as I dropped the order in the box I was gripped with fear, realizing that the interest on my money would probably be collected by the company for some time, at my expense. I resigned myself to receiving the memory board in 1977.

On June 23rd the postman came carrying a box three inches deep and a foot square. Sure enough, it was from Seals Electronics. I didn't open the box for a long while; I just stared at the box in disbelief and was somehow comforted by its shape. This must be a good sign, I thought.

Finally, I opened the box and peered inside. What a pleasant surprise. I viewed a large plastic envelope that contained four smaller parts packages. All of the components were of top quality. But what about the board? I quickly tore open the package that contained the board and examined it. It was beautiful! Not only was it first class in appearance, but it had no jumper wire holes. It had a solder mask on both sides and was silk screened on the component side. And, there was an assembly manual and two other documents.

I began reading the manual and, to my surprise, I could understand it. It was written in modern English, and even *I* could understand it. It described the assembly, installation and standby battery hookup. The theory of operation was described so that it could be easily interfaced with a home brew project. Could it be that this manual was written for the hobbyist?

Two more pleasant surprises were yet to come. Upon examining the two remaining documents, I found a multicolor full size printed circuit board layout and a beautifully done foldout schematic of the board circuitry.

My enjoyment increased as I began construction. I followed the instructions and the memory began to take shape. First I installed the diodes, then the resistors, next the regulators, and then the address selection switches. Oh yes, and the *sockets*! This kit was supplied with sockets for all ICs! I was becoming convinced that a tremendous amount of thought had gone into the planning of this kit.

Another thing that struck me as I continued to build the kit was that all the holes were the correct size. Not once did I have to file down a lead and stand on my pliers to insert a component lead through the board.

The sockets fell into place and I even tried to make a solder bridge on the board, but was unable to accomplish this due to the almost foolproof solder mask. I was now convinced that anyone could build this kit without error if he simply followed the instructions. The last item of construction was the placement of the capacitors and this also went without a hitch.

Now for the ICs. As I began to insert the ICs in the sockets, another thought struck me. It was impossible to damage them with the old soldering iron.

Finished! I quickly looked the board over with my magnifying glass and, finding no problems, placed it before me with a sigh. After gloating for a few minutes, I picked up the card and headed for the computer. Snapping the address switches into the proper position, I then placed the board in the slot and prepared myself for the big moment. The familiar click of the power switch seemed to be more meaningful and the whir of the fan and lighting

of the LEDs joined in to indicate that all was okay.

Now for the test. First I addressed the memory and deposited a few bytes of data. Everything seemed to be working. Next I loaded BASIC into the memory and it worked flawlessly. It worked! And the first time, too.

When my wife called me to empty the garbage I realized that I was not dreaming. I began to consider what performance tests I might use to prove that this memory board was not all that it was cracked up to be. I was really challenged now, and was determined to find a problem with this board. After all, there just had to be some shortcomings somewhere! Besides, my reputation as a skeptic was at stake.

With these purist concepts in mind, I set out to test my newly constructed memory board.

My first plan of attack was to prove that no static memory could come close to my present dynamic memory in low power consumption. To accomplish this, I cut the three power leads between my last extender board and the other boards connected to the computer bus. I stripped one quarter inch of insulation from the free ends of all leads and melted some solder on the exposed wire to aid in soldering them during testing. I then resoldered two of the power leads, restoring normal operation to those two sources of power. I connected my ammeter between the two remaining leads.

The next step was to install two dynamic boards to give a total of 8K of memory. Placing them in the test location, I then applied power and recorded the ammeter reading.

I repeated this process with the two remaining power leads to the boards, and recorded the results.

Now for the new memory board. I installed it in the same manner and measured the five volt power line (the only one required for the new memory).

After comparing the results, I was surprised to find that the new low power static board consumed only twenty percent more power than the two dynamic boards. For all practical purposes, the power consumption is an even swap.

Not being one who gives in easily, I continued my testing. This particular board was advertised as having the memory of an elephant, or something to that effect. So I proceeded to examine this aspect of its operation.

There is a very unique feature built into this board; that is, there is a diode switching network between the normal power line to the memory and the battery standby line to the memory that is brought in on pin 14 of the memory board. (This position is not used on the bus line of the Altair and other similar computers.) This means you can connect a battery across pin 14 and ground, and when power is interrupted, the memory is automatically switched to the standby source to retain memory content.

To test this feature of the memory, I constructed a simple power supply capable of maintaining three volts under load when connected to the memory while the computer was turned off. I then soldered a small piece of wire on the free end of the extender board at location 14. The positive lead from the supply was connected to this wire and the negative lead from the supply was connected to logic ground (pin 50).

Not wanting to start in a small way, I loaded BASIC in the memory and immediately turned off the power. I waited for a few minutes, switched on the power, reloaded the first byte of data (location 0) that was lost by the computer, depressed the run switch and up came BASIC. This was a milestone in the operation of my computer system.

I then decided that a longer period of testing was needed. I followed the same procedure as before, but this time I left the computer off for 24 hours.

When I returned to resume testing I first touched the memory regulator heat sinks to determine whether cooling would be necessary during standby operation. They were cool! When I powered up the machine as before, BASIC came up without a problem.

By this time I was completely sold on my new 8K memory. I was patting myself on the back for what I thought was extremely good judgment on my part in selecting such a nice piece of equipment. (I have not been noted for this quality in the past.)

I pondered for some time after the completion of this testing to be sure that nothing else could be done by me to break down the resistance of the memory.

It then occurred to me that perhaps a good test would be to operate the memory with a disc operating system. Since I happened to have a brother-in-law with such a system, it seemed that a trip to his place was in order.

Upon arrival, we installed the memory board in his computer and, as you have probably guessed, it worked perfectly.

In conclusion, I would like to take my hat off to the folks at "Seals Electronics," and to what I believe is a long awaited answer to the dreams of the computer hobbyist. It is obvious that they have done their homework in producing a kit which can be built with more than a reasonable expectation that it will work when finished.

If you plan to purchase memory in the future (and who doesn't?), be sure to include this one on your list of considerations. I think you'll be very happy with it. ■

The New Improved TT Decoder Updated

- - better

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One of the things I have enjoyed most since I started writing for *73* has been the interchange of ideas with readers. I am always getting new ideas from calls and letters. My recent article on a TT decoder (April, 1976, p. 52) probably generated more interest and applications than any of the others. This short article is to share a couple with you.

Most users had to build up a supply or regulator in order to get the 5 volts required by the decoder board and, since I had quite a bit of room left on the board, I subsequently got the artwork redone to include an LM309H type regulator on the board. It worked out nicely and the regulator pads can be jumpered if the regulator is not wanted.

It's funny how small things can slip by, particularly where printed circuit boards are concerned. After I had wired several of the boards for people, I suddenly realized that I had not provided a PC pad for the negative power lead . . . back to artwork changes again.

A ham in the area who also uses commercial radio services came up with an excellent application and very useful modification of the basic circuit and board. The man has a business radio in his home and one in his truck, and uses them to contact his wife for messages, etc. The channel he is on is a common user channel with many other subscribers. His wife, as do many others, got tired of hearing all the other chatter on the radio all the time. The man decided to use my decoder to turn his base station speaker audio on and off. He could do the receiver modification himself and then acoustically couple the touchtones in his mobile radio.

The only problem that came up with this arrangement was that the wife couldn't turn the speaker back off locally after it had been functioned on. The application and the problem led me to the circuit modification shown in Fig. 1. The only change that had to be made was to add two diodes such as 1N4148s or 1N914s to the inputs of the "off" NAND gate and a normally open push-button switch. The switch then shorts the diodes to ground, causing the output of the gate to go high and reset the output latch. In this case the user mounted the small push-button directly on the front panel of his commercial base station and the circuit board fits easily inside the radio. He is using the decoder relay contacts to interrupt the speaker audio.

This is just one of many possible applications. Many people have built the circuit to control autopatches using a "*" on and "#" off. If you have used this circuit for some neat application, I would be very happy to hear from you. ■

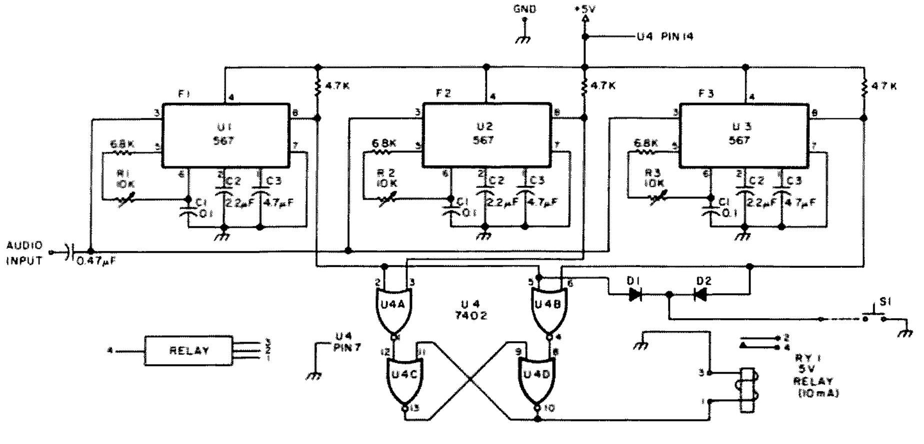


Fig. 1. Tone decoder with added regulator circuit and manual reset circuit. Diodes D1 and D2 (1N4148/1N914) are added to the circuit board and S1 shorts their junction to ground. Printed circuit boards are available from CONTACT Electronic Research and Development, 35 W. Fairmont, Tempe AZ 85281 for $5.50 postpaid. Wired and tested versions are also available.

73 Magazine *Staff*

The Polarity Changers

- - plus to minus

A problem often arises with some IC or transistor circuits when just a modest amount of negative voltage is needed to bias a switching circuit or to power an IC circuit stage that works best when it is powered from equal positive and negative supply potentials. For home station equipment, this situation is easily resolved by constructing a power supply which provides the necessary positive and negative outputs. For battery-operated equipment, an extra battery can always be provided, but this adds to bulk, eventual cost and perhaps even erratic operation at some time since the separate batteries used for positive and negative supply voltages will not age at the same rate. The greatest problem is usually with adapting such circuits to mobile operation where only +12 volts is available. Either a battery for a negative supply has to be used, the circuit modified for single supply operation or, as is usually the case, the idea given up of using a particular circuit for mobile operation.

This article describes a number of ways by which a negative supply voltage can be generated when only a positive source is available. Those who still remember vacuum tubes may also remember that this was also a problem then for mobile operation when tubes required a negative bias voltage. The usual solution was another winding on a vibrator power supply transformer or on a dynamotor. But, some manufacturers even then did try more ingenious approaches, and they are the basis of the circuits that are used these days to generate that needed negative supply potential.

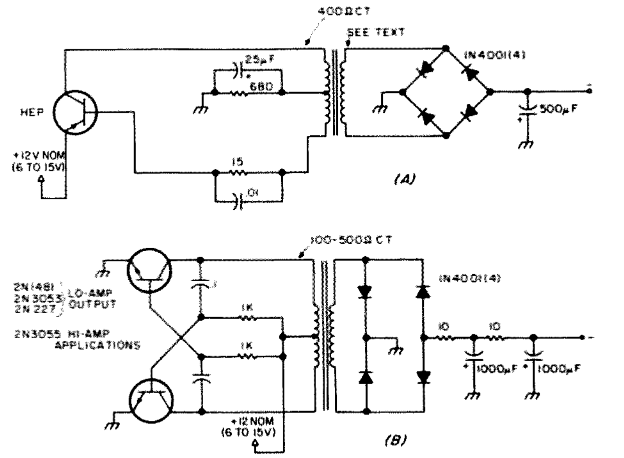


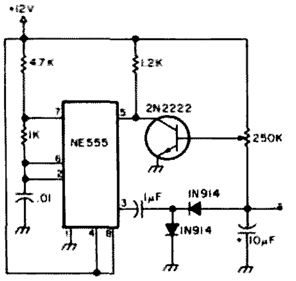
Fig. 1. Two forms of oscillator circuits which can be used to form a negative voltage supply. Output voltages and currents are available over a wide range depending on the transistors and transformers used as explained in the text.

Basically, there are two approaches that can be used to generate a negative ground potential when only a positive to ground potential is available. One is to build an oscillator (anywhere from audio to rf) which has a transformer output isolated from ground. The transformer output is treated like the secondary of an ac transformer (rectified and filtered) to produce a negative voltage. In tube days, rf oscillators were popular because high voltages for bias purposes could be developed across their tuned circuits. The other basic approach is to use a switching circuit to charge a capacitor with a positive supply. But, between charging intervals, additional circuitry literally lifts the capacitor up and turns it around with respect to ground, and it supplies a negative potential. So, the capacitor is alternately charged and electronically flipped around and discharged.

The following oscillator circuits are not the simplest form of positive to negative supply generators possible. Still simpler circuits are possible but they require special transformers, whereas the two circuits shown need only simple, readily available parts.

The circuit of Fig. 1(a) is basically just an audio oscillator with a transformer coupled output. It can be constructed using a wide variety of PNP general purpose transistors and with transformers having varying turns ratios so that output voltages of from 6 volts to 20 volts can be obtained. The secondary voltage is then rectified using a standard bridge rectifier circuit and a 500 mF filter capacitor. Not too much filtering is required since the oscillator produces a fairly good sine wave output. One may have to connect miniature transistor output transformers back-to-back to

Fig. 2. The inexpensive 555 timer IC is the heart of this negative supply which provides a variable output up to -10 volts. Note that the 1 mF capacitor by pin 3 is not an electrolytic type.



obtain a desired output voltage, depending on which types are available locally. For instance, one might use a 400 CT to 8 Ohm transformer back-to-back with an 8 Ohm to 10k transformer to get a voltage step-up. Some experimenting and breadboarding is necessary, but just about any desired voltage can be generated by using different transformer ratios and types of rectifier circuits (half wave, full wave or bridge). Generally, using low power transistors and the usual 99 cent 300 mW transistor transformers, output loads of up to 10 mA can be accommodated.

Fig. 1(b) is a standard multivibrator circuit with component values chosen so it operates at about 7 kHz. The idea is basically the same as in Fig. 1(a), but this circuit produces a square wave output and, depending upon the power transistor used, output currents of an Ampere or more can be generated at various voltage levels. Some 24 CT filament transformers will work well in this circuit. Otherwise, standard transistor output transformers have to be used either singly or back-to-back to get the desired step-up in voltage. Transistor output transformers or interstage transformers rated as 1 Watt, such as Stancor TA-4 or Allied 6T8HF, will do nicely with any of the low/medium power transistors mentioned in Fig. 1(b) to produce outputs in the 12 to 15 volt range at up to 100 mA load. The square wave output of the circuit requires that a bit more elaborate filtering be done, as shown in Fig. 1(b), to get a smooth dc output. Also, square wave generators will have rich harmonic outputs. The 7 kHz operating frequency for the multivibrator is a compromise between an operating frequency that is above the audio range of most audio communications circuits with which it is likely to be used and yet within the efficient frequency operating range of most inexpensive transformers. Nonetheless, if the supply is to be used with rf circuitry, careful power supply bypassing to the multivibrator and even shielding in extreme cases may be necessary to prevent hash in the rf circuits.

The circuits of Fig. 1 should satisfy most needs and can be built reasonably inexpensively. However, in these days of ICs, it would not be fair to omit some more sophisticated approaches to the negative supply voltage problem. Both of the following circuits appeared originally in *Electronics* and provide negative voltage generation along with regulation of the output voltage.

Fig. 2 uses the ubiquitous 555 IC timer. The 555 is operated as a free-running pulse generator. The pulse output frequency and pulse width are basically set by the RC components between pins 7, 6, 2 and 1. However, a control voltage applied to pin 5 can vary the pulse repetition rate. Output is taken from pin 3 where first a capacitor isolates the output from a ground reference and then the output is rectified and filtered. The output voltage level can be set anywhere from 0 to -10 volts by the potentiometer in the base of the 2N2222. This potentiometer, for any given setting, compares the output voltage to the supply voltage. If the output voltage decreases, the 2N2222 is turned further on, causing the control voltage on pin 5 to come closer to ground and hence to increase the pulse output rate. This, in turn, charges up the output 10 mF capacitor more often and brings up its voltage. The quality of the regulation depends on the output current demanded. It is about 5% at 10 mA output. Greater outputs can be supplied but then the regulation will become poor.

Fig. 3 shows another supply/regulator circuit that can supply fixed output voltages over the range of about -5 volts/30 mA to -15 volts/13 mA from a +15 volt supply. Thus, it can supply a bit more current than the circuit of Fig. 2 and can supply -12 or -15 volts when a +12 or +15 volt source is available, which is an advantage in many applications using operational amplifiers. The circuit uses an IC hex-inverter and a single transistor. Two of the inverters form a square wave oscillator. The other four inverters are paralleled as drivers. When the output goes positive referenced to ground, the 1 mF capacitor charges through the 1N914 going to the collector of the 2N3904. When the output goes towards ground, charge is transferred from the first 1 mF capacitor to the output 1 mF capacitor as the second 1N914 conducts. The output 1 mF capacitor now has a voltage across it which is negative referenced to ground. This transfer of charge between capacitors continues until the voltage buildup across the output 1 mF capacitor breaks down the zener diode. Then, the 2N3904 is turned off and the transfer of charge stops until the load current drain again causes the output voltage to fall below the zener voltage. Thus, the circuit is self-regulatory.

The circuit as shown will produce only 5 volts negative output from a positive 15 volt supply. This can be increased by using the alternative voltage multiplying circuit shown in Fig. 3 to produce -15 volts. -12 volts can be produced from a positive 12 volt supply with the same circuit by using an approximately 13 volt zener. The 74C901 hex-inverter operates from up to a positive 15 volt supply and can produce a full -15 volts when used with the voltage multiplying circuit. However, if only a positive 5 volt source is available and -5 volts is needed, the basic circuit of Fig. 3 with the voltage multiplying circuit can be used with a simple SN7404 hex-inverter. An approximate 5.6 volt zener will suffice for the zener reference diode in the base circuit of the 2N3904.■

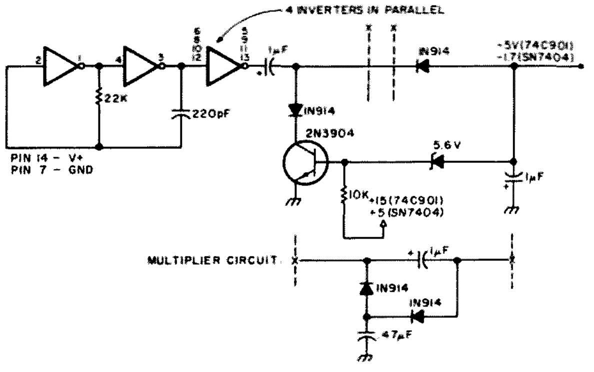


Fig. 3. Negative voltage generation circuit using a hex-inverter IC. If the multiplier circuit is inserted between points X-X, the basic output voltage will be the same as the positive supply voltage. The zener in the base of the 2N3904 must always be rated at 0.6 to 1 volt more than the final negative output voltage.

Repeaters in New Zealand

- - quite a few

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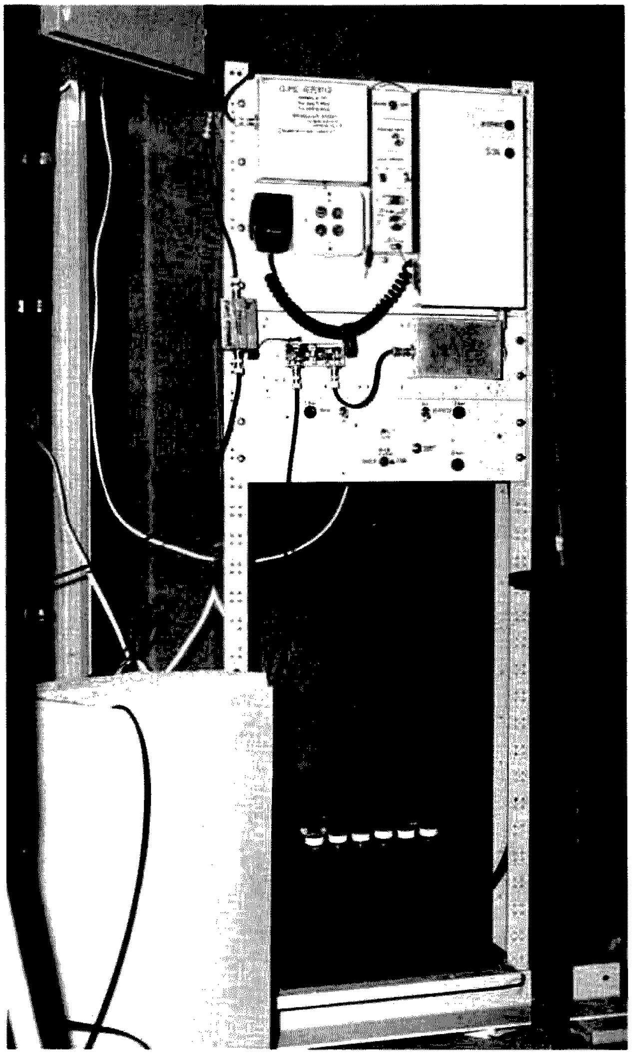


The Mount Climie FM repeater. Note the battery (below) and antenna filter box (left bottom).

FM repeaters hit ZL some five years ago, and since then have spread across the land. With a population of 4800 licensed amateurs, some 24 FM repeaters are now in operation, or about to become operational.

New Zealand is a land of mountains, lakes, rolling hills and open plains, and repeaters have helped to make VHF popular by overcoming terrain problems. The land in the region of Wellington, the capital, is all hills and valleys. People live in the valleys, and without repeaters VHF operation would be very limited for all but a few operators with hilltop sites.

The national radio amateur body is the New Zealand Association of Radio Transmitters (NZART), which has 75 branches. The licensing authority is the New Zealand Post Office (NZPO). NZART set up a committee some years ago to develop a band plan for the two meter band and to coordinate repeater development. In addition to the FM repeaters, some areas also have an AM repeater, and there is at least one two meter beacon station in each of the four ZL call districts.

ZL amateurs are fortunate in that the NZPO, while retaining the right to issue the license for a repeater, accepts to a large extent the views and requests of the VHF committee. So the amateurs have the responsible task of organizing their own band and repeater plan, ultimately seeking an NZPO license when all the various negotiations about sites, access, and other responsibilities have been ironed out and the need for the proposed repeater has been established. Most repeaters have been established to meet a Civil Defense or an Amateur Radio Emergency Corps requirement.

In the event of some disaster or emergency, the amateurs turn out to provide communications for the Search and Rescue Organization, the police, or Civil Defense authorities. Each NZART branch has an "E" series of callsigns allocated so that it is easy to tell when emergency traffic is using a repeater. For example, the Upper Hutt branch has the call series ZL2ELA to ZL2ELZ available. When E calls are heard on the repeater, normal amateur chitchat stops to allow the emergency traffic priority.

The relationship between New Zealand radio amateurs and the New Zealand Post Office is extremely good and in this we are very fortunate. New Zealand is one country where amateur radio is understood and supported by the authorities. In this regard, the IARU problems with WARC 1979 get both NZART and NZPO support.

The two meter band plan started out with four FM repeater channels and this was later extended to six. It can again be extended if found to be necessary. The following channels are in current use:

Channel A – 146.20/145.50
Channel B – 146.225/145.525
Channel C – 146.30/145.60
Channel D – 146.35/145.65
Channel E – 146.40/145.70
Channel F – 146.45/145.75

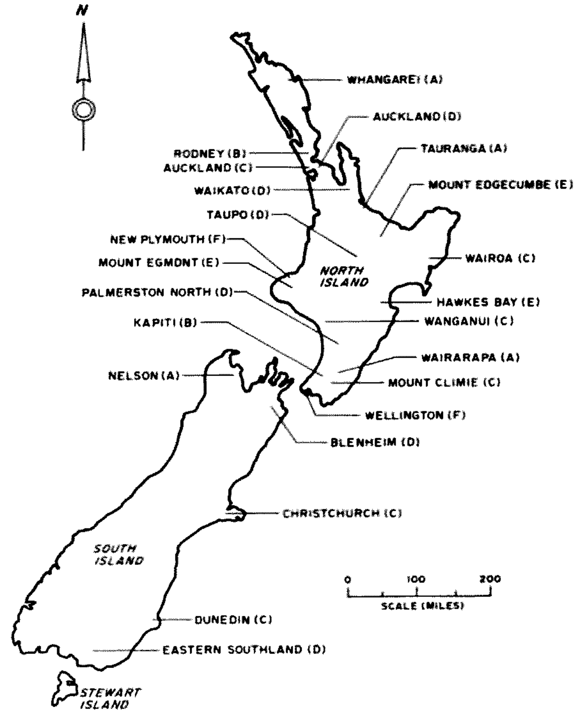
All repeaters are home-constructed, there being no off-the-shelf supply available. An enthusiast in one of the local branches of NZART usually constructs the repeater and finally becomes the "trustee" for the NZPO license.

All repeaters are open access; "closed" repeaters are not permitted. Carrier-operated entry is the rule. No tone-entry systems have been found to be necessary. The geographical spread and siting have made possible an almost exclusive channel allocation to each repeater. During hot summer weather, DX operation between repeater areas becomes possible. This is regarded more as fun than a nuisance.

The NZPO has not required a callsign or an identifier system for repeaters. All repeaters must be owned by a branch of NZART, and a member of that branch is the trustee for the repeater license. Repeaters cannot be owned by an individual. So the station using the repeater (i.e., the user callsign) and the trustee are responsible for the operational performance and operating discipline. In practice, this means that all repeater users have a responsibility to maintain a satisfactory standard of operating procedure. It seems to work out OK. "Repeater Rules" appear annually in the NZART Callbook. These reflect local operating practice:

1. The Trustees (as listed on the Post Office license) to have final responsibility for the repeater operation.
2. The repeater to be owned and maintained by the Branch.
3. The repeater to be open for use by all licensed amateurs.
4. Amateur Radio Emergency Corps and Civil Defense requirements in areas to have priority use over normal amateur traffic.
5. "Overs" to be kept short.
6. Breaks between "overs" to be frequent to let other users identify and call in.
7. Stations who can work together direct without using the repeater establish contact only and then change to some other channel.
8. Home station to home station contacts are discouraged.
9. The Radio Regulations to apply at all times, notwithstanding anything in these rules.
10. With the exception of mobiles, stations should not call a general CQ.
11. Stations using the repeater to identify when calling.
12. No one to be excluded from legitimate operation.
13. QSLs should be clearly marked "via repeater."
14. Contacts via the repeater will not be recognized for any contest or award.
15. A copy of these rules and the names of the Trustees to be posted on the Branch noticeboard.

The map shows the geographical layout and the channel allocations for the FM repeaters. Such a simple map cannot show the site and propagation considerations leading to the choice of each site. Recourse should be made to more detailed maps for this background.



Map of New Zealand showing location and channel of two meter band FM repeaters.

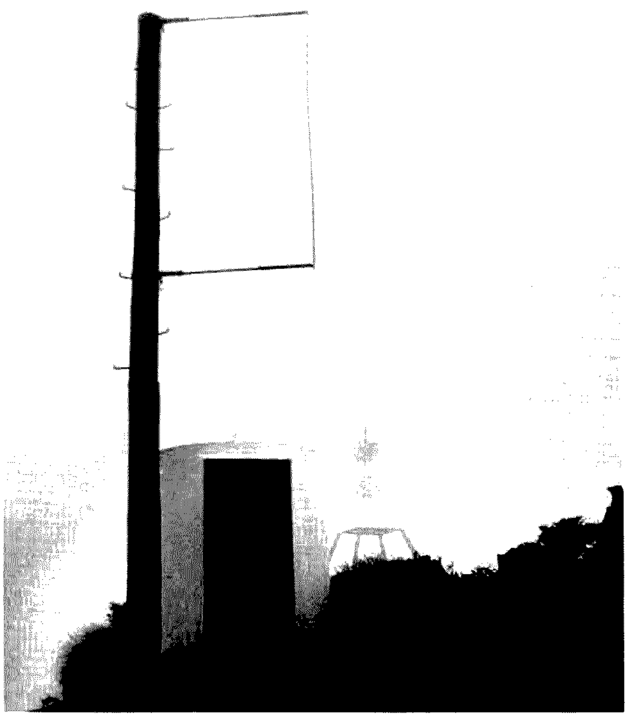
The highest repeater is on Mount Egmont, an 8620 foot high volcano. The repeater is sited about 3500 feet up the eastern slope of the mountain. One repeater (at New Plymouth) is destined to be sited on top of a 600 foot power station chimney. Most amateur repeaters live on someone else's premises, generally owned by the NZPO, the Broadcasting Council or the Civil Aviation authorities. One repeater which has its own hut is the Mount Climie repeater on "Channel Charlie," for which I am trustee.

Establishing "Charlie" has probably been typical of setting up a repeater anywhere: Negotiations for site, underground power cable to the site, a building, a pole, and so on, all had to be arranged. The hut was made by a concrete products firm, who said that they could deliver their product. When they heard that it was wanted 2823 feet up atop Mount Climie they still stuck to their word! A steep road gives good weather access, 11 miles from the Upper Hutt branch NZART clubrooms. The site is sometimes snowed in during winter.

A 200 yard long power cable trench was dug into the hilltop by branch members to get the 230 volt 50 Hz supply to feed the repeater. This is taken from a local microwave station.

The power supply authority had to erect an overhead line on poles to supply the microwave station. After some talking they agreed to provide an antenna pole for the repeater. This they delivered by helicopter and lowered into the hole – which they also dug!

Financing for the installation was obtained by selling kit sets for various branch construction projects. One such project was an FM transceiver kit known as the "Climie Transceiver." Some 110 of these were sold as kits and are in current use on various repeaters. Bulk buying of components and no labor or overhead charges enable branches to raise



The cloud-enshrouded Mount Climie FM repeater site. The trig station (behind) is for a spot height of 2823 feet. The antennas are in two identical sections – receive on top, transmit below. Each is a two half-wavelength collinear, fed with a balun and matching stub at the center. Steps on the wooden pole are an aid to climbing. The hut is reinforced concrete with a steel door.

money through kits.

The Upper Hutt branch of NZART is responsible for Civil Defense communications in the local area, and the cost of the power used at the repeater site has therefore been arranged to be met from the funds of other people! The branch is in the fortunate position of having a hilltop site and a repeater free of debt and free of running costs. It is serviced and maintained by voluntary effort. Contacts are possible at almost any time throughout the 24 hours because the channel is monitored by many people. It has been used for many emergencies and many exercises.

The "Channel Charlie" repeater runs off a float-charged 12 volt battery. It is all solid state and does not use mechanical relays or tubes. Several alarm circuits are fitted. One alarm shows up when the 230 volt ac main supply to the hut fails – to warn users that the equipment is running on the raw battery only. The other is an intruder alarm on the hut door – to advise unauthorized entry. The repeater can be shut down remotely by the trustee should this be necessary. Other facilities are in the process of experimental development.

So far, only the two meter band has been used for repeaters in New Zealand. The band extends 144 to 148 MHz. The 70 cm band plan is in the process of being polished and some groups are keen to see some repeaters established on that band. No crossband repeaters are envisaged and the linking of repeaters has not yet happened or been thought desirable.

Three grades of amateur operator certificate are in use in New Zealand. A Grade I certificate holder can use any amateur band. A Grade II certificate holder can use all bands except 40, 20, 15 and 10 meters; i.e., he can use 160, 80, 6, and all amateur frequencies above 144 MHz. A Grade III certificate holder is restricted to voice communication on bands above 144 MHz only.

There is one common theory and regulations examination set by the NZPO. Passing this examination alone can assure a Grade III certificate. Passing a Morse test at 12 words per minute in addition gets a Grade II certificate. With additional operating experience on 80 meters, a Grade I certificate can be obtained. The result is that the usual pattern is for the budding amateur to get a Grade III certificate first and later graduate to the other bands. This means that the new amateur has immediate access to VHF repeaters; this has contributed to extending the popularity of repeater operation. Grade III licensees are indicated by the "T" series of callsigns, e.g., ZL2TCU.

Visitors to New Zealand who hold an amateur license issued in certain overseas countries (including USA) can obtain a license to operate while in New Zealand. The "reciprocal licensing" arrangements vary from country to country. The address for enquiries is the Radio Section, New Zealand Post Office, Post Office Headquarters, Wellington, New Zealand. Several weeks notice should be allowed.

Visitors are welcome on all ZL repeaters. Operation on a repeater is an easy means to learn of local amateur club meetings and of other activities. Shack crawls and eyeball QSOs can soon eventuate once a strange or a new callsign appears on the repeater. See you in ZL? ■

Briefs

WR6ABE: over 700 users, 15 years on the air, extraordinary coverage throughout Southern California, one of the first big repeaters on the West Coast, but now a silent key, at least until early in the new year. K6OQK, the owner of the repeater, took it off the air in late October, hoping a cooling off period might end the QRM, obscenity and assorted garbage that's been wrecking the system for months. In the view of more than one reporter, ABE's problems grew from a small minority, plus its incredible coverage of the Los Angeles area. As Arny Gamson K6PXA, editor of *Scatter* (the journal of the Southern California Teleprinter Society) put it: "Is this a trend in ham radio where a very small percentage of jammers, drunks, and inconsiderates can ruin it for the majority?" We hope not.

The 20 meter jammer, heard for weeks and believed to be of Russian origin, is finally QRT. The incredible "buzz saw" noise was heard over a wide range of frequency, running from 40 through 15 meters here on the east coast. Despite international protest, the jammer persisted until early November. In fact, no one is really sure if the "buzz" was a jammer at all. W6PN, a former director of engineering for Radio Free Europe in Munich, is quoted as saying the noise was not a jammer. Instead, he says in the British *Short Wave Magazine*, "Its millisecond pulses, overmodulated at about 5 kHz, would be more suitable for propagation studies or some wide band operation."

Anti-antenna zoning harassment to hams and CBers is increasing throughout the country. In the latest case, an Illinois amateur has filed suit in an effort to prevent his city from forcing him to remove his 72 foot tower and antennas.

Walter Weber WA9FXG of Orchard Place IL first erected his tower last April. He was later told that he needed a building permit, after neighbors complained that the tower posed a danger to residents and interfered with their television reception.

When it was later decided that the tower violated the 35 foot building height limitation in his area, Weber sought a zoning variance. While the local Zoning Board recommended its approval, it was subsequently denied by the Orchard Place City Council who said they feared approval would set a precedent for other types of structures.

Weber's suit asks that the court declare the city's building code unconstitutional or declare that the height limitation does not apply to radio towers. He contends that defining a tower as a building is too broad and makes the building code vague. Weber added that many roof mounted television antennas exceed the height limitation.

There's help coming for amateurs who've run amuck of local zoning and interference laws. A national group of attorneys and judges, who are license holders in both the amateur and citizens band services, have formed the Personal Communications Foundation, a nonprofit, soon to be tax-exempt California corporation. Using thousands of their own dollars to get started, they plan to establish liaison and working committees to deal with issues like land-use restrictions, tower ordinances, deed restrictions, TVI-RFI and nuisance problems, and the related problems of jamming and other unlawful operating practices.

The cost is estimated to be about 80 thousand dollars for the first two years of organization, with the operation becoming self-supporting thereafter. The lawyers won't be making any money . . . to the contrary, the organizers are actually losing funds out of their own pockets to get PCF rolling. There is no affiliation with ARRL, or any other organization, although PCF is seeking advisory help. The organizers say if one dollar could be donated by one out of every three US and Canadian amateurs, within a year PCF could have a list of attorney liaisons available for publication.

According to one of PCF's founders, Los Angeles Attorney Jon Gallo WA6PTM, attorneys across the US have volunteered to open their files. That way, Gallo says, any individual could receive information from the foundation to help overcome communications-related legal difficulties. Local ordinances are being enacted not only banning towers over 35 feet and large antennas, but setting penalties for TVI-RFI as well!

PCF says it knows of such ordinances in 47 states, with at least five cases resulting in fines to licensed CBers for TVI-RFI. It's easy to see, PCF reasons, that amateur licensees are bound to be affected. The idea, says Gallo, is to cut the cost of defending hams and CBers by providing a national clearinghouse of legal information for attorneys. PCF emphasizes it will not actually defend anyone . . . but instead will try and cut the legal bills a tower fight or TVI case can bring. Stay tuned for further details.

The battle continues over operation of the Port Chester NY 34/94. A 15 signature petition demanding discontinuation of operation has been denied by WR2ABE trustee Michael Troy WA2TYV. Edward Zeiser WA2OQO apparently led the petition drive, claiming "unmitigated interference" to 146.34 and 146.94 simplex operation on Long Island. Zeiser addressed his petition to Stan Zak K2SJO, Hudson Division Director of ARRL. It turned out Zak had no connection with WR2ABE other than a wire line control point, given as a courtesy since he is local CD chief. In answer to the petition, WA2TYV suggested putting an end not to the Port Chester repeater, but instead to operation of 34 for simplex purposes. "Today's FM gear allows plenty of room for simplex, both above and below 146 MHz . . . while repeaters are restricted to the 146-148 MHz segment; no ham is forced to stay on 34 or 94 simplex."

In Ohio, Robert Scott W8SFK has printed a thousand protest letters, blasting the Ohio Repeater Council for assigning FM repeaters on 146.10 to 146.70 MHz. Pointing to gentlemen's agreements making 70 a national RTTY frequency, Scott terms the council's action "a flagrant violation of trust and a miscarriage of integrity." Scott argues that the very founding principles of the council are self-policing, common sense, good judgment, and a gentleman's agreement. According to Scott's letter of complaint, a new 10/70 near Findlay OH is disrupting simplex teletype in the entire northwestern quadrant of Ohio, the southern tier of Michigan, and northeastern Indiana, along with over 20 operators in greater Toledo. The Ohio Repeater Council has another point of view. Wrote George Hinds WB8JYR (the OARC Chairman), "Indianapolis, Cincinnati, East Liverpool, Cleveland and now Findlay have voice repeaters on 10/70 . . . The first three have been long established . . . The only operational RTTY repeater in the same region is Detroit on 22/82, not 10/70." Hinds went on to suggest there are many other frequencies on 2 meters for RTTY. "You have no more 'grandfather' rights to work simplex on the repeater segment of 146 MHz than did the fellows who long cherished 94 as a simplex frequency . . . Faced with the facts, not with dreams of the 'good old days' when 146-147 MHz were barren wastelands, OARC can no more sanctify 146.70 for you than we could keep repeaters off 94, 76, or 88, all of which at one time were simplex."

Icom East Distributor Kayla Bloom Hale W1EMV has resigned. Hale, a former editor of *73*, says she plans to retire to her Dublin NH home and do some writing, hamming, and relaxing. Kayla says she's tired of the grind, the never-ending shows, the thousands of miles of travel each year. On ham radio Hale is optimistic. "It's on the way up, just like the sunspot cycle . . . with a lot of CBers becoming disillusioned and turning to ham radio . . . I just hope they don't ruin it." In February of 1968, when Kayla became editor of *73*, she wrote some similar thoughts. "I was one of the 'save 11 meters' group way back when . . . since we lost the fight, I have not paid too much attention to what is going on on 27 MHz . . . Recently, after listening to the CB band, I was completely stunned by what I heard . . . Calls like, This is the 'Barefoot Boy' calling 'Yankee Pirate' . . . I feel certain these calls were not issued by the FCC . . . Amateur radio gave up 11 meters for this?" Things haven't changed much in 8 years, have they?

El Paso TX has a new repeater, designed for solar powered operation on top of North Mt. Franklin. Operation began October 9th on 146.10/70 MHz. The machine uses only about 11 mA on receive, about 500 mA transmit, with a power output of 2 to 3 Watts. Telemetry will be used to remotely monitor the repeater, using the output of the club's companion 28/88 machine. To conserve power and eliminate kerchunking, the COR is VOX operated. Still to be completed at press time was the machine's ID, telemetry, and control boards. An enclosure will also have to be built on the mountain to house the equipment. Except for Hallicrafters PC-18 boards, the entire repeater is home brew. That includes the cavities! Coverage is expected to be at least 100 miles in all directions with HT coverage of El Paso, Las Cruces and Alamagordo.
Reprinted from The Beam, *Bulletin of the Sun City Amateur Radio Club, El Paso TX.*

The denials persist, but Icom has indeed discontinued the much-loved IC-230 2m transceiver. Replacing the 230 is the IC-245, featuring continuous VXO tuning, 144-148 MHz, and programmable offsets. Priced at $499.95, it is seen as a prime competitor for the new Kenwood TR-7400A. Further Icom-Kenwood competition can be expected between the proven TS-700A and new Icom IC-211 base all-mode rig. Sales of the IC-22S continue to back up the dealers, with Engineering Specialties, a West Coast firm, offering the first commercial outboard encoder for the rig's diode matrix synthesizer (see New Product review this issue). We've also learned that Icom will release its first lowband radio early this year. A low power rig with digital readout, the Icom will cover 80-10 meters, will be super compact, and can be expected to be only the beginning HF-wise if well received.

FCC district offices are expected to begin using multiple choice comprehensive code exams in early January. The only possible holdup at press time was the government's contract for dupes (copies) of the newly recorded code exams. According to an FCC spokesman, the decision to switch to multiple choice was not based on a desire to make the code exams easier . . . but rather to make the tests fair. One official told *73* it was the Commission's belief many applicants were failing code exams due to nervousness, not a lack of code proficiency. Technician class applicants can expect 10 multiple choice questions for the 5

wpm test, General and Extra class applicants could see longer code questionnaires, but that was not certain at press time. Written exams, incidentally, break down to about 50% rules, operating procedures, and communications practices for the Novice, Technician, and General classes . . . with the remaining questions on radio principles and practices. The balance for Advanced and Extra is about 40-60, according to the same FCC spokesman.

The FCC continues to unlock the door on 1 x 2 callsigns. Latest batch covers N and X calls, with all Extra licensees eligible starting July 1977 (see FCC News Release).

John Lassig K5GFV has petitioned the FCC for amateur privileges on the 11m CB band. Lassig argues ham operation, under CB rules and regulations, would actually help FCC enforcement efforts and probably bring scores of CBers into ham ranks. (Lassig's petition appears elsewhere in this issue.)

At press time the crunch of new license applications had only begun to take effect in Gettysburg. With hundreds of Novice classes starting up all over the country this fall, it seems inevitable delays will be the result. Turn-around time, despite the expected crunch, was nothing short of unbelievable in mid-November. Using the special amateur radio post office box number 1020, and printing "Amateur Radio Novice Application" across the lower left of the envelope, brought written exams in less than 10 working days! It might help to write "Completed Amateur Exam Enclosed" on the return envelope as well. Again, that's FCC, PO Box 1020, Gettysburg PA 17325.
Thanks to Kettle Drums, *bulletin of the Kettle Moraine Radio Amateurs, Waukesha County WI.*

Confusion reigned among Technician class licensees during early November, as the FCC computer at Gettysburg fouled up those Novice class call reissues. The result: WN calls on repeaters and several cases of mistaken identity. The Technicians have been advised to use the WN calls until the computer errors are corrected. Novices, incidentally, received somewhat frightening letters from FCC . . . informing them that their tickets had been revoked and warning them not to use the WN prefixes. The second paragraph of the letters went on to inform them of their new WA-WB-WD calls . . . but we hear things got a little shaky upon opening those unexpected envelopes.

Clegg Communications, after going direct and eliminating the dealers last year, is now offering quantity price discounts on 2 meter and 220 MHz radios. Affected are the Mark 3 15 Watt 2 meter transceiver and FM-76 10 Watt 220 MHz transceiver. All units will carry full 90 day warranties, and Clegg says they will also supply Hustler, KLM, Phelps-Dodge antennas and KLM amplifiers at group prices. If your club is interested, contact Clegg at 208 Centerville Road, Lancaster PA 17603.

"Repeater DXer chastised by Canadian DOC" was the word at a recent session on the Ohio Area Repeater Council. It seems a formal complaint had been filed with the DOC by the Mansfield OH 34/94 system because of repeated interference to autopatch calls, search and rescue operation and normal QSOs by a Canadian station with a penchant for DXing and the resulting "keying up" of two or more repeaters simultaneously. It is understood that the offending station agreed, upon being contacted by the DOC, to cease and desist the practice. *Reprinted from the Lake Erie Amateur Radio Association* Repeater Newsletter, *October '76.*

Actual text of the Michigan State Law on scanners: "750.508. Any person who shall equip a vehicle with a radio receiving set that will receive

signals sent on frequencies assigned by the Federal Communications Commission for Police purposes, or use the same in this state, unless such vehicle is used or owned by a peace officer, or a bona fide amateur radio operator holding a Conditional, General, Advanced or Extra class amateur license issued by the Federal Communications Commission, without first securing a permit to do so from the Commission of the Michigan State Police upon such application as he may prescribe, shall be guilty of a misdemeanor, punishable by imprisonment in the county jail not more than one year or by a fine of not more than $500, or by both such fine and imprisonment in the discretion of the court."

You'll notice that no mention is made of any CB license, commercial license, or Novice or Technician grade license!

Reprinted from The Printed Circuit, *Bulletin of the Great Lakes Repeater Association, October '76.*

AMSAT, the Radio Amateur Satellite Corporation, now has over 2,500 members, according to the organization's annual report. That's a growth rate of 9%. Among the year's accomplishments: Canadian and US use of both OSCAR satellites for experiments in downed aircraft location, FCC authorization of ASCII on the satellites which enabled stations to remotely access a computer in Canada via OSCAR 7, University of Arizona and National Institute of Health researchers' experiments with the relay of electrocardiograms (EEGs) through OSCAR 7, and continued work on a prototype computer for use in onboard spacecraft control, with an eye on AMSAT Phase III. The Phase III spacecraft prototype is progressing with a December 1979 launch date projected. A second project, AMSAT-OSCAR D (A-O-D), is also underway with two transponders under construction. One will be two to ten meters while the other is a four Watt two to 70 cm unit developed by the Japan AMSAT Association (JAMSAT). Launch date for A-O-D is set for June 1977.

The Chicago FM Amateur Radio Club (CFMC) really scored on election day. Club efforts brought two television news stories, after the FMers provided communications for LEAP (Legal Elections in All Precincts) lawyers. WA9LRI reports participation from 30 amateurs who worked from 5 am through 9 pm using 2, 220, and 450 repeaters. CFMC dispatchers staffed LEAP offices, sending attorneys and their amateur communicators to investigate voter complaints throughout the city. Aside from the TV publicity, project LEAP brought radio PR and an article in the *Chicago Daily News.*

There are 15,500 licensed amateurs in Canada, and 1,400 of them have responded to a national poll on DOC proposals to restructure Canadian licensing. At issue is a non-code Experimenter class, and a 5 wpm Novice license. From the Canadian Amateur Radio Federation's poll results, it is apparent Canadian hams don't like the idea of non-code licensing. It was 63% against, 4% in favor, with 16% favoring an above 50 MHz Experimenter class. The idea of Novice licenses drew a much more positive response, with 55% of those questioned supporting it.

Our thanks to VE3CDC for passing along the CARF results.

Members of the Amateur Radio Society of India will soon have a new headquarters. The Indian government recently allotted the society a 4050 square foot tract of land in Delhi for a building and antenna farm. The land will be rented to the Society for a token fee. Members are at work planning the new facilities, which are expected to be operational early in 1977. Donations are being solicited. Contributions may be sent to: Amateur Radio Society of India, P.O. Box 534, New Delhi-1, India.

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Australia

A VFO for Sidebanders

- - 5-5.5 MHz

Many transceivers today use some form of frequency synthesis or mixing process to derive a desired output frequency.

The mixing method is a very good one for several reasons, one of which is excellent frequency stability. For example, if an output frequency range of 28.0 to 28.5 MHz is required, it could be obtained by mixing 5 to 5.5 MHz and 33.5 MHz, the latter being furnished by a crystal oscillator. Using this method, the stability of the output frequency will be similar to that of the 5 MHz component, any drift which may occur in the crystal frequency being relatively small.

To derive a stable output frequency it only remains therefore to provide a source of 5 to 5.5 MHz signal which, when set to the required frequency, will continue to maintain that frequency and not be affected by the changing environmental conditions the oscillators may undergo during a communication period.

Reprinted from *Amateur Radio*, the Journal of the Wireless Institute of Australia, October, 1973.

Using this method of frequency production, the vfo can be allowed to run continuously, preferably 24 hours per day.

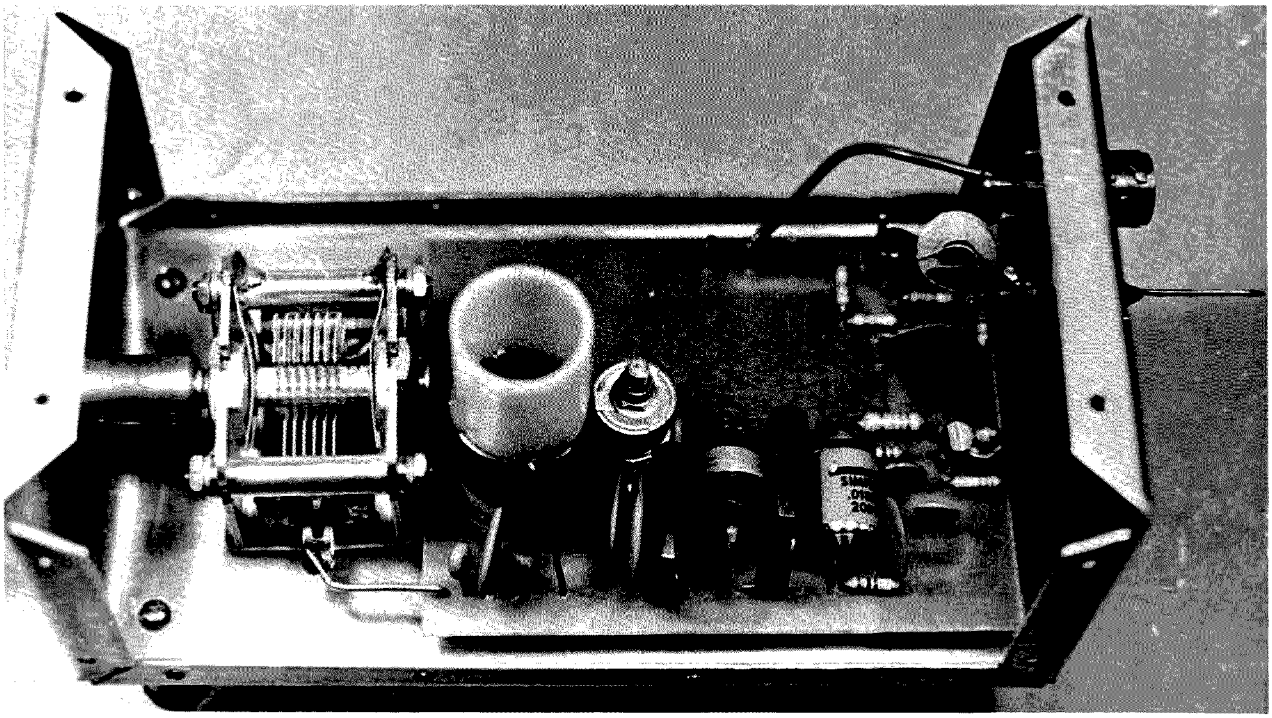
The vfo to be described here will provide such a variable source. Frequency range is 5.0 to 5.530 MHz. Stability is in the order of 2 parts per million per hour after warm-up. The frequency curve can be linearized using the split segments of the capacitor shown. Output voltage is 3 volts peak to peak sine wave into 1000 Ohms. Supply requirement is 12.6 volts at 25 mA. A supply voltage change of plus or minus 1 volt will result in a frequency change of about 1 Hz.

An FET is used as the maintaining device rather than a bi-polar transistor, in the interest of improved stability with changes in temperature.

The components of the oscillator and buffer amplifiers are laid out on an etched fiberglass board measuring 7 x 9 cm. Good mechanical stability can be secured using the form of construction shown, a U-shaped box and cover measuring 15 cm long, 6.5 cm high and 8.5 cm in width.

An ordinary ¼ inch solid coupler is used on the capacitor shaft inside the vfo box and a plastic rod should be used to connect the capacitor with the drive mechanism. A number 3 knitting needle is exactly ¼ inch in diameter.

The entire box is mounted on four 1/8 Whit. screws which are secured to the main exciter chassis through four



rubber grommets which provide some mechanical, electrical and thermal insulation. A considerable improvement in stability can be obtained by enclosing the vfo box in one inch thick polyfoam insulation. The coax from the vfo output socket provides the ground return for the supply.

The capacitors used at C4 and C5 are ceramic N750 type for frequency drift compensation. The values shown were arrived at after some experimentation with temperature versus frequency. It will probably be necessary to find the exact amount of capacitance by similar experiments. If the frequency increases with temperature, there is too much negative capacitance; if the frequency decreases with increasing temperature, there is too little. Use C2 to restore the correct frequency range. Remember to give the components time to reach room temperature after soldering before taking frequency measurements. If a very stable vfo is required, you must be prepared to spend some time in determining the exact amount of capacitance required.

The author spent considerable time experimenting with various types of coil formers and fixed capacitors in the tuned circuit. A good quality ceramic coil former is ideal of course, but here in Melbourne there appears to be no ready supply. The former finally used was a ¾ inch Wynne (teflon).

An output waveform which is distorted may be traced to an FET which has too much gain. As 2N3819s have considerable parameter spread, it may be necessary to try a few FETs in order to obtain a clean output waveform. ■

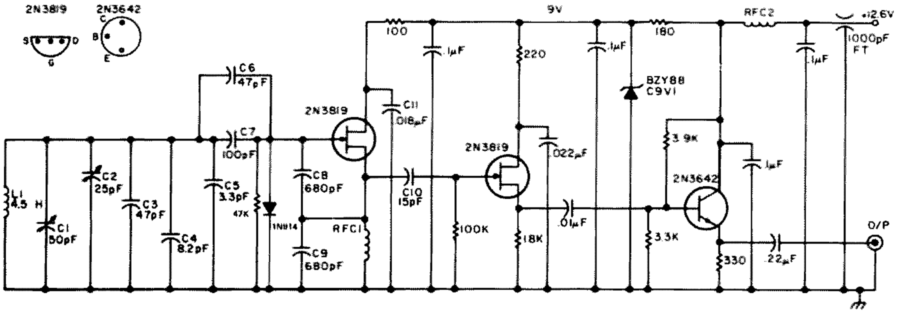


Fig. 1.

Parts List

C1 – 50 pF Variable Polar C28/141 or similar
C2 – 25 pF Trimmer C005 BA/25E
C3 – 47 pF Ceramic NPO
C4 – 8.2 pF Ceramic N750
C5 – 3.3 pF Ceramic N750
C6 – 47 pF Ceramic NPO
C7 – 100 pF Ceramic NPO
C8 – 680 pF Silver Mica
C9 – 680 pF Silver Mica
C10 – 15 pF Ceramic NPO
C11 – .018 uF Styroseal
All other capacitors as shown
All resistors 1/8 Watt 5%
L1 – 4.5 uH: 17 turns 18 swg enameled copper on 3/4" Wynne former (start and finish held in place with a small amount of Araldite)
RFC 1 – 2.5 uH Single pie (Aegis)
RFC 2 – 2.5 uH Single pie (Aegis)

Gil Boelke W2EUP
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Practical Solar Cell Power

- - great for remote repeaters

Sometimes you find yourself surprised at what you can do when you think hard about a problem. A good example is energy conservation (a popular subject these days), and techniques developed for WR2ACA.

Most of the time there is no shortage of power because the wind blows often enough and hard enough to provide what is necessary. Nevertheless, there are times when power must be rationed carefully in advance by the design of the equipment. Conditions of energy availability can be divided into three categories:

(1) Abundant wind, generators working, full battery charge.

(2) Average, moderate winds with normal repeater activity. Repeater draws more power than generators deliver, but idle periods allow catch-up.

(3) No wind at all or failure of the charging system for extended periods.

If the first condition persisted all the time, we could install electric heaters in the place and have no problems. Power consumption of the equipment would be of little consequence.

The second condition represents normal operation as we experience it 90% of the time at WR2ACA. Here energy must be budgeted carefully so that idling drain stays low enough to allow recharging of the batteries as rapidly as possible.

Depending on the battery charge level at the start of condition (3), normal operation will continue until the charge is reduced to the minimum required to keep the system "alive" to assure self-recovery at the end of the energy drought (assuming no back-up system or failure of same). In order to provide continuous operation of vital systems (such as the control and intrusion alarm systems), and to make sure there is enough energy to excite the wind generator when the wind does return, the batteries must never be allowed to go completely dead. When you reach this point, it becomes crucial to conserve every mA in the vital systems.

Various pieces of equipment that are used in different time cycles can be considered from different points of view in terms of power drain requirements. For example, if the transmitter is to deliver 50 Watts of output, at least 50 Watts of power must be supplied to it even if it is 100% efficient. For a system voltage of 13 volts and a 50% efficient transmitter (good) that operates for a continuous two hours per day, 15.4 Ampere-hours are consumed per day.

On the other hand, a receiver that draws 100 mA but runs for 24 hours per day consumes 2.4 Ampere-hours over the same period. The receiver draws only 1.3% as much current as the transmitter, but it consumes 15.6% as much energy per day because it runs 12 times as long each day. With this time ratio (or "duty cycle"), a current drain increase of 1 mA in the receiver is equivalent to a 12 mA increase in the transmitter. Thus it is 12 times as important to find a way to conserve current in the receiver as in the transmitter.

If the receiver is only one of several in the system and there is a fair amount of logic drain involved, it is easy to rival the energy requirements of the transmitter in normal operating cycles.

So, we conclude that receiver drain is important. In emergencies, even all but one receiver could be shut off to save current for the systems critical to the recovery of the repeater, but we start to take reliability risks since failure of that receiver alone would cause total loss of remote control capability. But we could take that risk if necessary, saving energy to sustain the other systems: intrusion alarm, wind-generator tachometer, touchtone decoder, logic memory, battery monitors and active measuring equipment.

If we provide for system self-recovery and take the chance, we could even shut off the last receiver. This could be done automatically when the system is on its last legs and you would lose voluntary remote control. The receiver(s) would be automatically reactivated when the voltage came up due to renewed wind or if the intrusion alarm tripped.

That saves the drain of all receivers, but unless you have been careful in the assignment of mA in the design of the vital systems, you might not be able to hang on long enough after such a drastic measure.

So, let's categorize the equipment in terms of current drain and systems role:

(1) High-drain low duty cycle with little chance of improvement (transmitters, loudspeaker amplifiers, remote motor drives, etc.).

(2) Medium-drain circuits that draw current only when the repeater is activated but not transmitting (receivers, transmitter synthesizer circuits, etc.).

(3) Potentially low-drain circuits on vital systems needed for control, protection and self-recovery.

The last category represents the majority of circuits in which a mA here and there rapidly adds up to surprising levels. If the total power drain of all these circuits can

Reprinted from *The Link*, Bulletin of the Buffalo Amateur Radio Repeater Association, Inc., May, 1975.

be held to a small fraction of the self-discharge current level of the batteries, we have done good work.

Nickel cadmium batteries of the vented type can hold most of their charge after standing for a year, but the batteries we have to work with are of questionable history. It is probably optimistic to expect self-discharge to take longer than 6 months. If that is the case, a 440 Amp-hour bank drains itself at a constant 100 mA. The current capacity is less, but ultimately we would like a capacity of at least 400 A-H.

You can see that the current levels involved are still comparable to the self-discharge rate – hence further effort in conserving current is worthwhile.

In the present WR2ACA repeater, current drain is about 8½ Amperes at full repeat operation, about 500 mA activated but not keyed, and about 120 mA idling. The idling current can be broken down into a 450 MHz receiver drawing about 45 mA, a 2m receiver with preamp at about 55 mA, and about 20 mA for the remaining systems.

It is the idling current that provides the greatest opportunity for improvement; hence in it lies the thrust of this article. It is true that the system as is could be left alone and operate satisfactorily. However, if two or more additional receivers were added to the system, the drain could grow rapidly. Thus, with expansion in mind, our techniques could stand some improvement.

A technique used in the new 2m receiver has solved the problem, at least for the receivers. It is based on a simple idea; turn them off for most of the time!

When the repeater is idling, the receiver serves only one purpose: to detect the presence of a control signal. Suppose we turn the receiver off 9 seconds out of every 10. During the one second it is on, the receiver determines whether or not a signal is present. If one is, the squelch circuit holds the receiver on until such time as the signal again disappears and the squelch closes again. As long as no signal appears, the receiver is on only 10% of the time; hence it draws only 10% of normal drain.

This technique was utilized on the old ACA receivers, but it wasn't effective because the only way to put them in this mode was by remote control. In order to get the system back to normal, it is necessary to hold at least 10 seconds of carrier to make sure you have covered one of the "on" periods, then transmit the correct control codes. A 10 second wait is too long so it wasn't practical to idle the receivers this way for normal operation.

The idea was still attractive anyway because two receivers operating in this way, if normally consuming 100 mA, would only draw 10 mA (or possibly less by using a lower duty cycle).

If you could shorten the "off" time to a tolerable waiting period, it would be necessary to reduce the "on" time by the same proportion to save the same current. The limiting factor boils down to the shortest possible time you can turn the receiver on and reliably detect a signal.

There are many practical pitfalls that must be circumvented to make a receiver turn on rapidly. Assuming that these can be overcome, what are the limiting factors dictated on theoretical grounds?

The answer is easy for the case of a strong signal but somewhat more involved if weak-signal detection is a requirement. For linking receivers it can safely be assumed that the signal is always full quieting since the transmitter location power and signal path is known and fixed.

In this case we only have to have power applied long enough for a signal to propagate from the antenna terminal to the point of detection. Most of this delay is in the i-f filter that determines the receiver's selectivity. FM filters I have measured show delays of 200 to 300 microseconds. If we allow another millisecond for the detector to operate, the "on" time is only 1.3 milliseconds. To save 90% of the power, the receiver can be set to sample every 13 milliseconds! In everyday operation a delay as long as 150 milliseconds is hardly noticeable because it takes many receiver squelch circuits that long to operate; hence, if the sampling period is increased to 130 milliseconds, the receiver current drain is only 1% of its normal value!

The limiting factor in a repeater receiver, as opposed to a linking receiver, depends on how weak a signal you would like to detect. In the noisy signal case, the receiver must be left on for a period of time to make a statistical average of signal power to noise power. This process is called integration.

All weak-signal detection schemes can be boiled down to filtering and integration combinations of one sort or another. Disregarding the filtering aspects for the moment, the sensitivity afforded by an integration system is proportional to the integration time. (There's that nasty word *time* again!) Simply stated, this means that the receiver "on" time must be longer for a weak signal than a strong one, forcing us to choose the "best" compromise between sensitivity, sample interval and the reduction of current. An FM signal having enough noise on it to make copy difficult can be detected in 10 to 20 milliseconds. If we assume the 20 millisecond figure, the receiver can be turned on 5 times per second and still save 90% of its current drain!

After a series of hair-tearing sessions on the ACA receiver, a sensitivity of about 0.1 uV for a reliable squelch break could be achieved. To allow for temperature variations (and Murphy), the squelch setting was tightened to about 0.15 uV. A minimum of 3 samples per second was chosen as a tolerable objective. The result is that the standby drain is reduced from about 45 mA with a preamp to a very desirable 3 mA.

When a signal is received during one of the samples, the squelch breaks and locks the receiver on for the duration of the signal. If the sender subsequently transmits a turn-on code (whistle or touchtone) to activate the repeater, the receiver is locked on for the entire time the repeater stays in the active state. Thus you only have to "wait" for 1/3 second when you turn the repeater on; after that, the receiver becomes as normal as any other 4 channel repeater receiver.

None of this is really new; duty cycling techniques are as old as technology itself. They have been applied in communications to hand-held transceivers with their tiny batteries, an obvious application. But applied to our battery-operated repeater system, it works wonders. If 100 mA of continuous receiver drain was tolerable before, we could accommodate 33 repeater receivers or nearly 300 link receivers (or a mix of the two)!

Of course it is possible to design lower current receivers, too. At the present time this approach would eliminate the integrated circuit limiter discriminators and require more costly transistors. Thus it would increase the number of parts, and certainly increase the difficulty of design.

Pulsing is easier. We could go further – design a low current receiver and *then* pulse it for even greater savings.

Then again, do we really need more than 300 receivers? ■

73 Magazine *Staff*

A Simple RC Substitution Box

-- using a matrix

Those amateurs who are constantly engaged in circuit experimentation or development work have probably purchased or built elaborate R and C substitution boxes. Such substitution boxes greatly simplify the problem of finding just the right component value to use to optimize circuit performance for any desired condition (maximum gain, bandwidth, stability, etc.). For those amateurs who just occasionally build some accessory circuits, substitution boxes would also be very useful when a given circuit doesn't work exactly as it should or when one wants to determine if an available component will do in place of a specified value. Unfortunately, cheap RC substitution boxes don't buy you too much. The increments in which they cover RC values are usually too large and calibration can be poor. One can substitute potentiometers for fixed resistors in a circuit, but their calibration is poor and one has to constantly check the value of a setting with an ohmmeter. The result of all this is that most occasional circuit builders end up soldering in components of a fixed value into a circuit and by trial and error arrive at a successful result or a hopeless jungle of tack-soldered components.

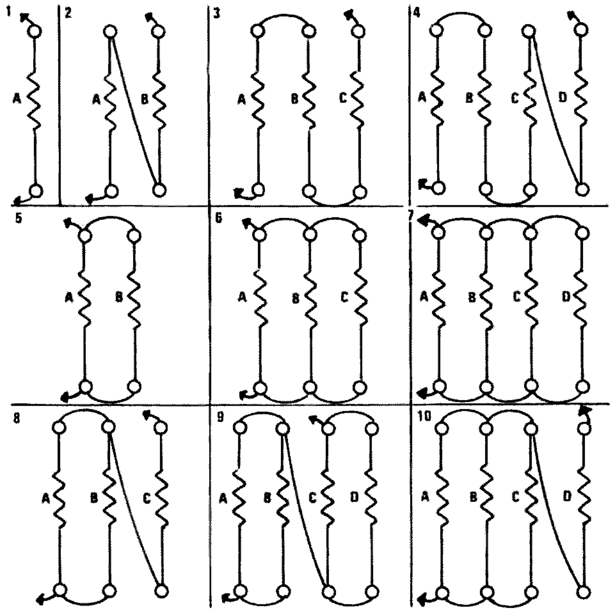


Fig. 1. Interconnection diagrams for four resistors in substitution matrix.

The simple matrix described in this article can solve those problems for the occasional circuit builder at a very low cost and still achieve accurate results.

Most RC substitution boxes, whether they be for resistance or capacitance substitution, make use of switches to select components of various values. However, another approach would be to take a fixed number of components (R or C) of different values and hook them up in as many ways as possible (series, parallel, series/parallel, etc.) to obtain a succession of different overall values. However, how many fixed values should be chosen to keep the circuit complexity within bounds, and what should their individual values be both to obtain a good overall substitution range and have a smooth progression of resultant substitution values?

We'll let a computer solve some of the latter questions, and it's not surprising that a computer comes up with a "binary" type answer. We'll use resistors to demonstrate the idea, but it is equally applicable to capacitors, as explained later. Take four components (resistors) of value 10, 20, 40 and 80 Ohms and let's see how many different ways they can be interconnected. The interconnection possibilities are illustrated in Fig. 1, starting with the simple use of one of the resistors alone and then various series and series/parallel connections. There is nothing new about these circuits, but what is interesting is what happens if one tries all the circuit possibilities and then arranges the resultant values that can be achieved in order. The result, as shown in Table 1, is a wide, smooth range of resultant values going from 5 Ohms to 150 Ohms. Four *properly* chosen resistors have resulted in the equivalent of almost 40 different resistor values progressing in very even steps over a 30 to 1 range!

Table 1 is, in fact, a universal value table. It shows resistance values of 5 to 150 Ohms being achieved by four individual resistors of 10, 20, 40 and 80 Ohms. But, it can be scaled up or down to achieve different ranges with other, similarly ordered values of individual resistors. For instance, the following would be the range of values achievable with the resistors shown:

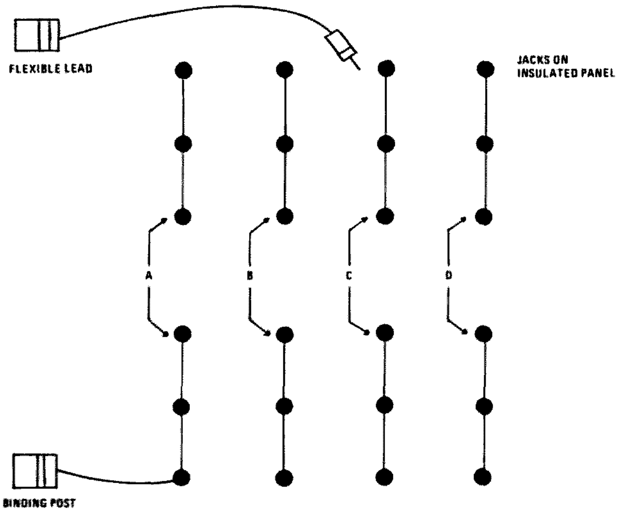


Fig. 2. Matrix panel suitable for either resistor or capacitor usage.

Ohms	Circuit	A	B	C	D
5	7	10	20	40	80
5.6	6	10	20	40	
6.2	6	10	20	80	
6.8	5	10	20		
7.5	6	10	40	80	
8.0	5	10	40		
9.0	5	10	80		
10	1	10			
11	6	20	40	80	
13	5	20	40		
16	5	20	80		
20	1	20			
22	9	10	80	20	40
24	9	10	40	20	80
26	8	20	80	10	
27	5	40	80		
28	8	10	40	20	
29	8	10	80	20	
30	2	10	20		
33	9	10	20	40	80
36	8	40	80	10	
40	1	40			
45	10	10	20	80	40
46	8	40	80	20	
48	8	10	20	40	
50	2	10	40		
56	8	20	80	40	
60	2	20	40		
70	3	10	20	40	
80	1	80			
90	2	10	80		
91	8	20	40	80	
100	2	20	80		
110	3	10	20	80	
120	2	40	80		
130	3	10	40	80	
140	3	20	40	80	
150	4	10	20	40	80

Table 1. Circuit numbers refer to those shown in Fig. 1.

0.5 to 15 Ohms – use 1, 2, 4 and 8 Ohm resistors. 50 to 1500 Ohms – use 100, 200, 400 and 800 Ohm resistors. 0.5k to 15k Ohms – use 1k, 2k, 4k and 8k Ohm resistors. 15k to 150k Ohm – use 10k, 20k, 40k and 80k Ohm resistors. 150k to 1.5 M Ohm – use 100k, 200k, 400k and 800k Ohm resistors.

The resultant values can be checked by anyone using the usual series/parallel resistor formulas for any of the circuits shown in Fig. 1. A more practical question might be how to implement the idea in a simple, reliable form. One could, of course, devise a special switch to achieve all the hookups shown in Fig. 1. Some manufacturers capitalized on this idea. However, a simple home brew way to arrange the four resistors in any of the circuits shown in Fig. 1 is to use a simple plug and jack switch matrix as shown in Fig. 2.

Four columns of six plugs each are used with the individual resistors inserted in the positions shown. The lower "output" terminal is fixed at the bottom of the "A" column. The upper "output" terminal is connected via a flexible wire so it can reach any of the plugs on the upper row of the field. By moving the latter jack wire, plus the use of a few jumper wires between columns, any of the circuits of Fig. 1 can be wired. With a little practice, one quickly develops a system to go from one circuit configuration to the next.

The matrix of Fig. 2 can be built on any insulating material (perforated board stock or plexiglass), using inexpensive non-insulated plugs and jacks. One could permanently solder in the resistors, but if they are made "plug-in," the same matrix can be used for different resistance ranges by plugging in different sets of four resistors. The matrix board is a neat and orderly way of interconnecting the four resistors. But if one had to do it, they could also be interconnected using simple jumper leads by keeping Fig. 1 and Table 1 handy for reference.

Standard value resistors do not come in all the desired values (4k and 8k, for instance). Choose the closest available values to those shown (3.9 and 8.2k, for instance), but measure them once with a good ohmmeter. Usually resistance values, unlike capacitor values, are well within the manufacturers' stated tolerance. Standard, inexpensive 10% tolerance resistors should work fine for most circuit work. But, again, check them first before relying upon them. The tolerances can either build up or cancel out in the various series/parallel circuits. The power rating of the resistors used depends upon the circuit applications intended. For most low level transistor circuits, 1 or 2 Watt resistors will certainly suffice. If one obtains the four resistors for the 0.5 to 15 Ohm range, they should be of the 10 Watt size since they will most likely be used for power supply or audio power amplifier circuit applications.

What about using the matrix for capacitor substitution? Of course, series and parallel resistor circuits have their equivalent in parallel and series capacitor circuits. The circuits of Fig. 1 and Table 1 can be used if one remembers the equivalent circuits. For instance, for 150 Ohms Table 1 calls for the use of circuit 4 in Fig. 1, which is all resistors in series. If one wanted 150 pF (using individual capacitors of 10, 20, 40 and 80 pF), the equivalent capacitor circuit is used – connect all capacitors in parallel. For 5 Ohms, Table 1 uses circuit 7 and connects all resistors in parallel. For 5 pF, connect all capacitors in series. For 30 Ohms, Table 1 uses circuit 9 or AB parallel in series with CD parallel. For 30 pF, use AB in series and then parallel with CD in series. Table 1 can be scaled up or down for capacitors the same as it can be for resistors. The total range for each set of four capacitors will remain a 30 to 1 range: 5 to 150 pF

for fixed capacitors of 10, 20, 40 and 80 pF, 0.1 to 3 uF for fixed capacitors of 0.2, 0.4, 0.8 and 1.6 uF, etc.

Unfortunately, capacitors, and especially electrolytic types, vary widely from their marked value. Tolerances of up to -20 and +40 percent for electrolytics are common. One can build a substitution matrix using disc ceramic or mylar capacitors and rely upon the capacitor values to be close enough to their nominal values for general substitution work. In practice, this means a substitution matrix going up to about 1 uF maximum. Beyond this value, when one has to use electrolytic capacitors to build the substitution matrix, it is imperative that the actual capacitor values be measured if the substitution matrix is to have any reasonable accuracy.

This article has described a simple individual R or C substitution matrix. If the resistors and/or capacitor sets are made for plug-in use, the matrix of Fig. 2 can be used for either type of substitution as required by an individual circuit. With a few matrix boards and several sets of resistor and capacitor plug-in sets, a handful of components can be used to replace *several hundred* for substitution, testing and experimental purposes.

Finally, how about RC combinations such as time constant circuits, low pass and high pass filters? These can also be built for various values and frequencies by combining R and C elements on one or more matrix boards. The variety of values here is so broad that it is impossible to define any table for them. However, by using the known R and C values for the individual RC substitution boards and standard formulas, one can easily develop a duplicatable set of response configurations usable for a wide variety of circuit experimentation. ■

Edward A. Lawrence WA5SWD
1716 Cascade
Mesquite TX 75149

The Compactron Audio Driver

- - three tubes in one

Although transistors are definitely taking over in many areas of electronics, there is still a place in tube-type equipment of modern design for compactrons. The compactron I used in a recently constructed modulator was the 6K11-6Q11. This is a triple-triode, which has two sections that are equivalent to a 12AX7. The remaining section is very similar to a 6C4. So by merely "lifting" the values from the *Radio Amateur's Handbook* or other such source, we can build the complete audio preamp-driver in a single envelope. Fig. 1 shows the schematic I used. I fed a pair of 6L6s, but any pair of pentodes in AB1 up to 6146s could be driven.

Because of the very high gain in such a small area, more than normal care with such things as lead dress must be used to avoid feedback that might lead to oscillation. I found it necessary to include an rf filter at the microphone input, and I shielded the filter with a 35 mm film can. This prevents rf on the microphone cable from getting back into the amplifier.

This audio section would go quite well with K1CLL's rig described in *73*, June 1966, page 18. ■

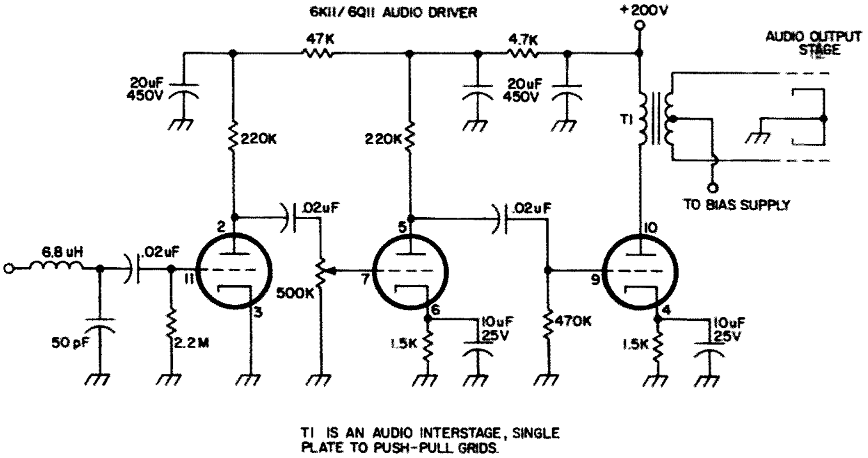


Fig. 1. 6K11/6Q11 audio driver.

Social Events

WAUKESHA WI
JAN 22

The 5th annual Midwinter Swapfest of the West Allis Radio Amateur Club will be Saturday, January 22, 1977 starting at 8 am at the Waukesha County Expo Center. Tickets: $1.50 advanced, $2.00 at door. Reserved tables by advanced reservation only – $1.50 per 4 ft. table. Non-reserved tables first come, first served. Talk-in on 146.52 MHz. Directions: I-94 to Waukesha Co. F, south to FT, west to Expo. For information and tickets write: WARAC, P.O. Box 1072, Milwaukee WI 53201.

FORT WAYNE IN
JAN 23

The annual Fort Wayne Winter Hamfest will be held at Shiloh Hall north of Fort Wayne, Indiana on January 23, 1977. Hours are from 9 pm to 4 pm local time, and early parking is available. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC-ARTS). Admission is $1.50 by advanced ticket, or $2.00 at the door. Table space is available for vendors at $1.00 per half-table (about four feet). For more information or advanced tickets and table reservations (held until 9:30 am), write to Hamfest Chairman, AC-ARTS, Inc., P.O. Box 342, Fort Wayne, Indiana 46801.

CORPUS CHRISTI TX
FEB 4-6

The Texas VHF-FM Society will hold its winter meeting at the Holiday Inn, Emrald Beach, 1102 S. Shoreline, Corpus Christi, Texas, on February 4, 5, 6, 1977. For further information contact: James Linthacum W5LCN, 1802 Daly, Corpus Christi, Texas 78412.

MANSFIELD OH
FEB 6

The Mansfield Ohio Mid Winter Hamfest Auction will be held February 6, 1977 at the Richland County Fairgrounds, Mansfield, Ohio. Prizes, flea market, auction – large heated building. Doors open 8 am. Talk-in 146.34/.94 and .52/.52. Tickets $1.50 in advance, $2.00 at the door. Contact Harry Frierhen K8JPF, 120 Homewood, Mansfield, Ohio 44906 or phone (419) 529-2801 or (419) 524-1441.

TRAVERSE CITY MI
FEB 12

The Cherryland Amateur Radio Club will hold its 4th annual Swap 'n Shop Saturday, February 12, from 9 am to 4 pm at the Northwestern Michigan College in Traverse City. A donation of $1 will include a chance on all prizes. There will be plenty of free display tables for whatever you may wish to bring in electronic equipment and parts. Everyone is welcome and a turnout of over 300 hams and experimenters is expected from all over Michigan. For more information please contact Bill Mader WA8WWM, at (616) 326-6392 or Box 2, Empire AFS, Michigan 49630.

WHEATON IL
FEB 13

The Wheaton Community Radio Amateurs will hold their 15th Annual Midwinter Swap & Shop on Sunday, February 13, 1977, from 8 am to 5 pm, at the DuPage County Fairgrounds on Manchester Road (near County Farm Road) on the west side of Wheaton, Illinois. Some tables will be provided, but bring your own if possible. WCRA invites anyone with an interest in buying or selling new or used electronic equipment to attend this hamfest, which will be inside large, heated buildings at the fairgrounds. Advance tickets (available until February 1) are $1.50, and tickets at the door are $2.00. Write Oran Hiscox WB9JJL, Ticket Chairman, Wheaton Community Radio Amateurs, P.O. Box QSL, Wheaton IL 60187. Commercial exhibitors should write Paul Sexauer W9JTO, at the same address.

GRIFFITH IN
FEB 19

The Lake County Amateur Radio Club's 24th annual banquet is Saturday, February 19 at 6 pm, at the Griffith Knights of Columbus Hall, 1400 South Broad Street, Griffith, Indiana. All the delicious home-cooked food you can eat, wine fountain, entertainment, guest speakers, special awards, door prizes, cash raffles and a dance band after. Tickets are $7.50 each: no door purchase. Write (prior to Feb. 3) to Herbert S. Brier W9AD (W9EGQ), 409 S. 14th Street, Chesterton IN 46304.

VIENNA VA
FEB 20

The Vienna Wireless Society annual Winterfest will be held at the Vienna Community Center. Indoor tables, sales, technical sessions, prizes and food. 8 am to 5 pm. Drawing at 3:30 pm. Admission is $3.00; tables $5.00. Information write Box 418, Vienna VA 22180.

NORWOOD MA
FEB 25

The Norwood Amateur Radio Club will be holding its annual auction on Friday evening at 7:30 pm on February 25, 1977 at the Norwood (Mass.) V.F.W. Post on Dean Street, Norwood. This is just off U.S. Route 1 south.

DAVENPORT IA
FEB 27

The annual Davenport Radio Amateur Club Hamfest will be held Sunday, February 27, 1977 at the Masonic Temple in Davenport, Iowa. Admission is $1.50 advance – $2.00 at the door. Talk-in on 28/88 and 52. Refreshments and tables are available. For info and tickets send SASE to Dick Lane WAØGXC, 116 Park Avenue, So. Eldridge IA 52748.

LAPORTE IN
FEB 27

The LaPorte, Indiana ARC will hold its Winter Hamfest on the 27th of February, 1977, beginning at 8 am (Chicago time) at the LaPorte Civic Auditorium. Good food, plenty of free tables, 50 miles east of Chicago. Talk-in on 01-61 and 94, donation $2 at the gate. Information from LPARC, PO Box 30, LaPorte IN 46350.

Repeater Update

73 will soon be publishing updates to our *Repeater Atlas*. All repeater owners are urged to contact us if their systems have changed from the original listings, or if they have put new machines on the air. Our listings are being computerized, which will make it a piece of cake to keep you informed about the repeater situation. But we can't do it without your help, so get cracking!

Please return completed questionnaire to:

REPEATER ATLAS 73 Inc., Peterborough, New Hampshire 03458

☐ I don't even have a repeater going.
☐ Repeater is private, don't list it.
☐ Repeater is private, list for reference only.
☐ Repeater is open (at least to transients).

Repeater Call ________ Trustee ____________ Sponsor ____________

Location ____________________________ State ________

Input	Output	Access	Range
______	______	______	L A R
______	______	______	L A R
______	______	______	L A R

(Circle one; L is local for up to 15 mile mobile range, A is for up to 35 miles, R is for over 35 miles mobile coverage @15 WERP.)

Autopatch ? open ________ private ________

Notes:

Ham Help

After subscribing to *73* for 6 months, I must say I am impressed with the content of this magazine. As a computer programming student, I find your I/O section very profitable. I need some help in getting my Canadian Amateur Radio Certificate, in the technical areas. Also, anybody in the area with RTTY equipment for sale, please contact

Robert S. Reid
1573 West 65th Ave.
Vancouver, BC V6P 2P9
(604) 263-3620

I have built the "accu-memory" authored by J. M. Garrett WB4VVF described in the August, 1975, issue of *QST*. I also have a "Hal MKB-1" Morse keyboard. For some time while operating one or the other of these two fine units, I have thought how convenient it would be to combine the two pieces of equipment. My problem is how to load the "accu-memory" with the keyboard and how to use it as a buffer to store and release the code on command or automatically. Maybe some of our more knowledgeable readers would be able to help.

Bob Fream WB8OHP
22238 Long
Dearborn MI 48124

I'm willing to help any non-ham who lives in my area get his ticket.

Ed Sieb VE2BAQ
PO Box 296
Cote St Luc, PQ H4V2Y4

We need help. Our recently started Amateur Radio Club at our high school desperately needs equipment. We are doing our best to make money, but we're not making enough. Any cheap or free working equipment would be appreciated. Write us a letter and tell us what you've got.

Michael Harrison WBØNFZ, Pres.
Central High School ARC
116 College Ave.
Flat River MO 63601

Classes, Novice and General, will be offered at Upper Moreland Adult Evening School beginning in January. For the area of North Philadelphia, Willow Grove, Hatboro and Warminster PA, call K3JJO, 643-7300.

W. H. Newell
Box 224
Ft. Washington PA 19034

Anyone in ham land have any manuals on the Heath DX100 or the DX100B? I'd like to borrow or buy.

SSGT Howard H. Ragan
K7ATU/DA4AU
1141-2 USAF SAS
APO NY 09189

I need ham help with theory!

Jerry Otto
5901 Count Turf
Louisville KY 40272
502-937-4384

I have an old Dumont transicom VHF FM unit that was taken out of service at the Fairborn OH Fire Dept. It was given to me by a friend who works there. The model (FCC type #) is 5814-D, Serial #140, and the chassis # is 158030. This is the number I got off the back end of the chassis. The problem: I can't seem to locate a schematic or any other information on the unit. I want to be able to convert it to the 144-148 MHz band. So, could anyone in the country please help me in locating a schematic and other info on the Dumont unit? Any help would be appreciated and I'm willing to pay for the help!

Larry Lawhorn WA4MJQ
1706 Brentwood Rd.
Richmond VA 23222

Wells Chapin W8GI
507 Franklin
Kingsley MI 49649

The Junk Box as an Art Form

-- new use for blown capacitors

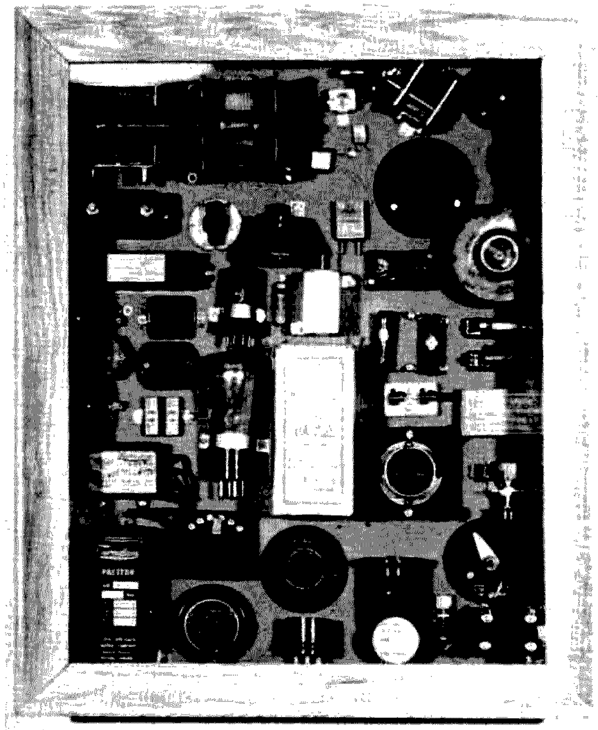
How would you like to have an attractive station decoration and at the same time preserve your antique parts? Well, it's possible by building a shadow box as shown in the photograph.

Over the years one finds that his storehouse of antique parts gradually disappears through loss and breakage. Putting them on a shelf is a real dust catcher, and, in addition, you just don't have the room; besides, a mess of old parts is not attractive.

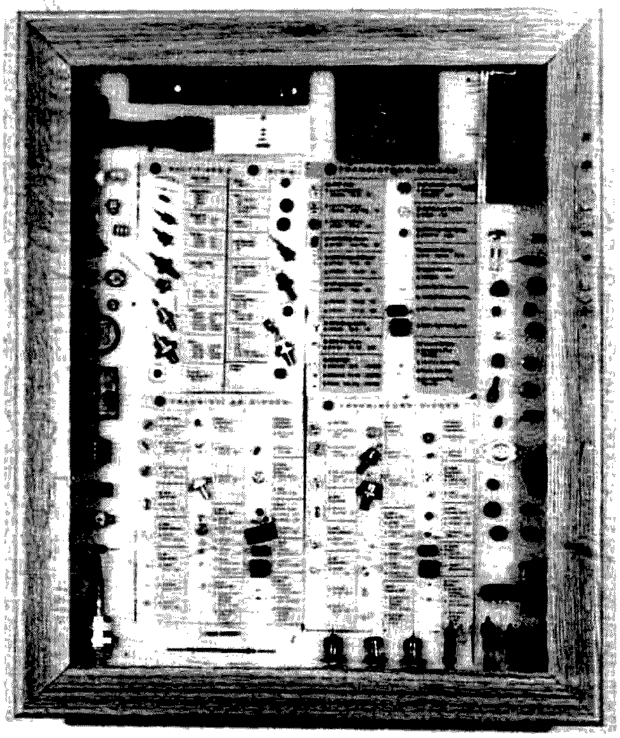
Some of the rare gems in this box are wireless specialty condensers, a Faradon, old dials, a rheostat, an old tube box with the tube removed and mounted next to the box, old variable condensers, a crystal detector, a Thordason audio transformer, and many others. Your junk box is a gold mine.

Select the parts you want to preserve and then try different arrangements. When you have the arrangement you want, measure the width, height and depth you will need and make your box to size.

You can buy the material, the frame, felt, etc., at the local discount store. Use standard sizes of frames. You will find the natural oak frames are best, but others



Shadow box with antique components.



A companion piece that shows circuit boards, integrated circuits, transistors, and the history of miniaturization.

lend themselves quite well. The total cost of my whole project was \$2.75 plus about three hours of interesting labor.

Select frames that have about a ¼" lip on the back so that you can set the shadow box over them and then screw it to the frame. Be sure to apply glue to the glass, as the objective is to make the whole box dust and airproof so the parts will be good for life. Seal the edges to the frame after you have screwed the box to the frame.

The frames I used were 14" x 21" and were just right for these parts. Make the shadow box out of ¼ inch plywood as it is easy to work with and does not split when you nail at the edges. Before you nail, apply a small amount of glue on the edges. Make the sides first and square them up and let set overnight. Then lay on a piece of plywood and mark the back and saw. Then apply glue and nail. Now paint the box inside and out, and after it's dry, glue a piece of red or green felt to the inside – bottom only.

There is not a set procedure for mounting – you will have to improvise as you go. Most all of these parts were mounted with small screws. Some components mounted easily after soldering on small lips, etc. Very lightweight brass sheet was used for clamps, etc. The ¼" plywood gives you plenty of bite to mount any medium sized part. Be sure that the screws don't go through the back and scratch up your wall or table.

This makes a wonderful decoration for the wall of your ham shack – just put screw eyes in the top at each edge and hang it on the wall. This same idea lends itself to a lot of things around the ham shack and perhaps you can even make the XYL happy by making her a shadow box for memorabilia she might like to display. ■

C. Warren Andreasen WA6JMM
P.O. Box 8306
Van Nuys CA 91409

The Mod Squad Goes 220

-- pub serv receiver for pocket 220

There is the slogan "use it or lose it," which we have all heard in connection with the 220 MHz amateur band.

Here in Southern California, I took this to heart and, lo and behold, that band is in my opinion the best band of all! That band now has more activity and more repeaters than 2 meters does in some parts of the country, with many hundred users in the Los Angeles area alone.

The one problem we have is the lack of available equipment. So far only one handheld transceiver has come out for this band and, as of this writing, it is not yet being delivered. We have need for something small, light and not too expensive. What I (with the help of proddings and suggestions of Bill Duhaime WA6NTW) have developed is a sensitive 12 channel (that's correct – *12 channel*) pocket receiver that is an ideal back-up receiver, duplex receiver, and in my case, the remote end of an auto burglar alarm system.

This receiver is a converted MR-2 receiver (Photos 1 and 2). It was designed to cover up to 170 MHz, has built-in nicad batteries, comes complete with charger and is available for about $80 from several sources, including me. When conversion is complete, the receiver has a sensitivity of better than .5 microvolt, and is free from intermod and image problems. The receiver has three filters incorporated in its design, with two in the 10.7 MHz i-f and one in the 455 kHz i-f, and is, in sort, a darn good receiver. It has 20 transistors, including five stages of limiting and a very fast squelch which gives no squelch tail to speak of.

Photos by Herbert Dick

The Conversion

The first step of the conversion is to modify the local oscillator multiplier. The crystal oscillator stays the same, as the crystal will be in range of the normal tuning of oscillator coil T8. Referring to Fig. 1, and the diagram supplied with the radio,

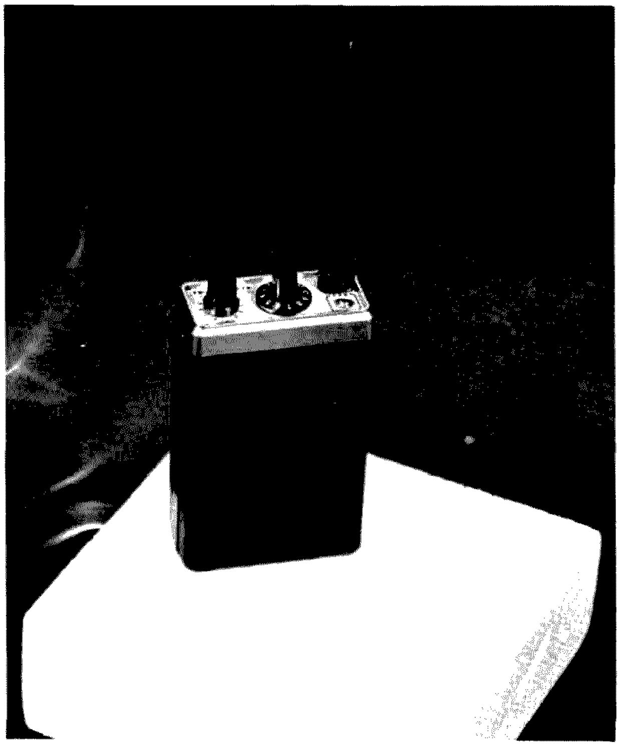


Photo 1.

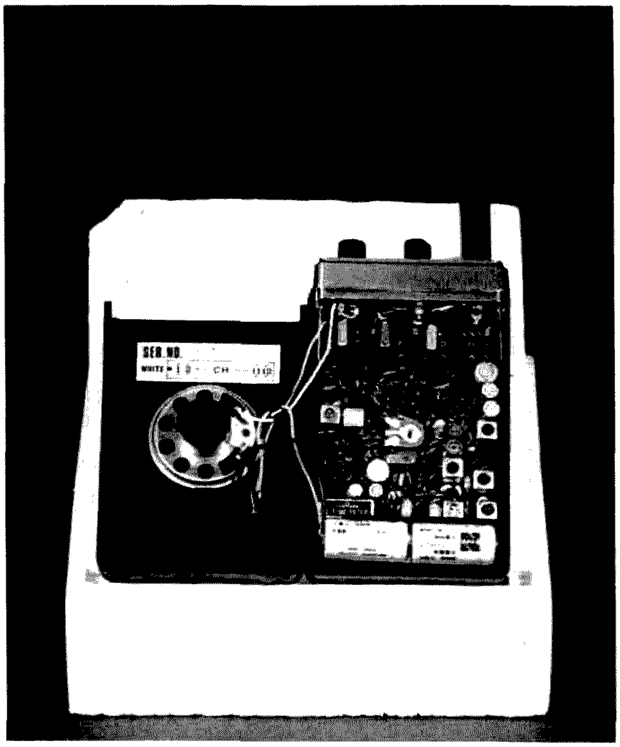


Photo 2.

locate C2. This capacitor is OK as is, but if you wish to use the crystal from a Midland 13-509 receiver, as I did, this capacitor may be removed, making the crystals interchangeable. T8 will now tune with the slug near the top of the coil form. The crystal frequency will be the same as the Midland 13-509, which is the desired 220 Mhz frequency minus 10.7 MHz, divided by 4 (3rd overtone series resonance into 20 pF load capacitance). The next step is to modify T4. This stage is made to quadruple by replacing the 7 pF capacitor (C28) with a 5 pF capacitor and removing one turn from the secondary of the coil.

The method of modifying this, and all following coils, is as follows: Remove solder from can tabs and *carefully* work the can off coil. Be very careful since the coil form will break easily if forced (see Photo 3). As the can pulls clear, note the ferrite cup that will probably stay in the can. Do not lose or break this as it is an important part of the coil. After placing can and cup aside, remove solder from all five pins of the coil form and gently remove this form from the PC board. Next place coil in a soft-jawed vise and gently hold in place (Photo 4). Locate the secondary winding (the three pin side) and using a needle and small soldering iron, gently lift the wire from left end pin (bottom view with 3 pin side facing you). Carefully remove one turn and reconnect wire after removing insulating varnish. Reassemble the coil form by installing back on PC board in the reverse order as removed. This coil will now tune to the 212 MHz range needed and the receiver will now hear a strong 220 MHz signal if one is provided.

The next step is to modify the input tuned circuit by replacing the 7 pF capacitor (C4) with a 3 pF, C1 with a 10 pF capacitor and remove one turn from the secondary winding of T1. This winding is lifted from the same pin as it was in the local oscillator multiplier. Next, the output circuit of this same stage (rf Amp) must be changed. Remove the same one turn from secondary as in the other two coils and replace the 7 pF capacitor (C6) with a 5 pF capacitor. Now go to the mixer input coil (T3) and in a like manner remove one turn from its primary and replace its 7 pF tuning capacitor (C8) with a 5 pF capacitor. The conversion is now complete with the exception of tuning.

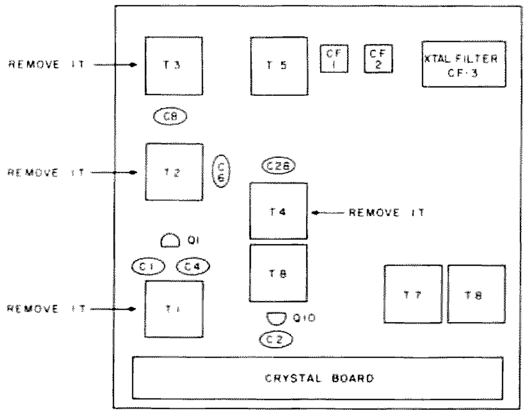


Fig. 1.

Tuning

Place a crystal in a position and select it with the channel switch. With a strong signal source and an attenuator (rotatable beam and distant transmitter), tune the oscillator and multiplier coils for maximum received signal. The tuning of the multiplier is quite critical and should be done with care for maximum sensitivity. Note: The slugs are very brittle and a proper fitting tuning tool (even if home brew) must be used or the slug *will* break. Always attenuate signal until noise is heard and tune for maximum quieting. Following the same procedure, likewise tune antenna coil T1, amplifier output coil T2, and mixer input coil T3. If all is working properly, the MR2 will now work better on the 220 MHz band then many popular rigs work on two meters. I should mention that this receiver works very well on two meters, before the conversion, and is a very good buy for that purpose alone. ■

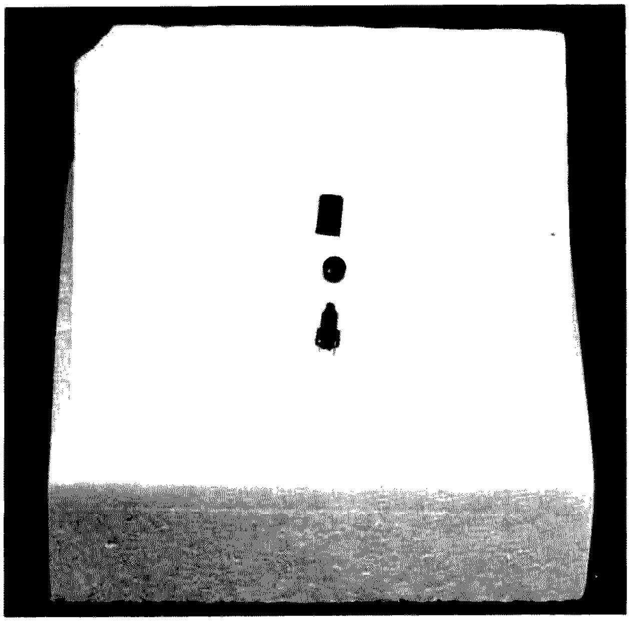


Photo 3.

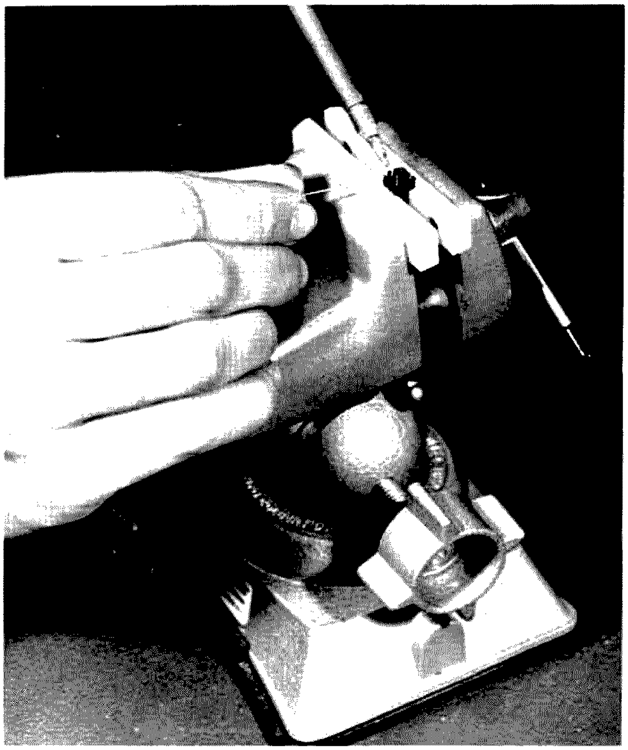


Photo 4.

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Double Sideband: Something New?

- - one for voice, one for SSTV

One of the modes of operation permitted by the FCC for SSTV is the operation on ISB (Independent Sideband). In this mode of operation the voice signals are transmitted on one sideband while at the same time the associated SSTV signal is transmitted on the other sideband. At the present time there are no commercial amateur radio transmitters on the market that have this mode of emission available. Several amateurs have been active on ISB using circuits they have developed for SSB transmitters that use the filter method of sideband generation as described in the SSTV Handbook.[1] My transmitter is a Hallicrafters HT-37 which generates its SSB signal by the phasing method of sideband generation. I decided to try and see if I could figure out a way to get ISB from my HT-37 for my SSTV transmissions. This article presents the results of this effort and shows how I was able to generate ISB from the HT-37 by using an external unit and a very minor modification to the HT-37 transmitter.

The phasing method of sideband generation was first used when SSB appeared in the ham bands. A well-known circuit that has been used by many builders of SSB gear was presented in the G.E. Ham News[2] back in 1950. That circuit was used to develop the SSB transmitter made from the old Command transmitters[3,4] and forms the guidelines for the ISB unit in this article. I first considered just making another exciter like the one in the HT-37, but the unavailability of the proper components led me back to the old standard phasing circuit design used many years ago.

In this ISB system the HT-37 is used to generate one of the two sidebands and an external exciter is used to generate the other sideband. The output of the external unit is fed to the same mixer as that used in the HT-37 SSB generator. Due to the method of heterodyning in the HT-37 to obtain the proper sideband for that particular frequency, it is necessary to manually select the desired complementary sideband when using the external ISB exciter. The particular SSB used for each band is identified from a chart on the front panel of the ISB exciter. The design and operation of phasing type SSB exciters are very well described in the referenced articles and will not be reviewed in this article.

Construction

The unit shown in the photographs was constructed on two separate chassis, one stacked on top of the other. The overall size of the finished exciter is 3½" wide by 7½" high by 12" deep. It is housed in a surplus aircraft equipment cabinet. The top chassis contains all the electronics, and the bottom chassis has the power supply. The power cord and the output connector are at the rear. The front panel contains

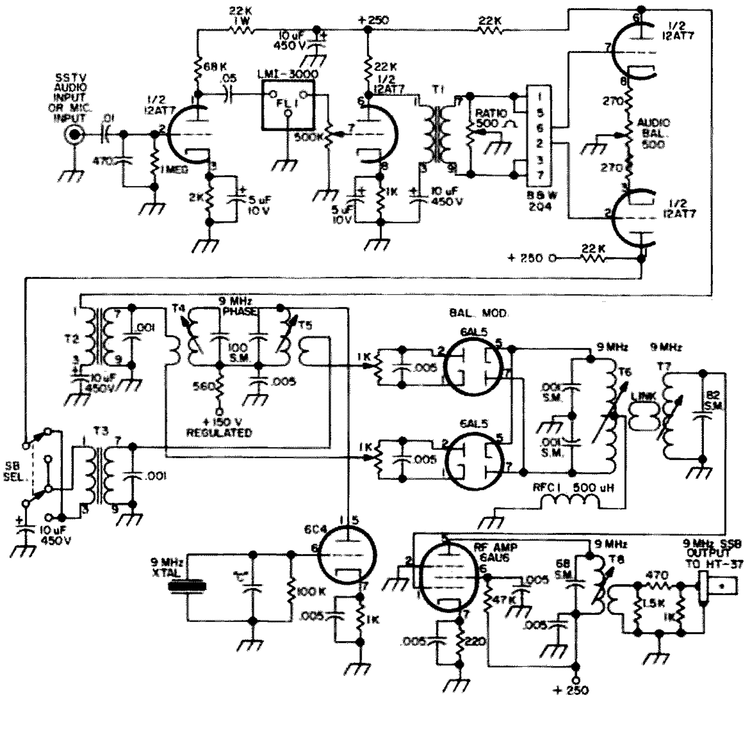


Fig. 1. ISB exciter for HT-37. T1, T2, T3 = Lionel #GH1203-2-H 22k to 600Ω. FL1 = UTC LMI-3000 low pass filter.

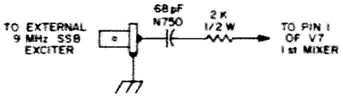


Fig. 2. HT-37 modification.

the audio input connector and gain control, the sideband selector switch, power switch and pilot light. I used a commercial low pass audio filter in the speech amplifier section to limit the upper frequency response to 3 kHz. This filter may be deleted and a filter using TV width coils substituted as shown in the referenced articles. I had an LMI-3000 unit in my junk box, so that is what I used. The other filter will work equally well in this circuit. T1-T3 are surplus Lionel audio transformers of the type used in the reference 3 article. A good substitute would be the Lafayette AR-151. T4 and T5 were made from surplus SCR-522 coil forms. They are 3/8" diameter and have 12 turns of number 20 wire with a three turn link at the cold end. They are padded with a silver mica capacitor to resonate at 9 MHz with the slug about halfway in the coil. T6 is a slug-tuned coil of 5/16" diameter with 8 turns, center-tapped. The link is two turns wound around the center of the coil. The wire on T6 is also number 20 enameled. The link wire is made from single strand plastic insulated number 20 enameled. The T7 and T8 are small ¼" diameter coil forms, slug-tuned and wound with 20 turns of number 30 enameled wire. The link is three turns on the cold end. The coil is padded with silver mica condensers to resonate at 9 MHz with the slug at midrange.

The power supply should provide 250 volts at 90 mA and a regulated 150 volt output at 10 mA. The 80 mF of filtering seems to be sufficient for this unit to provide good dc to the audio and rf circuits.

The modifications to the HT-37 were surprisingly simple. The schematic diagram of the HT-37 shows that the output of the internal 9 MHz exciter is fed to a mixer V7. I decided to feed my external exciter into that same mixer grid. A hole was drilled in the front panel midway between the driver tune knob and the band selector knob. A type BNC connector was installed in this hole. The 68 pF capacitor and the 2k resistor are then wired from this connector to pin 1 of V7. You will find that locating the connector at this position on the front panel of the HT-37 makes for very short leads from the connector to the tube socket. This is the only modification required to the HT-37.

For proper operation of the ISB system, the 9 MHz oscillator in the external exciter must be zero beat with the 9 MHz oscillator in the HT-37 exciter. I accomplished this by monitoring the output of the HT-37 9 MHz signal via the newly installed BNC connector on the transmitter front panel, on a communications receiver (Hammarlund Super Pro, 1945 vintage). The output from the external 9 MHz oscillator was also picked up by the receiver and the detected beat note observed. A padding capacitor was installed across the crystal to pull it down to zero beat with the HT-37 exciter oscillator. The external 9 MHz oscillator was initially several hundred Hz higher than the HT-37 9 MHz oscillator. These two oscillators must be zero beat to assure that the recovered sideband will contain the proper frequency information. If they are not zero beat, and the receiver is tuned so that the picture information has the correct frequency information, then the accompanying voice will not have the proper sound. The adjustment of the 9 MHz ISB exciter is just like any other phasing type SSB exciter and is fully described in detail in reference 4; therefore it will not be repeated here.

Operation

The output of the external ISB exciter is connected to the HT-37 by a 3 foot piece of RG58A/U coax. The SSB system at K7YZZ includes a second hand Heathkit Warrior linear using four 811As in grounded grid. The system must be adjusted so that you now share that power between the two sidebands. This means that you cannot run the same SSB power on ISB as when you operate in SSB. My linear normally runs 200 mA on meter peaks when on SSB. This means that I must not run over 200 mA on ISB, or I will be over-driving that linear. I then have to divide this power between the two sidebands like this: The SSTV signal is fed to the microphone input of the HT-37 and the level adjusted so that the linear is running only around 100 mA. Then the microphone is connected to the external exciter and the gain adjusted so that on speech peaks the linear power amplifier meter moves from the SSTV level of 100 mA up to 200 mA. This means that the two independent sidebands are now sharing the power, driving my amplifier in an acceptable manner. If you wish to run more SSTV power, then increase the gain on the HT-37, but you also

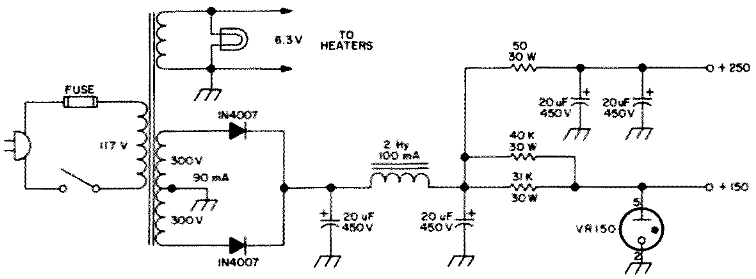
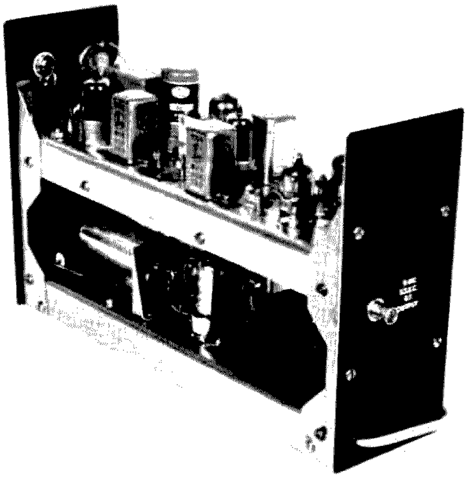


Fig. 3. Power supply.



must reduce the gain on the external ISB exciter so that the voice peaks will not exceed the power amplifier ratings.

I think probably one of the strangest things you will encounter will be the sudden realization that you are being heard at the same time you are being seen. Usually SSTV is a series of pictures followed by voice transmissions. Here suddenly you are being seen and heard at the same time, and it is quite a surprise the first time you work a station that can receive ISB SSTV transmissions. I have not gotten used to that sensation yet.

The unit described in this article has been in service for about two years and seems to hold its adjustments very well. The unwanted sideband suppression is of course not as good as a filter rig, but it is entirely acceptable for a phasing type SSB exciter. I would be pleased to hear from any other builders who are working with phasing type ISB exciters for SSTV. I wish to thank "Gervie" W7FEN, who assisted me with many on-the-air ISB tests. ■

References

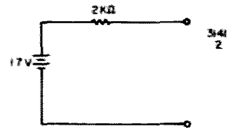
[1] *Slow Scan Television Handbook*, Chapter Eight, Miller and Taggart, a *73* publication.

[2] "SSB Jr.," *G.E. Ham News*, Nov. Dec., 1950 (Vol. 5 No. 6).

[3] "Cheap and Easy SSB," A. Vitale, *QST*, March, 1956.

[4] "Single Sideband For the Radio Amateur," ARRL Publication 1965, Fourth Edition.

Fig. 2. Dc Thevenin equivalent network.



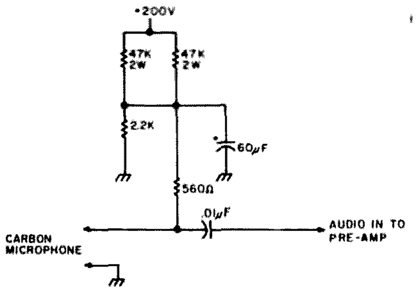


Fig. 1. Typical carbon mike input network.

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Carbonize Your Crystal

-- a return to the carbon mike

Surplus FM units are still a good investment for the ham who wants to get on the FM bands and still have good quality equipment. For less than $100 you can get a tube-type rig which can give you 25 W output and receiver sensitivity better than a microvolt. Also, these tube-type rigs are not as susceptible to intermod and desense problems as some transistor rigs.

One problem with these radios is that they require the use of a raspy sounding carbon microphone. It would be nice to use one of the mikes from around the shack, but that means buying an amplifier to get the low level output from a ceramic, crystal or dynamic mike up to the level that is put out by a carbon mike. Then there is the problem of getting power to the preamp and/or finding someplace to mount it.

A carbon microphone is basically a resistor whose resistance is varied when a signal (voice) is applied to its input. This same definition could be applied to a transistor. So we can replace the carbon mike with a transistor which will give us enough gain to use a lower output microphone. First it is necessary to bias the transistor to "look" like a carbon mike. To do this we adjust the bias to the transistor so that the key down voltage across the transistor is the same as the key down voltage across the carbon mike.

Fig. 1 shows a typical carbon mike input network from a Motorola PA-8664, 30 W transmitter. This can be converted into a Thevenin (dc) equivalent circuit as shown in Fig. 2, or the equivalent can be determined experimentally as shown in Fig. 3. To make the measurements, momentarily key the transmitter and measure the voltage across the carbon mike button as shown in Fig. 3(a). Open circuit the path through the carbon mike and again key the transmitter as in Fig. 3(b). This time you are measuring the Thevenin voltage. Now, exchange the voltmeter for a milliammeter and measure the current drawn key down. The Thevenin resistance can be calculated by dividing the voltage in volts by the current in mA to give the resistance in K Ohms. This combination, as shown in Fig. 3(c), is a dc equivalent that allows you to experiment with various surplus transistors without having to key up your transmitter continually until you strike the right combination to bias the transistor. This equivalent can be set up using a bench power supply or a combination of batteries. It only requires a few mA, so almost anything will do.

Once the equivalent is set up you must choose what kind of mike you wish to use. If it is a low impedance dynamic mike, you will want to use a low impedance input

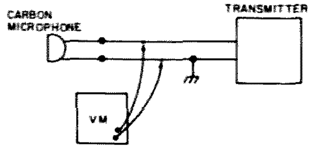

Fig. 3(a).

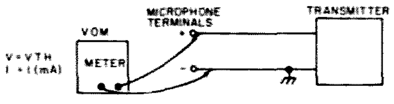

Fig. 3(b).

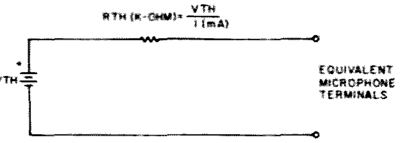

Fig. 3(c).

transistor (BJT) to get the best power transfer. For a high impedance mike, an FET will be required. I used 2N3396s for the BJTs (5/$1.00 from Poly Paks), and 2N3819s for the FETs (2/$1.00, Poly Paks). But any NPN BJT with a beta greater than 150 should work and most n-channel FETs should, too. Just be sure they can stand the open circuit voltage of the mike circuit.

The circuit for high impedance microphones is shown in Fig. 4. The FET requires a dc path from the gate to ground which is provided by the mike itself. While adjusting the bias you may want to put a resistor from gate to ground rather than a microphone. Any value from 50k to several megs should do. R_X is a 1 or 2k pot. Simply turn on the power and adjust the pot until the meter reads the same voltage as you measured across the carbon mike in Fig. 3. As an alternate method, adjust R_X until the voltage between the drain and source terminals of the FET are about one third of V_{th}. After R_X has been set, measure its value and replace it with the nearest fixed value resistor. This circuit has provided satisfactory gain, but if more should be needed it could be obtained by bypassing R_X with a small 5 uF capacitor.

The circuit for low impedance microphones is shown in Fig. 5. R_X is a high resistance pot such as one megohm. The mike does not need to be in place for the bias to be set. Simply turn on the power and adjust R_X so that the voltmeter reads the voltage in Fig. 3, or you can set it again to about one third of V_{th}. Once this is done, replace the pot with a fixed resistor of the same value and you are ready to go. You can get more gain from this circuit by dividing R_X into two resistors and bypassing the junction of these two to ground. But, again, this was not found to be necessary.

Once the mike circuits are biased, it is a simple matter to fit them into a microphone case if desired. This method is preferred but the preamp could be mounted in the control head or even on the chassis of the rig. I have used these circuits for many years and have gotten good audio reports.

Another possible use for the high impedance circuit is a quick and easy coupling circuit for a repeater which would allow taking the audio from the receiver before the audio output stage, so that you could adjust the monitor level without fear of affecting the repeat level. Also, since it has a high input impedance, you could use it for mixing several sources into one transmitter without loading effects as sources are switched on and off (see Fig. 6). ■

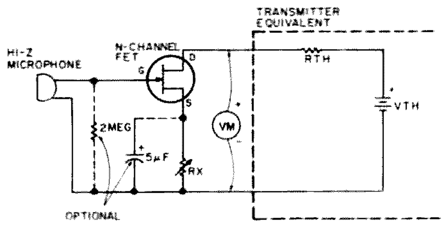

Fig. 4. For high impedance mikes.

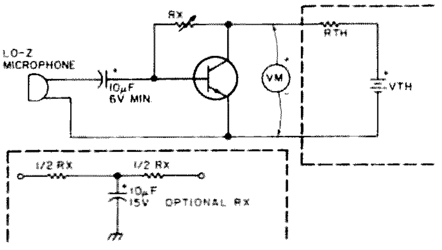

Fig. 5. For low impedance mikes.

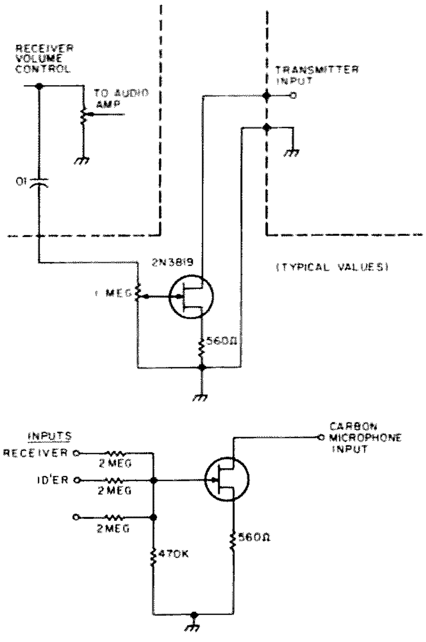

Fig. 6. Typical uses.

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How Does Sideband Really Stack Up?

-- the SSB solution?

More and more, our VHF amateur frequencies are being eyed by commercial interests such as business and government, and personal communications needs continue to escalate. We should have had fair warning several years ago when thousands of surplus FM units were dumped on the market when overcrowded conditions forced splitting 50 kHz channels into 25 kHz ones.

Needless to say, CB Class E on 220 MHz is not the *only* threat to our VHF and UHF allocations. With fire, police, government, VHF marine, common carrier, mobile telephone, industrial, and military users all looking for new frequencies, VHF is overloaded in many metropolitan areas. The fact is that the FCC has opened a *new band* around 960 MHz (*practically microwaves*!), just to accommodate some of these stations![1]

Another fact is that there have been numerous attacks recently on portions of our bands. Class E CB, for instance, was originally proposed for two meters. Emergency medical services included several channels in the 432 MHz band in a shotgun request for frequencies for paramedical support requirements. Offshore drilling interests have successfully gotten a docket for temporary use of 432 MHz for HIRAN, a radiolocation system. This is similar to the "shared" use we suffer on 220 MHz (HIRAN is on a "non-interference" basis), where military radar takes the lion's share! There has even been a plan to replace the six meter band with TV channel 1.[2]

As you can see, "Use it or Lose it" is *not* a dead motto!

I've never been one for throwing up my hands and saying, "Oh well, you can't fight city hall or big business." Amateur radio has thrived because of brave souls who have challenged the status quo by engaging in "impossible" pursuits using "inadequate" resources. Oscars 6 and 7 are ample proof of this. You'll look long and hard to find a "professional" or government satellite that cost only $60,000. The first Oscars cost even LESS!

Back when mobile radio was being studied and it took six Amps just to light up the receiver, industrial engineers studied the strengths and weaknesses of AM, FM, and SSB.[3] AM came out third overall because of its interference problems (heterodynes), susceptibility to ignition noise, higher current drain due to the modulator, and difficulty in obtaining and maintaining a high level of modulation. FM was the ultimate winner because its limiting effect made it less prone to ignition interference, its capture effect reduced co-channel interference, its modulation requirements were simple, and "hands off" operation was characteristic because of positive squelch action and relative immunity to degradation due to off frequency operation (±1 kHz). General design considerations and economy were factors in the adoption of FM.

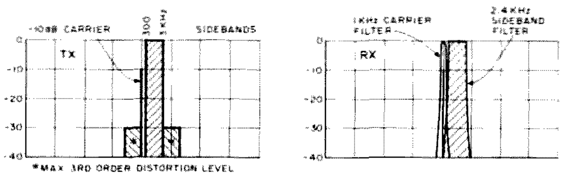

Fig. 1. Phase locked sideband. Note: Receiver sensitivity to the carrier is greater than to the sidebands, due to the 1 kHz filter. This somewhat makes up for the -10 dB level.

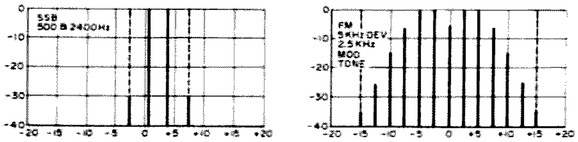

Fig. 2. Occupied bandwidth.

But technology has advanced some since this decision was made, and perhaps it is time to re-evaluate the situation in light of ever expanding needs.

TYPICAL USES

The Small Fleet

Quite a bit of VHF use by small businesses is limited to one or two base stations talking to three or more mobiles. Trucking firms, farmers, security patrols, and road services are a few of the types of users that come to mind.

Normally a 25 or 100 Watt mobile serviced by a 100 Watt base station is used. Converting to SSB would require little *operational* change other than occasional touch-up of a clarifier to net mobiles to the base station frequency. As this can be done with a simple VXO circuit adjusting a few Hz, no operational difficulty exists.

Certainly the tripling of available channels, greater range, and lower current drain far outweigh the inconvenience of touching up a clarifier a few times each day!

Repeater Uses

Many users are tied one way or another to a repeater system. There are more complications with this kind of operation with SSB than with FM, admittedly, but none that are not handleable.

While translators such as those Oscar satellites use work very well, the auto-tuning nature of a phase locked system might be preferred.

Several means of doing this can be used. Basically, an SSB signal with a partially suppressed carrier (-6 or -10 dB) is transmitted and the receiver filters it out, limits it, and phase locks the BFO to it, so that automatic frequency control is maintained. It does not affect the other characteristics of SSB. Bandwidth is still under 3 kHz. Average power drain is still less than FM. Phase distortion is still less than FM. Additionally, a carrier-operated squelch and call-up system can be used very easily.

ADVANTAGES OF SIDEBAND

Excellent Range

Since SSB uses a narrower bandwidth, it has better weak signal efficiency. Its range is about one and one half to two times that of FM.

Narrow Bandwidth

Five kilohertz channels are not out of the question with SSB. Occupied bandwidth of less than 3 kHz yields reasonable fidelity.

Reduced Multipath Distortion

Sideband is narrow and does not depend on carrier phase, so it is far less affected by reflections and phase distortion. Even phase locked systems are not affected, as the BFO, not the transmitted carrier, is used for detection.

Simplicity

While FM transmitters are relatively simple, SSB transmitters are not that much more complicated. SSB receivers are certainly simpler than the FM receiver. Sideband modulation can be set by measuring output power and looking at an oscilloscope. FM deviation requires more complicated (and expensive) equipment.

WEAKNESSES OF SIDEBAND

Critical Tuning

The main criticism of sideband is its requirement of close tolerances. Tuning must be within 30 to 50 cycles for natural sounding reception. While in the days of tubes, crystal ovens, and 10 Amps of heaters in the box, this may have been a real problem; today's rigs with a normal multiplication factor of 12 generally hold a tolerance under 300 cycles. Since SSB is normally heterodyned up to frequency, drift can be kept to 1/12th of this, or under 30 cycles. And, of course, a clarifier system can be used over a limited range, such as plus or minus 300 cycles. Phase lock techniques may also be applied.

More Difficult Noise Suppression

While it's not difficult to recognize the greater difficulty of suppressing impulse noise, etc., in SSB, the problem is not as insoluble as one might suspect. Noise blankers, even of simple design, do very well in most cases. More complicated designs do even better. Frankly, under weak signal conditions sideband is much easier on the ears than FM's "chunk ... chunk ... ker-chunk" and high pitched rushing.

More Difficult Tone Access, etc.

SSB is not compatible with the high accuracy subaudible systems used by many systems at the present time. There would be little problem for audible burst systems, as the frequency tolerances are not as tight as those at subaudible, but subaudible could only be used in a phase locked system. Of course, in a phase locked system the generation of subaudible would be simpler than the present system of requiring only a crystal oscillator of the appropriate frequency near the transceiver i-f. In other words, with a 10.700 i-f a 10.700.100 crystal oscillator would generate the subaudible quite easily. Cost would be about the same, of course.

Range — Putting Numbers to the Theory

Since SSB requires a receiver bandwidth less than 3 kHz for fairly good fidelity (250-3250 Hz), while FM requires about 12 kHz, sideband shows a 6 dB advantage in sensitivity (based on dB = 10 log BW_1/BW_2).[4]

As only one sideband and no carrier is transmitted, there is a theoretical advantage of an additional 3 dB in the transmission of SSB. Sideband doesn't have to split its loyalties between two (or more) sidebands, as does FM.

Assuming this 9 dB advantage, one can easily see that a signal that is 9 dB out of the noise in a sideband system will not even be detectable in an equivalent FM system! While 9 dB S+N/N ratio is by no means a spectacular signal, it *is* readable, especially in an emergency situation.

Looking at it from a different viewpoint, if we assume that 1 uV is a reasonable signal level and that SSB has a 9 dB advantage in system gain, the following calculations give us some idea of sideband's range extending characteristic.[5]

$$e = \frac{3.2\, a\, h \sqrt{ERP}}{d^2\ \text{Lambda}}$$

e = 1 uV
a = 30 feet (base antenna)
h = 6 feet (mobile antenna)
ERP = 25 W x 2 (base power x ant. gain)
d = unknown
Lambda = 2 meters

Shifting the formula around yields:

$$d^2 = \frac{3.2 \times 30 \times 6 \times \sqrt{25 \times 2 \times 1^*}}{1\ \text{uV} \times 2\text{m}} = 2036$$

d = 45 miles

Adding the 9 dB effective gain of the SSB system, we have:

$$\text{Power gain} = \frac{9\ \text{dB}}{10}\ \text{antilog} = 7.9\ \textit{times}$$

$$d^2 = \frac{3.2 \times 30 \times 6 \times \sqrt{25 \times 2 \times 1 \times 7.9}}{1\ \text{uV} \times 2\text{m}} = 5724$$

d = 75 miles

As one can see, the advantage is about 1.7:1 (75/45) for SSB over FM.

continued

*25 W x 2(tx ant gain) x 1(rx ant gain)

Practical Experience

With the introduction of the Echo II by KLM a short while ago, many hours of experience with VHF sideband have been logged. Since the rig is solid state, it is a natural for mobile, and many have put the rig into mobile service.

I've been involved with this mode for some time, and have noted the superiority of sideband over FM for simplex work in the rolling hills along the California coast. Between my home in Santa Cruz and my job in Watsonville (some 25 miles away), I have had only fair results with most FM stations. With SSB I am able to get very good signals from even a 3 W PEP station over the same distance, and I work several San Jose area stations with good signals (about 40 miles, through 3000 foot mountains).[6]

San Francisco Bay area stations have little trouble working simplex from mobile to base from almost anywhere in the area (about 65 miles long by 30 miles wide) and frequent contacts outside the area are logged. In fact, higher powered stations (70-140 W) are consistently working out to 125-150 miles from their mobiles, with occasional contacts out to 320 miles.

Cost Effectiveness

The introduction of the ICOM IC-202 two meter SSB walkie-talkie demonstrates clearly that the cost factor of SSB need not be higher than that for FM. This unit lists for about $270 in the U.S. Considering that the 202 has bandswitching (4 bands), VXO (200 kHz), CW, S-meter/RFO meter, noise blanker, and several features not required for normal commercial service, its price is comparable to current FM rigs. It is also well designed in technical areas. Measurements at SBE on two separate units showed transmit distortion products to be -30 dB below each tone of a two tone test (-36 dB by ARRL methods). Receiver intermodulation was 70 dB (+10 kHz and +20 kHz). Receiver sensitivity was 0.125 uV @ 10 dB S+N/N ratio. The noise blanker is quite effective, and AGC holds the audio to less than 15 dB change from 0.3 uV to over 1,000 uV.

A Chance to Participate

This is where amateur radio can do something that is in keeping with the highest tradition of its service. We can experiment with something that the commercial boys have written off (much like they wrote off those "useless" frequencies above 2 MHz years ago). Some of us on the West Coast have taken a tip from the Oscars and kicked around the idea of a sideband translator in the middle of California. Considering the direct distances common to SSB, much of the state could be covered by such a machine. Anyone interested should contact me. Others should take up the task in other areas and with other ideas (such as phase lock techniques, tone squelch, etc.).

We've already seen the potential of the mode, but more data and more active stations are needed. It's lots of fun, too, by the way! See you on two sideband? ■

References

1 *HR Reports*, various issues, 1975.

2 *Ibid.*

3 *Analysis of AM, SSB, and AME*, W. P. Henneberry, 1965, Technical Material Corp. publication; *Report #R-7305*, Office of Chief Engineer, FCC, November 1973; *First Primer on SSB*, 3rd Printing, 1963, p. 11.

4 "JUP on FM," *CQ*, Norm Sternberg W2JUP, May 1974, p. 46.

5 "Sensitivity, Noise Figure, and Dynamic Range," *Ham Radio*, Jim Fisk W1DTY, October 1975, p. 8.

6 "The KLM Echo II" (New Product Review), *73 Magazine*, James Eagleson WB6JNN, October 1975, p. 16.

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Son of the Overload Relay

- - if you can't buy 'em, build 'em!

In theory, an overload relay should be part of every amateur installation, especially those running high power. When placed in the negative high voltage lead, these protective devices can prevent many an expensive headache. These relays used to be listed in all the ham radio catalogs, but they are often difficult if not impossible to locate in the modern electronics emporium. However, it is relatively easy to utilize an inexpensive surplus item and to come up with a suitable overload relay. This should prove to be a worthwhile addition to any ham rig.

A surplus 24 V dc relay from the Command Set Unit is used in this circuit. This item is number 7735 and is found in the small tune-up unit, BC442, found in every complete aircraft installation. Hundreds of these units are gathering dust in ham shacks across the land, and in case you may not have a spare BC442 on hand, they are still available on the surplus market at prices as low as $5.00. For this price you will not only obtain the necessary relay, but also a very accurate and rugged rf meter with expanded scale. If your luck holds out, you might even find a surplus 50 uF vacuum condenser hooked into the back of the unit.

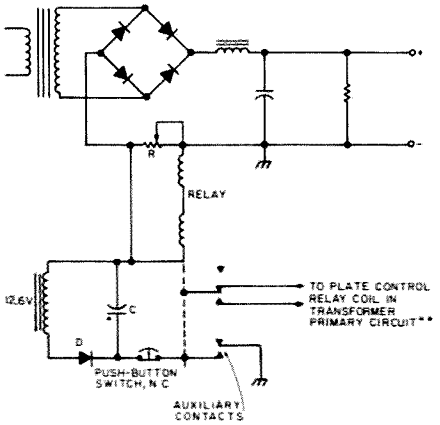

*Fig. 1. C — Electrolytic filter condenser, 100 uF (minimum value, preferably 250 uF), 25 V; D — Diode, ½ Ampere, 100 piv or more; Ry — Relay, part no. 7735 from Command Set Unit, BC442, resistance approx. 170 Ohms; R — Suitable for current drain, suggested starting point is 3 Watt, TV type 100 Ohm potentiometer; SW — Normally closed, push-button switch. **Note 1: Relay contacts may be used to control transformer primary directly if primary current is 5 Amperes or less. Note 2: If power transformer also furnishes filament supply, the main set of contacts may be used to open the high voltage, either in positive or negative lead, since the relay is insulated for high voltage on these contacts.*

Referring to Fig. 1, we note that when a pull-in current of some 90 mA is applied to the relay coils, the normally closed set of contacts at the end of the relay arm will now open. However, unless we employ some sort of "latching," the relay will continue to oscillate back and forth as long as the overload exists. To prevent this, the auxiliary set of contacts (normally open) are used to connect a small dc voltage to the relay coils, thus keeping the relay energized once it has been actuated by an overload.

This auxiliary voltage can be easily obtained from a small 12.6 V transformer, since only 100 mils are required at most, and even this small load is of an intermittent nature. The 12.6 V ac is rectified with a small silicon diode and filtered with a low voltage electrolytic condenser. This will give approximately 17.5 V dc, more than adequate for holding the relay in the "overload" position once it has been actuated. Or you might use a 6.3 V ac transformer with a voltage doubling circuit.

If and when the overload is removed, a quick push upon the release button will interrupt the holding current, thus restoring the relay to its normal position. Should the overload persist, the relay will be triggered again, thus protecting your valuable equipment. The purpose of the resistor R, wired in parallel with the relay coils, is to allow individual adjustment so that the relay will not kick out at normal operating currents.

The setting of the variable resistor is determined by the dc resistance of the relay coils, roughly 170 Ohms, and the amount of current that the operator desires to bypass around the relay coils. For example, assuming you want the relay circuit to kick out at 300 mA, it would be necessary to shunt a resistor of approximately 65 Ohms across the relay coils.

Some experimenters may object to the drop of 10 to 15 V when the relay is in its normal position. This is a very small loss when it is compared with an operating potential of some 2000 to 3000 V. However, for the ham running low power, the relay coils may be rewired in parallel in order to operate on half the dc voltage first mentioned for hold-in. In this case, this would be approximately 9 V dc. This can be obtained from a 6.3 V filament transformer, plus the necessary silicon diode and low voltage electrolytic filter capacitor.

In this lower voltage application, the current is roughly doubled, so it would be advisable to increase the

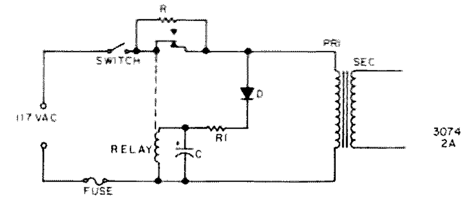

Fig. 2(a). Surge suppressor circuit, primary. For 1 kW (ICAS) power supply. Per Radio Handbook, *17th Edition, page 727. C — 800 uF, 50 V; R — 5 Ohms, 50 Watts; R1 — 600 Ohms, 10 Watts; Ry — 24 V dc, 280 Ohms (typical); D — ½ Amp, 400 piv.*

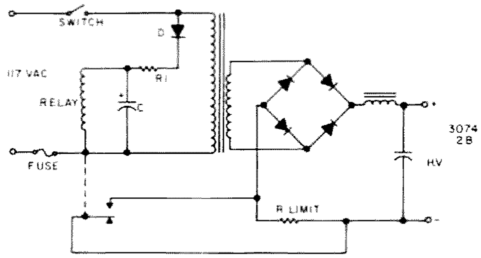

Fig. 2(b). Surge suppressor, secondary. D — ½ Amp, 400 piv; R1 — 500Ω 10 W, W.W.; C — 500 uF, 25 V; Ry — part No. 7735 from BC442; R limit — according to power, suggest 25Ω per 100 volts.

size of the filter condenser. Such a setup would be very suitable for a small linear amplifier using several TV "sweep" tubes in parallel. Some hams may find it inconvenient to ground the circuit at the two points shown on the schematic. This is overcome quite easily by mounting the relay on a small piece of bakelite. In this case, the two points in the circuit with ground connections must be "lifted" from ground and connected together.

Knowledgeable hams will spot a further function for this relay. It makes a fine shorting relay for surge suppressor use in power supplies. Most ham rigs, with condenser input, use this protective circuitry, but locate it in the primary lead to the HV transformer. This is done since suitable relays with good high voltage insulation are not usually available to the home constructor.

Commercial rigs, on the other hand, generally place the surge suppressor in the secondary of the plate supply. The current limiting resistor then becomes considerably higher in value than it would be when put in the primary circuit, roughly in proportion to the ratio of voltages. If a 120 V circuit were using a 20 Ohm resistor to limit current inrush, then a similar wattage resistor would be placed in the secondary circuit; but if the supply delivered 1200 V, the resistor ought to be roughly 200 Ohms. This would limit the inrush of current to a maximum of 6 Amps.

It is best to be on the safe side and to go to a slightly high value of resistance, rather than too low. As an example of commercial practice, the surge suppressor circuit in a 25 kW commercial television transmitter uses a 2500 Ohm, 200 W resistor, to limit current inrush to a 36 uF bank of filter condensers operating at 6500 V dc.

The values listed under Fig. 2(b) represent a compromise. Other R-C values may be used, but they will alter the time constant. ■

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No-Wire Antenna Switch

- - a clever remote system

It seems we are living in a period of shortages and, in case you hadn't noticed, we hams seem to be facing another shortage, that of coaxial cable. I don't know exactly what has caused this shortage but I do know that coax is getting tougher to get. This article describes a remote switch that can result in a substantial savings in coax and may simplify multiple antenna systems.

Originally I came up with this idea to feed a tri-band quad. Now, the quad is a fine antenna and the fact that it can easily handle three bands makes it even better. However, there is a little problem in feeding three driven elements on one antenna. Neither three feedlines nor a matching system appealed to me, and neither did using three hundred feet of RG/8U. The result was a remote switch mounted on the boom of the quad with one feedline to the shack and separate lines from the boom to each element. This saved quite a bit of coax but added a control line for the remote switch. There had to be a better way.

After some experimentation, a remote switch was perfected that did not need a separate control line, used inexpensive relays for switching, was small enough to mount on the boom of the antenna, and did not cause a noticeable increase in swr. In order to eliminate the control line, the antenna coax was used to carry dc to the relays while also carrying rf to the antenna. This dual use of a feedline is a very common practice in TV antenna preamps where the preamp is mounted on the antenna. The feedline carries power to the preamp and signal back to the set.

To accomplish the necessary switching, two relays are required. With both relaxed, the 20 meter element is connected to the main feedline. With one relay energized, 15 meters is connected, and when the other relay energizes, 10 meters is connected. To make independent selection of the relays possible, steering diodes are used in series with each relay. Then by simply reversing the polarity of the control voltage, either relay may be energized.

Remote control is handled at the operating position by the control unit, which houses a simple power supply. Referring to Fig. 1, rf is fed into the control unit at J1, passes through C1, and comes out at J2. RFC1 is used to prevent rf from entering the power supply while allowing the dc voltage to be applied to the rf line. Capacitor C1 blocks the dc from getting back into the transceiver or linear. Switch S1 is a center-off slide switch and is used to provide either a positive or negative voltage to the rf line.

At the remote switch end of the system, the rf passes through C2, through the contacts of relays K1 and K2, and out to the appropriate antenna. If no control voltage is applied to the line, rf will be fed out to J4. If a positive voltage is applied at the control unit, relay K1 will energize and rf energy will be fed out to J6. If a negative voltage is applied, relay K2 will energize and the rf will be switched to J5.

In constructing this project, it is necessary to use high quality relays for K1 and K2. Since they will probably be mounted up on the tower or even on the boom of an antenna, they must be reliable. The relays used here were surplus types of the hermetically sealed variety and had 24 volt coils. Keep in mind that, if you are using long runs of coax, there will be some loss of voltage at the relays due to the dc resis-

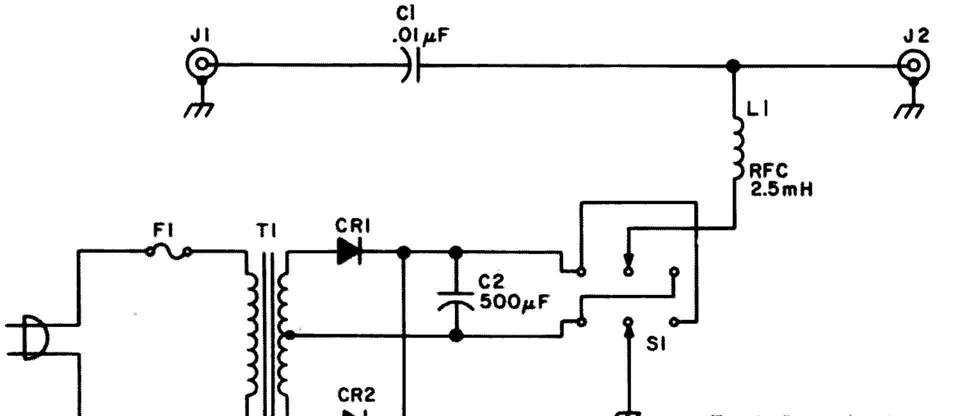

Fig. 1. Control unit.

tance of the cable and connectors. For this reason I do not recommend using relays with less than 12 volt coils. For example, the 24 volt units I used draw very little current and thus cause very little voltage drop to occur in the line. Also, the capacitors used at C1 and C2 should be capable of handling the rf power you plan to use. At the 200 Watt PEP level, I have found high quality disc ceramics satisfactory, but at higher power levels I recommend using transmitting type capacitors.

The power supply components are not specified because they will depend upon the relays used. Typically, a filament transformer and 1 A diodes should be satisfactory. Use enough capacitance in the power supply to keep the relays from chattering.

The remote end of the system should be built into a watertight container having appropriate mounting hardware to attach it to your tower or wherever you plan to locate the unit. Use coaxial cable to connect between the jacks and the relays, and anywhere the rf path is more than 1½ inches. This should result in a system with almost no reactance to cause high swr. Although I could not measure insertion loss on my unit, it appears to be very low. Below 30 MHz, I cannot tell any difference on my swr indicator when using the switch or connecting directly to my dummy load. At 2 meters it results in about 1.5:1 indicated swr. Since I only use it on HF, the swr is no problem.

This system of remote control has many possibilities other than those mentioned here. For example, if you only need it for two antennas, use only one relay. Perhaps with a little work this system could be used to switch the pattern on a set of phased verticals or wire antennas. All you have to remember in expanding upon this system is that the capacitors block dc and look like a short to rf, while the rf chokes pass dc and block rf. I have used this method in conjunction with a standard rf switch to work up a five-band antenna switch using three feedlines. Separate lines were used for 80 and 40 meters since these antennas were not located near each other, while 20, 15 and 10 meters used a single line. The saving in coax has been more than enough to offset the cost of building the switch, and not having the extra coax lines running into the shack has helped to clean up my operating area. I think you too will find this a useful and money-saving addition to your shack. ■

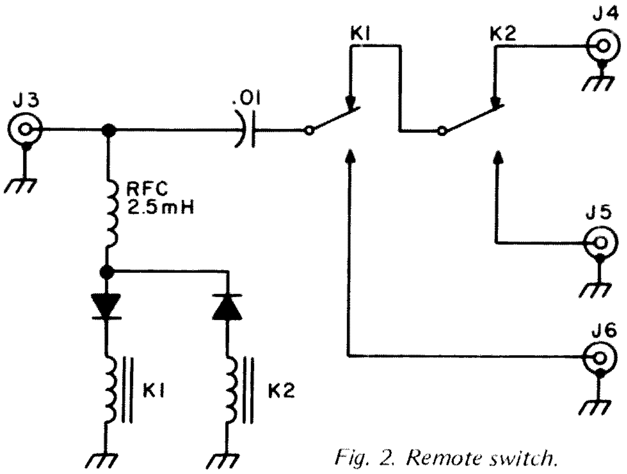

Fig. 2. Remote switch.

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The Beeper

-- NASA-type beeping

For some time now, we have considered using the "begin/end" beep which NASA traditionally uses for all voice space communications. Its potential use in amateur radio, whether on the low bands, the two meter repeater band, or, for that matter, any phone band, seemed obvious. Perhaps the main concern with high noise QSOs, be it QRM, QRN, or simple wind noise when mobile, is trying to identify when the mike on the other end has been keyed or dropped. A device similar to this one has been incorporated into some repeaters, but usually only as an "out" indicator.

The specifications we desired for such a device were clear. It would:

1. Automatically initiate a beep when the mike is keyed either on or off.
2. Produce a different frequency beep for each status. We preferred to use a high tone going in and a low tone coming out.
3. Produce the tone for only about one half of a second and hold the transmitter in while it was being produced in the "out" state.
4. Be totally solid state with no use of relays or electromechanical devices.
5. Be inexpensive and easy to build, with readily available parts.

The final version was designed specifically for the Kenwood TS-520 transceiver, but a relay option was added to allow use with any transceiver or transmitter. The unit operates conveniently from a 6 V dc power cord used for calculators, tape recorders, etc. In this sense, no power supply was needed. The power cord we used was bought from a clearance supply of calculator power cords, for which there was no longer a calculator made. They are available new for about $4.99, but most surplus houses have them for half that. We found that a few power cords we tried would not work properly, causing the unit to switch back and forth between tones. This was traced to a poorly regulated supply, which caused the unit to

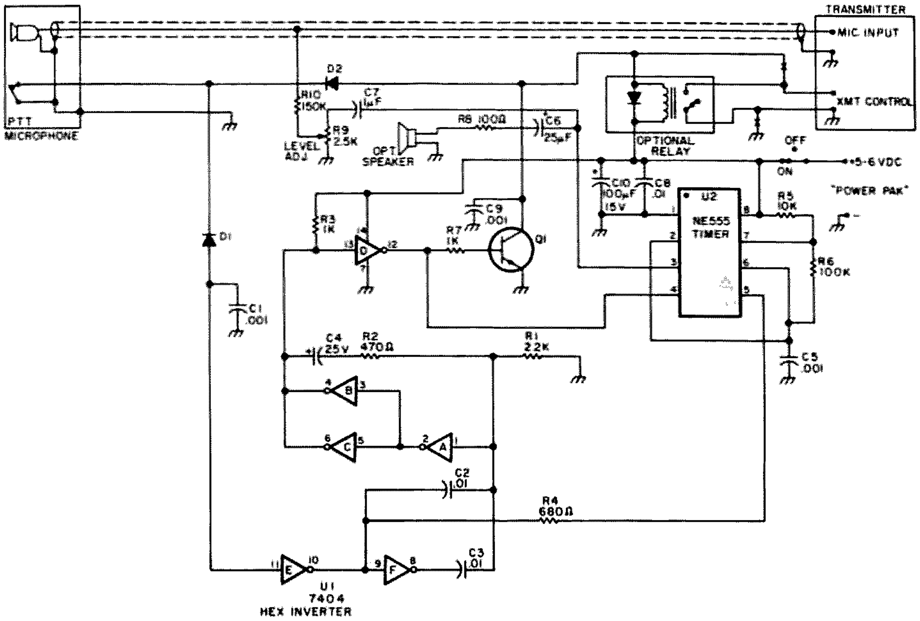


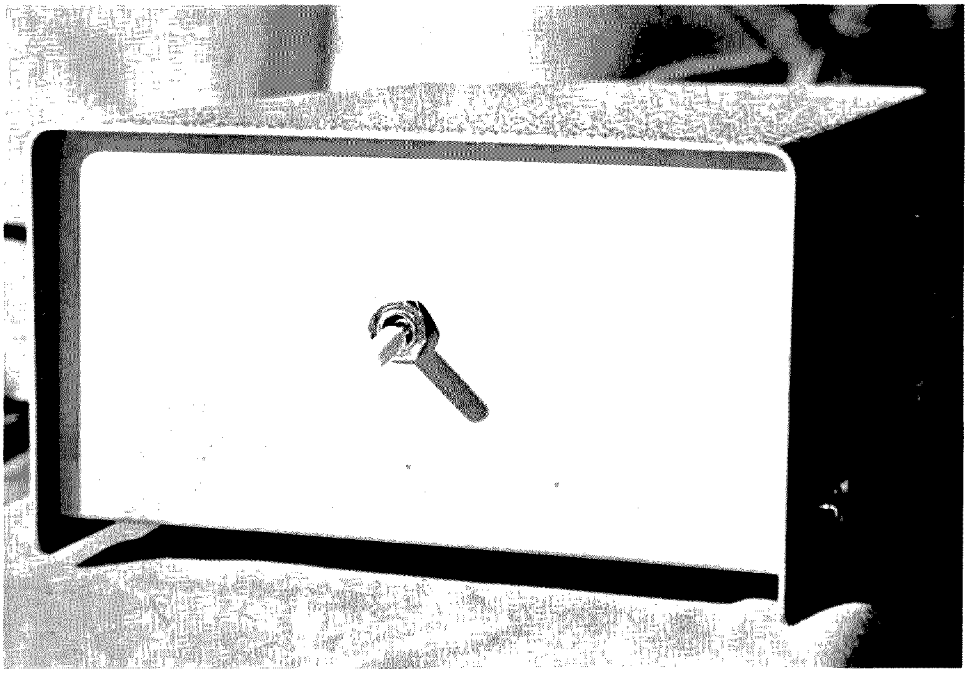
Fig. 1.

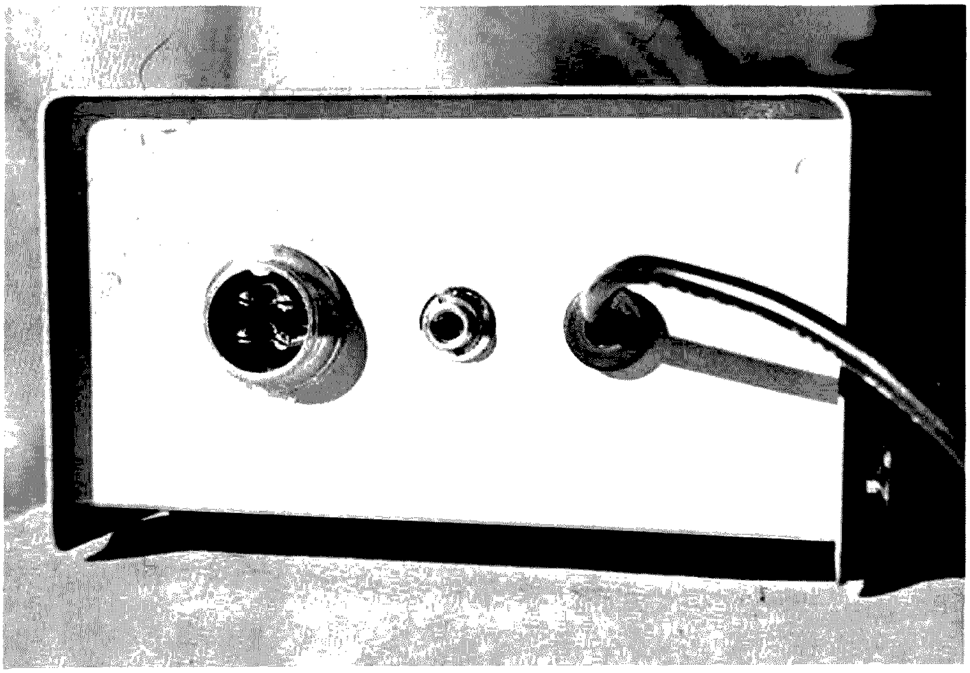
switch on and off. The unit, of course, works fine on batteries, so this method can be considered for portable operation. Also, our final version incorporated a speaker so that the operator could be assured that the unit was functioning properly. This audio feedback adds less than $1.00 to the cost, and can be disregarded if not desired. (However, this option is an attention-getter.) Finally, the beeper does not interfere with normal transceiver operation when turned off. No disconnection need be made at any time.

Basically, the "NASA Type Beeper" uses a 555 IC as a tone generator because of its ability to directly drive a speaker, be turned on and off by a TTL control signal, and vary the frequency of the tone by using the "modulator input" pin. A 7404 hex inverter provides buffering functions and a monostable multivibrator with a one half second time duration. Inverter sections A, B, and C form the monostable multivibrator. When depressed, the PTT microphone switch supplies a ground through isolation diode D1 to inverter section E. Its output goes high, sending a positive pulse through capacitor C2 and causing inverter F's output to go low. This sends a negative pulse through capacitor C3. Capacitors C2 and C3 are connected together and drive inverter A, the first stage of the monostable timer. It would appear that the opposing pulses through C2 and C3 would cancel, but the output stage of each inverter section is far better able to produce negative pulses than positive ones. A good scope shows a healthy negative pulse at the input to inverter A whenever the mike button is closed or opened. Thus the one half second time period is initiated at the beginning and end of each transmission. During this time period, the output of inverter D goes high, enabling the 555 timer and turning on transistor Q1, which is used to hold the transmitter on during the "out" status. The transmitter thereby "waits" for the "out" beep, even though the PTT switch has been turned off. The "modulation" pin of the 555 is connected through resistor R4 to the output of inverter E, so that, depending on whether the PTT switch is open or closed, a different frequency tone is produced. The tone is fed into the high impedance mike line through trimmer R9 and resistor R10. R10 should be a 10k for a low impedance microphone. The trimmer allows the tones' level to be controlled.

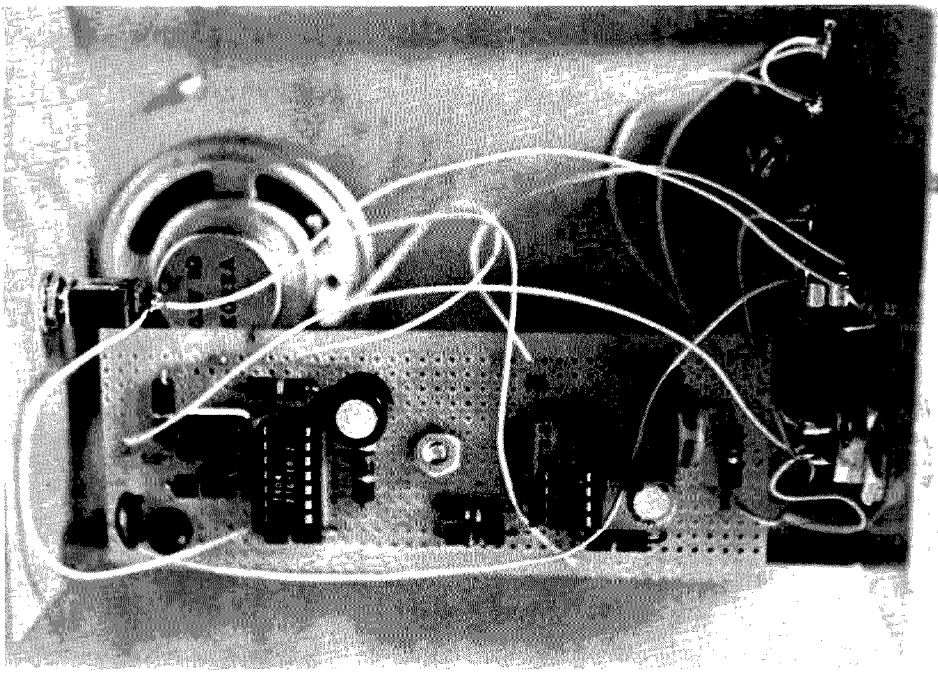
If the transmitter you construct this unit for requires the completion of a voltage higher than 30 volts, a negative voltage, or a system other than the grounding of 12 V dc as in the Kenwood TS-520, then the relay option should be used. The relay should operate on 6 volts at low current to reduce power consumption. Radio Shack offers an SPST 6 volt low current relay that is ideal (see Parts List).

Construction hints: The unit fits most conveniently in a 6" by 4" by 2" minibox, which allows extra room should you want to incorporate the relay. Point-to-point wiring was used on our





Photos by John Farquhar



unit, as it seemed less bother than making a printed circuit board. The ICs were mounted in sockets to allow quicker servicing or troubleshooting, but this is an "extra" and the ICs could be soldered into the circuit. One single stand-off was positioned in the center of the board, using a single screw and a few nuts. All interfacing connections were placed at the rear for cosmetic reasons and only the power switch was placed on the front panel. A few holes were drilled in the bottom of the case and a small 8 Ohm speaker was epoxied to the case. One note of caution: Shielded cable should be used between the transceiver and the beeper to prevent rf pickup.

After continual use of the unit for a month or so, we found the beeper to be a novel and useful addition to the station. We have experienced no confusion in QRM situations as to when we have switched back to the other station. In fact, operating the transceiver without the beeper on leaves quite a void now and something just seems missing. Happy beeping! ■

Parts List

R1	2.2k
R2	470 Ohm
R3	1k
R4	680 Ohm
R5	10k
R6	100k
R7	1k
R8	100 Ohm
R9	2.2k trimmer
R10	150k
U1	7404 hex inverter
U2	555 timer
C1	.001
C2	.01
C3	.01
C4	25 uF
C5	.001
C6	25 uF
C7	1 mF
C8	.01
C9	.001
C10	100 uF @ 15 V

Q1 – General purpose NPN

D1, D2 – General purpose silicon diodes

Relay (optional) – Radio Shack 275-004

Miscellaneous: SPST switch, connectors, shielded cable, power cord, speaker, mini-box

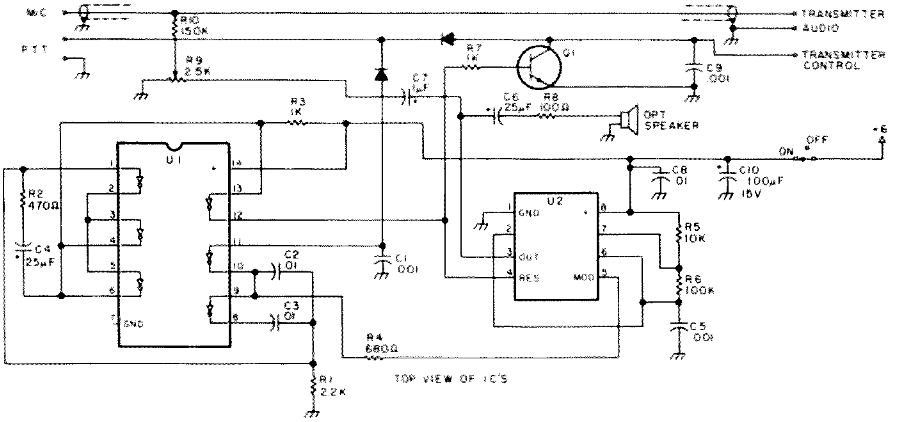


Fig. 2. Pin diagram.

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Ham Phone Answering Service

-- leave messages

The advantage of crystal-controlled transceiver systems for dependable short range communications is known to many amateur radio operators. This is especially true on two meter FM where many amateurs use

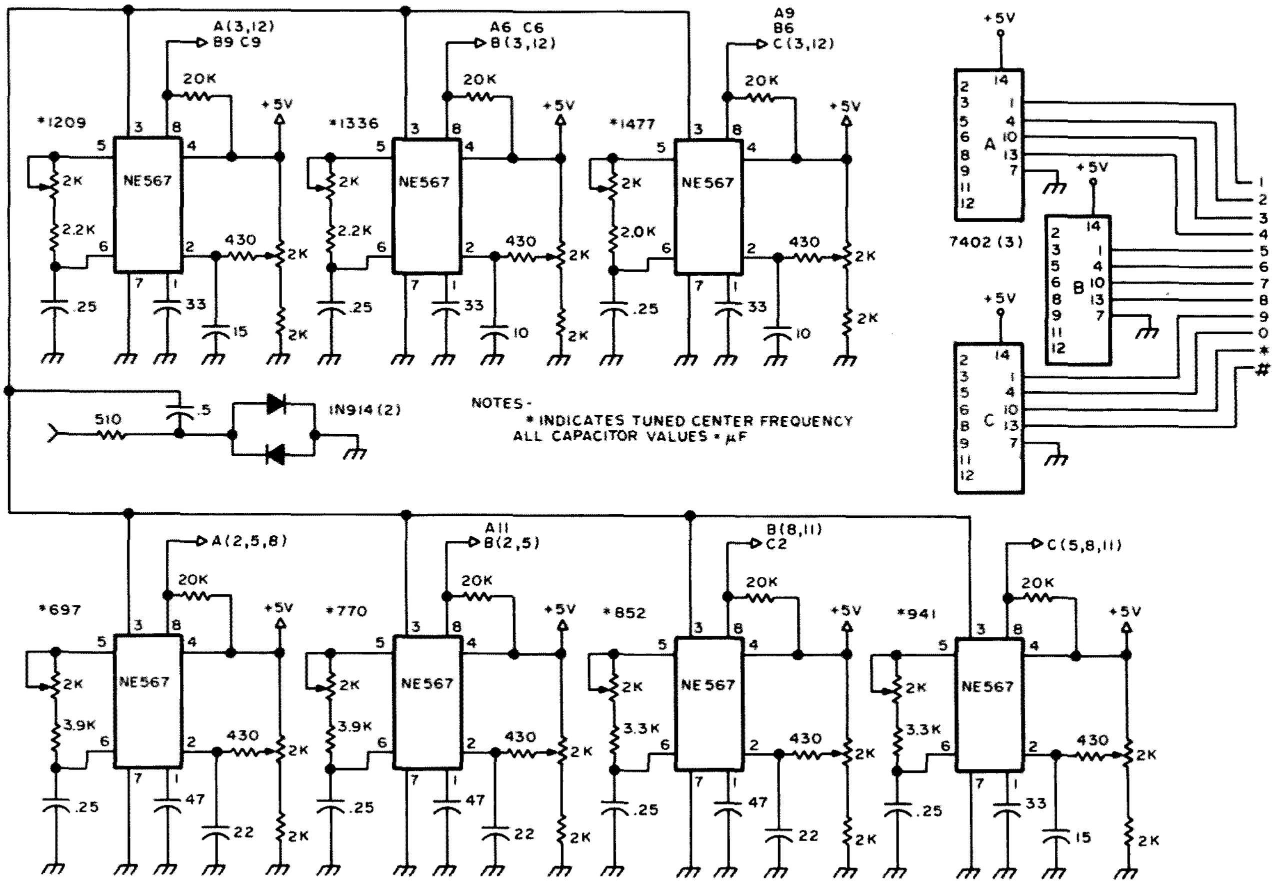

Fig. 1. Tone decoder. It is good practice to bypass all Vcc pins on all chips with a .1 uF capacitor. The 5 volt power supply should be regulated to ±5 mV ripple.

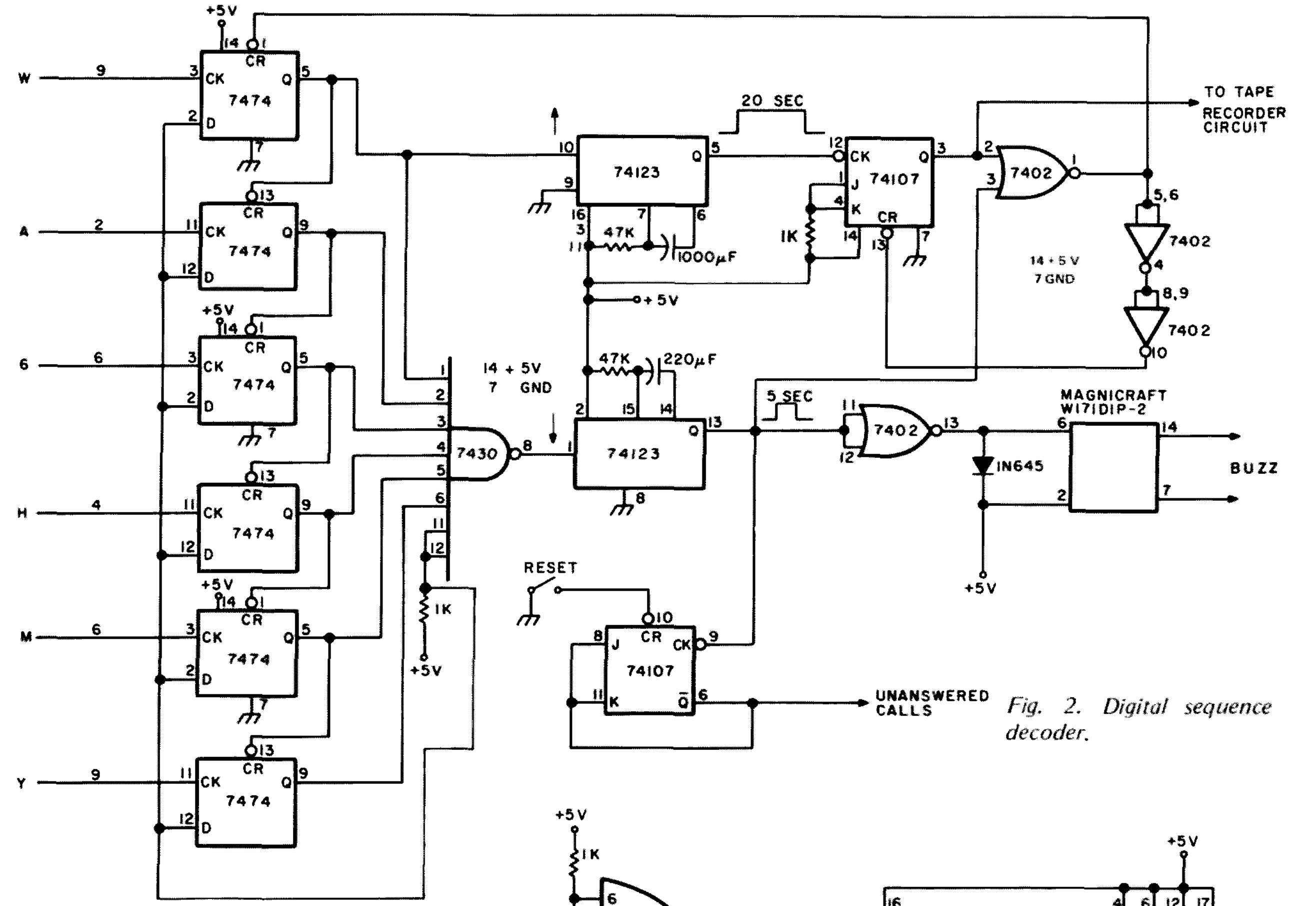

Fig. 2. Digital sequence decoder.

this capability to communicate from car to house. Many of us OMs have pursuaded our XYLs to get their amateur radio licenses so we can talk to them from car to house. But with all the brilliant technology of our beautifully human-engineered turnkey transceivers, there has been one big problem. The XYL won't turn on the receiver because of all "that horrible clicking and chatter from other stations."

The amateur radio telephone answering service and a touchtone pad solve this problem. It works like this: You're in the car and press up the XYL's call letters, a buzzer goes off in the house and she then turns on the speaker of the trans-

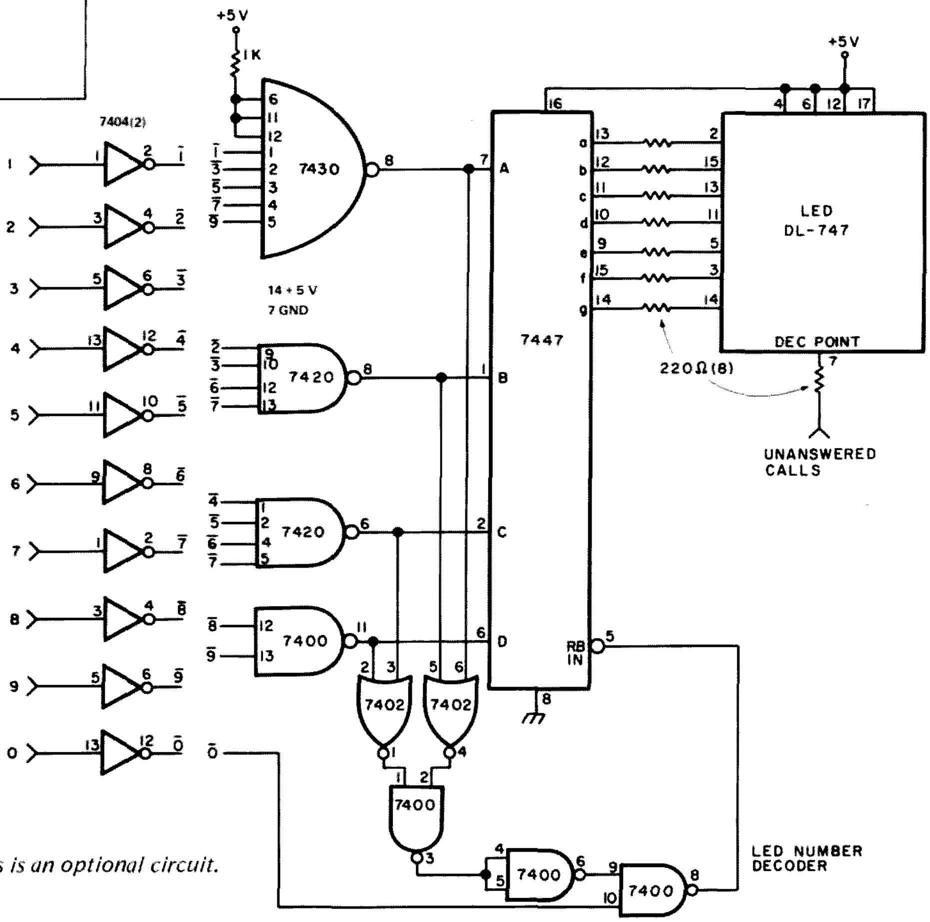

Fig. 3. LED number decoder. This is an optional circuit.

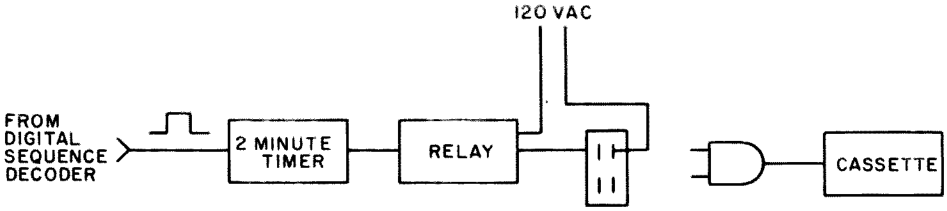

Fig. 4. Tape recorder circuit. Note: Depress record button on the cassette player.

ceiver and the QSO begins. If she missed the call she will see a light indicating a missed call and she can then play back a cassette recording of what was said on the channel.

Functional Description

Fig. 1 shows the tones coming off the transceiver speaker where they are converted to 12 digital logic outputs. For example, if the #2 touchtone pad button is depressed, the #2 line out of the tone decoder outputs 2.5 volts (a TTL logic one). All of the remaining 11 lines are .4 volts (a TTL logic zero). As the tones are decoded in a precise order, in this case WA6HMY, which is 926469, the digital sequence decoder outputs a relay closure which activates the buzzer for five seconds. When the buzzer stops, the missed call light comes on, which can be turned off with the reset switch in case other calls come in. If the reset switch is not pushed, then 15 seconds after the buzzer stops the tape recorder records what is being said on the channel for two minutes.

As the tones come in, the LED indicator will display what numbers are being sent. This is handy for checking out touchtone pads.

Circuit Description

The tone decoder circuit is taken from the Signetics application notes on phase locked loops. The values of the resistors and capacitors were calculated with my junk box in mind. The only critical component is the .25 uF capacitor used. It should be made with mica or polystyrene or of equally temperature-stable material. This circuit should be tuned up using an audio generator and a frequency counter. Put the counter on pin 5 and tune the left pot so that pin 8 pulls down to .4 volts when the counter reads the correct frequency as you adjust the audio generator. Tune the right pot to get a 4% bandwidth. There is interaction between pots, so it requires some tuning back and forth. Each of the seven phase locked loop integrated circuits are tuned to the proper frequency in this manner.

The digital sequence decoder, LED number decoder and the tape recorder circuit require no special care and feeding. One can program the sequence decoder for any callsign or name or number sequence up to six digits.

I and several other hams in this area have built and used this amateur telephone answering system. It has made more efficient use of the populated channels and allowed annoyance-free 24 hour monitoring. ■

Recently there has been a lot of loose talk about making a greater effort to recruit a new wave of radio amateurs from the CB ranks. Fraternal welcome is a nice idea, and if there are other motives, self-interest needs no defense. But candor is important too, and has anyone mentioned the hazards of hamming? Let's be decent about this; we are dealing with innocents.

Ken Cole W7IDF
P.O. Box 3
Vashon WA 98070

Dear Good Buddy

- - the perils of radio

When you think of all the eleven meter groundplanes sprouted among the thickets of TV Yagis and visualize a CB migration to the ham bands, TVI comes first to mind, but in fact it is a routinely soluble problem already competently dealt with in countless articles. There are subtler perils, seldom referred to, lying in wait for the artless neophyte.

One type of trouble is invited simply by the switching of roles, the assumption of a new identity in the public mind. It is commonly thought that the CB operator is a social activist seeking conviviality and opportunities to lend a stranger a helping hand, but the radio amateur is seen as less comfortably explicable – a kind of enigmatic technician who takes mysterious pleasure in messing with electrons and communicates only with others of his arcane persuasion. The operative word here is technician, and as used it means that, unlike Citizens Banders, he understands, designs, constructs and fixes electrical things. Many people really do think this, and sometimes it seems that they all live next door.

To illustrate: Your neighbor knows you have a CB set, but when the automatic ice cube gadget in his refrigerator fails, it doesn't occur to him that because you talk to people on a radio you should have the privilege of dealing with his ice cube crisis. However, if he knows you are a ham, the situation is very different. Inexplicably you are transformed into Mr. Fixit, Savant of Electricity and, needless to say, Public Servant. With the speed of light the ice cube machine magically lands in your lap. If you fix it, your fate is sealed. The word is passed from cell to cell, the failed and feeble toys gathered up, and one by one your neighbors knock on your door, burdened with electrical detritus. Some are humble and others are astonishingly peremptory, but there is a depressing uniformity about the junk culture treasures they entrust to your care – they are out of warranty, grimy with dust, sticky with the residual miasma of short-order cookery, long-parted from their proud instruction manuals and the plastic cases are cracked. Most bear unfamiliar brand names, anonymous bargains from discount stores, and have the sad appearance that means abused and unwanted.

Almost every other repair job will be a certain type of TV set, heavy and inclined to tip over slyly with the nearly imperceptible acceleration of a sleepy drunk. These are called "portables" no matter how much they weigh, presumably because they aren't in a castered cabinet fitted with a turntable, a "control center" and two boomy woofers. All are series string and after removing the cracked plastic back, shard by shard, you will find that the last tube you check will have the open filament. Reassembly will require your wife's help and the temporary application to the plastic fragments of bits of Scotch tape, Duco cement and profanity. If putting things right isn't all that simple, you can try to explain to the owner that you need and don't have the proper scope, sweep generator and other shop gear. The look you get in response will tell you instantly that he is certain you are lying, indifferent to his misfortune and too lazy to help. This is the time to tell him what you should have said in the first place: that there are many good citizens in the business community trying to make a living for their families by fixing just such beat-up old idiot boxes. Say this politely and firmly. You'll feel good, and in the silence that follows you may hear your wife snicker in the kitchen.

Children are a smaller problem, even when they are six foot teenagers, but sooner or later every kid on the block will show up with a lifeless ten dollar transistor squawk box. They all have several and when one quits it is simply stuffed in a drawer and forgotten until word about Mr. Fixit gets around. The battery holder is thoroughly corroded, the dial cord broken and an invisible crack in the circuit board testifies to the last and fatal tumble from a skidding bicycle. Fix it and the kid's dad will appear at your door with a grateful smile and an armload of sick stereo. "How come not having the speakers connected would blow the output transistors? It didn't make a sound." In return for his grateful smile, you have handed him a mystery and he regards you with suspicion. Do you explain the theory and practical application of transistors in two minutes, or do you say, "Please, sir, you must just trust me, for I am Mr. Fixit?" He has the advantage, for no good deed goes unpunished, as the philosophers point out, and by doing a favor for his son you obligated yourself – another lesson learned? But you can't turn a kid down, can you? Well, you could refuse your technical help except to runaways and orphans. The message is on the medicine

label: "Keep out of reach of children."

But not to worry. Think about the bonus fringe benefits of having a ham ticket: Finally you have met all those fine neighbors you managed to avoid for years; your troubleshooting expertise has been honed and polished; you've learned so much about human nature that the rising tide of violent crime no longer perplexes you — now you think of a screwdriver as a weapon instead of a tool. No more fretting that the country is flooded with crummy unfused ac-dc junk, that behind every loose plastic knob is a metal shaft connected to the nation's power grid. You no longer wonder how much assurance is implied, and how much genuine concern expressed, when a factory affixes that "U.L." stamp or label. Newly toughened by exposure, you understand that it's a jungle out there, and one for which you were ill-prepared by the cheery ambience of CB, that Disneyland of the air waves. In return for wisdom and privilege you have forfeited your innocence, but what good was it anyway?

Once you have the free servicework panhandlers sorted out, it's a downhill feeling, and finally there is time to work some of that DX that tempted you away from the comfy slot on eleven meters where nobody bothered you. Then one evening as your wife answers the phone, there's a knock on the door and it's a whole new game. "Harry's the name, live down the street. The boy said you was a radio ham and go all over the world, right? Thought I'd say howdy to my cousin's daughter-in-law in the Peace Corps in South America. Think it's New Guinea." Take the phone, listen to a thought-gathering silence, a few hiccups and a fuzzy baritone: "Say, friend, you talk to foreigners on your little radio, huh? You admit that? Humph. Well, how about those people in Cuba and Russia? Yeah? Gummint let you do that? How ya know they're not spies? So what do ya talk to them for?" Smile and hang up.

Forget the nuts in the bleachers; what about home plate? The CB rig took up a cubic foot and cost two nights on the town, but ham gear is something else. The amateur license is in a sense a collector's item — an occult centripetal force is focused by your call letters and you will find yourself accumulating endlessly, if virtuously, in pursuit of diversity and improved performance. It's also a license to experiment — so test gear is attached, stacked and lined up neatly; surplus circuit boards and components overflow desk drawers and cartons. Discreet storage under beds and behind davenports is soon exhausted. I hate to mention money, but it is a fact that a beam can bite a budget cruelly, and a transceiver can swallow a family vacation whole. It was simpler for the old-timers, but today state of the art acceleration is phenomenal and, to the devout ham, intoxicating. Thus, "But you've only had this one a year, dear, and it looks just like new. And you were so pleased with it." The traditional reply ("Shut up and get dinner on the table") will not do. The CB rig is still in the kitchen, with sympathy on every channel. Times have changed.

Finally, it is only fair to mention that there are further risks attached to switching to hamming which, curiously enough, are concerned with the probability of making more friends. In exchange for giving up the doubtful option of anonymity ("Hey, Polish Princess, this is the Purple Cow."), hamming lets you know exactly who is on the other end of the horn. Calls, names, addresses and license class are in the callbook, so every QSO is that much more a personal and informative contact. And the diversification within the hobby (traffic nets, rag chewing, public service activities and DX riots) encourages closer contact based on shared interests. It is only fair to warn you that you may find that some of your new friends, helplessly adrift in a love affair with the electron, are inclined to take a rather light-hearted view of the more burdensome realities of life. Not to put too fine a point on it, aberration and eccentricity are not unknown in the ham community when imagination and ingenuity get out of hand.

An illustration: Not so long ago, when 21 MHz i-fs were standard in television sets, W7ATK (who shall remain nameless here), lived high in a TV-infested apartment building and an identifiable antenna would have violated a maxim of the TVI game — never blow your cover. The situation recalled an earlier and unpleasant experience with an adamantly unforgiving landlord informed by an aggrieved tenant that a trap vertical was not a "lightning rod." But the technical challenge was irresistible to a veteran of the FCC, and soon ten feet of base-loaded aluminum tubing was mounted on a bracket outside the bathroom window. Forty meters, with leakage on fifteen a calculated risk, and coil taps for moving the narrow bandwidth left and right. Atop it a plastic imitation anemometer spun merrily in the lightest breeze. Rational enough so far, but then instead of a simple ground to the plumbing, thirty-three feet of insulated wire (he refused to reveal what was on the end) was flushed down the toilet. On a table under the window the rig was disguised with a beach towel and assorted shaving gear. Bemused and too fond of inventing descriptive names for his ground system to listen to skeptical friends, ATK finally tired of wind-and-weather questions from curious neighbors and moved out of the city to a job with a broadcasting company. Long years of bossing me there encouraged early retirement, and presently he is writing a book, "It Only Hurts When It's Painful," about falling out of powered golf carts.

One more example, more illustrative of imagination then ingenuity: KL7AZH, now WA7LBX and once upon a time W7FQL, was inclined to view hamming as an avenue to unique accomplishments and "firsts" were his delight. To spare him any embarrassment from this account of one of his less successful efforts, his name won't be mentioned. He was living in a Bering Sea coastal village some years ago when suddenly he was severely afflicted with an urge to pull off an aeronautical mobile first, and since there was no way for wiser heads to prevail against a plan kept secret, he was soon airborne in an old Stinson with a pilot who had agreed to fly him from Wales over the Soviet island of Big Diomede. Visions of sugar plums danced in his head, spelling out "KL7AZH/AM/UAØ" or something like that. Now, looking back, he attributes his foolishness to his youth (he was only fifty), an unusually long winter and arctic fever. As it happened, circumstances intervened, infuriating him but preserving his spotless record with the FCC. The plane's Lear T-30 had been twiddled to eighty meters and tested with a dummy load on the ground, but over the ice floes and near the International Dateline it refused to function. Then the Lycoming radial threw enough oil to obscure the windshield, turbulence rocked the plane without mercy, and the fumes from the oil combined with fragrance from an earlier load of reindeer meat to produce pure nausea. Landing on return to Wales with vision restricted to the side windows was no problem, but someone

forgot to reel in the trailing antenna with its customary beer can fluttering at the end of the wire, and this took down a salmon-drying rack before parting. As the DXpedition stepped shakily to the ground, I asked him what he had been up to. "Get out of my way before I throw up on your mukluks," he growled, and then confessed. On his desk today is a battered beer can, and he likes people to ask him what it's doing there and why a burnt-out fuse is taped to it. Dreams die hard.

Currently WA7LBX is driving himself relentlessly to bring off another first: a QSL from every licensed blonde YL in Spain. A magnificent concept. But there is reason to believe the project isn't going too well. His wife, Martha, is only grudgingly supportive and complains that his normal cheeriness has so deteriorated under stress that waking him every morning is sufficiently risky that she pokes him with a long stick, standing well clear, and at the first sign of returning consciousness expediently trots off to visit a sister nearby. Hours pass before he is safely approachable. Alas, scaling the heights is a lonely business.

But most hams are just ordinary folks, good buddy, and it would be less than honest to leave you with the impression that the two gentlemen mentioned are representative. On the other hand, it's interesting that they're not regarded as all that odd. Some do say that spending years in the comparatively more potent rf radiation field of amateur radio does make a difference, and that the five Watt CB limitation was a lucky break for you people.

Well, so much for telling it like it is, more or less. Now gather up your courage and get that ticket. You'll never regret it, and welcome to the club. ■

LETTERS

from page 9

DOC to arrive at a final policy to be presented at the ITU Conference to be held in Geneva in 1970. From the outcome of the September 29th meeting, we have learned that the lower part of our UHF band, 420-430 MHz, might still be used by Canadian amateurs on a sharing basis with other services like beacons and radio direction finding, etc. The top part, from 440-450 MHz, will be taken away from us, to be used by satellite services. This leaves us with 10 MHz (430-440) which we can call our own. Keep in mind that these changes can come about at any time. There are 5 UHF repeaters in operation in the Toronto-Hamilton area at the present, and 37 UHF links at confidential frequencies to control various 2m repeaters. All of these are in the lower and higher parts of this band, i.e., 420-430 and 440-450 MHz. Also, amateur fast scan television is quite active in this area on 439.25 MHz (international simplex freq), and with 4 MHz bandwidth. The first amateur television repeater VE3TVR in Canada is being built here as well, and already cleared by DOC one year ago. More TV repeaters are being planned for Toronto and other areas in the country. There are 5 TV repeaters in full operation in the US; the Washington repeater has been going for more than 2 years, and many more are being planned. An amateur TV repeater takes up 12 MHz of the UHF spectrum. In western Europe, TV activity is very high. In Germany, a fast scan association was founded in 1969, in the same year England founded its association; their total membership at the present is well over 4000 hams. Fast scan in Canada is rapidly increasing. Readily available surplus UHF gear and cheap surplus CCTV cameras, and the simplicity and economy of readily available solid state devices and kits, make this all possible.

To my way of thinking, we are just beginning to make use of a "giant sleeper," the 70 cm band. Too bad that we might lose it, before we have a chance to use it. I suggest we all rally together and try to save this band, because once it's gone, we will never get it back. Discuss it on the air, at your next club meeting, ask your club executive to write letters to DOC stating our position. Support your amateur organizations and persuade them to fight this, or go all the way and write letters yourself.

"United we stand, divided we fall."

John Vanderryd VE3CYC
Hamilton, Ontario, Canada

PARASITE uP?

I am writing this letter in earnest support of Mr. Donald Peasley's letter to the computer section "I/O" editorial. I originally subscribed to *73 Magazine* because I was just a neophyte to ham radio and after the mail hype that *73* sent me — "more ads, more ham-related articles" — I took the bait. The mag has gone downhill ever since. It seems that the mag has developed a predilection-turned-penchant for microprocessors and computers and the like. I can see no need for one in my shack, as my Yaesu functions superlatively as ham radio and does the job for working the world (23 countries so far). This proliferation of computer-related articles has soured my one-time favor for the magazine. How about some more articles about gadgetry for the more abundant HF gear — Heath, Yaesu, Drake, etc? If I am not mistaken, these radios all perform well without a parasite microprocessor on their backs. The references to such strange and arcane terms like byte, ROM, RAM, software, interface leave me in the dust, and frankly I have no desire to understand them. The old saying goes, "If you want something done right, then do it yourself." It is particularly apropos here, as I would like to volunteer my services as a journalist and write some articles for the more conventional hams. Shortcuts for learning the code, building up your speed, observations on the ham bands, stories, and really relevant rhetoric on the affectation that we all labor, the attraction and excitement of the distant station.

Peter G. Kendall WN3ZRG
Newtown PA

Talk is cheap, Peter — let's see some of the articles you're promising. — Wayne.

POT SHOTS

Stop the presses! A few weeks ago I wrote you a letter concerning Trigger Electronics in Illinois. In the letter I stated that I had turned to Group W Broadcasting for help through their Call for Action program and that they had agreed to assist me in getting my money back.

Well . . . last week I received a phone call from the Chicago affiliate and we talked at great length. It seems that Trigger has quite a reputation out there. They had a "considerable" case file against them. Fortunately, my order was for only a few crystals and a filter (about $35.00). A few of our brother "hams" had ordered (but never received) entire station setups ($600.00-700.00).

The only lesson here is that anyone (especially the newcomer as I was) should be most careful when making a mail order purchase, even if it *is* very difficult to locate suppliers in some parts of the country (as is the case here near Cape Cod). Although it is most frustrating to wait for gear when you are all ready to go, 'tis far better to wait and search than to pay and never receive.

It may interest you to know how I first learned about Trigger's existence (but, unfortunately, not about their reputation). When I was first licensed last year, one of my first acquisitions was the ARRL's *Radio Handbook*. In there, there is a list of suppliers. I wrote to Trigger for a catalog, assuming that anyone who is listed in the League's handbook must have their endorsement. It was not until I had trouble with Mr. Treger that I wrote and told *QST* of my problem. A return letter stated that they had not let Trigger advertise for a few years, because of his "operation." It's a case of the left hand not knowing what the right hand is doing, I guess. The handbook, by the way is a '76 edition, the latest! Must have been too costly to have the page with the suppliers list reset for the '76 printing. Otherwise, they would have stricken Trigger's name.

I wish that I had subscribed to *73 Magazine* a few months earlier than I did. I would have known about Trigger then. Oh, well, Wayne, can't cry over that. Just renew my subscription for another three years and bill me directly. Better protect myself for future purchases.

No one told me that there is more to learn than the code and some theory.

When I upgraded to a General in June, I wanted to upgrade my station as well. I turned to *73* (again) and found Tufts Radio in Medford. Let me tell you, I found them friendly, prompt and fair. A few months later I ordered (by mail) a meter from them and got it within the same week (my check didn't even have time to clear before they shipped). They'll get all my business in the future!

Hope that this letter will save another newcomer from the hassle and frustration that I went through. Although we won't have Trigger around any longer, I suppose that there may be one or two more companies that operate with similar abandon. You keep up the good work that you are doing in your magazine. As for me, well, Wayne, if I find out about another one, I'm gonna take a few pot shots at them myself. I wrote about two dozen letters, all told, with this Trigger deal. I'll write a few dozen

Continued on page 157

SWR Myth Exploded Again

- - how does swr really affect signal strength?

Wallace H. Provost Jr. WA1JFU
15 Park Drive
Bedford NH 03102

Back a few years ago, when I lived in Vermont, I was discussing standing waves with a well-known amateur in Altamont, New York.

"Well, Wally," he said, "I had a standing Wave in my shack but I found she looked a lot nicer sitting down when she crossed her legs—love those mini-skirts."

Obviously that topic of standing waves is fine over a glass of beer in the local pub, but it is not the subject of this article.

I assume that the reader has already read the various handbooks and back issues of this magazine, and I will not bore you with dreary theory on transmission line design but rather get right into the meat of the problem.

Fig. 1 shows a simple station arrangement. The transmitter output matching network matches the impedance of the final tubes to the impedance of the transmission line. The matching section of the antenna matches the input impedance of the antenna to the line. In this unusual but perfect condition there are no standing waves.

Under this condition the losses in the line are caused by the resistance of the conductors of the transmission line and the rf leakage across the dielectric. These figures are easily obtainable.

In Fig. 2 we have a situation that is much more common. The antenna is not matched to the line. The line is terminated in a value of impedance other than its characteristic impedance. This could be caused by improper adjustment of the matching network. It could also be from operating at a frequency other than that for which the antenna was tuned, or, as in a great many cases, the matching network may not have sufficient range to match the antenna at the frequency at which it is being used.

If the antenna impedance was different than the characteristic impedance of the line but still resistive (a very unlikely case), the standing waves on the line would look something like Fig. 3. The solid line indicates voltage variations and the dotted line indicates current variations. You will note that the phase relationship between the voltage and current nodes is always 90°. The direction, as shown in Fig. 3, is determined by the value of load resistance. This is not a normal case. Normally the phase relationship would be some figure other than 90°, and if the termination were not resistive, this departure would be greater.

Let's look at these figures for a moment and see what they tell us.

Losses: At a current loop (the points of maximum current) the increase in current flowing in the conductors causes a loss due to dc resistance. At a voltage loop, the increase in voltage causes increases in loss through additional dielectric heating.

Impedance: The effective impedance changes as you progress, being maximum at a voltage loop and minimum at a current loop.

Breakdown: Thin conductors will burn out at a current loop. Closely spaced conductors will arc over at a voltage loop.

The losses due to swr are relatively unimportant other than at high VHF or UHF frequencies. In the high frequency bands the cause of a high swr will usually affect

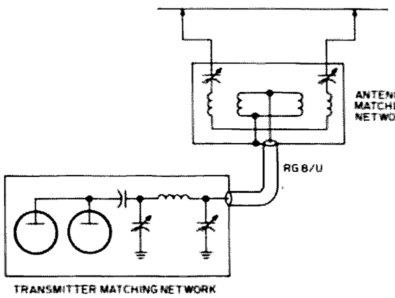

Fig. 1.

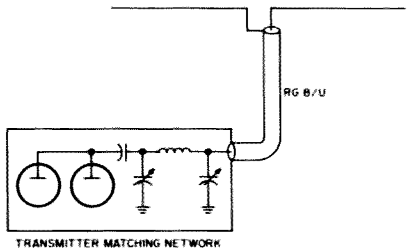

Fig. 2.

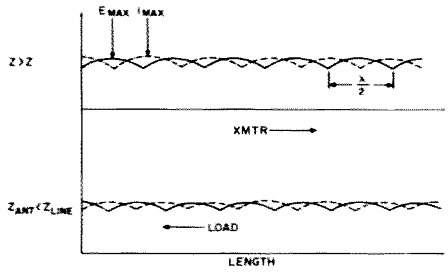

Fig. 3.

the system more than the losses in the line.

The impedance at the output connection of the transmitter, however, is extremely important. Most modern linear amplifiers do not have the ability to match a load different than their design impedance. The impedance presented to the transmitter is not the impedance of the antenna or that of the transmission line, but some other value depending on the degree of mismatch and the line length. You can see from this that in the case of moderate mismatch conditions it is possible to use the transmission line as a matching transformer, adjusting its length until the transmitter output circuit will properly match it. This, however, is a very limited and dangerous method. A number of current and voltage ratios combined with reactive elements can look good on the plate meter but cause excessive voltages across the loading capacitors of the transmitter. If you are having trouble with arcing in your amplifier, this could be the reason.

The insertion of an antenna tuner at this point will eliminate amplifier problems, but don't forget those high rf voltage problems – you have merely transferred them to the tuner. One other point: An antenna tuner will help the transmitter by providing it with a load it can match, but it does not help a poorly matched antenna and will not change the losses in the feedline.

Here are a few considerations:

1.If you were using a dipole antenna in outer space and feeding it with 50 Ohm cable, your swr would be 1.4:1. If, like mine, it is near the ground, it will be something else depending on the height and characteristics of the ground and surrounding objects.

2.The electrical length of the antenna will vary depending on the existence of nearby objects and its height above ground. This is particularly true of inverted vee type antennas.

3.If you cannot get an swr less than 1.5 on low frequency antennas, there is something wrong with the antenna.

4.On a wire antenna or a close spaced yagi antenna, do not expect a reasonable swr more than 25 kHz from the resonant frequency of the antenna.

5.Poor connections at the antenna are more common reasons for arcing than high swr. Solder all connections and wrap with plastic tape to protect from the weather. A sealant such as General Electric RTV is excellent.

6.Do not use your match box to cover up a poor antenna design; you are only kidding yourself. ■

LETTERS

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more, if I have to.

In fact, as I sit here and think of it, I wouldn't be opposed to acting as a complaint department for other hams. Tell 'em to write to me, Wayne, and I'll start case files. I have learned a lot by dealing with Trigger.

Steve Rossi WA1WGS
East Wareham MA

UPGRADE

You've tricked me into it again! I've got to write and try to answer something in the November issue.

You've asked about Technicians and 10 meters, and you've left-handedly implied that Techs should upgrade if they want to use 10. What prompts me to write is that your sentiments seem to parallel very closely those of many long-time hams of my acquaintance, namely that the name of the game is upgrade, and the name of that game is code speed. I want to try to point out an alternative to this circle.

Out there among my fellow amateurs, I'm sure there are those who feel exactly the way I do about it. I have no quarrel with upgrading except that to upgrade I must increase my code speed. Before I became a ham, I argued against code altogether, and I realize that I was wrong. Code serves a useful purpose for all hams and prospective hams. Where we differ is: "How much?" The proposals in the restructuring docket did contain one premise which I consider quite valuable, namely, advancement from Technician *without increased code speed.* I am proposing a new class of license, featuring Advanced class theory and 5 wpm code.

I personally have no interest in DXing the world on the low bands, or for DXing the states, counties or whatever. I work VHF for two primary reasons, both of which are because of its restricted range under usual conditions. First, there is the opportunity to meet most of the people I talk to, and second, DXing to any distance is a real challenge.

For some 15+ years, I have done my DXing *only* on the broadcast band (.54-1.6 MHz) and have heard 47 states and over 100 BCB countries (not to be confused with ham countries, by which count I'd have at least 20 more, or geo-political countries, of which I'd have about the same amount less). For these years, my SWL friends have badgered me almost constantly about how it was easier on SW and how I should do it that way. I don't want it that way, because of the challenge of overcoming the real obstacles presented by stations which are not designed or intended to reach across the globe. I have been actively a member and officer of the National Radio Club toward this end. (Info, write NRC Membership Ctr., Box 118, Poquonock CT 06064, if I may put in a plug.)

I am interested in antennas, and in propagation both on BCB and VHF, and would like to upgrade, but since I'll likely never use low bands or CW, I don't want to spend my hobby time beating out the code. I don't expect everyone to agree, and I might even change my mind, but let's let ham radio diversify itself even more, and cater to a wider variety of interests. In the light of your continued emphasis on CB and computers which I simply don't find interesting, this shouldn't be too outlandish a suggestion.

By the way, let's also have some more Repeater Directory updates in the magazine!

Russell J. Edmunds WB2BJH
Kinnelon NJ

EBULLIENT?

First I must let you know that whoever spoke to me one Monday at about five thirty pm was, far above the call of duty, more helpful, intelligent, receptive, vivacious and just plain ebullient than just about anyone I have ever talked to in my 30 years of business. If she is anywhere comparable to the rest of your staff, I can see why you put out such a great magazine.

I have worked hard all my life as a hardware sort of person (bulldozer hardware), but have also built all sorts of things with varying success for my business, including an unfinished submarine!??!

About 2½ years ago when the economy began to fall apart, I said to myself, "Hey, what's happening?" Since then I have become, in my opinion, a budding financial hobbyist – which quite naturally led to commodity trading. However, it didn't take me long to find out that an up to the minute running account of prices was a necessity to help prevent disas-

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Dirt Cheap Regulation

- - virtually freebee

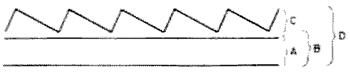


Fig. 1. (a) Reference voltage and regulator output voltage. (b) Minimum ripple voltage. (c) Ripple voltage. (d) Regulator input voltage.

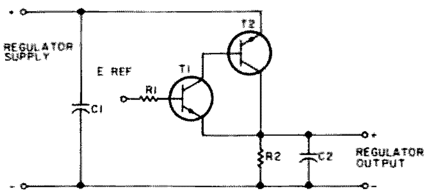


Fig. 2.

Entering the scene are transceivers, recorders and high fidelity radios, all operating on the approximately 13 volts of a car. On checking the catalog, you'll find you can expect to pay an additional thirty to fifty dollars so that you can use the same device in your home.

Although a number of regulated power supply circuits have recently been published, all have required specialized components, some of which may be available only through mail order. Here is a circuit which any ham or electronics enthusiast, who has accumulated the usual collection of unidentified transistors, diodes, resistors, and capacitors (who, in short, has the average junk box) can build a good quality regulated power supply cheaply and in a short amount of time. This regulator can provide either fixed or variable voltage as desired from either a transformer-rectifier dc source or an ordinary car battery charger.

This regulator consists of an NPN transistor in common base configuration and a PNP power transistor in common emitter configuration. The current gain of the transistor pair is the product of the gain of each of the transistors but the feedback is such that the voltage gain is unity. As a result, the output voltage of the regulator is almost exactly equal to the reference voltage. If the reference voltage is pure dc, the output voltage will also be dc and independent of the regulator supply voltage so long as the reference voltage is less than the minimal ripple voltage (Fig. 1).

The basic circuit of the regulator is as shown in Fig. 2.

T1 can be practically any NPN transistor and can be identified with an ohmmeter because the base collector and base emitter resistances of an NPN transistor will be low when the positive lead of the meter is connected to the base. Conversely, the resistances will be high when the negative lead is connected to the base. T2 should be a PNP power transistor mounted on an adequate heat sink. Most can handle a collector current of two to three Amperes. It can be identified, as it will have a low resistance between the base and either the collector or emitter with the negative terminal of the ohmmeter connected to the base.

The only moderately critical part in this circuit is C1. This capacitor should be large enough that the ripple voltage minimum is greater than the reference voltage by two or three volts. See Fig. 1(b).

Maximum ripple = rms input x 1.5 - 2.5 - regulator output voltage
or
= peak input voltage - 2.5 - regulator output

Thomas A. Reilly, M.D. W3GAT/2
32-25 88th St., Apt. 608
Jackson Heights NY 11369

C1 must have a value greater than:

$$\frac{\text{load current}}{120 \times \text{ripple voltage}}$$

where C is in farads.

C2 is optional but it can improve the transient current regulation if the load current varies widely, as occurs in class B power amplifiers. It can have a value anywhere in the range of 50 to 500 uF.

R1 should have a value between 10k and 20k and it simply limits the emitter base current of T1 should the reference voltage be present and the regulator supply voltage be off. R2 should be used either if C2 is used or if there will be times when the regulator will not be loaded. Select a value so that the current is between 1/10 and 1/20 the maximum current output of the regulator.

There are a number of methods to provide a reference voltage, and all are adequate. Remember that the quality of the reference is directly reflected in the output of the regulator.

Fig. 3 shows three methods to supply a reference voltage. Fig. 3(a) shows a zener diode reference supply. R3 should limit the zener current to about 5 mA. If C3 is larger than 500 uF the reference voltage ripple will be less than 10 millivolts. (This can be calculated with the formula used above.) Fig. 3(b) is a poor man's voltage reference. Each forward biased silicon diode will drop about 0.7 volts. So use as many as you need. Fig. 3(c) indicates a simple method to provide a variable output voltage from the regulator.

After the regulator is constructed, check the output voltage with the reference. They should be the same. If the output voltage is higher, open the base circuit of T2. The output voltage should then drop below the reference. If it does not, try another PNP transistor. If, on the other hand, the output voltage is low, there is a possibility that T1 should be replaced.

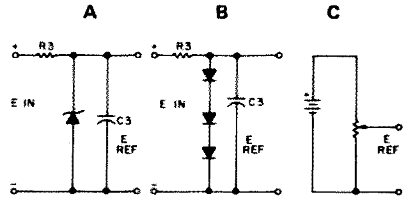


Fig. 3. (a) Zener, fixed voltage. (b) Diode, fixed voltage. (c) Variable voltage.

The voltage supply to this regulator is unfiltered dc and can most easily be obtained from an automotive battery charger, but a transformer with a full wave bridge or a full wave rectifier with sufficient voltage and current capability is fine.

I used a battery charger for a rectified ac supply which had an rms voltage of 13. The values of the components I used were: C1 – 2000 uF; C2 – not used; C3 – 500 uF; R1 – 10k, R2 – not used; R3 – 570 Ohms. With these values the regulator supplied 12.2 volts at 1.2 Amps, with a ripple of 30 millivolts. The heat sink is a piece of scrap aluminum 0.25 x 3 x 8 cm.

With a little imagination any voltage and current can be provided. There is no short circuit protection, but replacement transistors should be readily available in the junk box. So dig into your pile of unused and unidentified goodies, heat up your soldering iron, and spend a quiet hour building your brand new freebee voltage regulator. ■

LETTERS

from page 157

trous losses. A letter to the Chicago board of trade revealed that they sent out their price information using a strange 6 level Baudot code over the telegraph. To quote Ayn Rand – *"Somehow"* this has to be displayed on a TV screen. For several months now I have been building a computer somewhat based on an Altair-type bus, and after reading your editorial about Morrow the Genius, it clinched my thoughts about buying his CPU and front panel (Altair) combined.

I've read the *Bug Books*, *Martin's Computer Design*, the Osborn books and a lot of other stuff (magazines, etc.), but still do not know how I'll make that 20 mA loop signal appear on a screen or a printer or – hold your hat – appear in the form of charts on a plotter or graphics screen. Do people really do these things with computers?

I've *got to* do this, so maybe your magazine, with the right software stuff, may help. I'm not smart enough to take one of your *73* articles about Morse to ASCII and make a 6 level Baudot to ASCII converter or even figure out how the computer can tell the end of one code letter or number and the beginning of the next.

I could have bought a microprocessor all built for what I've spent on mine, but I do have a pretty good idea of how it works, anyway.

I may as well mention a few suppliers who were less than perfect:

Mini Micro Mart – After many phone calls, sent me a Univac printer (3 months), which I am not sure I'll be able to use (my own incompetence) $450.00 (Model 0769).

Processor Technology – Sol terminal board not received yet; ordered in July ($40.00) after I sent practically all over the world to obtain most of the parts. They wrote and said it would be redesigned, but they forgot me, I guess.

ARB Limited, Arizona – Sent them about $50.00 for parts, not yet received (even though he called me up on the phone – seemed like a nice guy, too).

Pet Peeve – suppliers who do not refund excess money but send a credit slip which I usually lose.

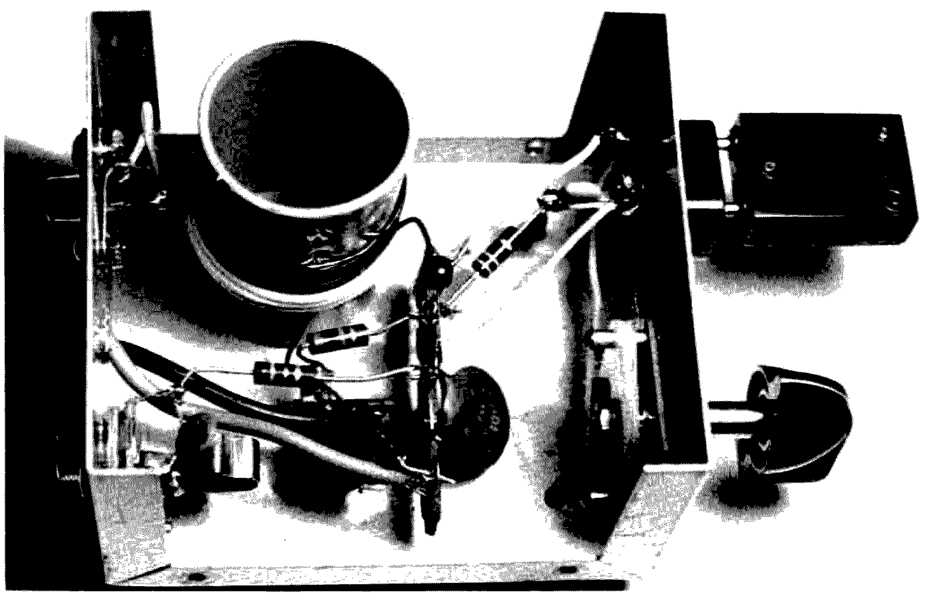
Arthur E. Bradford
Weymouth MA

LIMARC PR

"Welcome to the Wide World of Amateur Radio." With these words, narrated by the well-known CBS newsman Douglas Edwards, each Friday evening the listeners of WBAU (Garden City NY) are treated to a glimpse of what amateur radio is all about. In a pioneering effort, LIMARC (the Long Island Mobile Amateur Radio Club) has taken to the commercial FM bands to sell amateur radio to the general public. Produced and directed by Harvey Hurwitz WA2HYS and Steve Mendelsohn WA2DHF, the broadcasts attempt to provide some incentive for CB users to take that extra little step upward, and to alert the general public to the fact that there is a difference between the two services. Utilizing the studios of WBAU, located at Adelphi University in Garden City, these fifteen minute programs consist of group discussions about amateur radio versus CB, technical aspects of being an amateur, and how to find a course or the study materials required to upgrade from CB to ham. Most importantly, it highlights the differences between the two services in capabilities, scope, cost and basic requirements. No attempt is being made to downgrade the citizens band or hold it up to ridicule. We do, however, indicate by actual on-the-air recordings how different these worlds can be; for example, channel 19 compared to the local FM repeater on two meters. Short informative lectures on AMSAT, slow scan, ATV and similar subjects are given from a very light technical point of view in order to point up the vast differences between the two services. A debate was aired between an avid CB enthusiast and a group of hams with excellent results in the final on-the-air version.

One of the glaring omissions in the world of amateur radio is the critical lack of publicity. Unfortunately, this has led to many erroneous identifications in the news media where anyone with a radio was automatically called a ham. Listening to the various bands, one may often hear a tirade about the use of CB radio and its users. We must, however, face the unalterable fact that CB users outnumber hams by a staggering percentage. These numbers do constitute a vast reservoir of potential amateurs and, if the truth be known, many of our CB haters were in fact CB operators years ago. The use of the big stick technique is obviously useless, so we at LIMARC have taken this opportunity to use the soft sell. If it works for toothpaste, it should work for amateur radio. One of the local cable TV

Continued on page 163



Si Dunn K5JRN
3607 Binkley
Dallas TX 75205

A Vest Pocket QRP Rig

-- if you have a big one

"Simplify, simplify" was Henry David Thoreau's formula for a better life.

His philosophy came to mind recently while I was fumbling with some wires, cables, antenna switches, transceivers, antenna tuners, swr bridges and assorted other trappings of the ham radio hobby. Complexities are challenging sometimes, and often great fun. But they can be frustrating bores, too.

Proof is everywhere that ham radio is both progressing and becoming considerably more complex: digital readout transceivers, computerized CW keying machines, autopatches, slow scan television consoles, el-az mountings for OSCAR and EME antennas . . . sophisticated stuff when you consider where it all got started.

Can you imagine people actually communicating with *sparks*? And cat's whiskers and hunks of galena?

As I type this, I am flush with a victory for simplicity. I have just wired a tiny transistor to a crystal, three resistors and a few capacitors, made the little rig oscillate, and carried on a three-way QSO for over an hour through heavy QRM. I have just worked 400 miles with one-half Watt and a dipole that's only 15 feet high. I feel a bit like Marconi must have felt when he spanned the Atlantic for the first time. I called CQ with a piece of silicon and a hunk of quartz and two stations answered.

Simplify. I pulled out my junk box last night with the urge to build the simplest transmitter I could put on the air. It is not a marvel of engineering; it is not even a technological breakthrough. It's basic radio, and if I had my way, there would be a special ham band for basic radios and QRP wonders. As I type this, I have just tried to answer a CQ and been stomped flat by a kilowatt.

There is nothing complicated about this project. A 2N2222, available for as little as a dime, is used in a conventional crystal oscillator circuit. The oscillator is link-coupled to a low pass filter and a well-matched dipole, and that's it. The usual rules apply: Keep leads reasonably short, don't use a big soldering iron on the 2N2222, and listen to your signal to be sure you aren't chirping. Output tuning is a bit broad, so adjust C1 for best keying, even if it means giving up a few milliwatts.

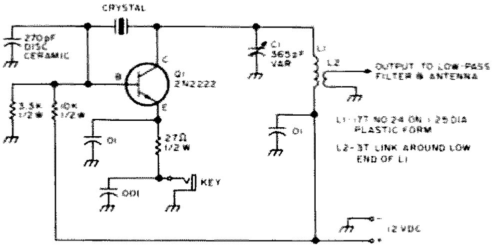


Fig. 1. Schematic. L1 — 17 turns #24 on 1¼" dia. plastic form. L2 — 3 turn link around low end of L1. C1 — 365 pF variable capacitor.

Early mornings and daytime seem best for QRP work on 40 meters. Add two or three turns to the coil if you want to work both 80 and 40. Or add a switch and a 75 pF capacitor across C1. At 12 volts, my version draws about 45 milliamperes. The 2N2222 will get warm if the key is held down for extended periods. Warm is okay, but hot is not. Got it?

As I type this, I have just worked Tennessee — 500 miles with a 569 signal report — at high noon. Nobody believes I'm running just one transistor . . . ■

William E. Rabenhorst WA4VWY
Box 2542
Vero Beach FL 32960

Where You Can't Solder or Weld

- - joining dissimilar metals

About eleven years ago a close neighbor in Washington, D.C., complained of TVI several months after she purchased a new TV set. The trouble was completely cured for the time being when her husband and son-in-law took down the old antenna and cleaned all contacts on it as well as both ends of the lead-in.

On another occasion, my all-metal 20 meter quad with aluminum tube inserts (see May, 1969, *73 Magazine*) started acting up after a few months. A resistance reading through 100 feet RG8-U feeder and the quad's driven element showed a variation from pure or normal resistance for that length, at one moment, to all the way to infinity over a brief period while a normal breeze was blowing.

How often have you read or heard of adjusting the element length of a home brew beam by shoving the shorter aluminum tubing further into the end of the main tubing until the desired overall length was obtained, with nothing more than a clamp or self-seating screw to hold it in place?

Then, too, have you not at one time or another been plagued with rectification in one of your antenna systems, particularly where aluminum and copper are used?

Scraping the enamel or other factory-applied coating off copper wire used for quads beyond the point where soldering is necessary causes oxidation or corrosion on the scraped surface, particularly down here in coastal Florida where the air contains salt spray. This is said to interfere with rf, which travels on the surface of the wire. Even power line insulators during a prolonged drought as we had in 1967 can keep you guessing temporarily as to the cause of poor reception until a good shower cleans the insulators not otherwise defective.

This article is intended to help you correct at least one source of trouble – one which involves the use of *incompatible metals* such as copper and aluminum.

Some years ago, while "reading the mail," a fellow was heard to say that his backyard was full of TV antennas which he had removed on service calls and found it necessary to replace with new material. On this point, it is a fact that there is a vast difference between the 12 foot lengths of aluminum tubing of different diameters and wall thickness purchased from a well-known supplier in Washington, D.C., and the comparatively poor material in use on many antennas, whether for amateur use or TV. Down here, TV antennas are mostly anodized on the outside at least, to prevent or hinder oxidation and/or corrosion in the salt air, but amateur beam antennas are not.

In 1953 Mike A. Miller, Assistant Chief of the Process Metallurgy Division of the Aluminum Research Laboratories, New Kensington, Pa., delivered a paper at the National Spring Meeting, AWS, Houston, Texas, entitled "Joining Aluminum to Other Metals." He discussed methods of joining aluminum to other metals by fusion welding, pressure welding, brazing, soldering, diffusion welding and resin bonding. The article's abstract states in part that aluminum can be joined to a large number of other metals by various methods. The joining method chosen will depend on the metal to be joined to aluminum, the design of the parts, the permissible temperatures of joining and on the service requirements of the completed assembly.

A lot of the foregoing may be of little interest to the average ham. Although Miller said aluminum and copper may be joined for electrical applications by employing a special arc-welding technique, several telephone calls to the Baltimore firm from whom the above-mentioned paper was obtained elicited a far more simple method for use by us hams (see Fig. 1).

Fig. 1 illustrates graphically the method of joining an aluminum tuning element that is telescoped or slid into the main tube. It is suggested that you first insert E, a wood dowel, into the end of the inner section to prevent a concave surface under pressure. Then slide the tuning element F into the main tube G to arrive at the resonant frequency desired. Drill holes at A through E, F and G to permit insertion of 6/32 nickel-plated steel bolts as indicated. A copper strip, with a similar hole at each end, is then tinned at its ends, including the inside edges of the holes, and placed in position as shown at D. B, nickel-plated steel washers, are then placed above and below the holes in the plated or tinned copper strip, and the assembly fastened securely with the nickel-plated steel bolts, A, and similar nuts, C. Of course, the "contact surfaces" of the aluminum tubing must previously have been burnished or cleaned. All that remains now is to cover the joint with Amphenol silicone compound or other suitable

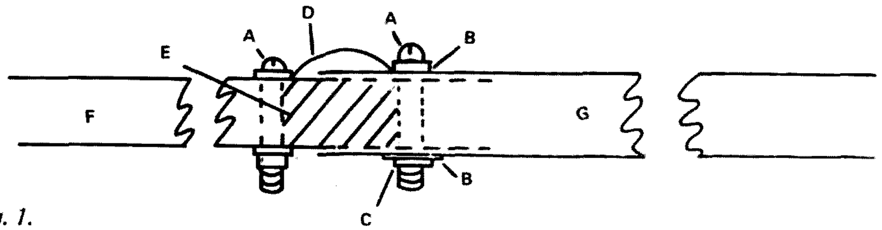


Fig. 1.

"goo" to exclude oxygen, whether from air, dew or rain.

Coax terminals at the feedpoint of a beam (see Fig. 2) are joined similarly except that the copper center conductor and the shield are substituted for the copper strip. Remember that, in Fig. 1 and Fig. 2, *no part* of the untinned copper must come in contact with the joint as illustrated, and nickel-plated steel washers are used on *both sides* of the tinned copper.

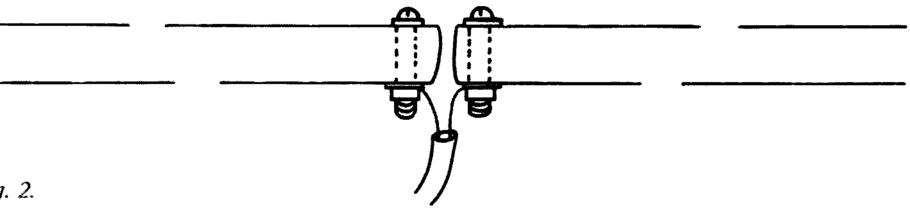


Fig. 2.

If your quad antenna uses beryllium copper wire, a better job is accomplished if the copper is silver-soldered instead of being tinned.

Aluminum or "clothesline wire" used for dipoles, fed with copper leads, are joined as in Fig. 2. Mash the ends of the aluminum wire flat; insert ends in a good vise. First drill a hole with a smaller size drill, and then enlarge the hole with a drill to take the 6/32 bolts referred to above. And don't forget the "coating."

If you are a DX hound, your antenna connections play a most important role in the power you "put out" as well as in the signals you hope to capture. ■

LETTERS

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channels has started to run these tapes on Wednesday evenings at 6:30 pm. Unlike many public service programs supplied to these stations by various sources, they have chosen to give the "Wide World of Amateur Radio" prime time, as they feel that with the high potential interest in radio communications, many CB operators will be listening at these hours. All participating stations have been warned that these tapes can only be used as a non-sponsored public service broadcast and the local amateurs have been warned that replay of these tapes or recordings made on the air can not be done on the ham bands.

Production of these shows requires the services of the WBAU studios with Bruce Barlow manning the board. A typical session will produce thirty to forty-five minutes of tape. This tape is then edited down to one or two fifteen minute shows. Our thanks go to Doug Edwards, who so kindly offered to record the open and close of each show. Editing is done at the studios of CBS New York, and we thank them for their assistance in making these shows possible. Logistically, the major difficulties involved are those of having a studio available, transporting the necessary participants to and from the studios, editing the tapes and making the necessary duplicates and getting the tape to the station on time. Being committed to a minimum of sixteen weekly shows, we have at this writing completed and aired seven shows and three are ready to go. It has been a difficult and sometimes trying experience, but we at LIMARC feel that proper exposure and adequate publicity can do nothing but help amateur radio.

Harvey Hurwitz WA2HYS
Oceanside NY

MORE JAMMING

I'm a Novice, and I've got a message for all you others who operate in the Novice bands: QUIT JAMMING!!!! Whenever I hear someone CQing, about the time I hear the guy identifying, I hear someone CQing almost right on top of him. That's not only bad procedure, that's stupidity! Some of you guys who don't venture into the Novice bands very much – go there sometime and you'll find out what I mean. You'll hear some guys CQing right on top of him and you'll never know who he was.

When I was studying for my Novice license, I knew about antennas, what frequencies I could use, and all that stuff except one thing: procedure. I didn't know how to use SK, AR, or what to say after the other guy handed it over to you. And then there are these guys who CQ anywhere without listening, usually jamming a DX QSO or trying to get the DX at somebody else's expense. And many of the League publications have been very vague about this. So, you guys, whoever's doing this, please give us guys who don't do this jamming a chance to get a decent QSO. *It ain't every man for himself, you know.*

Tom Carney WB9RXJ
Sterling IL

ONE VOTE

Keep meaning to write, but it seems like I am always too busy.

Re your I/O Editorial in October *73:* one vote for the I/O section. I do not now own a computer; however, I do hope to as soon as I find the time to get more involved. The I/O section makes me feel like I am keeping in touch; I do learn from it, and I certainly do feel that computers are a part of hamming. There will always be newcomers to hamming, hopefully, so one more big vote for the basics, i.e., what size resistor do I want to use here or why, and how do I compute what size capacitor to use there and, hopefully, just as basic material about computing. I do also enjoy the advanced articles.

I am a WW II pilot who still earns his living flying, and would like to take this opportunity to tell you how much I have enjoyed Mr. W. Sanger Green's articles, the "Autobiography of an Ancient Aviator."

Keep up the fine work; we're out here even if we don't write too often.

John G. Bilotta WA1PMK
Naugatuck CT

CRUDE, BUT NICE

I enjoyed very much your article on Tesla in the November issue. I have been trying to find some information on him, so the bibliography alone was worth the price of the magazine.

I would also like to pass on a rather crude indirect comment relative to your *Advanced Class Study Guide* made by an FCC engineer. I read the *Guide* over twice before taking my exam, and when the examiner told me that I had passed, he said "Man, you must have studied your ass off." Quite a compliment to me and *73.*

David M. Gray, Jr. WB5NZF
Moreauville LA

NOVICE HELP

I usually don't make an issue of subscribing to a mag by writing a letter, but I would like you to know I learned 5 wpm from one of your tapes I purchased in Medford, Mass. at Tufts Radio store a year ago July while on vacation in the east. It made it possible for me to get my Novice ticket, and I was wondering just the other day where I could get another one of your tapes. Hope I can do as well with it as the 5 wpm tape I learned from.

Paul E. Taylor WB9VCI
Monroeville IN

MMM

In your December, 1976, issue of *73,* page 119, you criticize Mini Micro Mart. I wish to disagree with you. I had sent in a sixty-nine dollar order for many books they offer and a keyboard which cost $27.00. This keyboard is fully ASCII encoded, case enclosed, with numerous other display switches and worth much more than their asking price.

All I'm saying is that *M.M.M.* had no problems with my order and I'll do business with them again. They seem to have no problems whatsoever.

Art Surges
Evergreen Park IL

SATISFIED

Well, I hope you're satisfied, Wayne. Even though I let my Technician ticket lapse eight years ago (I'm not much of a talker), I kept up my subscription to *73.* You kept pounding at me with 2m FM, repeaters and such. You urged me to buy your study guides and your code tapes. I just got back from the Federal Building, downtown Chicago, having easily passed the exams for my new Tech ticket. I hope you're satisfied. I am!

Chuck Neuman
Skokie IL

WHICH uP?

Congratulations on your new magazine, for which I have enclosed a subscription. I talked with you when you were in Jordan and also when you were in FO8 as well as several times on 20 meters when I lived in Oakland.

I just got started getting into computers. Thought the Kim 2 looked pretty good; however, thought I would wait for your magazine and get the information about many of the others.

My very best wishes for your continued success and good health.

Edward Van Bosch W6KDI
Walnut Creek CA

Otto Balke, Jr. WAØCKG
1804 Rose Drive
Columbia MO 65201

Exciting New Touchtone IC

-- make phone calls with your HT

After many tries and an equal number of failures to get the rf out of my MH8900 chip, I had just about given up on using the beautiful Chromerics keyboard which I had optimistically mounted on my rig. Then I saw the specs on the MC14410 chip. Too good to be true!

I sent off to Data Signal, Inc., for the chip, printed circuit board and components. The Data Signal circuit is shown in my diagram in the dotted lines. This is a great combination, and is so small that it will fit almost any corner of most rigs (lots of room even with the large crystal in my Wilson HT).

To keep a short story short, I wired up the board, installed it, and it worked. There was adequate drive for full deviation and the first attempt brought up the autopatch. So far so good.

Now, how to automatically key the transmitter when a key is depressed. Everyone who has operated mobile has had the mike cord wrapped around the steering wheel at some embarrassing time. You just can't drive, push buttons and key a mike all at once! After a voltmeter, mA meter and scope check of the entire circuit, there was no apparent place to obtain a good reliable indicator that a key has been depressed.

Enter the ubiquitous 741, the problem solver where all else fails. The 741 is stabilized in the off condition via R7, R8, and R9. A small tone signal is picked off the original circuit at the junction of the two 3.9k resistors and coupled to pin 3 of the 741 by the .01 ceramic cap. When a key is depressed, the 741 amplifies the tone and converts it into a series of plus 12 volt pulses. These are rectified by the diode which pumps the 2.2 uF electrolytic cap. This in turn switches on the NPN transistor, picking the relay. The 2.2 uF cap determines the hold on time for the transmitter. Leakage of the cap and other components eliminates the need for R11.

Adjustments

The only adjustments required are the selection of the electrolytic capacitor (I used 2.2 uF) to determine the "hold on" time of the transmitter, and the adjustment of R5. To adjust R5, put a voltmeter on pin 6 of the 741 and find the point where the 741 turns off with no signal (no key depressed) applied. Gradually go in the off direction while depressing a key. The point where the 741 remains off with the key depressed is the low limit. Set the pot half way between the no signal off point and the key depressed off point for best reliability.

R6 was added to take some of the load off the zener diode when used for mobile operation. The regulated 5.1 volts is used to bias the 741 to assure more stable operation. ■

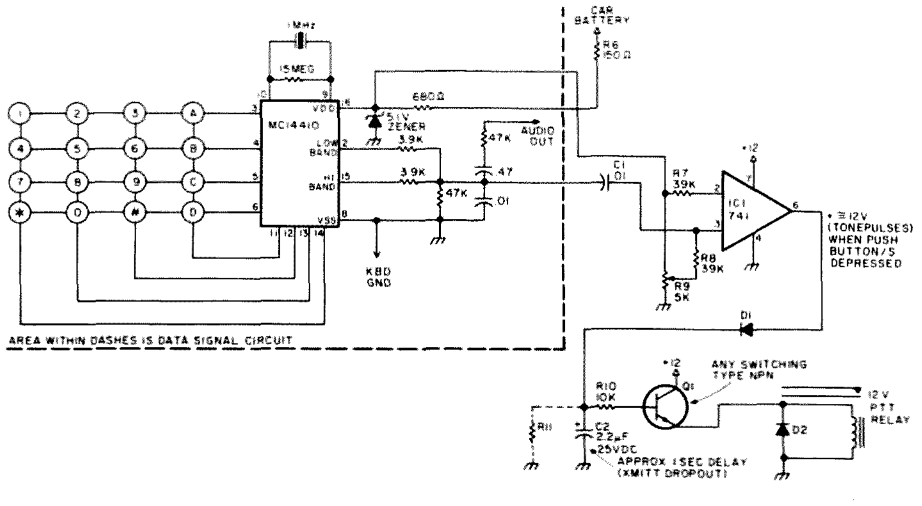


Fig. 1. Touchtone automatic keying circuit (transmitter) for the MC14410 chip. All resistors ¼ Watt.

Parts List

R6 — 150 Ohm ¼ Watt
R7, 8 — 39k Ohm ¼ Watt
R9 — 5k multi-turn trim pot
R10 — 10k Ohm ¼ Watt
C1 — .01 uF 10 V ceramic
C2 — 2.2 uF 25 V dc electrolytic
D1, 2 — 1N4001 or equiv. (not critical)
Q1 — 2N3567 NPN (any switching NPN which will carry the relay current will work)
1C1 — 741 op amp

Revisiting the COR

-- improvements on the April '76 model

William Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

The circuit I presented in the April, 1976, issue of *73 Magazine* worked just fine for me for six or eight months, but then my ham instinct to "add on" overcame my better judgment and I decided to improve the system. During that eight month period I had jury-rigged an identifier keying circuit on the original COR to key an identifier I had built. I wanted to clean up that rat's nest and add some features such as adjustable dropout delay to the COR so modification of the original became a necessity.

Features

In the revised unit, I wanted some extra features. These included dropout delay, transmitter time-out, control inhibit, and extra keying contacts for such uses as an identifier. I also decided, as long as I was about it, that I would put the whole mess on plug-in circuit boards and bring controls for the above delays and times out to the front panel.

Circuit

The revised circuit is shown in Fig. 1. The original relay is now replaced with a NOR gate, U1A. The input to U1A from the COR also triggers monostable U2 on the trailing edge. The output of U2 then goes back to the input of U1A and keeps its output low for a short time after COR release. This time period is adjustable and on mine is a front panel control. The 1 uF capacitor on U2 will be covered later in the article.

The second part of U1, U1B, uses the output of U1A and a low (ground) on the control line to produce a high on its output. The high output of U1B drives relay RY1 and also an LED indicator (optional). I use the relay contacts for PTT, ID key, and other uses.

Diode D1 and SCR Q5 are the active elements of the time-out circuit. D1 is present because the SCR I had would not turn Q4 off completely. Transistor Q5 is driven from U1A, which is high when no signal is present (squelched). This turns Q5 on and prevents C4 from charging. When the receiver unsquelches, Q5 turns off and C4 charges until Q7 turns on, which in turn opens the PTT relay. With the values shown, the time-out should be adjustable from about 50 seconds to about 3 minutes.

One more circuit is added, and that is Q6. Q6 is driven from the keying output of my IDer and turns the PTT relay on without triggering the COR or timer circuits.

Operation

I put the above circuit all together on the bench and it worked perfectly. I then built it on plug-in circuit boards and, wonder of wonders, it still worked. I then mounted that board and the identifier I had built in a logic rack on a new repeater panel recently built. I hooked up all the lines, powered the beast up and – ouch! – every time I keyed it up, it would retrigger itself every few seconds until I hit the control inhibit. It just sat there going click . . . click . . . click . . . ad infinitum.

I immediately took the standard TTL logic fixup mode. I put .01 uF capacitors on every chip and on every line that I possibly thought could help. To make a long story sad and short . . . it didn't work.

To make a short story out of several days of gloom and despair, I finally cured the problem entirely by accident. I accidently shorted a 1 uF capacitor from the timing pin on U2 (pin 14) to ground, and the problem went away. Although I had fears of drastically altering the timing, I still hung the 1 uF there and proceeded to test. Repeated tests indicated that the original problem had gone away and the timing had not been changed.

Conclusion

The circuit of Fig. 1 is now part of a control rack which contains the COR/PTT circuits, my IDer, and some audio interface circuits in addition to the control decoders. Fig. 2 shows the

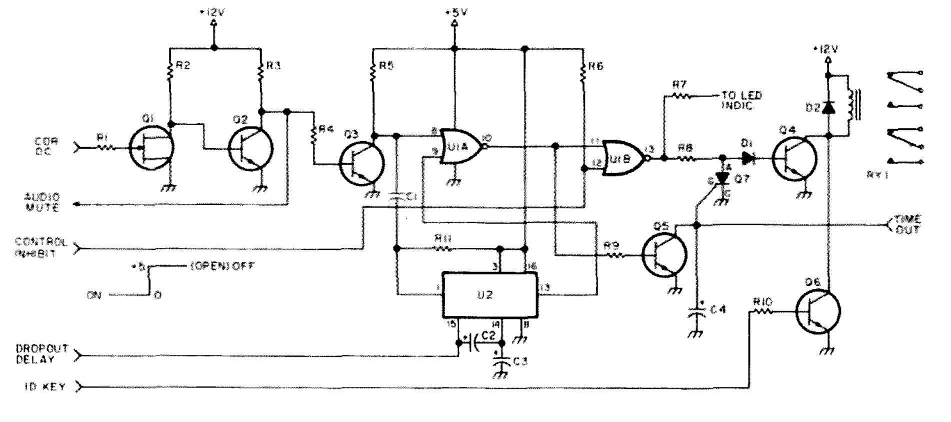
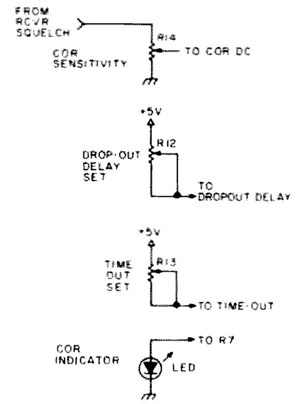


Fig. 1. Complete circuit of the COR/TIMER. The circuit requires a ground on "control inhibit" to operate. "Audio Mute" goes back to my audio interface board to shut off the audio during the dropout delay.

front panel controls I used.

Although I put mine on a multi-purpose, plug-in circuit card, I did design a printed circuit board for the circuit and they can be obtained from CONTACT R&D, 35 W. Fairmont Drive, Tempe AZ 85281 for $4.95 ppd. Also I am preparing a plug-in circuit board for the COR plus a single function tone control which should be ready by the time this gets published. Write to CONTACT for details. ■

Fig. 2. Front panel controls. These can be put on the board if desired.



Parts List

R1 – 1 M	D1 – 1N914/1N4148
R2 – 3.3k	D2 – 1N4001 or equiv.
R3 – 3.3k	Q1 – MPF102 or equiv.
R4 – 1k	Q2-Q6 – MPS6521
R5 – 3.3k	Q7 – 2N5060 or equiv. plastic SCR
R6, 11 – 4.7k	U1 – 7402
R7 – 470	U2 – 74123
R8 – 1k	Fixed resistors are all ¼ Watt 10%.
R9 – 2.2k	Panel Parts:
R10 – 2.2k	R12 – 50k
Ry1 – 12 volt relay	R13 – 50k
C1 – 0.1 uF	R14 – 5 Meg
C2 – 100 uF/12 V	LED (optional)
C3 – 1 uF/12 V	
C4 – 400 uF/12 V	

EDITORIAL BY WAYNE GREEN

from page 4

to get every club member to work a mention of the special guest into his contacts, not only for the chap he is talking with to hear, but for all local listeners. Some clubs have had great success with phone canvasses of every ham in the area, for getting them out to a special meeting is the first step toward getting them to join the club.

WHAT TO ADVERTISE

Just saying that some joker is going to be there to speak isn't likely to get people out. You may think your speaker is famous, but the chances are that a lot of hams won't agree. As in all advertising, think in terms of what the benefits are to the chap you want to come. Will he be really entertained? Tell him so. Will he also learn a lot which will be of value to him? Tell him!

When I talk to ham clubs I tell a lot of things that I could never print in the magazine. Our lawyers won't even let me tell you what well-known ham firms we've been having serious troubles with, and what the problems are. You might just get a lot of inside dope on what is happening in amateur radio, not only with manufacturers and dealers, but with some of the ham magazines.

Some hams would like to know the real inside information on what is going on with the FCC, with the ARRL, with *CQ Magazine*, with the coming WARC, and things like that. I kind of hint around a bit about these in *73*, but at a club meeting I answer all questions . . . even questions about *73* and *Kilobaud*.

Find out what your speaker may be able to talk about to enthuse the listeners, and stress that in the PR. The above two paragraphs were merely by way of example – please don't ask *me* to come and talk. I try to plan my life so I can just barely, with a very few hours of sleep and a seven day week, get 90% of what I should do done, with no time allocated for talking. On the few occasions when I talk to a group, mostly at conventions, I make a tape . . . and copies of the tapes are available.

DOLLAR AN HOUR

A few old-timers may remember with nostalgia the days when someone making a dollar an hour wasn't doing all that badly. If you happen to know any of these chaps, wake them up and tell them that Wayne Green has figured out a way to get back to those good old days . . . back to a dollar an hour!

Heck, I was chief engineer of a thousand Watt broadcast station at one time and made 90¢ an hour. Fortunately I worked a 90 hour week, so it did mount up. And the 90 hour week left no time to spend any of the money, so I saved doubly and eventually was able to buy my freedom.

So how do we get back to a dollar an hour? Simplest thing in the world – all we have to do is change our day to 100 hours instead of 24. This will make decimal time possible and simplify watches. Sixty minutes in an hour is ridiculous – shame on you putting up with such a nutty system for all these years.

If we change to a 30 hour work day we'd make about $150 per week at a dollar an hour. That would be a slightly smaller percentage of our normal working time (the 8 hour day), but not a lot.

The next step would be to have 100 minutes per hour instead of 60. This would make a new minute last about 8½ seconds, which should be long enough for anyone. We might call them centihours, with millihours being 0.85 seconds long.

Oh well, if you're going to fight every new idea that comes up . . .

NOVICE MAGAZINES ACOMING?

Yes, yes, I've read that stuff about a "new" *CQ* . . . pardon me for being a bit jaded as far as "new" *CQ*s go . . . they seem to be periodic fantasies which quickly fade away . . . and I would have put the present circulation of the magazine at more like 7,500 than the 40,000 claimed . . . either way some changes won't hurt.

While there is a need for more articles for beginners, my own feeling is that beginners are just as interested as anyone else in the state of the art and developments in all of the 25 or so hobbies which make up amateur radio . . . thus while there is a need for more fundamental type articles in the ham magazines, I doubt that there is much of a need for whole magazines devoted to "run, Spot, run" level articles.

The major interest at *CQ* has been in CB for a long time now and, other than a fast hormone shot to ailing old *CQ*, I wonder how long any interest will hold up in their loser. Money talks, and *S9* is where the money is. We'll see.

Ham Radio magazine has also announced a Novice magazine, but I'll be surprised if this doesn't eventually become a section of *HR* and sort of fade away.

And not to leave any charges of favoritism, I must mention *QST* too, much as it goes against the grain. They've been doing some strange things down there in Newington recently . . . I write and ask them about it now and then, but they don't answer my letters. For instance, at conventions I've been getting a continuous barrage of visitors to the *73* booth volunteering that they have dropped their subscriptions to *QST*. And I know there is serious concern in Newington over this, complete with a questionnaire to readers asking what it is about *QST* that they don't like. Yet, on the other hand, *QST* has been claiming incredible increases in circulation . . . a puzzle. Things fell into place a bit when during the New Orleans ARRL Convention an official explained that *QST* was now sending two copies of the magazine free to 30,000 libraries.

The recent ARRL claims have been for 135,000 copies distributed, so 60,000 to libraries would leave 60,000 to members, 10,000 for radio stores and 5000 for back issue sales, almost exactly what I had estimated. They can afford to send a lot of copies for nothing because *QST* enjoys an incredibly low postal rate . . . around 2¢ a copy the last time I got the figures on it. I haven't checked the cost per copy for mailing *73* lately, but I do know we are paying 70¢ per copy for *Kilobaud* magazine, and it is only 144 pages as against 208 or so for *73*.

None of this is of any real significance to readers . . . what counts in the long run is whether the magazine is interesting and really worth the money it costs. If the new Novice magazines meet this requirement, they will sell well.

THE PLAYBOYS

I got some reports on the New Jersey Playboy Club ARRL Convention . . . one from a ham who went there . . . disappointed, said many people left early. Another from a ham dealer who said it was great . . . lots of people, and they were spending money . . . always a pleasant thing for dealers.

Several of the exhibitors got a rude shock when a man showed up demanding that they collect tax on all sales and give it to him before they left. Tufts stood up to the guy, pointing out that no tax was due on sales made by out-of-state vendors, unless they were licensed by the state. Out-of-state vendors can sell if they only come in once a year; otherwise, they are supposed to get a license and collect tax. The tax man shut up when this was explained, and went away . . . never to be seen again.

Word is that one exhibitor was merrily charging the tax anyway, and the suspicion is that they did not turn in this money to New Jersey. Tsk.

One hint to readers . . . if you find yourself being charged a sales tax by an exhibitor at a hamfest who is there from out of state, get a receipt for the tax and check with your state to make sure the money was turned in. While none of us like to pay a tax, we don't want to be ripped off for the money either.

The Mighty Magnet Mount Antenna

-- the price is right: zilch

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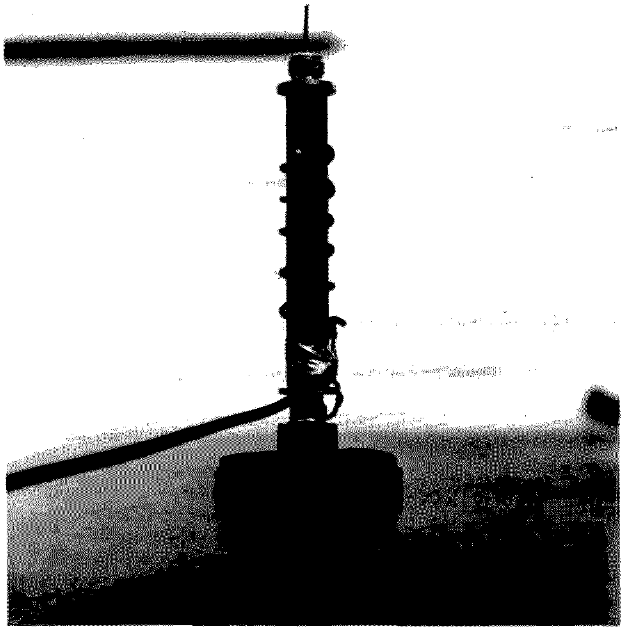
Here is a truly versatile magnetic mount two meter antenna that is easy to build. The heart of this antenna is the magnet, which must be able to retain its grip at high driving speeds and when low hanging branches hit the antenna. After some searching in my basement for a suitable magnet, I found a burned-out twelve inch loudspeaker. The speaker had originally been used in a rock and roll guitar amplifier and had a large 2½ lb. ceramic magnet. Such a speaker could be picked up gratis from any musical repair shop.

Assembling The Antenna

Before handling the magnet, remove your watch. Treat the magnet gently, since the ceramic is brittle like glass. Carefully remove the magnet assembly from the loudspeaker frame with a small cold chisel. Now remove the metal pole pieces that sandwich the magnet. These are usually lightly glued to the magnet and can be removed with the aid of a rubber hammer. The larger pole piece is turned over and glued to the top of the magnet with epoxy (see photo).

On the top of the magnet assembly, a loading coil is placed. I used an old high voltage insulator, but almost any insulating material such as phenolic, plastic rod or pipe will do. If copper pipe caps are epoxied to each end, this would form a suitable coil form. Another excellent coil form would be a large blown-out cartridge fuse which your local power company may be able to provide. The dimensions used are not too critical and can be anything from ¾ to 1¼ inches in diameter and about 8 inches high.

On this form 9 turns of #14 gauge copper wire is wound. The type of wire is not terribly critical and thinner wire could be used. As a radiating element, a 39 inch piece of coathanger or other stiff wire is used. For my antenna, I straightened



Close-up view of base and loading coil.

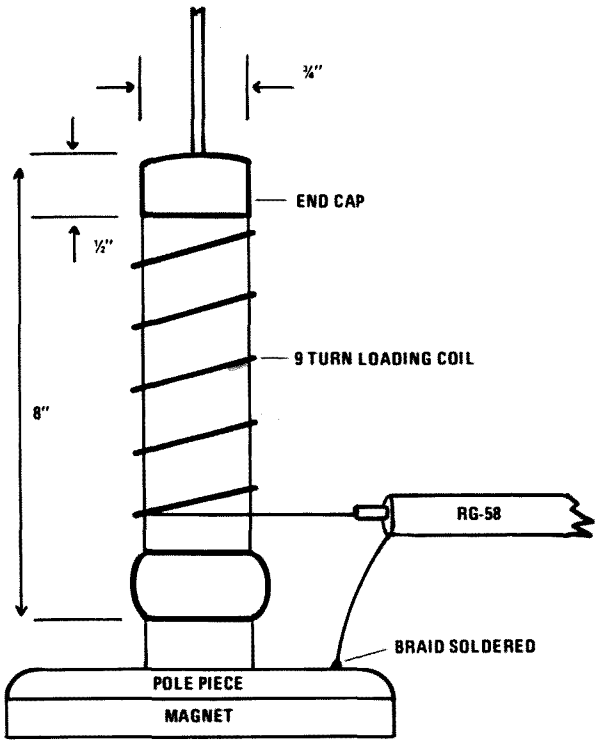


Fig. 1. Loading coil and base.

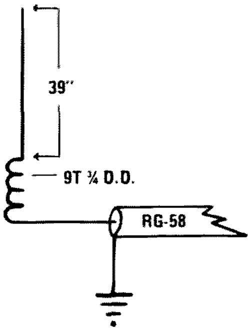


Fig. 2. Schematic diagram.

out a heavy coathanger in a vise and soldered it to the top cap. The coil assembly is now either soldered or epoxied to the metal base.

Finally a 14 foot length of RG-58 coaxial cable is connected to the antenna, with the inner conductor soldered to the bottom end of the loading coil. The outer braid is soldered to the pole piece with a large soldering iron. Alternatively, a hole could be drilled and tapped in the pole piece. The braid is then secured by means of a screw and lock-washer. As a final step, the exposed braid and inner conductor are sealed with silicone RTV to prevent water from seeping into the coax.

Tune-up

The completed antenna is now placed on a car roof or other large piece of sheet metal and the radiating element trimmed for lowest vswr. If a vswr meter is not available, cut the antenna to 39 inches in length, and as long as reasonably low power levels are used, the antenna should perform well. A good rule of thumb when testing any home brew antenna is to make sure that it receives correctly. Check it with an ohmmeter before firing rf into it.

Conclusion

My antenna, powered by the one Watt from a TR-22 and placed atop a 1960 Chevy, produced truly spectacular results. The WR1ABV machine in Boston could be hit solidly while driving through southern New Hampshire, at an airline distance of over 40 miles. Operating stationary mobile from Easton, New Hampshire, it was possible to hit the WR1AEA machine in northern Vermont with good results, a total air distance of 60 miles. I hope this antenna works as well for you as it has for me. Happy mobiling. ■

Antenna mounted on top of author's 1960 Chevrolet.

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A 15.75 kHz Oscillator

- - simple TV test unit

This is to describe a device of considerable value to the many hams that service TVs either in the shop or at home. It has not, so far as I am aware, been used or suggested by anyone else. It is simply a regenerative receiver set on 15.75 kHz, the TV horizontal oscillator frequency.

With it the horizontal oscillator frequency can be set correctly without a signal and the adjustment made in seconds without any doubt as to whether to increase or decrease the oscillator frequency. Many of us have spent valuable time in the shop blindly turning the slug in and out without the slightest idea where it should be for the correct frequency. If the oscillator is not working, there will be no signal regardless of adjustment. Adjustment of the horizontal oscillator in the usual manner only brings the frequency near enough that the sync pulse can lock it in step and thus is no assurance that in the free-running state it is on frequency.

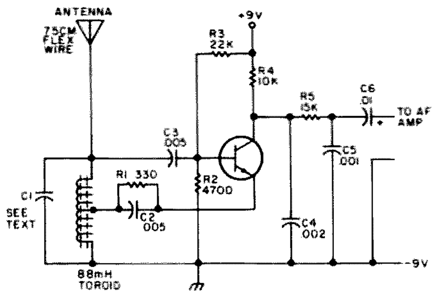

Fig. 1.

This receiver may be built into any small case such as that from a defunct transistor radio. Its variable condenser, audio amplifier and speaker may also be used if good. It may be made small enough to carry in a shirt pocket on house calls.

It is a simple project for you who are hams, but maybe not for those who only replace parts and consider radio a mystery. Not being entirely satisfied with the unit I have used for the last several years, and with this write-up in mind, I built another, per Fig. 1.

To conserve space and avoid hand capacity effect, an 88 mH toroid coil was used rather than a regular horizontal oscillator coil which would have required some shielding.

This circuit using the collector at ground potential for rf was chosen to simplify the audio takeoff. R5C5 provides additional filtering to keep rf out of the audio output. Use the audio amplifier in the original case, if convenient. If you must build your own, a small IC is suggested for compactness.

A regenerative receiver is most sensitive when not oscillating at full strength, so it is a good idea to use variable resistors to determine the best values for reliable but not excessive feedback, replacing them with the nearest fixed small resistors. While I used a 2N706 transistor, it is safe to assume that at least a hundred other types, requiring different bias resistors, etc., may do as well or even better.

C1 is made up of one or more fixed mica condensers in parallel with a small variable condenser or mica compression trimmer; the latter is definitely second choice. The total capacity required should be around .0018. Marked values are seldom correct. Temperature sensitive condensers are to be avoided for tuning. Silver micas are preferred. The temporary use of an external variable condenser of considerable capacity will expedite finding the proper value and frequency.

With this receiver's antenna near the horizontal area of an operating TV, listen for the 15.75 kHz signal when you are sure the receiver is oscillating. When zero-beat is obtained, with final tuning condensers in place in the final assembly, no further adjustment is required and it is ready for use.

With no signal or antenna on the TV to be serviced and with front panel control, if any, set at midrange, adjust the horizontal slug for zero-beat with the receiver and you are finished with that part of the job — no guesswork! If the sync doesn't take control, then that is a different problem, and there is no need to twiddle with the horizontal oscillator. ■

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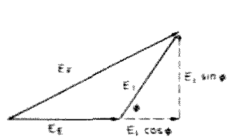
Japan

Behavior Mod for the HM-102

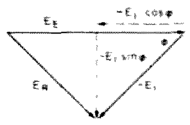
-- pretty simple

The Heathkit HM-102 swr bridge and power meter is an excellent swr indicator, and as an rf wattmeter it gives good results when the line in which it is used is a perfectly matched 50 Ohm line. Obviously this condition, if it occurs at all, will be present at only one specific frequency in a band, if the load is an antenna. The usefulness of the HM-102 as a wattmeter is therefore restricted by the fact that readings depart radically from true power if the swr in the 50 Ohm line is significantly different from unity. Furthermore, even in a matched line of some other impedance, the indicated reading is not true power being delivered to the load, but is so-called "forward" power from which "reflected" power must be subtracted to give a true power reading.

The HM-102 as assembled per Heath's instructions makes no provision for reading reflected power. However, it is possible with the rearrangement of a few components, some very slight surgery on the circuit board, and the addition of one .001 uF capacitor to provide for reading reflected power as well as forward power with the HM-102. This makes it possible to use it to determine the true power delivered to a load, regardless of swr or mismatch, on lines of any impedance.



$$E_F^2 = (E_E + E_I \cos\phi)^2 + E_I^2 \sin^2\phi$$
$$= E_E^2 + 2\,E_E\,E_I \cos\phi + E_I^2$$



$$E_R^2 = (E_E - \cos\phi)^2 + E_I^2 \sin^2\phi$$
$$= E_E^2 - 2E_EE_I \cos\phi + E_I^2$$

$$E_F^2 - E_R^2 = 4E_EE_I \cos\phi$$

Fig. 1. Vectorial addition of E_E and E_I in the forward power case, and of E_E and $-E_I$ in the reflected power case. The squaring is performed by the meter scale calibration, and the difference between the two scale readings is proportional to $EI \cos\phi$, the true power being delivered to the load.

Principles of Operation of the HM-102

In the HM-102, as in all typical directional rf wattmeters, the meter deflection for forward power or for setting swr sensitivity is proportional to the vector sum of two voltages. One of these is derived from and is proportional to the rf voltage on the line. The other is proportional to the rf current flowing in the line. With the swr sensitivity switch pulled "out" in making swr readings, these two voltages are in phase with each other if the load seen by the meter is resistive. With the swr sensitivity switch pushed "in," the phase of the voltage derived from the current is reversed so it is subtracted from the other voltage. The process of nulling the swr indication during initial calibration with a 50 Ohm load is actually the setting of the rf voltage sample exactly equal to the current sample. This is indicated by the null, since the two are exactly out of phase.

Now let's go back to a real fundamental of electricity. The true power being delivered past a point on any line is $EI \cos\phi$, where ϕ is the phase angle between the current I and the voltage E at that point. This is true whether we are dealing with dc, 60 Hz, or rf, regardless of mismatch, line impedance, or anything else. So in order to determine true power under any conditions, we need to measure this quantity.

For such a general case, the voltage derived from the current sample may have any phase relationship from -90

degrees to +90 degrees with the voltage sample, and their relative magnitudes may vary without limit. In the HM-102, meter deflection is proportional to the result of adding these two samples vectorially. The scale is calibrated to give an actual reading proportional to the square of this resultant.

This general case is shown in Fig. 1 for "forward" and "reflected" power. The rf voltage sample is represented by E_E, the voltage from the current sample by E_I. Their vectorial sum is designated as E_F in the forward power case and as E_R in the reflected power case, in which the polarity of E_I is reversed. As Fig. 1 shows, the arithmetic difference between the two scale readings is proportional to EI cos ϕ, which is true power flowing toward the load. We don't need to worry about the quantity "4" in front of EI cos ϕ. With a 50 Ohm resistive load, and with E_E and E_I set equal to each other, the normal calibration of the meter is done so that the correct power is indicated for the quantity $(E_E + E_I)^2$. This exactly equals $4E_EE_I$, so as you can see, the constant "4" is taken into account in the initial calibration, with or without the modifications we are talking about.

Circuit Modifications

From all the foregoing, it is evident that to read reflected power with the HM-102, we need a way to read E_R^2 by reversing E_I when using the power metering positions of the function switch, as we do when reading swr. It turns out that this can be done using the existing swr sensitivity switch to perform this function.

The original HM-102 circuit is shown in grey in Fig. 2 and the circuit after modification is shown in black.

The changes are made as follows:

(1) Remove the 100k resistor R3 from the circuit board and re-connect it in the meter unit from terminal 5 of the sensitivity switch to ground. Also connect a new .001 uF across R3 in this new location. Move .001 uF capacitor C14 to the location previously occupied by R3.

(2) Remove 82k resistor R9 from the circuit board and re-connect it between terminals 3 and 4 of the function switch in the meter unit.

(3) With a sharp knife or razor blade, break the foil connection on the circuit board between terminal 1 of R6 and the nearby end of R4, removing a small segment of foil. Leave enough of the foil coming from R4 to drill a small hole through it. Move the white lead from the interconnecting cable to this new hole instead of point B where it was originally connected.

(4) Move the red lead of the cable from point G on the circuit board to point B where the white lead was originally connected.

(5) In the meter unit, move the red lead of the cable to terminal 5 of the sensitivity switch.

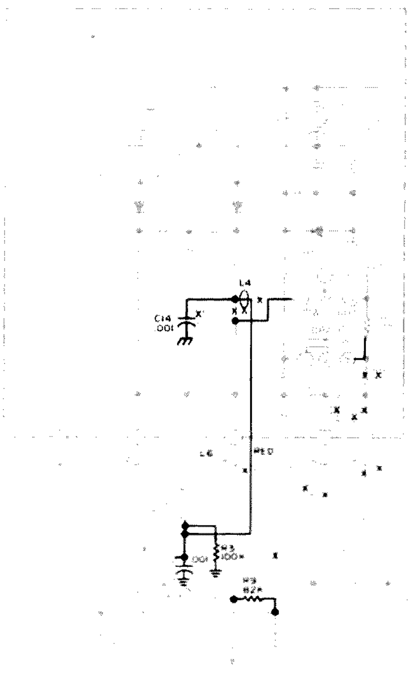


Fig. 2. Notes: 1. All resistors are 1/2 Watt 5% unless otherwise noted. Resistor values are in Ohms (k = 1000). 2. All capacitors less than 1 are in uF; greater than 1 are in pF. 3. Function switch shown in 200 position. 4. Calibrate switch shown in CAL position. 5. Sensitivity switch shown pushed in. 6. This symbol indicates circuit board common. 7. ⏚ This symbol indicates chassis ground. 8. ☐ This symbol indicates an external connection to the circuit board. 9. This symbol indicates a ferrite bead. 10. Overlay indicates circuit modifications.

That's all there is to it. Now the meter will read forward power on either scale with the swr sensitivity switch pulled out, and reflected power with the switch pushed in. True power is the difference between the two readings. The sensitivity control itself has no effect on the power indications when the function switch is set to measure power.

The calibration process and the use of the meter for swr readings are unaffected by these changes. Just be sure the sensitivity switch is pulled "out" for the power calibration! ■

Antenna Magic

--good advice on antenna fundamentals

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You have just taken your Novice exam and are eagerly awaiting the arrival of your ticket so you can make that first contact. The piece of wire that is hanging out your window for your receiving antenna will not be the answer for your transmitter's sky wire. So, what are your alternatives? There is a confusing array of antennas available commercially at a variety of prices and hundreds of articles have been written concerning the construction of everything from dipoles to log periodics. I found myself confronted with this situation thirteen years ago and since then have had considerable experience with simple but very effective antennas, and have made thousands of enjoyable contacts both local and DX utilizing these antennas and low power.

Some Basics

First of all, the use of high power is unnecessary. Most Novices cannot wait to buy that kW amplifier so they can have a "big signal." However, if you look at the dB gain in increasing power from one level to another using the formula gain in dB = 10 log P_2/P, you will find that going from 75 Watts to 1000 Watts results in a gain of only about 11 dB. This is less than a two S unit gain at 6 dB per S unit. Granted that this may be significant when chasing rare DX or under adverse conditions, but the majority of your contacts will take place in more favorable situations. So, to communicate effectively, an effective radiating element is imperative.

The Vertical

When I received my license, I purchased a vertical antenna to go along with my fifty Watt Viking Adventurer transmitter. I ground mounted the antenna and drove a six foot ground rod about a foot from the base in accordance with the instructions. In attempting to make my first contact, my worst fears were confirmed. The story that vertical antennas radiated equally poorly in all directions was true. I thought that there must be something to improve the effectiveness of this convenient antenna and there was. Whether you purchase a commercially made vertical or construct your own quarter wave antenna, a good radial/ground system is an absolute necessity whether ground or roof mounted. I found that at least three quarter wave length radials for each band either lying on top of the ground or buried a couple of inches will not only lower the swr considerably, but also vastly improve the radiation effectiveness. Using the formula, quarter wave length =

$$\frac{234}{\text{Freq. MHz}}$$

the radial and antenna length for the Novice bands will be: for 80 meters, 63 feet; 40 meters, 33 feet; 15 meters, 11 feet; and 10 meters, 8 feet.

If a multi-band trap vertical antenna is used, adjust each section for the lowest swr, starting with the highest band. Be sure the ground radial system is connected during the adjustment phase to insure an accurate swr reading. Although it may take time to perform these adjustments, eventually a point will be reached where a low swr will be found on each band. In observing the operation of many verticals, they seem to perform better on the ground with a good radial system than on the roof.

The use of the vertical has proven itself for me over the years and I have worked over one hundred countries running no more than 180 Watts. The small area that this antenna occupies and the relatively low cost puts this antenna at the top of my list for permanently affixed antennas.

The Ubiquitous Dipole

I have been in several situations where it was impractical to install my vertical after initially arriving in an area, and in order to get on the air, I have used a dipole. I am currently using my "portable dipole" with good results on 40 meters. When I put my rig on the air at my Rocky Mountain QTH this past January, there was four

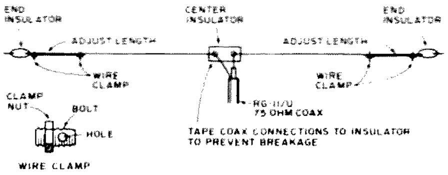

Fig. 1.

feet of snow on the ground. That slight inconvenience prohibited the installation of the vertical. This dipole has been used in various locations with equally good results.

Using the traditional formula for a half wave dipole, total length in feet =

$$\frac{468}{\text{Freq. MHz}}$$

the antenna can be constructed easily and very inexpensively. The higher quality RG11 coax (75 Ohm impedance) is recommended to feed the antenna to increase the transfer efficiency.

If the antenna is to be used as a "portable antenna" as is the one I have constructed, I have devised a simple method of tuning since the characteristics vary according to height above ground and its proximity to obstacles. This method can be used for adjusting the antenna from one band to another or changing the resonant frequency within the band. Using two small wire clamps (available at hardware stores) on each end of the dipole (see Fig. 1), the length of the legs can be varied. Using an swr bridge after setting the length employing the half wave formula, the antenna can be resonated for maximum efficiency. Since the antenna is never cut, the antenna can be lengthened or shortened at any time without having to solder additional lengths of wire to the existing antenna.

I have used this design on 40-10 meters and occasionally add fan elements to the center insulator to allow multi-band operation. I am currently using this antenna on 40 meters and it is only 20 feet above the ground at the highest point and is surrounded by pine trees. I have no trouble working almost everything I hear on 40 SSB and have worked into Europe, South Africa and the Pacific on 40 CW running 180 Watts from Colorado. This antenna was used as a hidden antenna mounted under the eaves of the roof of the bachelor officer quarters when I was in the Air Force and it performed well. Balun feed as well as direct coax coupling has been tried and the difference in performance was negligible. The balun would help reduce TVI if you are in an area where that is a problem.

Conclusion

Ham radio can be just as enjoyable running low power and using simple antennas as in using a beam and a kW. In fact, there is a greater challenge in using simple but efficient equipment. There is always a thrill when working a DX station under these circumstances. Do not let the antenna be the weak link of your station. Take your time in constructing your antenna and insure it is resonant to the frequency you prefer to operate. It does not have to be high in the air if it is well matched. I used a dipole only three feet above the ground in KL7 land for several weeks and had no trouble getting out.

It is not only inexpensive but very interesting to experiment with simple antenna designs. Do not let that rig sit idle for want of an antenna system. See you on the air! ■

Monitor scopes are still regarded as luxury items by many amateurs, even by those operating SSB equipment. This perhaps explains why there are many distorted SSB signals on the air.

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See Yourself Talk

- - build a sideband monitor scope

If we want to adjust our transmitters for optimum working conditions, a scope is a must. Being a home brewer, I decided to make my own.

The monitor scope that resulted is suitable for monitoring AM, DSB and SSB, on both receiving and transmitting. There is a choice of either the wave envelope or the trapezoidal pattern. It has a five position bandswitch which covers the following bands:

Receiver:
1. 455 kHz

Transmitter:
2. 160 and 80m
3. 40 and 20m
4. 15 and 10m
5. 6m

A 3BP1 cathode ray tube was used, although a DG 7-5 is to be preferred because it is physically smaller and the internal electrode connections are shorter.

To obtain sufficient brightness, about 800 V EHT is needed. A transformer from an old 6 V vibrator power supply was used. This transformer has a 300 V secondary; the center-tap was not used, and, with a full wave voltage doubler, -840 V EHT was obtained.

The HT needed for the EF91 Miller-transitron sawtooth timebase generator is taken from the -420 V point of the voltage doubler, filtered and reduced to -330 V. The anode side of the EF91 has to be grounded to enable the use of this negative voltage.

This system necessitates the use of a 6.3 V filament winding which should be left floating. The 6 V vibrator primary yielded 8 V, which was reduced to 6 V by means of a 6.8 Ohm 1 W resistor.

Flyback suppression is achieved by taking a negative pulse from the screen of the EF91. This pulse is limited by the OA210 and the resulting flat-topped waveform fed to the grid of the 3BP1 to blank the retrace of the timebase sweep.

Horizontal deflection is controlled by the 1 M linear pot marked "HOR." Vertical deflection is controlled by the 500 pF tuning capacitor. An OA81 germanium diode was used for detection of the horizontal sweep, because there was one in the junk box, but an OA91 would be preferable.

Due to the fact that the horizontal plates D3 and D4 are more voltage-sensitive than the vertical plates D1 and D2, the trapezoidal pattern appears slightly pulled out vertically. In practice this does not matter very much.

The trapezoidal pattern can be reversed, by reversing the polarity of the OA81.

Connecting the Scope to the Receiver and Transmitter

Coaxial cable must be used for these connections.

Receiver

Connect a 5 pF capacitor from the plate of the last i-f tube to the inner conductor of the coax lead.

Transmitter

Mount a 1 turn loop near

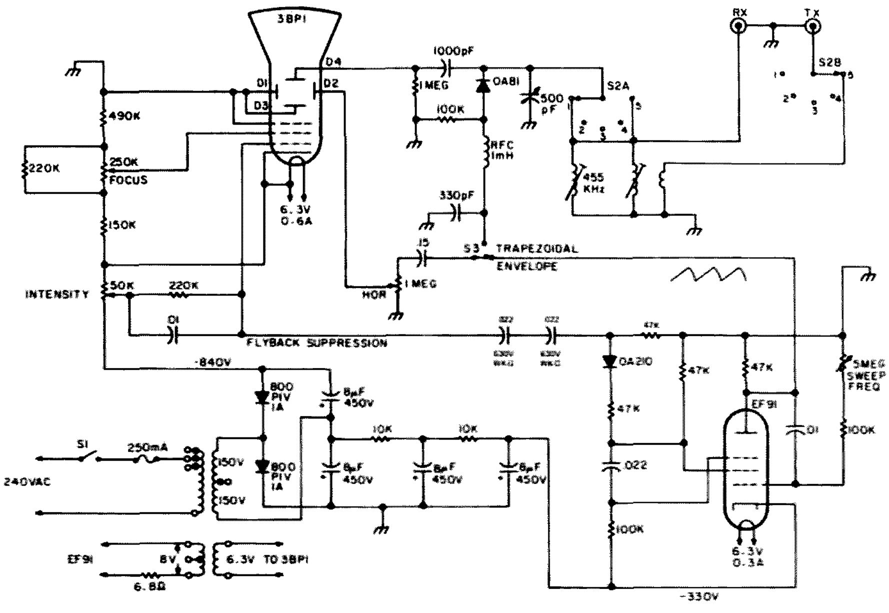

Fig. 1.

Reprinted from *Amateur Radio*, Journal of the Wireless Institute of Australia, October, 1974.

The monitor scope can be seen on top of my allband phasing rig.

the cold end of the PA tank coil and bring the signal out through a piece of coax cable.

Construction Hints

Do not mount the power transformer next to the CR tube. The transformer's magnetic field will influence the electron beam. It is better to mount the transformer behind the CR tube. The layout is not critical. One important point is to mount the 500 pF tuning capacitor with its associated circuitry as close as possible to the 3BP1 base. By keeping the connections between D4 of the 3BP1 and the tuned circuit as short as possible, this monitor scope will work up to 80 MHz.

Preferably, the CR tube should be shielded with a mu-metal shield. I must confess to once making a 144 MHz monitor scope using a DG 7-5 without a shield. It worked OK!

Information on the Coils in the Rf Section

Coil 1 is an i-f transformer with one coil shorted. The other coil is used with the fixed capacitor, which is normally soldered across it, removed.

Coils 2, 3 and 4 are slug-tuned. They are omitted from the circuit diagram for clarity.

Coil 5 is a hairpin loop.

All are link coupled, except the 455 kHz coil.

Note

If a DG 7-5 or some other CR tube is used, the EHT resistance chain should be altered to supply the correct voltages to the CR tube. ■

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The Hidden Charger

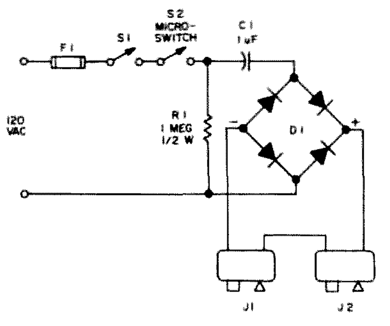
-- simplest charger yet

All right, all you fellow part-time home brewers, this is it. You have all seen the basic charging circuits before, as used in the textbook versions of "the-fundamental-way-to-charge-nicads" type diagrams. Well, this charger is little different except for one or two "convenience and/or safety" features. Just like the title states: This is an inconspicuous charger – plain and simple.

It is said that necessity is the mother of invention and my necessity was to save money! I'd just purchased one of the popular 2 meter hand-held portables and was determined not to shell out the extra twenty bucks or more to buy the accessory charger. After consultation with friends over a few beers, the simple circuit shown in Fig. 1 took shape.

In my particular case it so happened that I was fortunate enough to have an extra set of 10 AA nicads, and so, rather than have the HT sit in a charger for hours on end, I settled on a more convenient solution. I chose to charge one set at home while using the other in the field. Since I operate FM almost exclusively at this time, my "shack" is just about nonexistent. This meant that the charger would have to sit somewhere in the house. With this intent in mind, I conceived the "hide-away" design.

Fig. 1. Charger circuit.



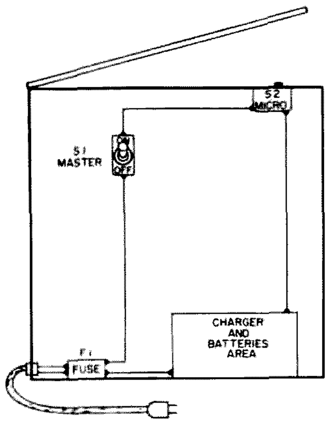


Fig. 2. Block diagram of basic layout.

A quick glance at Fig. 1 will reveal the circuit strategy. The details are rather straightforward. The circuit trickle charges the batteries at 40 milliamps which, in the case of my 450 milliamp hour batteries, was quite acceptable. Some who look at the circuit may balk at the high voltage that appears to be applied to the batteries, but this particular circuit is a variable voltage, constant current charger. Through the loading action the circuit voltage adjusts to the total voltage of the batteries being charged (12 volts in my case).

The charging current, however, is the variable and critical factor. In the case of constant current trickle charging, 450 milliampere hour AA cells should not be charged at greater than 45 mA. Elaborate current regulation could be employed here, but for the sake of simplicity and cost the current regulation in this charger is accomplished through the action of C1. It would seem logical then that C1 should be the highest quality and therefore the most expensive component of the charger. I used a 1 microfarad tubular capacitor that I had in the junk box, but a higher quality capacitor should be used (no electrolytics allowed). The 1 microfarad capacitor regulates to about 40 milliamps of charging current. As a matter of fact, the charging current increases by 4 milliamps for every .1 microfarad of capacitance used (hence 1 microfarad = 40 mA). This variance allows you to choose the right charging current for your need, but remember to stay under your particular charging current limits!

No elaborately filtered dc

is needed for charging, so the full wave rectifier (D1) was chosen to do the job. Just about any cheap little full wave package will do, as long as it is rated high enough. I used a package rated at 200 volts at better than ½ Amp. The resistor R1 is included as a bleeder for C1.

The rest of the circuit is a combination of my love for gadgetry and my previously stated desire for an inconspicious charger. I finally decided to install the entire unit in an old teakwood box that would halfway blend into most rooms.

The actual circuit itself (except for switches) was mounted on a breadboard chip which was placed in a small utility box that sat at the bottom of the teakwood enclosure. The batteries (along with J1 and J2) were simply allowed to lay on the bottom of the enclosure near the utility box itself.

I also didn't want curious souls opening the box while it was in operation and exposing themselves to possible shock. This is where S2 comes into play. S2 is a microswitch, of which I happen to have quite a few. I mounted the microswitch near the top so that closing the lid of the box closed the switch as well. In this configuration the circuit will be deactivated whenever the lid is raised (see Fig. 2). S1 is the master switch (optional), and it occurred to me as I was composing this article that a light bulb or LED indicator could be added. Remember, though, that the circuit voltage will vary from 120 V with no batteries attached to 12 V while charging. The indicator will have to be designed to compensate, of course. For added safety, all exposed wiring should be well covered.

The other minor details concern F1, J1 and J2. F1 is a little bit of extra safety to guard against the results of any accidental shorting. The fuse value is not given here since it will vary for most modifications of the design. Each builder should choose a value to suit his own needs.

J1 and J2 are inexpensive 9 volt battery clips. I used these as a cheap solution to the accidental reverse polarization problem. I decided to load the 10 AA batteries into one 4 cell plastic AA battery holder and another 6 cell AA plastic holder. I purchased the type of holders that sport the mating terminals for the J1 and J2 clips. They are available at just about any local electronics emporium. Note that they are wired in series. This is necessary for each holder set of batteries to get a full charge. It would take a real klutz to try to match the female terminals to female (or male to male), so the possibility of incorrect polarization is reduced somewhat!

A few words on the characteristics of the charger itself would be appropriate here. Do not leave the batteries connected to the charger when the unit is not in operation, since the internal resistance of the charger has a tendency to drain the batteries. Also, this charger is a trickle charger, so about 16 hours of charging time works out rather well. As a matter of fact, the batteries can be left charging longer than 16 hours, but such prolonged charging could develop a "memory" in the cells for a particular level of charge which the batteries will not exceed.

Well, that about wraps it up except to say that this charger article is simply a detail of how I happened to solve a particular problem in a particular way. It is absolutely wide open for experimentation and modification. The urge to modify flows in the blood of most hams, and by the time this article is printed I will have probably already changed the circuit beyond recognition! ■

Compressor IC Expander

- - why go only halfway?

73 Magazine *Staff*

All broadcasting stations employ some device to limit their maximum modulation level — usually a peak limiter. But besides this device, many also employ further speech processing equipment to keep the average modulation percentage as high as possible to achieve maximum effective coverage with the allowed transmitter power level. This means money to the station, and so speech processing equipment can be quite sophisticated and expensive; present solid state units cost about $800. These units perform two main functions: expansion and compression of the audio used to modulate the transmitter. With very low audio input levels, expansion is used to bring up the audio level. When the audio input level reaches a certain point, expansion ceases and then compression takes place as the audio input level increases further.

Almost all amateur type speech processing devices provide a compression function only. This simplifies the circuitry but it has several disadvantages. If one suddenly speaks at a lower than normal level, compression may not take place and the advantage of the speech processing device is lost. If one sets the gain of the compressor so high that compression takes place even with the lowest possible voice level, there will be a great deal of noise in the background and a particularly great noise buildup can develop between speech pauses, depending upon the time constants involved in the circuit that is used.

Building a compressor with an expansion feature also normally would involve complicated circuitry, but a circuit recently appeared (*Electronics*, August 7, 1975) which has greatly simplified the building of such an expander/compressor for amateur usage with any mode of voice modulation. The original circuit was designed for processing touchtone signals. This article describes the circuit and some modifications to it so it can be used for speech processing. The circuit uses only two inexpensive ICs (total cost about $1) and operates from a single supply voltage source of from 7-15 volts. It can, therefore, be battery-powered as a separate unit or housed inside an existing transceiver. In fact, with a little care in construction, it could even be built in the case of most mobile microphones and powered by a miniature 7.5 volt mercury battery every time the PTT button was activated.

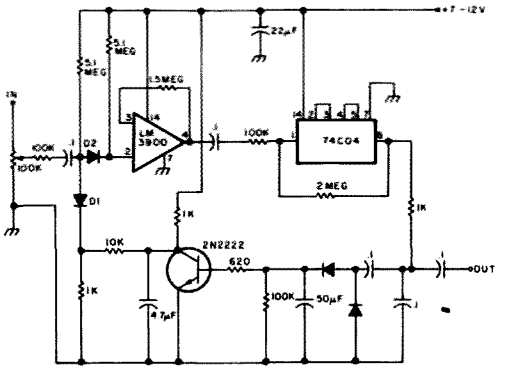


Fig. 1. Complete expander/compressor. Diodes are 1N914s.

The circuit is shown in Fig. 1. The circuit consists of two amplifier stages. The gain of the first stage is variable while the gain of the second stage is fixed. Some output is rectified and used to drive a 2N2222 which in turn varies the gain of the first stage. The neat little trick that is used to allow both an expansion and compression function centers around the biasing of diode D1. The bias on this diode is controlled by the 2N2222 stage. When the output signal of the fixed gain stage is low, the 2N2222 stage is not driven very hard and D1 becomes back-biased. Current flows through R1 into the non-inverting input of the first amplifier stage and its gain increases. As the output of the fixed gain amplifier increases, the 2N2222 is driven harder and D1 becomes more forward-biased. Current through R1 is diverted to ground instead of

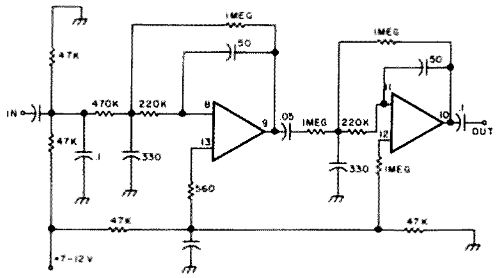


Fig. 2. Two stage low pass audio filters. The op amps are unused sections available in the LM3900 IC of Fig. 1.

to the op amp input and the gain of the input stage is reduced.

The input stage uses a conventional LM3900 op amp. Actually, there are four complete op amps in the IC although only one is used in this application. The input is for a medium to high impedance microphone. Very low impedance microphones will require a preamplifier stage both to raise the output level and to work into the expander/compressor. The 100k potentiometer is used to set the input level so with a normal speech level the unit is in its compression range. This can be checked by a listening test, or better yet, by using a scope to see that the output level of the unit remains constant at the highest setting possible of the input potentiometer. The highest setting possible is that just before the unit is driven so hard that the output clips and becomes distorted.

The second fixed gain amplifier stage actually uses a digital IC – the 74C04 hex inverter. Three of the inverting amplifiers in the IC are wired in series. The other three are unused. Linear operation of the IC is achieved by biasing the inverting amplifiers to the center of their linear range. Part of the output from this is rectified and filtered to drive the 2N2222 stage. The 50 mF capacitors in the base circuit of the 2N2222 and the 4.7 mF capacitor in the collector circuit determine the time constants involved. One may wish to do some experimentation with these values for optimum attack and release times. These values were changed from the original circuit to provide what sounded to be the best results for speech purposes.

A still further refinement can be added to the unit by utilizing the unused op amplifiers in the LM3900 as low pass filter stages. The main advantage to doing this is that in case the main stages are over-driven so they start to clip, the low pass filter stages will filter out some of the harmonics which are generated. The audio signal will still sound rough but at least severe distortion will be avoided.

The circuit of the low pass filter stages is shown in Fig. 2. The time constants are such that rolloff starts around 3500 Hz. The output level is in the order of ½ volt. A potentiometer (100k or higher value) may have to be used to control the output if the level is too high for use with an existing transmitter.

All in all, the circuit provides a worthwhile speech processing advantage with extreme circuit simplicity. With an op amp and three hex inverters left over (even with the low pass filter option added), one could probably add a tone encoder function and/or VOX function also if desired. Quite a lot for $1.00 worth of ICs! ■

Looking West

from page 16

dealing with FCC Chief John B. Johnston's appearance before the southern California amateur radio community. We have spent two columns telling you, thanks to the magic of magnetic tape, what John had to say to us. Now I wish to take a bit of editorial liberty and talk about how I interpreted what he said and what I feel is the best direction for us to travel in working with this fine man.

First, John can only act in our behalf if he knows what we want. This takes a constant flow of information from within the amateur community into his hands and those of his staff. Remember, though, that if you intend to write John because you see something that might affect the continued viability of amateur radio, it is not enough to sit and write criticism. Criticism brings with it a rather specific obligation to provide an alternative, another direction to follow or other specific ideas to back your point of view. Anyone can easily say "I don't like that" or "I don't like that because we can't do it" or even "You're crazy; go soak your head." The aforementioned takes virtually no intelligence and only the most gut level animal instinct. However, to sit down and analyze a given piece of pending legislation as an adult, to view it not only from a personal and thereby somewhat selfish standpoint, to, far more importantly, look at how any given proposal will ultimately affect all amateurs and amateur radio itself, and from this to formulate a reply that is constructive, is the obligation of anyone who decides to offer any form of official comment.

This, then, means that before you sit down to write it might be wise to discuss your views with others to see how they feel and if they can offer any input by way of comment or suggestion. By doing this, you then not only represent your views, but perhaps a cross section of your area's total amateur population. One of the best places I know to hold such discussions and thereby formulate replies to dockets issued by the Amateur and Citizens Division is at a local radio club. In fact, when an issue arises that calls for comment, one of the best ways that I can think of to get some attention for your point of view is to have a radio club behind you. One of the things that John is looking for is "commentary that is well prepared and representative of the majority of the amateurs of a given area, organized commentary of the type that not only offers either backing or criticism, but alternatives as well."

I tend to look at the radio club as the hometown grass roots political organization. It is one of the few forums we have other than talking on the air, and as such has a lot to offer. If you do not now or never have belonged to a radio club, but are getting the bug to take a more active role in helping plot the future course of the amateur radio community, that's really where it all starts.

In my book we have one heck of a good guy representing us to the Commission in FCC Chief John Johnston, but to be totally effective he needs to hear from us and get our ideas once in a while. While I might not agree with everything that he places before us in docket form, at least I know that he will take the time to read my comments and yours and base any final legislation on our needs, doing so to the best of his ability. I can ask little more. I can, though, wish him continued success in what must be one tough job.

Awards that amateurs can "win" are described by Mary and Ed Kellitz WA6EJP. ATV at left was also described that evening by an ATV expert.

73 Magazine *Staff*

Measure Your Wasted Power

- - how much are you losing in your feedline?

Transmission line attenuation is one of those items which most amateurs, especially newcomers, realize is important but rarely do anything about. One reason for this feeling probably has to do with the fact that transmission line attenuations, when quoted in dB, don't seem very meaningful. That is, a transmission line attenuation of 2 or perhaps even 3 dB seems to have a less disturbing effect upon an operator than learning that the output of his linear amplifier has fallen from 1,000 W to either 500 or 620 W. Yet, the transmission line attenuations quoted would have the same effect as far as the *radiated* signal is concerned. Also, many operators go through a lot of work to construct new linear amplifiers in order to raise their power level by a factor of only 2 or 3 times. Yet, on the higher frequency bands where fairly long transmission lines are used, the same increase in effective *radiated* power can be nearly achieved by replacing a long run of RG58/U line with RG8/U line!

Table 1 shows the attenuation characteristics of the three most common types of coaxial transmission lines on the various amateur bands. These attenuations are for brand-new line without connectors. Even so, the losses start to become significant on the higher frequency bands. When one considers line that has become aged, and when connectors and other "lossy" devices are used in a transmission line, the total losses can rapidly add up to significant values even on the lower frequency bands. The buildup of such losses can take place over a period of time and so gradually that no apparent deterioration in either transmitter or receiver performance is noted. The buildup of such losses will not be indicated by the tuning meters on the transmitter, nor on the swr meter readings as long as the antenna remains correctly impedance matched to the transmission line.

Most amateurs realize to some degree the desirability of keeping line attenuation as low as possible, but rarely do anything more about it other than initially carefully installing line believed to be fresh. The reason why line attenuation is not periodically checked as it should be is the difficulty involved in making such measurements by conventional methods. Certainly, few amateurs would want to measure the power input to a line, dummy load the far end of the line, measure the rf voltage across the dummy load, calculate the power output, and then finally find the line attenuation. Various errors can be involved in making such measurements, and good test equipment is necessary for accurate results. Some years ago a method for line attenuation measurement was suggested using the technique of shorting the far end of the line to create a complete reflection of the incident power traveling down the line. By swr measurement at the transmitter, the line attenuation could be determined. The basic concept of the measurement technique was good, but there were several disadvantages for practical usage.

The measurement technique described in this article refines the technique by the use of a carefully chosen load to create an artificial swr. The result is a measurement technique that is particularly sensitive to even small changes in line attenuation and a method that needs only a regular swr meter to implement. Even the swr meters built into some equipment which are calibrated only up to 3:1 swr are satisfactory.

Basic Theory

One should be familiar with the theory behind the swr method of line attenuation measurement. The method is based on the fact

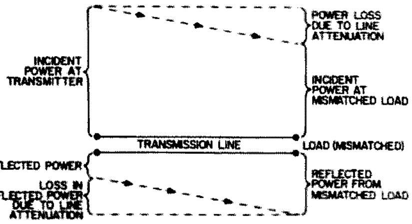


Fig. 1. The effect of line attenuation as explained in the text produces different swr readings at the transmitter and load (antenna) ends of the line. Example: P(incident) = 100 W, line attenuation = 3 dB, load swr = 5:1. Incident power at load = 100 x ½ = 50 W. Reflected power at load = 50 x .445 = 22.25 W. Reflected power at transmitter = 22.25 x ½ = 11.12 W. Power ratio at transmitter = 11.12/100 = .1112 = 11% of incident. Swr at transmitter (from Fig. 1) = 2:1.

Nominal Attenuation dB, Per 100 Feet

Band	RG58	RG8	RG59
160	.6	.2	.5
80	.82	.3	.65
40	1.3	.45	.9
20	2	.5	1.4
15	2.5	.62	1.6
10	3	.8	1.9
6	4.1	1.4	2.5
2	7.8	2.5	4.0

Table 1. Attenuation of various coaxial transmission lines on 160-2 meters. These losses are for brand-new cable and do not include additional losses due to connectors, relays, filters, etc., used in the transmission line.

that the swr values for any value of swr other than 1:1 will not read the same at both ends of a transmission line — if the line has *any* attenuation whatsoever. This concept is illustrated in Fig. 1. The ratios of the incident and reflected power at any point along the transmission line are related to the swr that would be read at that point. Note that at the transmitter end of the line, the reflected power is only a small portion of the incident power while at the load (deliberately mismatched to create a specific swr), the reflected power is almost as great as the incident power.

This change in the ratio between the incident power and reflected power at the transmitter end of the line is directly related to the total attenuation of the line. The effect is such that the presence of even small amounts of attenuation can be readily determined. The sample calculation shown in Fig. 1 should be followed through once carefully in order to understand the principle involved. Table 2 is a simple listing of how much of the incident power is reflected at a *load* for a given swr at the *load* terminals. It must be used to understand the example shown in Fig. 1. The example itself shows what the swr reading would be at the transmitter end of a transmission line if the line had an attenuation of 3 dB at the operating frequency used, and if the load were mismatched to the transmission line such that a 5:1 swr existed at the *load*. As shown, the swr reading at the transmitter would read 2:1 and not 5:1 due to the line attenuation.

In the manner shown, one could calculate what the swr readings would be at the transmitter for any given *load* swr and various line attenuations. A listing of the results of such calculations for load swrs of 5:1 and 3:1 and various line attenuations is shown in Table 3. Note

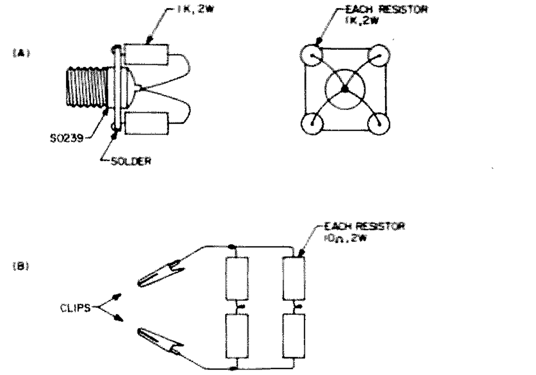


Fig. 2. Two resistor assemblies that may be used at the antenna end of a transmission line to create a given load swr for test purposes. The usage of each assembly is explained in the text.

particularly how sensitive the swr reading at the transmitter is to even small line attenuation values. For example, for a 5:1 load swr, the swr reading at the transmitter would be 5:1 if the transmission line used had no attenuation. However, even a line loss of only ½ dB will cause the swr reading at the transmitter to be 3.9:1 instead of 5:1. The load swrs shown in Table 3 were chosen to be listed because, in practice, they are usually the most handy to use. They permit good indication of the range of line attenuations likely to be encountered in most installations, and the range of swr readings produced at the transmitter is within the range where most swr meters (including those built into transceivers, linears, etc.) can be clearly read.

Using The Technique

Using the technique just described to make actual line attenuation measurements is not at all difficult as long as a few precautions are observed. Any swr meter can be used, either a separate unit or one built into a piece of equipment, as long as swr readings of up to 3:1 can be calibrated. One must be *sure* of the calibration of the swr meter, or else the measurements made will be meaningless. The instruction book for most swr meters describes a calibration procedure. In any case, one can check the calibration by using 2 W carbon composition resistors directly at the swr meter, choosing the resistor values to simulate different swrs. For example, an swr meter meant for use in 52 Ohm transmission line can be checked for its 2:1 swr reading by using a 104 Ohm resistor (nominal 100 Ohm unit), for its 3:1 swr reading by using a 156 Ohm resistor (nominal 150 Ohm unit), etc. Usually from a batch of 10% tolerance resistors, one can find the necessary resistor values. If this cannot be done, or if a good ohmmeter is not available, 5% tolerance resistors in stock values can be used for calibration. In any case, noninductive-type resistors should be used and the swr meter checked over the range of frequencies to be used.

Once one is confident that the swr meter calibration is correct, a resistor unit must be constructed to simulate either a 3:1 or 5:1 swr at the antenna end of the transmission line to be tested. One suggested method of construction is shown in Fig. 2(a). A grouping of four 2 W composition resistors is soldered directly on an SO-239 coaxial fitting for use in a situation where the transmission line used employs a standard PL-259 connector at its antenna end. The resistors are wired in parallel and chosen in the example shown to provide a 5:1 swr for a 52 Ohm transmission line system. The resistor unit can be checked that it provides the correct swr by connecting it directly to the antenna side of a calibrated swr meter. Usually if the resistors were carefully chosen beforehand using an ohmmeter, there will be no difficulty. Again, the resistor unit should be checked on all frequencies where it will be used to check line attenuation.

After everything has been calibrated, the far end of the transmission line is disconnected from the antenna and connected to the resistor unit. A few Watts of transmitter power are used so a proper "set" reading can be obtained on the swr meter at

swr	Incident Power Reflected (%)	swr	Incident Power Reflected (%)
10	67	2.5	18.3
9	64	2.0	11
8	60.5	1.9	9.6
7	56	1.8	8.2
6	51	1.7	6.7
5.5	48	1.6	5.3
5	44.5	1.5	4.0
4.5	40.5	1.4	2.8
4	36	1.3	1.8
3.5	31	1.2	.8
3	25	1.1	.2

Table 2. For a given swr at a load, the listing shows the percentage of incident power which the load does not accept and reflects back along a transmission line.

For 5:1 Load swr

Cable Attenuation, dB	swr at Transmitter
.5	3.9:1
1	3.3:1
2	2.45:1
3	2.0:1
4	1.7:1
5	1.5:1
10	1.15:1

For 3:1 Load swr

Cable Attenuation, dB	swr at Transmitter
.5	2.6:1
1	2.3:1
2	1.9:1
3	1.7:1
4	1.5:1

Table 3. Transmitter swr readings as a function of line attenuation for load swrs of 5:1 and 3:1.

the transmitter when it reads forward power. The meter is then switched to reflected power, the swr read, and the total transmission line attenuation determined using Table 3.

The method can actually be used in many installations without even disconnecting the transmission line from the antenna. If one knows that the antenna has been adjusted to provide a 1:1 match to the transmission line at the transmission line/antenna interface, it is only necessary to parallel the antenna terminals with additional loading to create a 3:1 or 5:1 swr. A grouping of resistors made up as shown in Fig. 2(b) might be used for this purpose. In this case, resistor values must be used which are lower in value than the line impedance, since they are placed in parallel with the antenna terminal impedance. As shown, four nominal value 10 Ohm resistors are grouped together and chosen to produce an overall resistance of 13 Ohms, which in parallel with a 52 Ohm antenna will provide an effective termination of 10.4 Ohms for a 5:1 swr. One resistor could possibly be used if the swr meter used at the transmitter were sensitive enough and only a few Watts of output power were necessary. The "clip-on" resistor unit can be checked, of course, by directly coupling it to the swr meter where, by itself, it should provide a 4:1 swr reading.

Summary

Many amateurs who check their transmission line attenuation for the first time are shocked at the values they discover, particularly on the higher frequency bands. One should realize that besides the transmission line itself, one will also be reading the attenuation introduced by the various relays, filters, switches, etc., used in the transmission line in more elaborate station setups. No matter what the attenuation is due to, however, it of course reduces the radiated power and the sensitivity of the receiving system (assuming the same antenna is used for receiving).

A periodic check of line attenuation will quickly reveal any developing problems. In installations where the antenna end of the transmission line is particularly difficult to get to, one might even consider installing a relay at the antenna so a test resistor unit can be selected to check the line condition whenever desired. Before the installation of any transmission line, its attenuation should be checked so one will then have some basis against which to evaluate later attenuation measurements made when the line is installed. ■

BE MY GUEST

visiting views from around the globe

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number is recovered, it can be identified in minutes through the police computer system. Ham and CB callsigns are, of course, not put into the computer, thus making on the spot identification virtually impossible.

3. Fill out a theft report. Depending on how the local police operate, either they will come to you or you'll have to make a trip to the station.
4. If possible, take a couple of photograghs showing forced entry point.
5. After filling out the theft report, obtain two copies, one for yourself and a second for the friendly local insurance company.
6. Call your friendly local insurance agent and begin the fun known as making a claim.
7. Go fix yourself a drink.
8. Relax!

The problem of mobile gear ripoffs is going to get much worse. Here's hoping that you don't become another statistic.

Steve Zawicki WA1UUK

Reprinted from Key Klix and Splatter, *the official newsletter of the Montachusetts Amateur Radio Club.*

Tragedy On Mt. Wilson

Late this evening it was dramatically proven that preparedness and training in the art of locating a hidden transmitter can pay off. The Mt. Wilson Repeater Association has been holding bi-weekly T-Hunts using the input channel to the WR6ABE repeater and doing so while the repeater is in full operation. I cannot think of any more adverse conditions under which to try and T-Hunt anything.

About 5:45 on the evening of Saturday, September 4, a rather raucous noise appeared on the input of WR6ABE and stayed there. Later in the same evening a rather foul-mouthed character appeared on the system claiming responsibility for this sickening act against the Southern California amateur community.

A check of the input by various stations around the city gave an approximate location for Mr. Foul Mouth, but didn't reveal the source of the raucous buzzsaw noise. Not being able to hear the interference from the lowlands even on the rather super-sensitive L-Per DF receivers connected to base station antennas, the T-Hunt crew decided to play a hunch and go check the area of the site itself.

By about 3 am, the T-Hunters were sure that their hunch was correct, but the darkness and rather rugged terrain made any further attempt to get an exact location a dangerous job. Around 4 am the T-Hunters came down off Mt. Wilson and arranged to meet later in the day.

Later that afternoon, September 5, again the T-Hunters headed back up Angeles Crest Highway to the area of the WR6ABE site and brought with them not only DF equipment but metal locaters as well. It took another few hours, but the winner and champion of this T-Hunt turned out to be the ham who located the jamming device about a quarter of a mile from the repeater.

Bill Pasternak WA6ITF
Panorama City CA

By the time you read this, WR6ABE will be silent. Owner Burt Weiner K6OQK decided in late October to shut his Mt. Wilson machine down for 60 days, rather than put up with the jamming, obscenity and varied shenanigans of a handful of users. Some users reportedly have threatened to sue on grounds it and all repeaters are not the property of the owner but rather, by virtue of the service they perform, have become a public utility. One user is trying to drum up support for a separate suit on the grounds he had to buy crystals to use the repeater and the shutdown would make them useless. He claims fraud and is demanding that the system stay on the air to protect his investment (see Briefs). — Ed.

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud in exchange for a spot on your ham or computer club newsletter mailing list. Deal?

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	3	3	3	3	3	7	7A	14	14
ARGENTINA	7	7	7	7	7	7	14	14	14	14	14A	14
AUSTRALIA	14	7B	7B	3B	7	7	3B	7	14	14	14	14
CANAL ZONE	7	7	7	7	7	7	7	14	14	14A	14	14
ENGLAND	3A	3	3	3	3	3	7	14	14	14	7	7
HAWAII	14	7B	7	3	3	3	3	3	7	14	14A	14
INDIA	3	3	3B	3B	3B	3B	7	14	7B	7B	3B	3
JAPAN	14	7B	7B	3	3	3	3	3	3B	3B	7	7
MEXICO	14	7	7	7	7	7	7	14	14	14	14A	14
PHILIPPINES	14B	7B	7B	3B	3B	3	3	7	7	7B	3B	7A
PUERTO RICO	7	3	3	3	3	3	7	14	14	14	14	14
SOUTH AFRICA	7	7	3	3A	3	7	14	14	14A	14	14	14
U. S. S. R.	3	3	3	3	3	3B	7A	14	7A	7B	3B	3
WEST COAST	14	7	7	3	7	7	3	7	14	14	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	7	7	7	7	7	7B	14	14	14	14	14A
AUSTRALIA	14	14	7B	7B	7	7	3B	3B	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	14	14A	14A	14
ENGLAND	3	3	3	3	3	3	3	7	14	14	7B	7
HAWAII	14	7B	7	3	3	3	3	3	7	14	14	14
INDIA	3	7	3B	3B	3B	3B	3	7	7A	7	3B	3B
JAPAN	14	7B	7B	3	3	3	3	3	3	3B	7	14
MEXICO	7	7	3	3	3	3	3	7	14	14	14	14
PHILIPPINES	14	7B	7B	30	3B	3	3	3	7	7	3B	7A
PUERTO RICO	14	7	7	7	7	3	7	14	14	14A	14	14
SOUTH AFRICA	7A	7	3	3	3	3	7B	14	14	14A	14	14
U. S. S. R.	3	3	3	3	3	3B	3B	7A	7A	7B	3B	3B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	7	14	14
ARGENTINA	14	7	7	7	7	7	3B	7B	14	14	14	14
AUSTRALIA	14	14	14B	7B	7	3B	3B	3B	7	7A	14	14
CANAL ZONE	14	7	7	3	7	7	3	7	14	14A	14A	14
ENGLAND	3B	3	3	3	3	3	3	7B	14	14	7B	7B
HAWAII	14	14	7	7	3	3	3	3	7	14	14A	14A
INDIA	3B	14	3B	3B	3B	3B	3B	3B	7	7	3B	3B
JAPAN	14	14	7B	3	3	3	3	3	3	3	7A	14
MEXICO	14	7	3	3	3	3	3	7	14	14	14	14
PHILIPPINES	14	14	7B	3B	3B	3	3	3	7	7	7B	14
PUERTO RICO	14	7	7	3	3	3	3	7	14	14	14A	14
SOUTH AFRICA	14	7	3	3	3	3	3B	7B	14	14A	14	14
U. S. S. R.	3	3	3	3	3	3B	3B	7A	7A	7	3B	3B
EAST COAST	14	7	7	3	7	7	3	7	14	14	14A	14

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed

JANUARY '77

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1 D
2 D	3 U	4 U	5 D	6 U	7 N	8 N
9 N	10 U	11 N	12 N	13 N	14 U	15 U
16 U	17 N	18 N	19 N	20 N	21 N	22 U
23 N	24 N	25 N	26 N	27 N	28 U	29 U
30 N	31 N					

73 AMATEUR RADIO

FEBRUARY 1977
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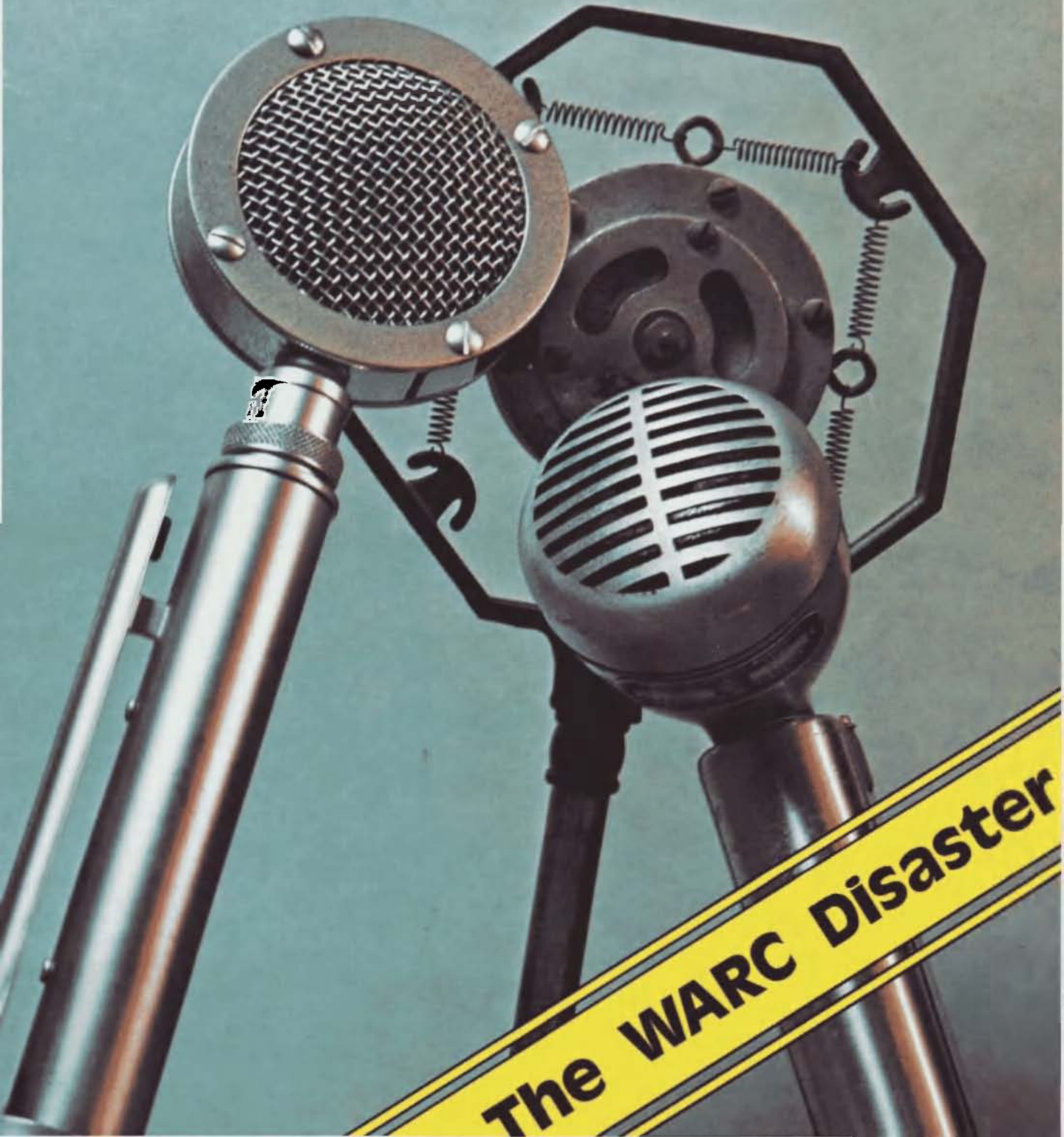

The WARC Disaster

73

#197 FEB 1977

COVER: Some of Wayne's microphones. Photo by Ed Crabtree.

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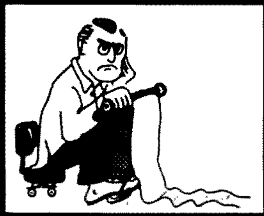


...de W2NSD/1

EDITORIAL BY WAYNE GREEN

ARRL REPORT

Well, here comes Wayne Green bad-mouthing the League again . . . right? Right. This time it has to do with a letter from *QST* (which many of our readers have been forwarding) which asks why authors are not writing for *QST* any more.

I think I can answer their letter . . . perhaps better than many of the readers who got it. I'll try to do it without being sarcastic or nasty, which (you know) has to be a major effort for me.

The ARRL has set itself up as the representative of amateur radio. While many of us realize that this is largely fiction, the image that ARRL must project to maintain this fiction is one of service and infallibility. This image has been getting pretty tacky of late, particularly with respect to any correlation between promises made by League officials and performance in the WARC situation. The decision by *QST* to stonewall the situation has disillusioned tens of thousands of amateurs and has, in a large part, I believe, been responsible for the loss of interest on the part of both the subscribers and writers in the magazine.

I think all of us would feel a lot different about *QST* if we knew that the ARRL was fielding teams of ambassadors to the Third World countries to sell the concept of amateur radio so that we would have some votes to back us up at Geneva. There is still time for this — but *nothing* is happening!

The recent FCC revelation that much of what ARRL had been telling us in *QST* about possible new ham bands was just hot air hasn't helped the ARRL image at all. We don't like being lied to.

The Board of Directors of the ARRL Foundation had the right idea . . . they wanted to get the League to stop talking and *do* something about the ITU frequency conference. Their efforts to get money from the League for this purpose failed, so then they went about setting up a fund drive to get money so the Foundation could act. When the ARRL refused to even let them do that, the board resigned in protest . . . en masse. Can you even think for a moment that hams such as Bill Eitel and Pete Hoover don't know how serious the ITU situation is and how desperate the need for immediate action is?

When amateurs regain confidence in the League, I think we'll find plenty of authors submitting articles. Authors want to be proud of where they are published, not ashamed. As soon as amateurs feel the League is being honest with them and doing the job they claim they are doing, there will be articles and subscribers.

The recent election of ARRL directors was a particularly sorry spectacle. One director was replaced by a new man . . . all the rest either ran unopposed or else won their elections . . . every last one of them. This indicates to me a massive apathy on the part of ARRL members. While the directors have very little to do with running the League, they are the only ones who can make any major changes in the people who are running the League and who are letting amateur radio, as we know it, go down the tubes.

I'll tell you this . . . if ARRL convention program committee chairmen have any sense, they won't ask *me* to come and talk. I have no good news as far as WARC and the ITU are concerned. I do have a lot of inside information, but there is none that you really want to hear. The League knows this just as well as I do, but I know they are far more interested in spending $800,000 on a new wing for the HQ building than trying to protect our bands. I just happen to think that the rainy day the ARRL saved up that $1 million they have in the bank for is here.

Hmmm, I didn't realize I was so steamed up over that. Sorry if I came on stronger than I intended.

Congratulations to Don Miller W9NTP for winning the Central Division directorship of ARRL. Don is one of the authors of the SSTV book . . . not the long-forgotten DXer. Congratulations, too, to Gay Milius W4UG for winning the vice director's spot in the Roanoke division. With those two exceptions, every ARRL officer held tight, so we're probably headed into two more years of inaction.

If a director or vice director comes to your club for a visit, put him on the spot and ask him to tell you what happened with the ARRL Foundation . . . he knows full well about it, if he'll level with you. Ask him about the money that has been spent from the $100,000 fund to protect amateur radio . . . he also knows exactly how that has been spent and why not one word of it has ever been printed in *QST* or even leaked in the ARRL annual report. Start asking questions, so you can get to know your League and perhaps push for some serious reforms.

FLY THE FLAG

It really got home to me a few years ago when I began traveling. Until I had had a chance to visit other countries and talk with the amateurs there in depth, I really hadn't understood some of the profound differences between the opportunities we have here in the US and the problems people face in other countries . . . just about *all* other countries.

While I am not now much on owning things, back in the late 50's, while I was editor of another magazine . . . possibly one which you are unfamiliar with . . . I was single and had quite a few hobbies up and running. There was my Arabian horse which I spent several years riding and training . . . a Chris Craft express cruiser for water skiing and boating trips . . . a two-place seaplane . . . and not one, but *two* Porsches. On the hamming front, I had a 75m kilowatt, an all band kilowatt, and a 2m kilowatt . . . all homemade . . . an amazing amount of RTTY equipment . . . and I was putting out a monthly RTTY bulletin to about 2000 subscribers. As I said, I was single.

When I visited other countries, I would occasionally find someone wealthy enough to own a plane . . . or a boat . . . or a sports car. But it took enormous wealth to be able to afford all these things at once . . . it was just totally beyond possibility for all but a very few. Since I was not making a lot of money and I was able to afford all those nice toys, it emphasized the difference in opportunity between countries. Not many of us are energetic enough to try and do all those things at once, but if we want to, it isn't that difficult to do. It is *our* choice.

Though we have a lot of problems with our courts, with our government, with big business and the other power structures, in all we have a lot more opportunity here than our counterparts have in other countries . . . and I've visited almost a hundred of them now.

Perhaps I'm off base, but to me, despite the harassment I've had from our courts, government, and big business . . . and they've each done fantastic jobs on me . . . I think the United States is great and I am proud of the good things that people are doing. Just think of it . . . despite two hundred years of the worst things that the courts, government, and business could do, the spirit of the nation has come through and triumphed. I say

Continued on page 27

BE MY GUEST

visiting views from around the globe

The Lady in the Harbor

It is simple to write about the amateur radio happening on Liberty Island NY, on the four day Thanksgiving holiday, 25 to 28 November 1976. How did it happen? It was the brainstorm of "Doc" Lew Levitt WB2NDI, Kings County Radio Club, Brooklyn NY. "Wouldn't it be nice if amateur radio could be treated to an event similar to Op-Sail '76 to celebrate the Bicentennial?" Getting the idea into reality took months of concerted effort by lots of people. The actual event, the four days of glorious activity, was the climax of some anxious times. Doc brought his idea to the Hudson Amateur Radio Council (HARC), where he proposed that it take on the big job of organizing, coordinating the preliminaries, and then operating WL2USA. What follows will describe the nitty-gritty of getting the idea into reality – the many hours of planning, letter writing, and telephone calling. Most of the work was done in the morning before work, and in the evening after work. There were some unavoidable interruptions during regular working hours, but these were kept to a minimum.

The value of this narrative lies in showing that anyone who takes on anything worthwhile to do, for the first or for the millionth time, will find that there is going to be lots of lost motion, lots of frustration. If it comes off, in spite of all obstacles, you will honestly come by a sense of gratification and achievement that no one can take away from you. This will give you confidence to go on to even greater and higher goals. When Doc Levitt came to HARC and made his proposal, it was very clear that it might be a tough assignment. Then why did I take it on? It was complicated enough to be interesting.

Problem Number One: In order to get a permit from the U.S. Department of Interior (National Park Service) to put on a special event on Liberty Island NY near the Statue of Liberty, an applicant must agree to observe the regulations that are in force. Most are simple housekeeping ones, others regulate the limits of the activities, and others say no camping, no fires. We set out to find a way to get around the regulation about camping and structures. The solution was obvious – so we thought. Thus very early in the game, we became our own worst enemy. We learned a lot in a short time about negotiations with U.S. Government agencies. It was bad enough dealing with the FCC for the special call. Doc Levitt is one of the most persistent persons around, and, thanks to that, the special call was issued, but not until after months of waiting, griping, calling (but mostly waiting and waiting some more). We decided to "go to higher authority" for exemptions to permit us to erect structures. After all, an antenna *is* a structure! The whole project nearly folded then and there. For future reference, anyone dealing with the U.S. National Park Service should remember this: The U.S. Park Service rigidly adheres to the "captain of the ship" policy. It is an enviable policy, in that it maintains authority and responsibility in the field. The best qualified to make a decision is on the scene, and the decision is made on the spot. It has proven to be very effective. It was our tactical error to try to circumvent the authority of the Superintendent of Liberty Island. Once we accepted the stringent restrictions, we found that he was also prepared to go out of his way to extend the help he was authorized to give. We became very good friends. Without the Service's kindness and help, we would not have been able to take our gear, set up for four days, and operate at all. From the very first day (during our site visit), they gave excellent advice and suggestions on how to prepare for the worst. They even made storage facilities available. We had access to the maintenance shed for inclement weather and contingencies, where we could set up at least the 2 meter, 20 meter, and OSCAR station. To Mr. Luis Curbelo-Garcia and Mr. Dean Garrett, many thanks. Moral: Find out very early. If you can't fight 'em, join 'em . . .

So a month before the event, we had the site. It was also three weeks before the HARC Convention at Great Gorge, and the convention committee had more pressing matters than worrying about li'l ole WL2USA. We got individual help, but in general we were on our own.

Most of you who went to the HARC Convention saw how we tackled Problem Number Two: How do you motivate people to go out into the cold, get on a subway, buck the crowds (while lugging a rig), ride to the tip of Manhattan, dress for the rigors of wind and spray, and stay for at least four hours? It wasn't easy. You set out to get as much help as you can, from anyone, and from anywhere. Keep in mind that the impetus has to come from you. It can get lonely. How persuasive was the blurb in the Convention program book? It was a flop. Two live takers came from it: Stu K2RPZ and Harry WB2FZE. They said they would come, because they knew what it might be like, but since they were well-weathered fishermen, they could hack it, no matter what! I wish there had been fifty more like them! Then I went to the DX session moderator to sneak time before the regular sessions to drum up more takers. No luck from that tack. The weekend before the event, we had to go the Island to conduct field tests, and literally test the water. Doc Levitt met us with his two meter FM rig, and we took our SBE 34. The purpose of going was to find out what loose ends were left, what had to be revised, and what it was going to be like. It was miserable, damp, and windy, and my rig didn't work. We were off to an inauspicious start, indeed . . . We also had to find out where to plug in the extension cords, where to find the johns, how to set up a mast and guy it according to regulations and for safety, where to get a snack, and where to thaw out. I was chilled to the bone, and three days later the ache was still there.

From left: Wally WA2NVG, Arnold WA2CID, Carlos WA2AUV, Allyn WB2ZKZ.

Would the four day stint do me in?

Father Vic W2IJC called long distance from Rensselaer NY for information and details about WL2USA. We made a sked for 3850 kHz. With John W2BPU in Teaneck, and Don WB2VJC on the side in Rensselaer, Father Vic said he would come. Things might be looking up. On the day before, the roster included Doc WB2NDI, Allyn WB2ZKZ, Larry WB2TXL, Paul WB2CNF and Ed WB2UDD. So on Thanksgiving morning, we loaded up the VW Rabbit, checked the ropes on the roof carrier to see if the antenna masting was secure, gassed up, and went down to the back of Midas Muffler to find old muffler clamps for the antennas. Then it was down the Jersey Turnpike for the Holland Tunnel and the Battery.

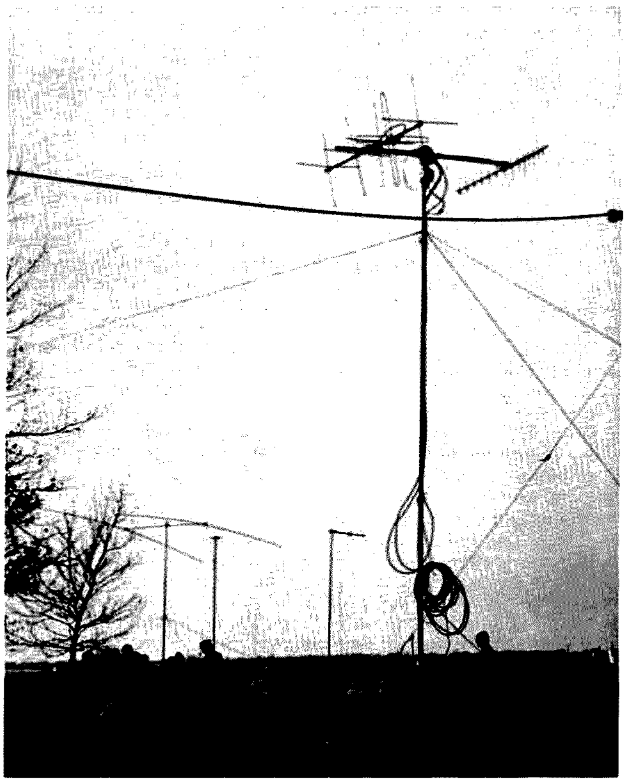
Liberty Two, the U.S. National Park Service bumboat, pulled up to the dock. We were waved on by the sentry to the Coast Guard parking lot adjacent to the Marine Inspection Office at the Battery. This was another example of how far the Park Service went to extend their help. There is very little parking in the vicinity of South Ferry. What there is, naturally, is expensive. More importantly, we needed access to the dock to offload our masting and gear. This was a very generous act. More on parking later.

The skipper of *Liberty Two*, I found, was a signalman on the *USS Utah* at Pearl Harbor. He and I must have been a few hundred feet from each other during the war years. My activities as a civilian radio operator on the tugs and dredges took me into the same areas of the Navy Yard. It took over thirty years and several thousand miles to find out about each other. This brings up another point: You can expect to discover new things and meet lots of nice people when you set out to do something worthwhile. I am sure the skipper would have been just as helpful otherwise, but it was still awfully nice to be aboard a tug again, feel the vibrations of the engines underfoot and the spray on my face again! Then, to take me all the way back to those days, he let me use the FM rig aboard *Liberty Two* to inform the acting superintendent of Liberty Island when we got underway!

As operations go, most of us have been on field days much more elaborate than WL2USA. First of all, we were limited by the rigs that could be brought conveniently. *Liberty Two* had very limited space and storage. At no time were we in full operation simultaneously on 20, 40, and 80 meters. We set up the best we could with what was brought in rigs and in antennas, commencing at 8:00 am, and we made our first contact on 20 meters at 12:15 pm with Harvey WAØOBY in Missouri. We made our two meter contact a little earlier at 11:25 am, through WB2UDD's five Watt FM rig, with Steve WA2OHF. It was a cold, overcast day, and even at the slowest exposure the colored film did not give very good pictures. Ernie WA2HLY did the best he could with his camera. He loaned them to me for photoreproduction to black and white 8x10's. As you can see, we set up near the flagpole opposite Ellis Island and the Battery, with the 20 meter beam set into a flag stanchion and then guyed ten feet above the ground (to avoid scalping anyone). We used the armstrong rotator if we needed to. Considering everything, the two element beam did very well into Europe and nearly got us WAS. We missed by about six states, and Father Vic, bless him, got us Nebraska! Our 80 meter antenna was a home brew helically-wound vertical. Allyn WB2ZKZ and myself made it in a couple hours in our backyard QTH.

The showpiece of WL2USA was the OSCAR station that Art W4ART brought up from Arlington VA. Art was my other live catch from the HARC Convention. On the basis of the showstopping OSCAR demonstration at Great George, Art decided to come up to New Jersey and spend Thanksgiving with his family. He gave me a lot to be thankful for, too! With Art came Murphy, in spades. We set up the OSCAR station on Thursday, but missed all the passes for that day. It would have been nice, but it was asking too much to be able to set up in an hour to get the morning pass. Art had run out of gas and barely made it to the parking lot, and on a Thursday holiday afternoon we would not have found a gas station open for business. So we left his van in the lot overnight.

The next day, Friday after Thanksgiving, is a regular working day for the U.S. Coast Guard. Shortly before that, Art had found a badly damaged 432 MHz transceiver. It was clobbered – it hit so hard that the impact had sheared the mike plug plastic insert and bent the gain control shaft. I had personally put the station away. When I closed the storage shed door, I must have pushed it off the top of the pile onto the floor. As luck would have it, he had borrowed it! I thought Art would pack up and go back to Virginia . . . Not two minutes later, while I was still breathing hard, Dean Garrett came over with crisis number two: "You'd better call Chief Dick pronto. He is good and mad, since he's just been chewed out by the E-X-O for allowing an unauthorized vehicle of another governmental agency to park with tags marked W4ART." I think that's what may have saved me. Art had left his FCC identification in the car, too, and I couldn't get up enough nerve to tell the Chief that W4ART was not a government license plate. The other reason that I might have been saved was that there were other things going on. It must have been close to noon when I called back to apologize. The Friday after Thanksgiving had gone well, and the Chief allowed us to park there for the rest of the day – as well as Saturday and Sunday! He could have scuttled WL2USA and me too if he had barred us from parking. When it rains, it pours . . . but we were actually spared on that score. The weather for the four days was nearly springlike. So the blurb had done too good a job, and scared everyone away. We made 33 contacts with OSCAR on orbit numbers 9295A, 9307B, 9308B, 9320A. Amateur radio, public relations, the United Nations, the UN Meditation Group, the Bicentennial and the Statue of Liberty achieved Unity with the Universe in the middle of orbit 9307B at 1459 UTC. Art W4ART was explaining the OSCAR station to a member of the UN public information staff. Bernard Curchack from the UN Meditation Group had also come to Liberty Island to give thanks and pay homage to the Bicentennial. Unfortunately, the park authorities, in deference to WL2USA, refused permission to them. So it seemed the gracious thing to do to let Bernie read his poem of praise (panegyric) on OSCAR! It was, for all observers, a very emotional event. This was a very unique event indeed! While all of WL2USA was a noble undertaking, this particular event was transcendent and mystical. It made all the effort worthwhile. So on Sunday, when Father Vic came aboard, he put the topping on the affair by representing the clergy and our freedom of belief and conviction.



WL2USA antenna farm (Ellis Island in background).

The other circumstance that made WL2USA memorable was the cultural and ethnic mix. We had the WASPs, Jews, Afros, Hispanics, and people of Asiatic ethnic origins. All there to honor America by means of amateur radio. What other time would you expect two radio amateurs, Allyn WB2ZKZ and Carlos WA2AUV, to limber up after a stint at the mike with the ancient Chinese t'ai-chi? No way, no how – gung ho! Allyn is one half Chinese, and Carlos, Hispanic. They were all very decent fellows, full of enthusiasm, very competent. They will go fair and far. The other visitor from the Quisqueya Amateur Radio Club, Bronx NY, was Arnold WA2CID. Of all the calls for any Hispanic to get! El Cid of Charlton Heston fame is the national hero of Spain and the cultural superman of the Hispanic culture, and apparently it had not occurred to Arnold that this was the case. He was most delighted to be told this by me. We made as many DX QSOs as the number of operators (about three dozen), including Pete WB8NAS/1 and Sally WB8NOK/1, Luis HI8LMK/W2, Irene WA2LWG. The other radio club that sent operators was from St. Peter's Prep (K2OQJ) – Bob WA2DMF, Taras WB2ERD, Walter WA2ZNW. Paul WB2ZNF, Englewood NJ, was our statistician. According to him, WL2USA made a total of 1142 QSOs. Two meter FM accounted for 560, and the low band for 549. Limitations of time and coverage kept others from a QSO with us. If you feel you deserve a QSL for your effort, send a QSL card, tell us the time you tried, what you heard, and whom you heard, and we will send off the QSL to you as a souvenir. All who contacted us and were confirmed will, of course, receive the commemorative WL2USA QSL. Designing the QSL is a story in itself.

Whenever you set out to make a QSL card, you are making an esthetic statement. For me, it requires a lot of introspection and sober thought. In this case, we had to epitomize the spirit of the project. Some of the people I asked suggested we do it whimsically. Why not the Statue of Liberty holding a tribander beam? No – too frivolous. I recall the anguished responses when someone suggested a red, white and blue sash for the

Lady in the Harbor. Once committed to a matter-of-fact, straightforward treatment, the matter becomes somewhat easier. When Larry WA2FSY and Roz WA2EMC heard about the idea, Larry gave me a photoreproduction of a woodcut of the Statue. Then, to be authentic, should we include the Emma Lazarus quotation about the tired, poor and huddled masses? So a call was made to Dean Garrett and by return mail came a picture of the tablet in memory of Emma Lazarus. It is in Gothic sans serif type, cast in brass and located in a place of honor. An entire QSL card in Gothic sans serif just didn't seem to look good, nor did all italics or Roman. What to say, and how to say it? My tentative designs were shown to my artist friends, who were very helpful. Finally I went to the Suburbanite in Englewood to see Jules and Richard Jacobson. We went to the photo font machine and chose italics and Roman. The next day the Audio-Visual Department made me a 3¼ x 5½ inch negative for the QSL card and a 8½ x 11 transparency for transvue projection. Those who went to the DX sessions at the HARC Convention saw that result.

Again, there is more than meets the eye. In order to legitimately display the NYC Bicentennial logos, we had to get permission from Dr. R.L. Gaudreau, Executive Director of the NYC Bicentennial Corporation, the same outfit that brought you Op-Sail '76. Then, to get permission for the American Revolution Bicentennial logos, we had to write to the NY State Bicentennial Commission in Albany. Then, and only then, with the endorsement and approval of the U.S. National Park Service, we got permission to use the logos. This gave the DXpedition an exalted status, and you might say amateur radio had its own Op-Sail '76! Why not? This is why the U.S. National Park Service put out the red carpet to us.

Those who went to Liberty Island did amateur radio proud. They were worthy representatives of amateur radio. Without being self-conscious, they furnished the Voice of the Statue of Liberty and gave to a very limited segment of the amateur radio population of the entire world an opportunity to share with us our pride and joy in the Bicentennial. We have to tell you how seriously Joe W9RCJ took the matter. He finally called me at home in Englewood to ask if we were on the air and could we please sked him for 11:00 am on Sunday. Joe, you get the card as soon as Stu K2RPZ gets the negative from me and runs off the 1500 cards we need. There was no need to send an SASE, either. Then we must give Carlos WA2AUV the atta-boy award for trying hard. As we were getting on the ferry to get back to Manhattan for the last time, running down the gangway was poor Carlos, who had missed the one before and was trying to get there to help us out. Better luck next time, buddy . . .

So how about next time? Would I ever do it again? What could we do differently to make it better? What did we get out of it? We would do it again, emphatically! It was a once-in-a-lifetime chance to really do something worthwhile for ourselves and for lots of other people. As it turned out, the gods were kind, and the weather did not turn foul until the Monday after Thanksgiving. You had to dress for it, and be prepared. Different would mean just more lead time and less competition with a long holiday — and more planning ahead. This would assure more operators and transmitters and more opportunities to get QSOs. There is no way to make WL2USA a 24-hour operation without an act of Congress or some very special dispensation from the U.S. National Park Service.

Finally, what did I get out of it personally? Something rare. I got a chance to get to know myself, and what I saw I liked. To carry the ball for an event that goes beyond the boundaries of time and space, to show your pride and convictions and use state-of-the-art technology in the way and place we did it in the way we did it, is something I will be able to recall with pleasure for a long time to come. I hope others that came with me feel the same.

Wally Luke WA2NVG
51 Tenafly Road
Englewood NJ 07631

I/O–
a 5 Year Forecast

The general purpose computer industry has a better future in the United States and overseas than previously estimated, according to the Arthur D. Little consulting firm.

The installed base of computers should grow 9 per cent compounded annually in the US and 12 per cent overseas through 1981, the firm said in a recent report.

In its 15th annual five year forecast of the industry, ADL said International Business Machines apparently has recovered from its weakness in its share of the computer business and may become a greater threat to other computer makers.

Increasing profit margins for computer manufacturers also are forecast in the report by Frederick G. Withington and Oscar H. Rothenbuecher of the ADL staff.

Large general purpose computers are not about to be displaced by smaller minicomputer networks, the study said.

Computer shipments will rise rapidly as manufacturers continue making them easier to use, the study said.

Other reasons for the optimistic outlook include "the burgeoning of electronic office and funds transfer systems and the growing use of computers to offset inflation in labor intensive industries."

The installed computer base in the US should rise from about $46.5 billion at the end of this year to $70 billion to $75 billion, and from $40.9 billion overseas to $70 billion to $80 billion in 1981, the study said.

US manufacturers will maintain their dominance of the worldwide market, though it will decrease from 75 per cent this year to 67 per cent in 1981, ADL researchers said.

"The strongest competition for the US computer industry will come from Japan," the study said, noting that country "is making impressive strides toward an integrated, export-oriented industry" and is making inroads in western Europe.

Wider profit margins for computer makers should come from major decreases in manufacturing costs and new revenues from selling systems programs separately from the machinery.

Looking beyond the next five years, ADL says minicomputer networks may become more popular than the huge general purpose machines, though "the two types will live side-by-side for years to come, with most networks requiring a large central host machine.

"The big general purpose machines have a 20 year head start on systems programs," said Withington.

"Small computer networks are not likely to be able to offer equivalent convenience, versatility and stability until the early 1980's. After that the dominance of large computers may wane, but an 'Indian summer' of growth and profitability for them appears likely in the interim."

Reprinted from the Nashua Telegraph, *Nashua NH.*

A Ban on Linears?

If you've been wondering what effects CB is having on ham radio, wonder no more. The plague of outlaw SSB CBers may force an end to the manufacture of linear amplifiers, bring point of sale license checks, and FCC approval of all commercial equipment.

Those are the main points of a staff recommendation due before the FCC at year's end. Chief Engineer Ray Spence, in a *73* interview, said the ban would cover all linear amplifiers, not just those intended for use by CBers. Spence also said he hoped to avoid a ban, by adopting rules requiring dealers to check if a buyer is licensed to use an amplifier. Dealers could be held responsible, and face fines, if they sold to unlicensed persons. Already federal law bans the sale of amplifiers for CB use, but the first conviction under the two year old statute did not come until October. In that case, a Florida CB dealer was fined $250. Legal loopholes, forced by other services, have allowed continued manufacture of the banned amplifiers. The way the law stands, any unit capable of frequencies other than 11 meters is legal, but it's quite obvious what the gear is for, when you consider the 27 MHz receive preamps built into most of them and the 4 to 5 Watt input power. In light of these latest developments, it looks like ham radio may lose more than 11 meters to the CBers. FCC officals emphasize that they have tried everything they can think of to slow down the CB outlaws. Field Operations Bureau (FOB) personnel report illegal activity, despite well-publicized raids in several major cities, is on the rise, not the decline. (In Houston TX, a group of 10 SSB CBers were shut down, revealing the same pattern encountered elsewhere . . . ham transceivers and linear amplifiers modified for 27 MHz, big beams, and enough interference to other services to fill a new BCI-TVI-RFI handbook.)

Engineer Spence, himself an amateur, finds the idea of banning the manufacture of amplifiers "appalling." "It may end up a combination of the alternatives," Spence said, "with equipment approval and point of sale checks becoming law." Others at FCC see no alternative but a ban on amps. The irony in all this is that FCC's attention to the outlaws will only further delay, if not kill altogether, proposals for non-code licenses . . . proposals the outlaws claim they are working for by defying the law. In each issue of *SSB News*, a newsletter devoted to HF and VHF pirates, the editor states, "*SSB News* does not advocate defiance of FCC rules, but we do believe the FCC should act to provide for the needs and wants of the people, to designate additional frequency space on the 11 meter band for sideband hobby operation, and to make a Novice license more appealing by allowing sideband phone privileges for Novices on 10 meters!" (His exclamation mark.)

FCC officials say Class E CB (220

Continued on page 11

LETTERS

ADAM'S RIB

I am not a ham. Now, wait; don't all of you start jumping on me with both feet, at least not yet. I am one of an ambiguous group known as shortwave listeners, among other things. I have been a (dare I say it?) CBer since 1957 when that endeavor had just been born. Perhaps I should say that it was an Eve drawn from an unwilling Adam's rib. While the OT hams begrudged the loss of the band, it was not quite the dislike held for the lids who run rampant on today's CB channels.

With this introduction, you will assume I am about to engage in a furious tirade against hams or your magazine. Al contrario, I really enjoy your magazine, and still enjoy tuning the bands.

My reason for writing is two-fold. First, I want to disagree with the letter written by K. T. Derek, Pittsfield MA, which appeared in your Dec. '76 issue. If Derek is so against hams, why does he, or she, read *73* or bother writing to you? I read *73* compliments of a good friend of mine, WA1UFE, for exactly the reasons Derek pointed out. I don't find hams either "pompous" or "stuffed shirts," but they are proud. They have reason to be. If Derek or anyone else thinks they could "get a ticket tomorrow" if they wished, I think they ought to try it. I am a holder of a First Class Commercial Operator's License, not through one of these quickie memory schools that simply give the test answers, but through years of hard work, and I am proud of that! I can see that anyone who has studied ardently to get his Novice ticket would be just as proud. For this reason, hams wish to show off a little. I say that's great. You all deserve a round of applause. Anyone can say, "I could get a ticket if I wanted." But it is quite a different matter to actually do it. I would challenge Derek to try it first, before criticizing. It is like watching the tip of an iceburg protruding from the water and commenting, "There's nothing to it" or "Is that all there is?" Believe me, there is more to it than that.

More QRN came from the letter saying that the experimental phase of electronics went out with the 6L6 tube. If you think that, I am sorry for you. I have worked as an electronics design engineer for a big company. The only good designs coming from groups like that are the brainstorm black-boxes that we dream up on our own time. For the most part, the large companies are so wrapped up in sticking to standard procedures that they will not let their engineers develop new ideas on company time. All they are concerned with is cosmetic changes to existing products that have already proven their worth on the money market. Take just one example: the well-known TV games. To my knowledge, the first such unit was a basement "black-box" unit called "TV Tag," in which each player had a dot on the screen and they chased each other around the screen. This wasn't much, but it was enough to make one man go to his garage and build the famous "Pong" game. This started the Atari Company, which is now a big business. Only after the Pong game proved itself a moneymaker did the big companies jump in with hundreds of varieties of the game to get a little of the cream. No, I'm afraid your idea is just QRM.

My second reason for writing at this time, and a more important one to me, is the new *Kilobaud* magazine. I don't want to miss even one issue. If the I/O sections which have been appearing in *73* are any indication, this will be the magazine we have all been waiting for. I do not know what the yearly fee will be, but we can straighten that out later. Please put me down for a year's subscription, starting with issue number one, and bill me. Tnx.

Dan Mickle
Lodi OH

MISSED POINTS?

I must compliment your policy of printing everybody's views, however far off base they may seem. At the same time, I can't resist commenting on G3OGR's article in the December issue. I'm afraid, however, that it was ill-timed — it would have been more appropriate around the first of April.

Seriously, though, lest some beginner misinterpret the article, some form of analysis is necessary.

He was trying to prove or disprove the effectiveness of correct antenna matching in terms of radiated signal strength. He started with an antenna, cut to resonance, evidently, according to the basic antenna formula. However, he had no way of knowing the antenna impedance with which he was starting. This factor varies with wire size, wire type, physical orientation of the wire, its height above ground, and the conductivity of that ground. He points out that, with the wire going directly into the transmitter output, he was able to get a resonant condition. Well and good. Luckily the wire was within the range of the transmitter's output network, and so needed no tuner in the first place. Nonetheless, he noted plate current and antenna current. Fine. A given power into a given impedance produces a given current—Ohm's Law.

When he added a tuner, he had to change the settings of the transmitter's output network; consequently, the transmitter's output impedance was different. The tuner then transformed this new transmitter output impedance to the antenna impedance, which was the same as before. Same plate power, transformation through the transmitter output circuit to a lower impedance, then back up via the tuner to the same antenna load impedance as before. Pi-network and tuner resonated, little or no power loss, same antenna current, of course! All he proved was that the tuners do work. He varied the transmitter output settings and brought them back up to the antenna impedance with the tuner.

When he changed antenna length, the antenna current was different because the antenna load impedance was different. Since he was matching the new antenna impedance to his transmitter, and then putting the same power into the antenna, of course his radiated field stayed the same.

Now, when he mistuned his tuner to get a 5:1 vswr, and then put the same current into the antenna, he failed to say whether his plate current dipped to the same level or a different level — he only says that it dipped. I certainly hope he didn't operate for long under those conditions, since with a 5:1 swr, nearly forty-five percent of the power being generated was heating up the plates of his output tubes.

He noted that the antenna apparently changed the values of L and C required for resonance. Antennas do that. Depending on length, they add either L or C to the circuit.

His closing remark was quite correct. No tuner made will add S units to your signal. They only transform the antenna impedance to known values so that you can go into your equipment with coax of known value, and little things like interference filters will work. Also, when the swr is low, all the power being sent to the antenna is staying there. The tubes last longer and you don't have as much TVI, or as much rf floating around your shack. There is no myth to that. To increase radiated field, you must put more power into the antenna.

In conclusion, I want to emphasize that I'm not trying to pick the guy apart. He had the courage to experiment, which few hams do nowadays, and he had the pride to write his conclusions. My only criticism is that he seems to have missed a point or two in his evaluation of those experiments.

Bill Hood W2FEZ
Albion NY

G3OGR REPLIES

W2FEZ seems to be making some points I made, but in other words. The article does *not* cover the need for a flat line for harmonic filter, etc., but the fact that end-fed antenna length is unimportant in the terms described, and losses if any in using it as a load via an ATU. Without repeating it all, perhaps I can make my point again briefly. An end-fed wire does not need to be cut to resonant length in the interests of radiation. This is easily proved as described.

On the point of a high swr in a line from the pi tank, this does not of course cause 45% loss at 5:1, or virtually any loss. Assume the wire is fed directly from the tank, and tank values allow its impedance and reactance Zj to be suited; then maximum swr equals maximum antenna power. Now suppose the tank is engineered for 50 Ohms. We use L and C to suit, and able to take the calculated voltage and current. We may not be able to use this at some high value of Zj because excursions will exceed component ratings. But we could engineer the tank for any load, with the same output power. If we had enough L and C rating and adjustment, the tank could be used with 50 Ohms, 1k, or anything, with reactance too. I have fully adjustable pi tank, coax to swr indicator, coax to antenna tuner, antenna current meter, then antenna. Radiated power is the same for 1:1 swr as for 5:1, 8:1, or any other figure. This is readily proved in the terms described, which once again are nothing to do with the need for, perhaps, under 2:1 swr to avoid damage to a tiny transceiver tank, or matters such as TVI, etc., which were not the subjects covered.

Frank Rayer G3OGR
Worcestershire, England

GRATITUD

4259 Bedford Ave.
Brooklyn NY 11229

Dear Larry,

I don't know what this letter will mean to you. But this in all sides a great testimony of real Gratitud. Why ...? Well I say that one must be grateful for those peopple whom teaches us anything, even if this is only to put the table in the correct place. I haven't find too may Intelligent peopple in this rotten world. I'm shure that you are one of them; many technician know a lot about Electronics, but they have many tricks in their brains if they have any brains. This (I call tricks, only because my English is very short ...) avoids them to think correctly and to "give" others what they have. You call them Selfish ...? or egoist dogs. Thanks again and read this ...

I do not know how the counters count ... I pretend to make one for me, but this is almost impossible at the moment. I'm a very old 53- man, and although I work almost in any branch of Electronics this Digitals are new for me. I haven't too meny books about it and if any, they cover the line in a very rough manner, so its not easy to understand them, many as you know cover "the way to make them" (?) do I want to make them ...? Or

. . . how many technicians you know who want to make IC's . . .?

But YOU GO TO GROUND EXPLANATIONS, You make your things for very Stupids like Myself, and this is the way we need it.

This letter in the other way, is to ask you to GO ON. Even if you write only for me (I don't thik so) Just keep on. You have somebody who reads your articles with avid curiosity. I wait the mail every month, to keep my subscription to the best Amateur Mag. and see what new things I learn about digital affairs.

Keep ON again, just tell us HOW THE THINGS ARE MADE. Because I know how divider, or better What dividers make, But how . . .? What means Enable . . .? And so on . . .

I'm in Electronics since 1935. A real proffesional since 1938; I can make almost anything in the row, this is really something NEW for me, and I do not learn very fast by now, and I have many things I want to learn, in one word Larry, Medical Inst. and Industrial Controls are by now absolutelly Digital. Signal tracing is my system, but first I must learn what they are to see any signals. The world will be Digital . . .! Or is it allready . . .?

Again . . . How an divider, divides . . .? How an Flip Flop makes the thing . . .? You told me about. Now just give us more, you can make a complete description of a counter and how can I use it and most, how can I make one . . .? The list may be very long and very tedious to you, practically anything you can make will be quit welcome by many in any part of the world *73 Magazine* goes.

Good fellows like you, make *73* very atractive, very very atractive. We learn . . . and that's why and enough. Rather than having any Magazine with a lot of "Boxes", and also many explanations, I never read. I'll get *73* for as long as I can get anything from reading it. You are the first I read, Really HONESTLY SAID. All other magazines for Amateurs are very dificult to follow, for they make articles Absolutelly Imposible to copy, if they are not very expensive, they are too complicated and not always are with easy instructions to follow. Besides if they are not interested in Mexico, just why they send the magazine to us . . .?

Amateurs are beautiful, They make a lot of things "Without any Engineering". My contact with them is for I make repairs in any SW receiver or Transmiter. I'm not active because the rules in Mexico are very misadjusted. They want me to learn 5 words per min. in Morse Code . . . And I'm very old for learning anything I consider OUTSIDE OF ELECTRONICS. I argue to them that is more necessary to make to learn any guy whom makes an aplication for amateur, and more important to know, what they can make with 1000 Volts, and what they should NOT to do, and that this H.V., simply Kills. Those I remember long time ago, are Dead . . . because High Voltage Kills for ever, and nobody told them So.

Well dear Larry, (May I call you, Just Larry . . .? You call me Bill. This is the translation to English of my name which is Guillermo), I have friends all over our continent. Your contact with *73 Mag.* makes one of my best.

At least one man in Mexico, as I know is waiting for your writings and remainds you not to forget the next article to *73 Magazine*. I'll be waiting . . . Good By Larry, and remember again . . . We need your articles . . . Keep going ahead, give us more to read about Digitals. Many guys like me, need them. And I think this is all over the American Continent.

Guillermo Moreno Rivas
Sindicalismo # 87-219
Escandon Z 18
Mexico

You know . . . it's letters such as this that make it all worthwhile. I have gotten many letters which thanked me for the articles, but this missive is most sincere.

It speaks not only for my efforts, but for yours as well. You print them.

Larry Kahaner AB2NEL
Brooklyn NY

LESSONS FOR ADSIT

I've just finished reading Norbert Adsit's article, "Design Your Own PC Boards — the styrofoam solution," in the Holiday edition of *73*. I'm still smiling. Some time ago, I made my first PC board. A lot of time and effort went into its design and fabrication. That board ended up in the garbage can because I hadn't kept in mind that if you design the board from the component side, you must reverse everything from right-to-left when you transfer the design to the foil side.

It was a hard but enduring lesson and one that Norbert Adsit needs to learn.

For anyone who jumped in and made a board following the system proposed in the article, I believe they may be able to salvage their boards if they will mount the components on the foil side. Their soldering techniques will suffer since the components will block free access to the leads. The end result will look a bit primitive but should be serviceable.

For those who are adventurous, I suggest that they go ahead and mount their parts on the component side of the board. They will need to be extremely careful about making sure they are using the right holes since they won't be where they laid them out. I believe components with two leads can be handled easily enough if special attention is paid to polarity sensitive components such as diodes. Those parts with more than two leads, like transistors and integrated circuits, would require fairly drastic measures. In essence, these components would need to be placed upside down on the board and their leads bent back down into the board. This would be risky since it would be easy to break some of the leads or to get confused as to which lead was which.

I would use these methods only as a last resort. But for those who invested their time and energy making boards with Norbert Asdit's system, these ideas may have some value.

D. E. Stanfield
Atlanta GA

NORTH OF SIXTY

Just a little note from "North of Sixty" to commend *73 Magazine* and some of its advertisers. In addition to S.D. Sales, Godbout, and James Electronics, please include Bullet Electronics and Quest Electronics, who also give very good and speedy service. Bullet's kits have well-made, very small PCBs and, although some of the parts are not always easy to identify, the kits go together well and I have had no problem in getting them to work.

Nice to see that you have gone to the tear-out Reader Service card; sure is much better than having to cut a chunk out of the pages which made a mess when one collects the magazine and likes to keep it in as good condition as the Postal Service delivers it in (Ugh).

It's also very pleasing now to find that certain of the articles now have a source or printed circuit boards available; this is really a boon to would-be constructors who do not wish to fabricate their own.

Really like your magazine here — good easy to read articles, mostly easy to make projects, and a bit of humor thrown in.

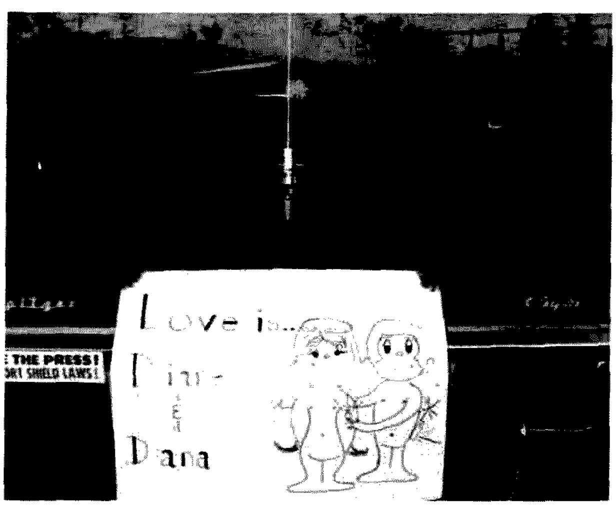
73 and keep up the good work.

F. V. (Vic) Greenleaves VE8AM
Whitehorse, Yukon

OLD HAT?

I'm sure an all ham radio wedding is old hat by now. But, I thought you might enjoy this picture. For us, it's the best in the album. As yet no one will confess to the artwork, as the "HT" wasn't there when we arrived at the church!

Dana Henry WB8GUU
Elyria OH



TECH REAX

I have been subscribing to your fine magazine for about three years now. Your articles and editorials are always interesting, and it is good to have someone such as yourself who can articulate what I'm sure many of us think and feel.

I would like to respond to your editorial in the December issue concerning support for Tech class operators on 10m. You posed several questions that I feel can be answered. The absence of activity on 220 is because there is basically no advantage or difference over two meters. If one already has 2m equipment, there is no practical reason to want to get on 220 since the range and type of operation is primarily identical. I think this also goes for the other VHF frequencies. Incidentally, I'm talking about the average everyday Tech class operator, and not about the more admirable (but rare) type who has the ambition and facilities to experiment with new and higher frequencies just for the sake of experimentation. Since 2m is the first band most Technicians get on, they stay there because there is no incentive to go elsewhere.

However, six meters is an entirely different case. From firsthand experience, I firmly believe the main reason the band is empty is the difficulty with television interference. 6m sideband would be great, except that most people live in subdivisions and not in the middle of a twenty or thirty acre farm. When half the people within a mile or two of you are running rabbit ears and trying to watch football on channel 2, any talk of high pass filters, low pass filters, and quarter wave twinlead stubs, etc., becomes purely academic. With the TV's AGC running wide open to bring up a weak TV signal, the only place for a filter would be the antenna lead's connection to the chassis inside the set. I don't have to spell out the time, expense, liabilities incurred, etc., involved in clearing up TVI for 50 or maybe even 100 cases such as this. Other options available might include letters and/or visits from the FCC, as well as explaining to the lynching

party on your front lawn exactly why it is necessary for you to regularly interfere with their favorite pastime. Thus, the only band available to Techs which even marginally offers any promise of DX, WAS, and all the other goodies associated with low band operation, comes out looking pretty dim when compared with its disadvantages. Therefore, when given an even halfway attractive alternative, most Technicians will take it, and there you are again up on 2 chewing the rag unobtrusively with some other Tech who lives across town instead of across the country.

Now comes the question of why the 200,000 General and above licensees don't flood onto ten with rag chews and DX pileups. It is a matter of relative value. They already have 75, 40, 20, and 15, with good antenna setups, nets, scheds, and a lot of friends on their favorite frequencies. They simply don't need 10m for their enjoyment of ham radio. In much the same way that Techs have no reason to move to 220, a General class licensee feels no compulsion to rush up to 10. The situation could be compared to offering a 79 cent bottle of Ripple wine to someone sipping on a case of champagne. He probably won't knock you down to get it. However, offer the same bottle to a wino with the Monday morning shakes and see what happens!! Similarly, Generals or above perceive 10m to be inferior to the other HF bands available to them because of erratic propagation or some other reason. This is not a value judgment of my own, but is based on the amount of activity found there. On the other hand, 10m would be extremely attractive to a Tech class operator because it would be the only HF band available to him. Also it would be far enough from television frequencies so that those problems could be handled in the conventional manner if they arose at all.

Finally, one could argue that SSB privileges for Techs on 10m might encourage some percentage of them to upgrade. CW is not every man's game and many people probably won't spring for the five or six hundred dollar tab associated with most 5 band transceivers just for Novice privileges. Many of those same people might, however, if they knew they could operate phone on at least one band while improving their code speed on the others. This would provide a strong incentive to upgrade since they would already have paid for the equipment, and all that stands between them and its full utilization would be the increased code proficiency. In addition, a few hundred purchases of rigs based on this premise certainly couldn't do our economy any harm, could it?

I have tried to confine myself to the topic of behavior and facts related to life in the real world. Discussions of whether a person should be "given" something when others have "earned" it, etc., are an entirely different subject. Similarly, questions such as, "If you want it, why don't you just get up to 13 wpm . . ." are not related to this discussion. Most people behave in a rational manner; that is, they expend effort only if they perceive the benefits to be worth the time and work required to achieve the goal. Evidently, there are a great many Tech class hams who don't perceive the increased privileges as being worth the effort involved. As ignoble as this may seem, it is still a fact borne out by the number of long time Technicians who have held their licenses for ten or fifteen years.

However, based on my own experience and conversations with others, there is still a strong desire to engage in HF type operation by most Technicians, and ten meters would attract many of them if the regulations allowed it. After all, that is the important thing — to get a significant number of ham operators on ten meters.

Thank you for giving me a chance to express my opinion.

Keep up the good work.

L.N. Thompson WB4WNV
Austell GA

EXTENDED BASIC

A helpful note regarding Joe Kasser's fine program in the Nov. *73* is that if anyone runs this program in Altair Extended BASIC, the variable "MODE" in lines 600 and 615 will conflict with a reserved variable MOD. Just change MODE to another variable such as M5 and the program will also run in Extended BASIC.

Keep up the good work.

John DuBois W1HDX
Boxborough MA

KANGAROO COUNTRY

I enclose $20 in US funds for a 3 year extension. I like the present format; it's very good. Thought the "Eyes for Your Shack" in Nov.-Dec. '75, one of the best articles that I have ever seen published. I like articles on advanced test gear very much; more please from the same author. Have had very good results from Bill Godbout, Poly Paks, James, and Gateway, on mail orders.

Greetings to all the *73* staff from "Kangaroo Country."

Wally Payne VK3YP
Victoria, Australia

A SIMPLER SOLUTION

All good credit to K5AR/7 regarding the "Turn Signal Reminder" on p. 166 of the Holiday issue of *73.*

Several years ago I found a simpler solution: I connect the Sonalert directly across the terminals of the turn signal flasher. Polarity must be observed, of course.

I found it necessary to muffle the unit by wrapping it with tape. My co-pilot objected furiously!

Chester L. Doll KØPTG
Omaha NE

FT-101 uP??

I don't know much about micro hard and software, and it'll be a while before I can afford a system, but you can bet your floppy disk I will be keeping *73* I/O and the new *Kilobaud* mags on my reference shelf for a long time!

Think of the future uses of computerized ham radio! How long will it be before microprocessor based transceivers are put on the market? Auto ID . . . processor-based CW/Baudot/ASCII system . . . "punch-up" frequency selection . . . a new mode?? Who knows, a Yaesu FT-101 uP???

Keep fightin', Wayne; we'll get our way yet.

Mark Herro WB9LSS
Oconomowoc WI

LIFE

I am pleased to become finally, after at least ten years, a lifetime subscriber to *73 Magazine*. You have pushed and prodded me on many occasions into trying new and exciting innovations appearing in the field of electronics. It was because of your insistence that I finally started into two meters, and I have been glad, of course, ever since. With the advent of *Byte Magazine*, I renewed an interest in computers and shortly thereafter purchased one which I have been using ever since. It is proving to be a source of continued inspiration and intellectual challenge both to me and my 13 year old son who is now the acknowledged computer program debugger of his school.

So I owe indeed a great debt of gratitude and thanks to you for all your encouragement, albeit indirectly.

With best wishes for a happy, healthy and prosperous New Year.

Gerald E. Meltzer M.D. WØFFC
Aurora CO

MICKEY AND FOXY

Thought I'd give you a bit of background. I, Mickey, am a hardware person, and my wife, Foxy, is a software person. Until the advent of microprocessors, I had always considered software to be "woman's work" (being a good MCP, as the women's libbers might say). I have an Advanced class amateur license and a First Class Commercial Radiotelephone License with Radar Endorsement and am employed in electronics by Ma Bell (sorry 'bout that!). After the Atlanta Hamfest this year, I came home and told Foxy that I wanted a computer. Contrary to what you might expect, her reaction was somewhat akin to my having said, "Robert Redford is going to spend a few days with us!" You see, my wife has had about 6-7 years of programming the big monsters (ISM, Univac, etc.) in COBOL and Assembly languages.

We discussed (argued) extensively as to what constituted a "minimum acceptable system," finally deciding that it was: 1. No bootstrapping allowed; 2. Minimum of 16K RAM; 3. Minimum two tape machines; 4. Hard copy printer; 5. CRT control terminal. Then we decided on a maximum of $1500 total system cost. The problem of which computer system was therefore very easily resolved; only from SWTPC could we purchase our "minimum acceptable system" for our "maximum total system cost" or less. On July 22, 1976, we took delivery of an M6800 computer, AC30 cassette interface, CT1024 terminal, and PR-40 printer from Atlanta Computer Mart.

Once the assembly of all the kits was completed, I felt that the fun was over, so Foxy gave me an operating system as a project. She helped in the "blueskying," and gave some help and encouragement when I got stuck (also helped in putting an article together), but mostly let me work it out for myself. So I must share the credit for the OS.

Mickey (and Foxy) Ferguson
Trenton GA 30752

Mickey and Foxy have put together a rather impressive Operating System for their 6800 and their article on it will be in an upcoming I/O section. A tape of the program will be offered through the 73/Kilobaud Software Library, also. – John Craig.

HOOKED

This letter is going to be a combination of things, as I've put off writing this for a long time, and the things I want to say piled up.

First, I want to add my praise for James Electronics to that of John Dieringer W6RVP. Their service is not only outstanding, it's phenomenal. I've ordered from them three times now, and in each case have received my parts back in *five* days. They must have employees waiting in line to fill orders. Keep it up, guys.

Second, tell Mary in Reader's Service not to despair; I finally noticed the little card in the back of your mag and decided to send it in.

Third, keep the digital (and *anything* on microprocessors) stuff rolling in. When I first subscribed to *73* this summer, I read the first issue and about cancelled my subscription. Where were all those pages upon pages of thrilling contest results? Instead, you had printed articles about incomprehensible boxes called microprocessors. Well, you've got me hooked now, and although I haven't got a computer, I'm about ready to subscribe to *Kilobaud*, out of sheer curiosity, if not interest. Those computers are getting more and more comprehensible with every issue. But I'd still love a book on the basics: programming (BASIC), memories, interfacing, peripherals, the codes used (what the heck are Baudot and ASCII?), or in short, anything for a newcomer. A tall order, Wayne, but

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BE MY GUEST

visiting views from around the globe

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MHz) is dead for the moment because of the 40 channel expansion and strong objections from other services. However, the Communicator Class proposal (Docket 20282 . . . 220 and above without code) is still being actively considered. FCC officials admit that both proposals are in limbo, while the CB problem takes their attention. They also emphasize that the impact on ham radio will be as minimal as possible. Nevertheless, it's clear that amateurs can no longer stand on the sidelines and watch the wrestling match between the FCC and CBers. There is more at stake now than Novices or Technicians with 10-4 accents. Our frequencies, amplifiers, and status with the FCC may be in jeopardy.

So what can we do about it? For one thing, amateurs everywhere should promise themselves that they will reply when the FCC asks for comments on the amplifier docket. There *are* some alternatives. How many ham rigs are capable of 10 meter operation? In the Holiday issue of *73*, 25 rigs are advertised with 10 meter capability. Only two of them operate with less than 200 Watts input. Consider the fact that the linears FCC is worried about average 2 to 4 Watts input, 100 to 250 Watts output. How about a rule requiring all linear amplifiers to have a minimum drive power of 100 or 150 Watts? Another alternative would be frequency coverage. How about limiting amplifiers to frequencies below 21.350 MHz? Remember, no matter what the FCC finally decides to do, home brewing will not be outlawed and existing equipment won't be affected. So the effects on ham radio *can* be minimized, if we all get off our tails and react constructively when the FCC requests comment. As one FCC official told *73*, "There are millions of CBers operating with illegal power or out of band . . . compared to the thousands of hams capable of using 10 meters with amplifiers, ham activity on 10 meters is a drop in the bucket . . ." Why not help flood the FCC's bucket . . . and turn the amplifier ban against the illegal CBers? Think about it. (Recent change in FCC procedures only requires an original and 5 copies instead of 13.)

Warren Elly WA1GUD
Associate Editor

Handicapping the Handicapped

With the large number of people becoming interested in amateur radio, an increasing concern for the FCC is arranging exams for handicapped persons who are able to travel to examination points but unable to take the test in the conventional way. Although the FCC did do away with Conditional class exams last year, those unable to travel can take the exams at home for Technician, General, Advanced, or Amateur Extra when a physician's certificate shows them incapable of the trip. Another change in the rules: Instead of the applicant picking his own volunteer examiner, that choice is now made by the FCC.

With blind or deaf prospective hams, the situation is a little different. An FCC spokesman told *73* that a formal testing structure has been in existence for the blind for a number of years. The code exam is the same, but the written test is done in one of two ways . . . Braille tests are available or the exams are read to the applicant by the FCC examiner. In both cases, schematic diagrams are eliminated.

The plight of the deaf applicant is the most difficult of all. In their case, the FCC makes no provision for a CW test. The FCC told *73* that according to the way international regulations are worded, the applicant is required to *hear* CW in order to obtain a license. This creates a sticky problem for the FCC, who must give the applicant a waiver from hearing the code, while still requiring them to pass the code exam. FCC field offices have no equipment for non-aural copy of code, so the applicant is forced to furnish his own means of transferring the FCC exam tape into a medium he can copy. The most common method used, according to the FCC, is some sort of homebuilt device that changes the sound into vibrations using a buzzer or speaker arrangement. Lights can be used; however, the slow damping factor of regular lightbulbs makes them impractical for speeds of over 5 words per minute. LEDs, because of their almost instant damping, should be usable to higher speeds, although no data on their use in this type of application is available.

The FCC told *73* they have no present plans to make provisions for deaf applicants because, as yet, their numbers are extremely small. No estimate was available on the number of handicapped amateurs in the country, and a check with the FCC field office in Boston disclosed that the examiner there had never given an exam to a deaf person.

Although deaf people represent a very small percentage of the population, and those who wish to become hams are an even smaller number, it seems the FCC should make some provision to help these people deal with the examination process. Nondiscriminations laws are in existence to help those who would otherwise be discriminated against because of their handicaps, and if the FCC is unable to do this, perhaps one of our readers could help with plans for an inexpensive sound-light or sound-vibration unit.

Those wishing further information about waivers required should write to The Chief of Rules and Regulations, Amateur and Citizens Division, Federal Communications Commission, Washington DC 20554.

Stan Miastkowski WA1UMV
Associate Editor

Inside the "Big Noise"

What is the "Big Noise" and what is its purpose? Those questions have been generating a tremendous amount of speculation since the appearance of the noise last summer with its subsequent disruption of radio communication throughout the world.

The sporadic interference has been heard throughout the HF spectrum from 2 to 24 MHz. Signals last anywhere from thirty seconds to half an hour, are pulsed at 10 Hz, and have been measured with bandwidths of up to 300 KHz.

Theories abound on the noise, the most common holding that it's some sort of propagation study. High-placed sources decline comment on the purpose.

Other theories range from HF radar to a new navigation system. The latter was backed by an FCC spokesman who said that although direction finding is very difficult, because of the large distance involved, the FCC believed the noise is coming from at least two transmitters located in the Minsk area of the Soviet Union, about five hundred miles west of Moscow.

A logical theory was put forward by George Jacobs of the Board for International Broadcasting in Washington. He theorized the Soviets might be testing parts for a new high powered transmitter and added that if the U.S. were building such a unit, we would be doing the same type of testing.

The noise disappeared for nine days during the middle of November and was believed to be gone for good when it abruptly appeared again. According to FCC Chief of International Operations Robert Cutts, the Commission sent 5 informal complaints through the Soviet embassy since the noise began. He added that a reply was not expected since the Soviets seldom even acknowledge receipt.

With the noise continuing as strongly as ever, the FCC asked the State Department to issue a formal complaint, the next step on the ladder of protocol. As that complaint was being prepared, an unexpected event took place – the Soviets replied to the FCC's complaint. The tersely worded statement from the Soviet Union called the noise an "experimenal use of the radio spectrum which will be terminating shortly." There was no further indication as to when the noise would be cut off or of its purpose. The Soviet embassy in Washington said that they were "aware of the situation" and declined further comment.

The Soviets' admission caught government officials completely by surprise and left them mystified. An FCC source theorized that the Soviet statement was the result of heavy political pressure coming from all over the world. Being extremely close to

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Special Report

by Warren Elly WA1GUD

It is most important that the material in this 73 Special Report be kept in the right context. The FCC draft must now withstand public comment (the deadline is January 31, 1977) before becoming final. It will then move on to other WARC sessions on an international basis, prior to the 1979 conference. The US, like all 100 countries envolved, has only one vote . . . and therefore the FCC's proposals carry a lot less weight than they may seem to on the surface. The frequency table does, however, offer an updated perspective on the FCC's feelings about amateur radio and CB, especially when one considers the 220 MHz allocations, and references to mobile services throughout the table.

THE BUZZWORDS

ITU — The International Telecommunication Union, whose regulations govern communications on a worldwide basis. 150 countries have agreed to be bound by ITU and its all-important table of frequency allocations. The ITU is directed by an Administrative Conference held each year, which can call for regional or general membership meetings on an "as needed" basis. It takes a vote of the ITU members to call such sessions. Every 7 years ITU holds a Plenipotentiary Conference of the membership, which in turn can call a world conference (WARC).

WARC — The World Administrative Radio Conference, held as necessary at the call of ITU members. WARC is the big one, where international allocations are decided.

IARU — The International Amateur Radio Union, ham radio's international lobby, with 90 societies representing nearly all licensed amateurs in the world. The IARU doesn't just lobby with ITU and during WARC; it also serves as ham radio's contact with the governments of each country, usually through their communications ministry or FCC equivalent.

Region 1 — The area including eastern and western Europe, Africa, the Middle East including the entire Saudi Arabian peninsula, all of the Soviet Union and Mongolia.

Region 2 — The Western Hemisphere including Greenland, but excluding Iceland.

Region 3 — What's left: the South Pacific, Southeast Asia, and Oceania.

The Breakdown

BAND	EXISTING (Region 2)	FCC (Region 2)	STAFF RECOMMENDATION (ARRL)[1]
1875m	no allocation	160-190 kHz exclusive *amateur*	160-190 kHz
160m	1.8-2.0 MHz subject to regional restrictions	1.750-1.9 MHz[2] *amateur* shared with fixed, mobile, aeronautical radiolocation and navigation	1.715-2.000 MHz
80m	3.5-4.0 MHz shared with fixed, mobile, broadcasting	3.5-4.0 MHz *amateur* exclusive through 3.9 MHz[3]	3.5-4.0 MHz
40m	7.0-7.3 MHz shared with broadcasting	6.95-7.3 MHz *amateur* exclusive,[4] *amateur satellite*	7.0-7.5 MHz
20m	14.0-14.350 MHz	13.950-14.400 MHz *amateur exclusive amateur satellite*[5]	14.0-14.5 MHz
15m	21.0-21.450 MHz shared with maritime mobile, fixed	20.7-21.2 MHz *amateur, amateur satellite* exclusive	21.0-21.5 MHz
10m	28.0-29.7 MHz exclusive	28.0-29.7 MHz *amateur* exclusive, *amateur satellite*	28.0-29.7 MHz
6m	50-54 MHz exclusive	50-54 MHz *amateur* exclusive[6]	50-54 MHz
2m	144-148 MHz exclusive	144-148 MHz[7] *amateur* exclusive, *amateur satellite*	144-148 MHz
1¼m	220-225 MHz shared with fixed, mobile, radiolocation, aeronautical, broadcasting	220-225 MHz *amateur, amateur satellite*, radiolocation, mobile[8]	220-225 MHz
¾m	420-450 MHz shared with radiolocation	420-450 MHz[9] *amateur, amateur satellite*, shared with radiolocation	420-450 MHz
3/8m	no allocation	902-928 MHz fixed, radiolocation, primary; *amateur*, mobile, secondary	902-928 MHz
1215 MHz	1215-1300 MHz	1215-1300 MHz radiolocation, primary; *amateur, amateur satellite*, secondary	1215-1300 MHz
2300 MHz	2300-2450 MHz	2300-2450 MHz radiolocation, primary; *amateur*, secondary	2300-2450 MHz
3300 MHz	3300-3500 MHz	3300-3500 MHz radiolocation, fixed, fixed satellite, primary; *amateur, amateur satellite*, secondary	3300-3500 MHz
5650 MHz	5650-5925 MHz	5650-5925 MHz radiolocation, primary; *amateur, amateur satellite, secondary*	5650-5925 MHz
10.0 GHz	10.0-10.5 GHz	10.0-10.5 GHz radiolocation, primary; *amateur*, secondary	10.0-10.5 GHz
24 GHz	24.0-24.250 GHz	24.0-24.25 GHz[10] *amateur, amateur satellite*	24.0-24.250 GHz
48 GHz	48.0-50.0 GHz	no amateur allocation[11]	48-50 GHz
71 GHz	71-84 GHz	71-76 GHz radiolocation, primary; *amateur, amateur satellite*, secondary	71-76 GHz
152 GHz	152-170 GHz	165-170 GHz radiolocation, primary; *amateur, amateur satellite*, secondary	165-170 GHz
200 GHz	200-220 GHz	no amateur allocation	no proposal
240 GHz	240-250 GHz	240-250 GHz radiolocation, fixed, mobile, primary; *amateur, amateur satellite*, secondary	240-250 GHz
300 GHz and above	300 GHz and above	no international allocation proposed[12]	300 GHz and above

[1] *The ARRL had proposed additional bands at 10, 18, and 24 MHz, all of which were left out of the FCC final draft (see text).*

[2] *In regions 1 and 3, the FCC proposes 1.725-1.750 MHz, which would in essence be another "DX window." "It cannot be readily determined whether or not worldwide allocation of these bands to the amateur service is practicable due to the lack of knowledge regarding spectrum requirements in other regions." — FCC WARC draft.*

[3] *In regions 1 and 3, 3.9-4.0 MHz is shared with broadcast, fixed, and mobile.*

[4] *In regions 1 and 3, 7.1-7.3 MHz is shared with broadcast.*

[5] *The FCC draft calls for amateur satellite allocations only between 14.0-14.250 MHz.*

[6] *In region 1, broadcasting is allocated between 47-68 MHz.*

[7] *In region 1, fixed and mobile is allocated between 146-149.9 MHz. See text for aeronautical pressure on 146-148 MHz.*

[8] *Class E CB is left in the FCC document under the mobile classification "To provide for extensive development of amateur satellite techniques; to provide for the expanded land mobile need." — FCC WARC draft (see text).*

[9] *There is no amateur allocation proposed for region 1 between 440-450 MHz.*

[10] *Amateur and amateur satellite are primary between 24.0-24.05 GHz; only amateur is allocated between 24.05-24.25 GHz as secondary to radiolocation.*

[11] *The FCC draft calls for reserving 48-50 GHz for aeronautical and maritime services.*

[12] *Although the FCC is proposing no international allocation for 300 GHz and above, WARC is not expected to affect amateur and experimental use domestically.*

The Analysis

1875 METERS

With the announcement of the FCC's proposal to introduce to the WARC a recommendation that hams be allowed to use the frequency band between 160 and 190 kHz, the possibility now exists that within a few short years amateurs may be able to explore a whole new area (to us, anyway) of the radio frequency spectrum. Although similar in nature to medium frequencies, the low frequency band is much more sensitive to atmospheric and electrical noise. Propagation is primarily by ground wave; however, skywave is possible.

Traditionally, LF equipment has employed large rf coils and tuning capacitors for high-Q selectivity. With the advent of integrated circuit operational amplifiers, however, miniature high-Q stages are now practical. Direct conversion "synchrodyne" receivers are also effective in this portion of the spectrum.

Conventional antenna practices have historically been used at low frequencies; most early long wave radio stations used high and large wire antenna systems. Because of the long wavelengths involved, indoor loop antennas are often satisfactory as receiving antennas, as they encounter a minimum of phasing and reflectivity problems. Often, a vertical ground or roof mounted whip is highly satisfactory. A good ground at these frequencies is mandatory.

The most that can be said of the proposed new 1875 meter band is that it will be similar to 160 meters, only more so, and if you like 160, you'll love 1875. I wonder who will be the first to work 100 countries on the new "Top Band" (if we get it)? *Includes excerpts from 73's forthcoming publication, "Communication Monitoring" by Robert B. Grove.*

160 METERS

With increased interest in the 160 meter band, due to the current decline in the sunspot level, many eyes will be turned to the WARC to see what will be the result of its action concerning the band many in the hobby affectionately refer to as "Top Band." The FCC proposal to the WARC contains what may at first glance look like a net loss of 50 kHz. However, after analysis, this may not be the case. The "new" proposed 160 meter band would run from 1750 kHz to 1900 kHz, with the bottom 50 kHz being coequal primary with direction finding. The top 100 kHz would be exclusive amateur and not shared with Loran as is currently the case. At present, 44 percent of the amateurs within the US in the states of AK, AZ, CA, CN, ME, MA, NV, NH, NJ, NY, PA, RI, VT, WA, and OR are not allowed to operate above 1900 kHz, and a majority of these hams are only allowed to operate in a 50-75 kHz section of the band below 1900 kHz. Therefore, by opening the entire 150 kHz 160 meter band to amateurs throughout the entire US, this would in effect be a gain to most "Top Band" users.

80 METERS

The FCC plan leaves 3.5-4.0 MHz the same as it is now. Between 3.5 and 3.9 MHz, amateur allocations will be worldwide exclusive, with only two exceptions. Above 3.9 MHz the FCC proposal allows for the same sharing with SW broadcast as now exists . . . as an FCC spokesman put it, "The existing character of 75 meters will remain . . ." The top segment of 80 meters remains threatened, however, with the SW broadcast interests pushing for the upper band.

40 METERS

If you're a 40 meter man, you'll love the FCC proposal. The lower end of 40 would go down 50 kHz to 6950, with the first amateur satellite frequencies starting there (for downlink purposes). From the new band edge through 7100 kHz allocations would be exclusive amateur, but SW broadcast would continue to enjoy its stranglehold over 7100-7300 kHz. There are some indications that the Soviets, at least, are becoming less interested in SW broadcast, and it's hoped by the time the WARC allocations get into practice the broadcast QRM may be abated. Another unanswered question is what the FCC will do about domestic sub-bands within the allocation. The debate of CW vs SSB is far from over, and 40 meters will be a battleground comparable only with 20m.

20 METERS

If you were to rank the HF ham bands in order of international importance, 20 meters would probably come out on top. And if the FCC proposal becomes a model for WARC, there may finally be some relief from the Sunday afternoon madness on 14 MHz. The FCC plan calls for 100 kHz worth of expansion, stretching 20m from 13.950-14.400 MHz. The entire band would be exclusive amateur, allocation-wise, with 14.0-14.250 a satellite band in the FCC plan. Again comes the question of how the FCC might divide the new segments, but first we have to get them at WARC, so it's tough to get a reading from Washington. Sources say, however, if amateur radio is to get anything out of the conference, the 20 meter expansion will probably be it.

15 METERS

A lot of the initial reaction to the FCC WARC plan has focused on 15 meters, largely because it is the most radical change for HF. The band would be moved down 300 kHz, to 20.700 MHz, while the top end would come down from 21.3 to 21.2 MHz. A gain of 150 kHz, with satellite authorization to boot . . . but a lot of fellows reacted negatively, arguing that their equipment couldn't make the hike. (Actually a pretty weak argument, if you think about it.) On the plus side, the new 15 meter arrangement would put us that much further away from fixed allocations at the top end of the present band.

10 METERS

There is no change in the FCC plan for 10 meters over current allocations. The band would remain 28.0-29.7 MHz on an exclusive basis, with amateur satellite sub-bands. Nearby, on 27 MHz, the FCC plan calls for the so-called ISM (Industrial-Scientific-Medical) and Fixed-*Mobile*. The key word there, of course, is mobile, which means CB for all practical purposes.

6 AND 2 METERS

The FCC proposal leaves both 6 and 2 meters as is, with exclusivity and the same frequency allocations. The major issue here is on 2 meters, where the international aeronautical community is fighting for 146-148 MHz. Within the FCC, our sources say, that battle was waged with little success. But many at the FCC (and especially in the enforcement division) are concerned about 2 meter repeaters. They, off the record, compare it to CB, and identify the band as a potential problem. Considering the worldwide use of 144-146 MHz for repeaters instead of the top segment as we have in the US, 2 meters may be a real WARC trouble spot.

1¼ METERS

If the aeronautical pressure on 2 meters isn't enough, 1¼ meters may give you something to think about. Added to the present allocations in the FCC plan is amateur satellite and *mobile* (CB). Taking the specifics, between 220 and 225 MHz, amateur and radio location allocations are retained, but added are satellite and mobile as *primary* services. The FCC is obviously thinking of the Class E CB proposal in making the allocation, but on the other hand, there isn't much enthusiasm in Washington for having hams and CBers share 220. There was a clear implication in off the record conversations with FCC officials that the mobile allocation was intended as a compromise, and not any sign that Class E is about to become reality. The best answer, more than one FCC source told *73*, is to use 220 . . . use it or lose it anyone?

¾ METERS

The ¾ meter band shows little change in the FCC document. 420-435 MHz lists radio location as the primary allocation, with amateur secondary. Between 435 and 438 MHz amateur would be the same, listed as secondary, with 438-450 MHz also unchanged. There are some major changes in Region 1 where 430-435 MHz would put radio location and amateur allocations on an equal basis. Also in Region 1, amateur satellite would be added between 435-438 MHz as a secondary allocation.

3/8 METERS

Another new band in the FCC WARC table is 902-928 MHz. Known as the 3/8 meter band, 900 MHz is set aside primarily for fixed and radio location services, with amateur and mobile newly added as secondary services. Some reports had also listed 935-938 MHz as amateur exclusive, but they were inaccurate.

1215-5925 MHZ

In the bands 1215 and above, the big story is satellite frequencies, lots of 'em. In fact, 85 MHz worth of new allocations are set aside in this range for satellites. Otherwise it's a matter of maintaining the status quo for the most part, with a few exceptions; like increased non-amateur use of 1240-1290 MHz, and the sharing of 3300-3410 MHz with fixed services on a secondary basis. The largest single satellite allocation in this range comes at 5650-5670 MHz, and it's listed on a worldwide basis.

10 GHZ AND ABOVE

Of two new bands proposed in committee above 10 GHz, only one survived the FCC debate — 240-250 GHz. (Another band at 300 GHz had been proposed.) To call 240 a new band requires some background, background that will be helpful in understanding the maze of information FCC staffers, and the commissioners themselves, had to sift through before reaching agreement. The band has been listed by the FCC before as an amateur allocation, but has not appeared on the international tables. Therefore, the FCC recommendations are aimed at international recognition . . . not domestic use alone. The Commission document lists amateur and amateur satellites as secondary allocations, to be shared with radio location, fixed, and mobile as primary users. But at 248 GHz the FCC has included a ±500 MHz wide ISM segment (Industrial-Scientific-Medical) which amateur users will have to work around. A similar situation exists at 165 GHz, where domestically there is some loss of allocation (at least on paper), but internationally it's a gain. But again, to say the 165 GHz band is losing frequency depends on how you look at it, since the range has been included in the FCC allocations table for some time, but left out of the rules (Part 97). As one Commission official put it, "Present action would afford amateurs secondary status in the band 165-170 GHz, but would no longer provide for 152-165 GHz which is presently available in the US . . . however, 152-165 GHz has never been implemented, so it is in essence a domestic loss only on paper . . ."

300 GHZ AND ABOVE

This range is currently unallocated on an international basis, but the FCC would like to see the WARC set it aside for amateur and experimental use, as it has been listed here in the US. Should 300 GHz and above remain off the international frequency tables, FCC planners say it would not disallow domestic use.

Continued

"On balance, ham radio occupies only a small niche in the global scheme of frequency allocations, and our strongest supporters are outnumbered and outgunned by the Third World."

No one event in the next decade is likely to affect the future of amateur radio more than the World Administrative Radio Conference scheduled for Geneva in September, 1979. Delegates from over a hundred nations will gather for 10 weeks to carve up the frequency spectrum and, in the view of government experts, diplomats, and much of amateur radio's own leadership, our hobby may lose a lot more than it gains. On balance, ham radio occupies only a small niche in the global scheme of frequency allocations, and our strongest supporters (the US, Canada, Great Britain, and West Germany) are outnumbered and outgunned by the Third World.

The Third World

If you've read very much about the current situation in the United Nations, you know that the Asian and African nations that make up the Third World now hold the balance of power in the General Assembly. (US Senator Patrick Moynihan could correct your perspective should you doubt that assessment.) In the ITU, the situation has been that way for over a decade! Because each nation at WARC only has one vote, regardless of its amateur population or actual use of the spectrum, the cards stack up much the same way as they do in the UN General Assembly . . . the more affluent industrial nations are at the mercy of the newer countries that hold much of the world's untapped natural resources.

The underdeveloped nations are not tuned into ham radio any more than they are interested in satellite ground stations or CB. Amateur licensing, for many of them, was a function of colonial government . . . now replaced by independence. Most of them would sooner build up point to point HF stations for communications than invest in satellites. At the heart of the problem is a lack of the technical expertise needed to utilize newer forms of communications, communications often pioneered by amateurs. But with amateur populations diminished, or hampered by an unsympathetic government, there is no training ground in the Third World for higher technologies . . . and thus there is little support for amateur radio.

Ham Ambassadors?

One answer to the problem is amateur ambassadors, people who can demonstrate ham radio's usefulness and persuade the developing countries that hams can help their nation grow. It is a fact that economic and technological abilities of nations can be measured in terms of their amateur populations . . . the more hams, the mora advanced the country. The ham ambassador idea probably might have worked better some years ago considering what's happened to American prestige abroad. Government sources in Washington react to the ham ambassador idea by half-seriously suggesting that the ambassadors should carry the passport of some other country, since in much of Africa a US passport starts you off on the wrong foot!

The new alignment of political power in the world must become more to us than newspaper headlines and TV reports, and for the American amateur radio operator, the reality of the situation is about to hit home. Don't expect any major expansions of the ham bands below 30 MHz at WARC '79, and don't look for any relief from foreign broadcasting. Instead, work for a maintenance of the status quo . . . yes, work for it, by debating the issue and replying to the FCC's frequency allocation proposals, and by conducting yourselves like ham ambassadors on the air.

Frank Williams of the FCC's International Conference Staff is one of the most knowledgeable American experts on the 1979 WARC. Williams not only advisad the FCC on its choice of frequencies for the various services, but has worked with dozens of foreign officials responsible for WARC preparations in other countries. Williams warns that individual amateurs, through their conduct on the air, can have great impact on foreign decision makers. He relates the story of a recent visit to 4U1ITU, the International Amateur Radio Club station in Geneva. In the presence of a telecommunications official from an African country, an off-color incident occurred on 20 meter SSB involving an American station. Williams didn't want to elaborate, but he says foreign diplomats are impressionable, and they don't only listen to 20 meters. Those stationed here in the US are the best their government has, and they *are* listening to amateur radio. Our conduct on the air could have more impact than a dozen amateur ambassadors, from what Williams told *73* in a lengthy interview.

Cutting Up the Pie

Aside from the international political situation, the list of services vying for frequency space is long . . . aviation, private microwave, radio relay, AM broadcast, SW broadcast, fixed satellite, citizen's band, private land mobile, amateur, radio astronomy, auxiliary BC, common carrier, domestic land mobile, TV broadcast, maritime mobile, and more. That's 14 against 1 just for the attention of the WARC delegates! But what is the US doing about WARC?

WARC and ARRL

The answer depends on to whom you talk. FCC officials, at the end of intense work sessions which produced the final allocations draft, said they started back in 1972 in cooperation with the White House Office of Telecommunications Policy. The ARRL's involvement is controversial, with the league claiming its contribution started at the outset with a headquarters staffer in on the four member amateur subcommittee of the OTP advisory committee. The ARRL role was purely advisory, and focused almost entirely on the complicated series of committees charged with recommending an allocations table to the FCC. Except for the ARRL's relationship with the IARU, little was done on an international basis. Here at home there has been considerable in-fighting over WARC. In mid-1976, the entire ARRL Foundation Board of Directors resigned in protest after they were denied the right to work either within the League or outside it on WARC preparations. Amateurs who served on ARRL committees expressed deep concern that all wasn't going well, and questions about the use of League appropriations (set aside for frequency allocations work) continue to be stonewalled. *QST* has offered a steady diet of optimism . . . although the November issue provided a first hint of the *real* story, with an editorial entitled, "Will Amateur Radio Exist in 1980?"

In an interview, Dave Sumner K1ZZ of the League's international staff outlined the ARRL's WARC

CARF

The Canadian Amateur Radio Federation (CARF) has reported to the DOC on recommendations for the 1979 WARC conference. The report includes a request that allocations be made for amateur operation below 10 kHz on a shared basis with other services, that 10 kHz be opened between 160 and 200 kHz for amateur use, that 40 meters be expanded up to 7325 kHz, along with 20 meters (expanded up to 14500 kHz), with status quo on 160, 80, 15, and 10 meters. The Canadian proposal also includes some new amateur bands, 29 meters (10100-10400 kHz), and 16 meters (18100-18500 kHz). The CARF document contains strong references against continued sharing with broadcast services on the 80 and 40 meter bands. 6 and 2 meters, 220 and 450 MHz are included, along with 1296, 2300, 3300, 5650 MHz and the 10, and 24 GHz bands . . . along with 48, 71, 240, 165, and 300 GHz and up . . . all for amateur use in the CARF proposal. The DOC, according to informed Washington sources, is expected to release its findings in late February.

CONFERENCES, CONFERENCES, CONFERENCES

The ITU is built on conferences. Conferences to call conferences . . . and then another conference to call yet another conference. As complicated as it is, we can see similarities in other branches of international relations. How many times, for example, did Henry Kissinger do the negotiation shuttle? How many more sessions of SALT will be necessary before the next arms agreement?

Building up to WARC '79, there will be scores of conferences, at the national, regional, and international level. And one of the most critical areas for amateur radio will be the African and Asian conferences, not unlike one held last June in Gaberone, Botswana. It was the first IARU regional conference ever held in Africa.

To begin with, it was an International Amateur Radio Union meeting, and therefore was pro ham radio. But throughout the news accounts of the session there are signs of concern. As H. Walcott-Benjamin EL2BA, the President of Liberia's Radio Amateur Association, put it: "The amateur service is dependent upon the support of national administrations in order to obtain and maintain adequate frequency allocations. This has placed restraints upon the present day operation and future development of amateur radio . . ." Walcott-Benjamin went on to list the constraints: ". . . lack of suitable frequencies capable of supporting communication during the usual day and yearly propagation variations, congestion and continuing interference due to the large and increasing number of amateur stations, and intolerable sharing arrangements with other services with a steady increase in the number of amateur stations expected to reach one million by 1982. The future of amateur radio now stands at the crossroads . . ."

Mr. Walcott-Benjamin's words were not the only indicator of the rough road ahead; *Radio ZS* reported that there had been political discrimination which had prevented some (African) society members from attending the meeting. The South African journal went on to report that the conference showed evidence that there is little understanding of the problems faced by various African amateur radio societies.

It was those same problems that brought the African IARU delegates to Gaberone last June, in hopes of mapping plans to demonstrate amateur radio's usefulness to all of Africa. As *Radio ZS* put it: "Something had to be done to bring the importance of the decisions that would be made at the WARC to the attention of all member societies in Africa and to their various governments, as those decisions would influence the future of the amateur radio service throughout the world . . ."

Among the resolutions adapted at Gaberone was a draft plan aimed at developing amateur radio in Africa . . . specifically in Botswana, Lesotho, Rhodesia, Swaziland, and Zambia. It calls for IARU sponsorship of club stations in each country, improved availability of ham radio equipment, more visitation to the area by other IARU regional representatives, and, of course, another conference be held in early 1978, to solidify the African position prior to a pre-WARC session scheduled for Budapest.

efforts. According to Sumner, ARRL General Manager Dick Baldwin W1RU served as the fourth member of the amateur service committee (the remaining members were all FCC staffers, including Frank Williams, Prose Walker, and Merle Glunt — now an ARRL consultant). The committee draft automatically became the League position, with the emphasis on hammering out differences in committee instead of in public. As Sumner put it, "We felt it was far better to have a united front on the allocations than resort to public debate."

Three new HF bands at 10, 18, and 24 MHz were proposed in the ARRL (and FCC staff) report, but all of them were left out of the final FCC draft. Sumner says headquarters was disappointed by the Commission decision to leave them out, but isn't giving up. "We badly need them," Sumner told *73*, "for two basic reasons — increased propagation needs and the growth in numbers of hams around the world." ARRL, in its reply to the FCC draft, will apparently argue for the new bands in terms the Third World countries will understand. The earthquake last year in Nicaragua will be high on the list, with the argument that access to 10 MHz, for example, would have insured a reliable circuit after 20m had closed. The emergency was handled using 40m, but nighttime conditions made it rough. Sumner admits that if the new bands are allocated, hams will have to live with more sharing arrangements on HF.

Above 10m, the ARRL position was more or less a matter of keeping the status quo. Sumner pointed to two exceptions: the need for more satellite frequencies at UHF and the new 900 MHz band. In the ARRL view, 900 MHz could be a way of keeping CB off 220 MHz. Sumner says the League is constantly in touch with the CB industry, trying to persuade them that 900 MHz would be suitable for Class E CB. "If we can figure a way to convince them they want 900 MHz," says Sumner, "we could hold onto 220 MHz and realize net gain overall."

The Current Box Score

The reality of the WARC situation is best summed up by FCC official Williams, who says, "It's difficult to forecast ... nothing is really known about the other countries ... there are no hard proposals forthcoming from the others ..." Williams adds he's not totally pessimistic, since the world is not completely unresponsive to the amateur service, but he's not especially optimistic either. On ham ambassadors, Williams agrees there has to be some kind of international public relations and healthy debate here at home. Most of all, amateurs must keep informed, he says, and be responsive to the FCC's plea for comments.

The FCC draft is the first made public in the world. Canada is expected to follow suit in February, but aside from those two, most of the 100 nations headed to WARC two years from now have not even started their preparations. A look at the history of previous WARC conferences shows the current lack of preparation to be about normal. And it can be interpreted to mean the trend of previous conferences will continue ... the trend of fewer HF allocations with an

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"Most of the 100 nations headed to WARC two years from now have not even started their preparations . . ."

increased emphasis on SW broadcast, UHF, and the range above 10 GHz. The prime exception came in 1947, when the delegates set up the 15 meter amateur band, with sharing arrangements granted international broadcasting. It was not called the 15 meter amateur band, because ham radio was not officially recognized by WARC until 1959, when the conference voted to add the amateur service to the allocations tables.

The FCC Draft

Elsewhere in this *73* Special Report, you will find a detailed breakdown of the FCC draft. In spokesman Williams' opinion, the amateur service came off quite well. He points to the new LF band between 160-190 kHz, downward expansion of 160 meters (although 100 kHz would be lost between 1.9 and 2.0 MHz), an improved SW broadcast situation on 80 meters up to 3.9 MHz (the 3.9-4.0 SW sharing arrangement would continue), an expanded 40, 20, and 15 meters, status quo on 10, 6, and 2 meters, some changes on 220 and 450, and extensive alterations (including a new band) above 900 MHz. A theme of the document is increased emphasis on satellite communications, with the lowest downlink frequency coming in at 6.950 MHz (the bottom of the proposal's new 40 meter allocation). Williams attributes the movement towards more satellite frequencies to amateur representation on the committees that drew up the original requests used to formulate the FCC draft, as well as the OSCAR program.

Between the Lines

Two issues remain unresolved by the FCC draft — 220 MHz CB and strong pressure from the aeronautical services for 146-148 MHz. The FCC table leaves, as primary allocations, mobile services in the 220 MHz band. FCC spokesman Williams echoes the sentiments of several commissioners, who've said publicly, "We may never make that decision." The FCC may never make *its* move, but the WARC will probably include the mobile allocation, setting the stage for future domestic debate. The question of aeronautical use of 146-148 MHz will apparently lie with the WARC, although pressure from within the US government was resisted at the FCC level. (One problem with the segment is the use of 144-146 in many other countries for repeater use, with the US actually in the minority in its repeater allocation at the top end of the 2 meter band.)

What's Next?

After the FCC comments period expires, the finishing touches will be put onto the draft, and it will become the official US position for WARC '79. Since it is the first made public, the FCC allocations are likely to become a platform for debate around the world. It may actually end up as a strong weapon in the hands of the Third World, which could be spurred into action by opposition to the US proposals. If nothing else, the FCC allocations table can be expected to stir debate, and the WARC story will begin to take on a more international flavor. But in the final analysis, only time and the complex web of international relations that links blocs of countries together will tell what WARC '79 really holds for amateur radio.

EXCERPTS FROM THE FCC WARC DRAFT

Amateur Service

The Amateur SWG (Service Working Group — advisory committees who proposed individual allocations for each service to the FCC) requested exclusive worldwide allocations between 160 and 190 kHz, 1715 and 2000 kHz, and 3500 and 4000 kHz; we can only partially accommodate these requests because of the requirements of other services operating in this long established portion of the spectrum. We are proposing to add the Amateur Service in the band 160-190 kHz on an exclusive basis. Exclusive allocations are also proposed between 1725 and 1900 kHz in Regions 1 and 3 and between 1750 and 1900 kHz in Region 2; we are additionally proposing an exclusive worldwide allocation in the band 3500-3900 kHz along with a continuation of the present allocations between 3900-4000 kHz.

The Amateur Service Working Group requested expansion of the Amateur allocations at 7, 14 and 21 MHz. Additionally, the SWG requested new allocations at 10, 18, and 24 MHz for the Amateur services. In both cases, wholesale relocation and reduction of existing Fixed services allocations would be required, with other services being affected to a lesser degree. In the presence of requests from other services whose needs we deem to be more pressing, we have not been able to fulfill the total requests of the Amateur SWG. We are, however, proposing some expansion at 7, 14, and 21 MHz, as set forth in the proposed table.

The Amateur Radio SWG requested that present allocations between 27.5 and 1215 MHz be maintained, that provision be made for Amateur Satellite operations in the band 220-223 MHz, and that Amateur operations be permitted in the band 902-928 MHz. At this time, no conflicts appear to the first two allocations requests. As the table shows, we propose to provide a primary allocation for Amateur Satellite at 220-225 MHz. Amateur operations in the band 902-928 MHz for Region 2 are proposed as a secondary service.

The Amateur Radio SWG requested that the present allocation at 1215-1300, 2300-2450, 3300-3500, 5650-5925 and 10000-10500 MHz be maintained. They stated that the relatively wide, but shared, allocations are necessary to permit experiments with wide band emissions and to prevent interference to/from users in adjacent bands. They also requested that a small segment in each of these bands be allocated to the Amateur Satellite Service in order to permit experimentation with space communication techniques. They pointed out that a 2304.1 MHz beacon was built into the OSCAR 7 satellite but could not be utilized for lack of an international allocation.

The Amateur SWG requested that the present allocations at 24-24.05 GHz and 24.05-24.25 GHz be retained and that the domestic allocations specified in Docket 19973 at 48-50, 71-76, 165-170, 240-250 and above 300 GHz be implemented internationally, because of the intensive interchange of ideas which takes place between amateurs in different countries. As our table shows, we are proposing no change to the existing allocations and also proposing additional allocations at 71-76, 165-170, and 240-250 GHz as in the Domestic Table. However, we are reserving the band at 48-50 GHz for Aeronautical and Maritime services.

Broadcast Services

The AM Spectrum SWG requested that the band 535-1605 kHz be continued as allocated to the Broadcasting Service on an exclusive basis, and that neighboring frequencies between 525-535 kHz and 1605-1805 kHz be also allocated in certain regions. As the proposed table reflects, we have added Broadcasting on a primary basis to Regions 2 and 3 at 525-535 kHz; we have continued the exclusive allocation at 535-1605 kHz; and we have added Broadcasting at 1605-1615 kHz on a shared primary basis in Region 2. While 1615-1805 kHz has not been included in the table at this time, additional spectrum space in this band for AM Broadcasting will continue to be considered in view of the potential heavy demand for new stations by commercial, non-commercial, and minority group applicants and in view of the direct public interest benefits of this service. The use of reduced

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Briefs

Compiled by Warren Elly WA1GUD

Any item may be reprinted, as long as proper credit is given.

At press time the news wasn't good for the Bicentennial Relay project. Despite weeks of trying, an appointment still had not been made to see President-Elect Jimmy Carter and deliver 45 messages of congratulations sent via amateur radio (five governors formally refused to participate). Carter was apparently too busy choosing a cabinet to accept the messages, although he did find time to, among other things, reply personally to a group of New Hampshire ski operators who were worried about competition from state-owned ski areas who'd requested federal aid. *The New York Times* reported Carter was getting out of touch, becoming isolated from the people. Meanwhile, Bill Miller K4MM, the prime amateur protagonist trying to get the appointment, had nothing new to report. "We're doing the best we can," he told *73*, but as time slipped by, it was beginning to look like ham radio occupied a lowly place on the new President's priorities list.

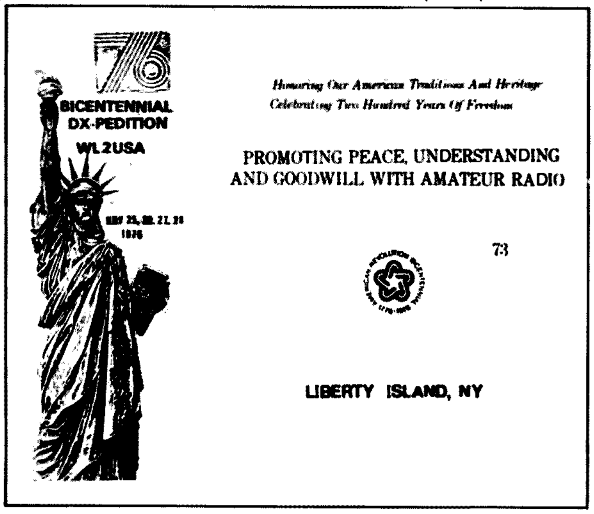
The relay was the idea of Eric Shalkhauser W9CI, a Bradley University professor who participated in the first Presidential Relay held in 1916. (Shalkhauser's series on the history of ham radio will begin in *73* with our next issue.) ARRL officials, QCWA officers, Miller, and Shalkhauser were to participate in the delivery, but unless the new President personally accepted the messages, ARRL officials reportedly would not be in attendance.

Messages from the governors, and the Mayor of the District of Columbia, were ready for delivery within two weeks of election day. The traffic was handled via OSCAR, RTTY, CW, SSTV, and SSB, with several governors offering their congratulations personally via 2m HTs. That attracted a lot of local press attention, but at press time the bottom line on the national level remained political red tape 1, ham radio 0.

The FCC continues its crackdown on illegal CB activity. Raids at Syracuse NY, Houston TX, Lima OH, and Columbus GA are among the latest. FCC Enforcement Chief Richard Smith told *73* the same pattern is coninuing, with amateur equipment and over-powered CB units confiscated, and users facing stiff fines. Indications are the FCC won't have any measure on how effective the program has been until summer 1977, but a survey conducted last year showed out-of-band operations on the increase while identification and license applications for legal CB were up. As the crackdown continues, FCC staffers in Washington are pondering plans to shut down the outlaws. A three point proposal was due to be submitted by year's end with a rule-making notice to follow. Banning the manufacture of all linear amplifiers capable of 11 meters, requiring dealers to see proof of license before selling gear, and type certification of all equipment were the prime recommendations. Amateur gear *would* be affected, although hams would not be stopped from modifying commercial gear or home brewing their own. Existing gear would be exempt, and manufacturers would be given a grace period to redesign their product lines.

The manufacturers (as you can expect) don't think too much of the idea. Robert Levine of Dentron told *73* he'd call about 15 manufacturers together at the SAROC Hamfest in Las Vegas in a bid to block any possible ban. "Illegal use of linears is a threat to ham radio as a hobby and to the livelihood of the manufacturers who want their equipment used legally," said Levine, who emphasized only major manufacturers would be invited to the SAROC session. (See Guest Editorial this issue.)

The ever-changing nature of the CB market has very nearly sunk a line of amateur products. Throughout the fall, persistent rumors in the industry hinted at the fact that Hy-Gain Electronics Corporation of Lincoln NE was in trouble because of a multi-million dollar commitment to 23 channel CB. With the emphasis on the CB market, amateur products were rumored to be in the process of being phased out.



Hy-Gain Amateur Products Manager Kip Kitterer admitted that with the emphasis being placed on CB, amateur products were placed in limbo with little in the way of advertising or development money being made available. However, early in December, a decision was made to remedy the situation. Hy-Gain was split into two completely independent companies. Hy-Gain de Puerto Rico, headquartered in Coral Gables FL, now has complete responsibility for all CB and scanners. Hy-Gain Electronics took over the Lincoln plant and handles the entire amateur product line of antennas, a new hand-held 2 meter rig, and the 3750 transceiver. All marine and commercial land mobile equipment will also be manufactured at the plant.

Saying the company is now in the best position ever, Kitterer expects to broaden the product line. Four new VHF yagi antennas will shortly be available and the company will update and redesign its entire antenna line.

Despite the fact he's being used for false advertising and nondelivery of ordered items, Irael Treger W9IVJ of Trigger Electronics is still sending out catalogs, according to the Illinois Attorney General's Office. AG's spokesman John McPhee says he's pressing for a court injunction to stop the mailings, but is running into trouble finding witnesses. According to McPhee, most witnesses have been willing to sign affidavits, but are unable to appear in court. At press time McPhee was seeking the aid of local Chicago groups to find area people who'd dealt with Trigger. The mailings, meanwhile, have reportedly shifted in emphasis from newly licensed hams . . . to CBers!

WL2USA, the Thanksgiving weekend bicentennial operation at the Statue of Liberty, cleared 1200 contacts, according to organizer WA2NVG. Unfortunately, there weren't enough operators to cover all bands, as had been hoped for, and the station was only able to operate on 20 meters. Despite the problems, it's reported the project was a success . . . and quite educational in terms of dealing with government red tape and Murphy.

Don't look for many changes on the ARRL Board of Directors. After this past year's elections, five Directors were reelected without contest, along with two Vice Directors. In five other Director and Vice Director races, it was incumbents all the way, although some elections were closer than expected. In New England, for example, Vice Director John Lindholm W1DGL won by less than a hundred votes. The only surprises were the election of Don Miller W9NTP as Central Division Director (note this is not the Don Miller of Minerva Reef, etc.), and in the Roanoke Division, incumbent Vice Director Donald Morris W8JM was beaten by Gay Milius W4UG. *West Coast DX Bulletin.*

In what is believed to be first action of its type, a group of Southern California amateurs has voted to expel a member from its ranks. During a special meeting early in December, the Community Amateur Radio Service of North Hollywood voted in secret ballot to expel a Los Angeles member for reasons that he "has not demonstrated the level of maturity required for participation in a program serving a law enforcement agency . . . and has knowingly used the air for his own amusement in such a way as to lessen the pleasure of others."

It was alleged that the expelled member had refused to remain on his assigned post when directed by net control, saying that he would rather go home. A recording was also presented showing that he had interfered with traffic handling during a declared emergency.

Members further said that the ham's primary form of self-gratification was his habit of harassing other operators who were operating legally. They cited cases of his breaking into QSOs to announce that he had nothing to say but had a "right" to interrupt.

Since the Community Amateur Radio Service is affiliated with the Los Angeles Police Department, members said his actions have brought shame or discredit to the group. The ham was expelled from the organization and his actions outside the organization condemned as being "a detriment to the amateur service." Adding salt to the wound, the membership further declared that he cannot be considered for readmission to the organization until he "has demonstrated that he has become a mature and responsible member of the amateur community."

The increasing numbers of people entering the amateur radio ranks has created a great increase in the amount of "questionable" practices, especially on repeaters. It appears that the action of the Community Amateur Radio Service, although the first, will probably not be the last attempt to clean up the airwaves.

The ARRL may be having some second thoughts about lobbying in Washington. According to a report in the *West Coast DX Bulletin*, the loss of tax exempt status by the National Rifle Association and Sierra Club was attributed to lobbying expenditures in excess of Federal limits. At issue is section 501 (c) of the IRS Code, which most interpretations say, allows 5% lobbying expenditures out of an organization's total budget. The ARRL board is reportedly considering

a major lobbying campaign anyway, with some directors saying the dollars lost if tax exempt status was revoked may be less important than fighting legislative and administrative actions affecting amateur radio. The stakes, however, are high . . . because some of the major advantages of AARL's tax exempt status are the major reductions in mailing costs for *QST* and in property taxes on the Newington CT headquarters.

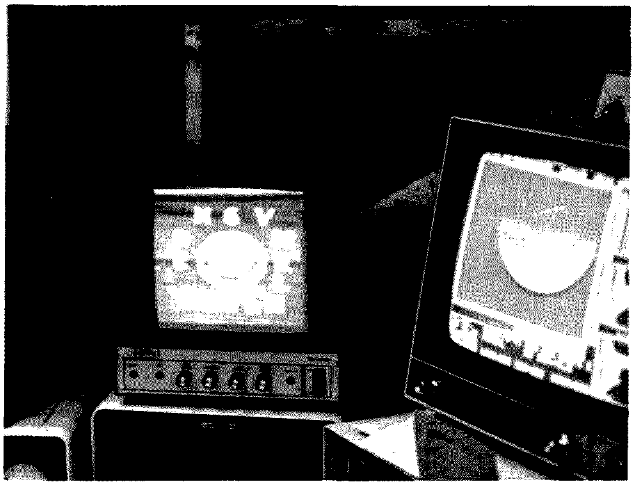
Award-winning humorist, radio talk show host, TV broadcaster, film writer, and amateur extraordinaire Jean Shepherd K2ORS will soon be writing for *73*. Shep's latest accomplishments include a monthly column in *Car and Driver*, the TV play "Phantom of the Open Hearth" (recently broadcast nationally on PBS), and his long-running PBS series "Jean Shepherd's America." Several times the winner of *Playboy* magazine's humor award, Shepherd can be expected to produce some interesting material on ham radio, as anyone who's witnessed his hamfest talks can tell you. Shepherd's latest novel, "The Secret Mission of the Blue Assed Buzzard," about his Army career, is due this month. As *the New York Times* put it in a recent article on Shep, "He is a tribal storyteller, trying to explain us to us."

The bureaucratic red tape which permeates all levels of government has not failed to reach the FCC. In one recent incident, an Illinois amateur was threatened with administrative action against his license after a mix-up within the postal system.

John Maenpaa WB9JOJ of Dundee IL became entangled in the mess a year ago while conducting Novice classes. Five Novice exams were lost in the mail between Gettysburg and Dundee. All students subsequently received their licenses when another set of tests was sent, but that was not the end of problems. The FCC insisted that the tests that were never received be returned. Maenpaa told *73* that the FCC refused to acknowledge his reply and threatened action against his license.

At last report, the situation was still up in the air. Maenpaa said he has spent hundreds of hours teaching Novice classes and is now reconsidering his position, saying he only stands to lose his license if he continues.

Amateur licenses are really up, according to FCC spokesman Dick Everett. Everett told *73* the increase is "dramatic" . . . with a completely reorganized processing center at Gettysburg turning out exams and licenses in 8 to 10 days on the average. Two years ago ham licenses were slipping by nearly 300 a month. Now the total is up over 280 thousand . . . and climbing. Don't forget to use Post Office Box 1020, Gettysburg, when filing exams, renewals, and address changes . . . it's bound to speed things up.



The latest news from the Jet Propulsion Laboratory in Pasadena CA is that the Mariner pictures transmitted by N6V are now available on cassette. And club station W6VIO is still available for schedules to SSTV the Mars pictures, with special interest in providing the material to school groups. N6V's license expired in mid-November, according to club spokesman Jim Lumsden WA6MYJ. Jim tells *73* JPL is now working on next year's launch of M-J-S, Mars-Jupiter-Saturn . . . a fly-by flight. It is possible the vehicle will reach Uranus as well, with SSTV pictures and another special event call in the works. If you want the 60 minute SSTV cassette of the Mariner pictures, including the famous first photos from both the orbiter and Mars lander, send $3.75 to W6VIO, JPL, 4800 Oak Grove Rd, Pasadena CA 91103, attention R. Piety M/S 158-205. Schedules can be arranged by writing Jim Lumsden at the same address, M/S 233-103.

The United Nations inaugurated their new amateur radio station, K2UN, on October 21, 1976, which was completely equipped by Yaesu Electronics Corporation of Paramount CA. Impressive dedication ceremonies included worldwide contacts with amateurs in other countries.

Mr. Mohamed Mili, Secretary General of the International Telecommunication Union, is shown at the operating console with Mr. Max C. de Henseler HB9RS, President of the club's station, looking on. Mr. Harry Dannals W2TUK, President of the American Radio Relay League, Mr. Stan Zak K2SJO, Director of the Hudson Division of the ARRL, and U.N. dignitaries were on hand for the dedication.

The purpose of the station is to foster good will among the people of all nations in the world through friendly radio contacts in a hobby they share. The Yaesu Electronics Corporation provided three complete stations for U.N. use. Yaesu equipment is also in use at the headquarters of the International Telecommunication Union station, 4U1TU, in Geneva, Switzerland.

Antenna Specialists is offering a free antenna range calculator. A =10 SASE to 12435 Euclid Ave., Cleveland OH 44106, is all it takes.

The Long Island Mobile Amateur Radio Club (LIMARC) has taken to the broadcast airwaves with ham PR. WA2HYS, WA2DHF, and WN2DRO are producing a weekly show on WBAU-FM. The idea is to portray ham radio in unique ways, and it's apparently working. The station has signed the LIMARC effort for another 13 weeks, and several groups are considering use of the material on a national basis. If you're in the NYC area, tune in on Friday nights at 7:45 on WBAU-FM, 90.3 MHz.

A $75,000 prototype HF transceiver was stolen in the Ottawa, Canada area last summer, and the authorities apparently still have no leads. The rig was in Canada for a demonstration by the US Army. Although it is not classified, it does represent an extremely high level of miniaturization technology, according to a report in the *Ottawa Citizen*. Lifted from a National Defense station wagon parked outside a local motel, the transceiver is capable of operating on both the amateur and CB bands. *The Canadian Amateur*, Kingston, Ontario.

An amateur from Jacksonville FL has received the first single band Worked All States award for RTTY. The award, issued to "Big Al" Mitchell WA4HLP, was only the 18th WAS ever earned for the mode.

Mitchell used 20 meters and ran less than 100 Watts. At the time of the award, he had been a General for only four months, beginning his ham career at the age of sixty.

Faster and more accurate location of downed airplanes and illegal transmitters is the aim of a California group headed by Hartley Postlethwaite IV WB6COW. The Happy Flyers (Hams And Pilots Piloting And Yakking) was originally formed to provide a group of qualified volunteers to be available during national emergencies and for public service. Since its formation, the group has branched out into ten "squadrons," primarily situated in the west.

Postlethwaite proposes to integrate the national repeater system into a network for locating downed aircraft. As a plus, the same system would make for easier detection of illegal transmitters and jammers. The Federal Aviation Agency requires all aircraft, from the smallest homebuilt to the 747, to carry an Emergency Locator Transmitter (ELT), which is automatically activated when a certain G-force is exceeded, as when a plane crashes. The ELTs transmit on 121.5 MHz, the international aircraft distress frequency. When the transmissions are picked up by any of the FAA centers located across the country, automatic alarms are set off. Unfortunately, many planes go down in remote or mountainous areas where the low power transmissions from the ELTs are almost useless. It may be many hours or days before the ELT transmissions are detected, often by a passing airliner that is flying too high to pinpoint any location.

Postlethwaite is proposing that all amateur repeaters be equipped with a 121.5 MHz monitor which would activate an alarm on the repeater if it received an ELT transmission for more than six minutes. (The six

Continued on page 118

New Products

TEN-TEC TRITON IV HF TRANSCEIVER

Ever since 2 meters, I've been looking for an HF rig I could take with me just like my HT and use mobile (where my 71 MGB-GT makes space a vanishing commodity). Those of you driving big cars may have bigger gas bills, but you've got me beat to heck on going mobile.

So, let's look at my situation, and consider what's available for HF portable/mobile. The list of self-contained mobile rigs isn't very long, not if I'm going to get into 20 SSB during the day, and 75 SSB at night. For one thing, I've got to have some power, and the ability to quickly change bands, preferably while in motion.

Enter the Triton IV. It weighs less than 12 pounds, measures just over a foot wide and four inches high by ten inches deep. The Triton IV is a no tune solid state, 200 Watt input, CW-SSB transceiver built at Sevierville, Tennessee.

It is the latest in a line of innovative transceivers made by Ten-Tec. Argonauts made Ten-Tec famous, and helped popularize QRP rag chewing, DXing, and just plain QRP hamming. Ten-Tec radios have attracted an intensely loyal following, and Argonauts have taken many a convert from the kW crowd.

The guy who got me interested in the Triton IV was Alan WA1MSK. He'd been regularly checking into 75 meter QSOs mobile with S9 signals, and there were often fixed stations having a much harder time. After hearing several of Alan's mountaintopping expeditions with Paul WA1VEI, the jealousy bug mingled with the mobile bug, and it was all over; I had to taste a Triton IV.

The Triton IV immediately gives away its lineage, because the Ten-Tec designers borrowed a lot of ideas from the Argonaut. One idea they left behind, though, was QRP: The Triton IV drove my SB-200 amplifier to full input with ease, and (using only the Ten-Tec and dipoles) DX, local QSOs, and nighttime schedules were handled nicely.

Mobiling proved to be most interesting . . . my last mobile rig was an HW-32 . . . and mobiling with the Triton IV brought back fond memories. The MGB's legendary ignition noise (second only to the infamous 280Z of W2NSD) was fooled by the Triton IV. Either I've discovered a new way of suppressing ignition noise, or Ten-Tec knows how to fool it (but I haven't cured the 2m rig, so it must be the Triton IV). An accessory noise blanker is also available.

The approaching Christmas holidays and Old Man Winter prevented a jaunt up Mount Monadnock or some other nearby peak, so my 12 V battery-powered DXpedition was scratched from the test. Instead I took the rig on holiday, threw up a wire, and proceeded to have a blast operating battery portable. All I packed was the Triton IV, mike, key, and dipole antenna . . . and it all fit into a briefcase with room to spare! (Murphy helped me forget a 12 V battery, so I had to buy one at a local hardware store.)

The best thing about the Triton IV is honestly hard to pick. I know you're probably saying that's a put-on . . . but it is not. The Triton IV is about the most flexible transceiver I've ever seen. I really like its *true* break-in CW . . . just like VOX, but more. You can hear in between words – even characters. CQ QSOs are suddenly spontaneous, less stereotyped. The system really gives you an advantage in DXing, because you can slip your call in fast. (The transmit-receive switching is instant, and your QSO rate in contests is bound to improve.)

Tuning the Triton IV is easy . . . switch bands and turn the carrier on. Peak the drive with the ALC LED, tweak the receiver to resonance, and away you go. (That's unless Murphy got your antenna!)

All no-tune rf amplifiers require a proper load, so unless your antenna is properly matched, no final (transistor *or* tube) is going to work efficiently. The Triton IV's transmitter is rugged; using Ten-Tec's ac power supply, it shut down automatically when faced with a bad match, but ran without strain into a good one. A front panel swr indicator on transmit doubles as an honest S-meter on receive.

Ten-Tec has made a lot of these Tritons and Argonauts. The hams there are dedicated and proud. Their owner's manual says a lot more about company philosophy than any other manuals I've read lately. "There are sufficient Tritons now in the field to indicate to us that there are several rather serious information gaps in . . . the case of new technology such as solid state no-tune rf amplifiers. The main concern appears to be a matter of fundamental technical knowledge regarding swr, efficiency, and protective circuitry such as LAC and power supply overload protection." Ten-Tec goes on to list 10 points to keep in mind when using the Triton IV; most concern antennas and swr and the thrust is one of ham radio's cardinal rules: the better the antenna, the better the signal.

That company philosophy I mentioned earlier comes through in Ten-Tec's warranty statement as well. "The warranty is *not* voided for attempted repairs to defective units, the installation of additional switches, etc., when there is no change in the basic circuits." The final transistors are warrantied for 5 years, pro rata. A set of lab measurements came with our Triton IV test unit. On typical ham shack test equipment (power meter and monitor scope), the power output specs matched within 5 Watts, carrier suppression appeared better than reported, and, as the receiver specs indicated, no unwanted signals could be heard. The Triton IV was fun to use . . . a pulsed crystal calibrator which attenuates incoming signals (nice), front panel ALC control, *full* break-in CW, sidetone monitor, two CW bandwidths with an optional filter, an 8 pole crystal filter, offset tuning, selectable sideband, excellent stability, 200 W input, and enough accessory connections on the back panel to run an amplifier and remote receiver (including muting). There's power for VHF-UHF converters (OSCAR anyone?), digital frequency readout (pre-wired for Ten-Tec's own unit), and a half dozen other Ten-Tec accessories, including a 160m converter and remote VFO.

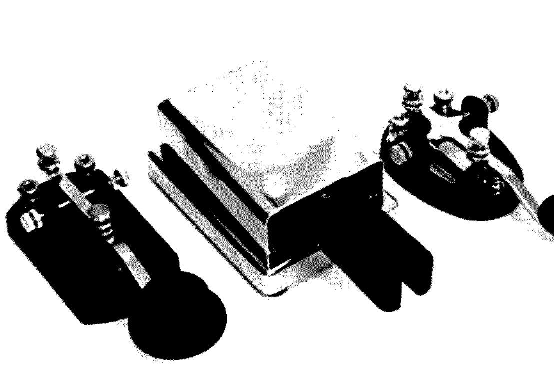
In short, the Triton IV does what Ten-Tec says it will. It's an attractive, reliable, flexible, all-transistor HF transceiver . . . and it's got a lot of class. Ten-Tec Triton IV, price class $699.00, ac power supply $99. *Ten-Tec Inc., Sevierville TN.*

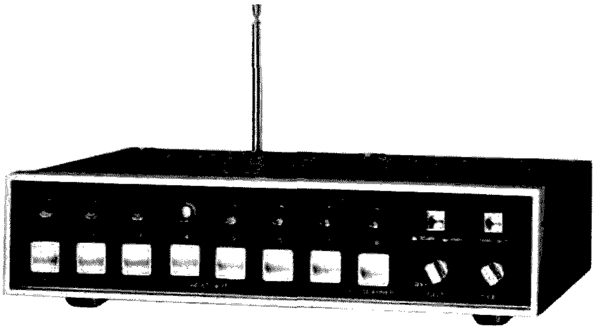
Warren Elly WA1GUD
Associate Editor

NYE-VIKING KEYS

CW is not dead. In fact, with the ever-increasing number of Novices entering the amateur ranks, and the recent extension of Novice privileges to Technicians, CW is enjoying an increase in popularity not seen since the day of the spark transmitter. The choice of keys is as wide as the quality of fists. They range from $1.49 mass merchandise varieties to high priced gold presentation models. For both the newcomer and the experienced brass pounder, picking the right key can be a frustrating job.

Much has been written about the pros and cons of straight keys, bugs, squeeze keys, electronic keyers, etc. Most hams, however, would probably agree that the old favorite is the standard straight key. One of the largest selections of straight keys available comes from the William M. Nye Company of Bellevue, Washington. In a time well known for products that are low in quality and high in price, the Nye-Viking line of CW keys and accessories stand out as an exception. They have eight separate straight keys ranging in price from $6.65 for the standard black and chrome to $13.50 for the top of the line heavy duty with a shorting switch. Their keys are





mounted on die cast bases and are available with brass, chrome, or nickel-plated hardware.

Both the beginner and old-timer will find the Viking keys a joy to use. Adjustment is easy and they have the solid feel that's necessary for serious CW operating. In fact, after a three hour session at the transceiver working the Novice bands, there was no evidence of the dreaded "glass arm."

Although the straight keys are the standard of the Nye-Viking line, they also make what are called the "Super Squeeze Keys." While they can easily be utilized as a sideswiper, the Viking squeeze keys are designed for use with an automatic keyer. For the sake of nostalgia, Nye also offers a telegraph sounder for $28.00. Also in the Nye line are two matchboxes, retailing for $212 and $355.

Nye also told me that a new random wire tuner will be available about the time this article goes to press. It will handle full legal power from 2-50 MHz and will retail for below $300. Completing the Nye line is a heavy-duty low pass filter which sells for $19.95, and two phone patches, with or without built-in speakers. They retail for $44.50 and $36.50.

Some readers will recognize the Viking keys and matchboxes. The line was originally manufactured by the E. F. Johnson Company. In 1973, they decided to phase out their amateur products line and the William M. Nye Company purchased the design and manufacturing rights. Since that time, they've improved and expanded the line, adding the squeeze key to the original products.

The Nye Company is a small organization with a high quality, carefully built product line which should give the owners a lifetime of dependable service. In these days of mass production, that's a pleasure to see. *Wm. M. Nye Company, Incorporated, 1614-130 NE, Bellevue WA 98005.*

Stan Miastkowski WA1UMV
Associate Editor

MODEL TTLP LOGIC PROBE

Sylvanhills Laboratory's TTLP logic probe was designed to be used in testing logic levels that are either static or asynchronous. Since most counters, flip-flops, etc., change states on the trailing edge of the input waveform, the unit was simply designed to capture the negative-going pulse. And it uses a seven-segment LED display to tell you if the voltage is a logical one or a logical zero. If the voltage is 0 to .8, the display reads "0"; if the voltage is 2.2 to 5, the display reads "1". Simple as that!

The connections are even easier . . . connect the black lead to the ground of the system under test, connect the green lead to a 5 volt supply point, and you're all set. If you have power, a decimal point is displayed. Touching the probe to the terminal under test then gives you a logical 1 or 0. (Voltages between .8 and 2.2 give a blank display.) All in all, it's a simple and easy to use logic probe for the hobbyist or TTL designer. Options include an overvoltage protection circuit (should the probe be touched to a voltage as high as +24 V for several seconds), and a model TTLP-2 (with memory). The basic TTLP-1 is $19.95; the TTLP-2 is $24.95, and the "overvoltage protection" is $.75. By the way, this is a fully assembled probe, not a kit. For further information contact *Sylvanhills Laboratory, Inc., #1 Sylvanway, Box 239, Strafford MO 65757, 417-736-2664.*

Bob Leach
Systems Manager

NEW SCANNERS FROM HEATH

Heath Company has introduced two new 8 channel VHF Scanning Monitors. The GR-1131 Hi Band Scanner and the MR-1134 Marine Band Scanner are designed to provide hours of exciting and informative listening.

The GR-1131 Hi Band Scanner monitors any combination of 8 channels in the "emergency services" band (146-174 MHz), automatically tunes in on police, fire, ambulance, U.S. Government weather broadcasts, and more. The GR-1131 scans each channel, stopping on any signal, and resumes scanning after the transmission. A priority channel feature checks the channel you're most interested in every 4 seconds and automatically switches to it if there is activity on the channel. Other features include channel lockout buttons, lighted channel indicators, automatic or manual channel selection, and a 4 pole crystal filter for good selectivity. For crowded signal areas, an optional 8 pole filter is available. It also features a built-in telescoping antenna and provision for an external antenna. Operates on either ac or 12 V dc. The GR-1131 is perfect for volunteer firemen, civil defense personnel, or just for listening.

The MR-1134 Marine Band Scanner is a valuable accessory for boat owners or anyone who lives near a harbor or lake. It monitors any 8 frequencies in the 156-163 MHz marine band, and picks up weather reports, marine emergency channels, harbor instructions, ship to shore and ship to ship communications, and more. The MR-1134 has the same deluxe features as the GR-1131, and includes a rugged splash resistant case ideal for marine use.

The two scanners are mail order priced at $89.95 and $99.95 respectively. *Heath Company, Benton Harbor MI 49022.*

NEW TWO-PALLET ALUMINUM TOOL CASE

Jensen Tools and Alloys has introduced a new tool case for the field engineer or technician who frequently travels by air. Constructed of jet smooth, seam free molded aluminum, the case weighs only eight pounds yet is strong enough to stand on. It is designed to resist abuse and take the hardest knocks of airline baggage handling equipment.

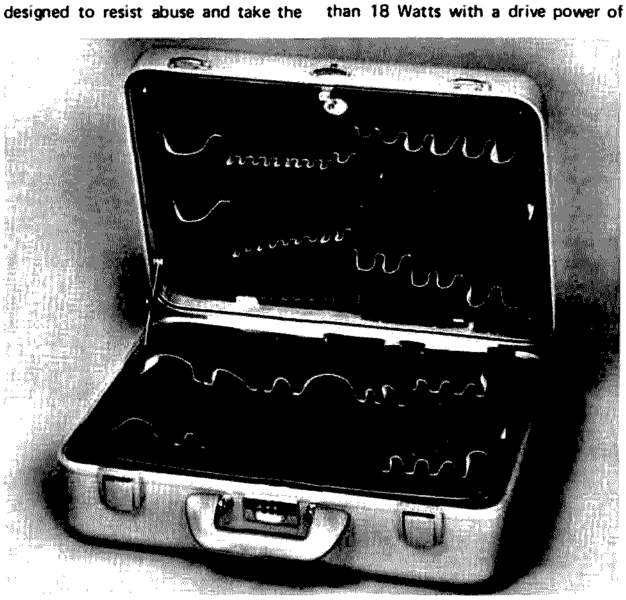
Among its features are a full length piano hinge across the back, a tongue and groove closure with a live rubber gasket to seal out moisture, dust and dirt, a document pouch inside the cover, and a keyless combination lock.

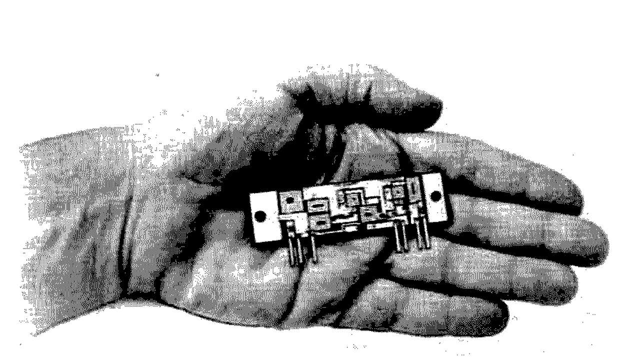
The bale-type latches are chrome plated and the matching handle is made of tough Tenite. The two removable pallets hold a full complement of tools and the pockets are both riveted and stitched for strength. Inside dimensions of the case are 17" x 12½" x 5".

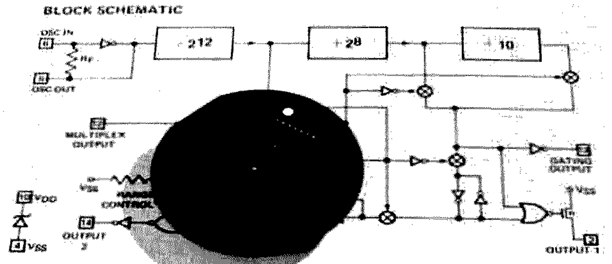
The case sells for $145.00 with quantity prices substantially lower. To order, or for a free catalog describing other tool cases and tool kits, write: *Jensen Tools and Alloys, 4117 N. 44th Street, Phoenix AZ 85018 or call (602) 959-2210.*

AMPEREX VHF & HF AMPLIFIER MODULES

Amperex Electronic Corporation has a new line of VHF and HF amplifier modules containing internal matching networks for broadband applications. Two units, designated BGY32 and BGY36, operate at 68 to 88 MHz and 148 to 174 MHz respectively. Each module will deliver better than 18 Watts with a drive power of







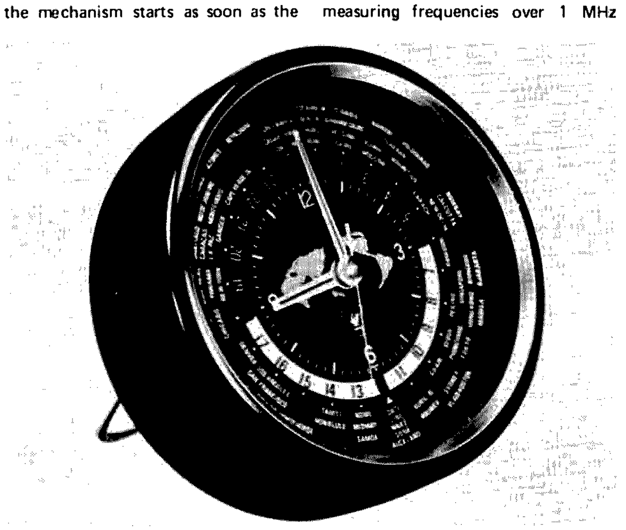
less than 150 mW at a supply voltage of 12.5 volts. The input impedance and output impedance are matched to 50 Ohms with no instability into a VSWR of up to 3:1 over all phase angles.

Both the BGY32 and BGY36 will not be damaged with VSWRs of 50:1 through all phase angles at heat sink temperatures of up to 70° C.

The price for both modules is $52.50 in quantities of 1-9, and $44.50 in quantities of 10-99. Delivery of sample quantities from stock with production units available in 90 days. *Amperex Electronic Corporation, Hicksville NY 11802. (516) 931-6200.*

YAESU 24 HOUR CLOCK

A new precision clock which tells time anywhere in the world at a glance has been announced by Yaesu Electronics Corporation. The time in any principal city or time zone can be simultaneously coordinated with local time on a 24 hour basis. After the initial setting, as the clock runs, a Time Zone Hour Disc advances automatically, showing correct time all over the world without further adjustment. The clock is especially designed to withstand shock, and may be hung on a wall or placed on its desk mount. The clock will run an entire year on a single 1.5 volt flashlight battery and the mechanism starts as soon as the battery is inserted. It measures six inches in diameter by two and one half inches deep. An excellent item for the business office, ham radio operator, short wave listener, boat owners and others who want an accurate, dependable clock. Priced at $30.00, it is available at all authorized Yaesu dealers in the United States. *Yaesu Electronics Corporation, PO Box 498, 15954 Downey Avenue, Paramount CA 90723.*



INTERSIL FREQUENCY COUNTER TIMEBASE

Intersil has broadened its line of timing microcircuits through the addition of the ICM7207A, a new frequency counter timebase. Used together with a 5.24288 MHz crystal and a 7 digit unit counter such as Intersil's ICM7208, the new circuit becomes a complete timer-frequency counter.

The new circuit is pin for pin compatible with Intersil's ICM7207; however, it has 0.1 and 1 second count enable window output.

When used with the ICM7208, the circuit's four outputs provide the gating signals for the count window, store function, reset function, and multiplex frequency reference. The 1 second count enable makes it possible to obtain 7 significant digits when measuring frequencies over 1 MHz with the least significant digit reading in Hz.

The ICM7207A will take crystals from 1 to 10 MHz, providing outputs at crystal frequency, and at $\div 2^{12}$, $\div 2^{20}$, or $\div(2^{20} \times 10)$ divider stages.

The new circuit has a stable HF oscillator, and it dissipates less than 5 mW at 5 volts. According to Intersil, the new circuit will be quite useful for applications requiring a system timebase, oscilloscope calibration generator, marker generator strobe, or frequency counter controller. The circuit is packaged in a 14 pin DIP. Dice are also available. Pricing is as follows: ICM7207AIPD 1-24 $6.60, 25-99 $5.35, 100-999 $4.40. Dice pricing is as follows: ICM7207A/D 25-99 $4.20, 100-999 $3.50. *Intersil, 10900 North Tantau Ave., Cupertino CA 95014.*

LARSEN KULROD™ MOBILE ANTENNA

Not unlike the proverbial search for an honest man, my search for the best mobile antenna has been fraught with peril. I've been led through radio stores, electronics catalogs, and dark alleys. I've tried gutter mounts that gut the finish, trunk lip mounts that creep off, and "super" magnetic mounts that fall off in a five mile per hour breeze. Couple those frustrations with a complete inability to obtain a swr below 2:1 and you have the stuff of which nightmares are made.

Finally, I can stay home nights . . . I can sleep peacefully and dream of rare DX. All because I've found it – the most nearly perfect mobile antenna that I can expect in this life. It's called the Larsen Kulrod™, made by Larsen Electronics, Incorporated of Vancouver WA. As far as I can see, Larsen manufactures and sells the most complete line of mobile VHF/UHF antennas available. It takes a few minutes to figure out the massive Larsen catalog, with its proliferation of mounts and whips, but no matter what type of mount you need or want, chances are they have it.

If you're at all like me, you've probably never been completely happy with your mobile mount. But happiness can be found here. A quick look at the chart of available mounts includes a strong gutter clamp model, a trunk lip mount, a trunk gutter mount, and two permanent hole mounts – the standard 3/4 inch hole and an absolutely beautiful 3/8" hole mount that can be installed with standard tools without the need for getting inside the car body. It's called a blind mount and will solve numerous installation problems.

The shining star of the Larsen mounts is innocently called the magnetic mount. So what, you say? You've seen plenty of magnetic mounts, most of them quite useless at speeds above 35 miles per hour since they exhibit a propensity for falling off. This mount is different. It's guaranteed to stay put at up to 100 miles per hour. (Professional race drivers, take note.) The magnet itself will lift 18 pounds, which is more than enough pull to keep it clinging tenaciously to the car. This feat is done by two methods, one using ultra-strong magnets that were recently developed, and the second by the very simple idea of increasing the mount's surface area. It works, and well. With the concern we all have for having our rigs end up in the hands of some rip-offer, the magnetic mount seems the logical choice for ultra-quick removal and hiding.

If the standard line of mounts isn't enough, adapter mounts are available for just about any existing antenna. All you have to do is screw the Larsen on and you're ready to transmit.

The whips themselves are available for any frequency from 27 to 500 MHz. They're made of the highest grade stainless steel and are coated four times to make sure no corrosion gets in the way of signal output. I made the mistake of trying to cut the whip with a pair of heavy pliers, something that can be done with most antennas. No way. The pliers wouldn't even make a dent in the surface. A vise and sharp hacksaw were needed. Following instructions, I cut the whip for 146.52, and was given a 1:1.1 on the swr meter. The 5/8 wave really punches out, even mounted on an angle on the small trunk of my car.

The situation was the same with the base loaded 6 meter whip. Pick your frequency, cut the whip, and see the swr needle move hardly at all. Best of all, my antenna-laden vehicle can be returned to an innocent antenna-free

Continued on page 140

Tracking the Hamburglar

RIPPED OFF: Icom IC-22 2m transceiver, s/n 1311934. Stolen from vehicle in Regina, Saskatchewan on September 24, 1976. Contact Ed Berryere VE5GE, 1410 East Heights, Saskatoon SASK Canada S7J38S.

TAKEN: Icom 22-S transceiver, s/n 0182. Stolen from my car. Contact Glenn Packard, 28 Bryan Street, Havertown PA 19083.

STOLEN: Icom 230, s/n 240686. Heathkit HA202 40 Watt amplifier – 2 meter, series #03608. Larsen JM 160 magnetic antenna. Taken from my parked car at my house, October 16, 1976. If found contact the Eaton County Sheriff's Department, or Robert Handy, 484-6300, or the Michigan State Police.

RUSTLED: Motorola Metrum II, #C064 with 94, 76, 88, 82, 67, 75, 85, 34, 70, 52, 91, 79. 1B PL. Motorola HT220 H23FFN #TP1174C with separate 12 freq t&r sw, 1BPL, TT on back, "custom WB9BVT" on rear. Robert Scott WB9BVT, 200 W. Chicago Ave., Oak Park IL 60302.

LOOTED: ICOM IC-22A #3405272 with "Kenneth Tendick" on rear, 94, 82, 88, 52, 79, 76, 67, 61. Kenneth Tendick WA9FQT, 1675 Von Braun Trl., Elk Grove Village IL 60172.

LIFTED: ICOM-22A #1827, wired for DV21, Motorola mike. Oscar Klein K9LTC, 18 W. 080 W. 14th St., Villa Park IL 60181.

ROBBED: TR22C #810284, sure mike, BNC ant jack. John Duval K9FIA, 4824 Francisco, Downers Grove IL 60515.

TAKEN: ICOM IC22A #4611. Edward Holz WB9FVG, 7927 S. Komensky, Chicago IL 60652.

KIDNAPPED: FT101B, s/n 316498 stolen in Dallas, Texas on November 25, 1976. Howard Vorpahl, 222 S. Marsalis, Apt. 210, Dallas, Texas, (214) 747-0991.

LIFTED: HR 2B Regency, s/n 49-01623, was stolen on November 26 between 5 & 6:30 pm from my auto parked in my driveway. Also taken was a Heathkit Micoder. My name and call were etched on the side of the inner chassis, and my call was etched near the power plug. A fuse holder had been added to the rear panel (Buss GMW sub-miniature). The light for the dial had been modified so that a short had to be made in the power plug to make it light. Thomas DiMilla Jr. W1VGZ, 8 High St., Saugus MA 01906, phone: 445-0050 8 am to 4 pm; 233-7541 all other times.

LOOTED: IC 22A transceiver, s/n 4611, taken from my Pinto at 4300 W. Roosevelt Road in Chicago on November 23, 1976. Cicero police report number 35310. It has all the standard factory crystals plus 147.45 in/147.75 out repeater set. Also in the set are crystals for MARS. They are 148.01 simplex and 148.01 in/143.99 out. Edward C. Holz WB9FVG, 7927 S. Komensky, Chicago IL 60652.

RUSTLED: 2m-FM transceiver, Regency HR-212 s/n 24-01253 taken from my car on November 23, 1976 in Coral Gables, Florida. Claude G. Edge W4PLZ, 1178 Firthview Drive, Melbourne FL 32935.

HIJACKED: Trio TR 2200 2 meter FM transceiver, s/n 621270, was taken on November 23, 1976 along with my 1976 Chevrolet Corvette. The transceiver was not in its case and had the on/off volume control removed and wired to the console of the car. If anyone finds both the car and radio, keep the radio and give me the car! Richard C. Bean WA1KDL, 103 Forbes Road, Westwood MA 02090.

Social Events

MANSFIELD OH
FEB 6

The Mansfield Ohio Mid Winter Hamfest Auction will be held February 6, 1977 at the Richland County Fairgrounds, Mansfield, Ohio. Prizes, flea market, auction – large heated building. Doors open 8 am. Talk-in 146.34/.94 and .52/.52. Tickets $1.50 in advance, $2.00 at the door. Contact Harry Frierhen K8JPF, 120 Homewood, Mansfield, Ohio 44906 or phone (419) 529-2801 or (419) 524-1441.

TRAVERSE CITY MI
FEB 12

The Cherryland Amateur Radio Club will hold its 4th annual Swap 'n Shop Saturday, February 12, from 9 am to 4 pm at the Northwestern Michigan College in Traverse City. A donation of $1 will include a chance on all prizes. There will be plenty of free display tables for whatever you may wish to bring in electronic equipment and parts. Everyone is welcome and a turnout of over 300 hams and experimenters is expected from all over Michigan. For more information please contact Bill Mader WA8WWM, at (616) 326-6392 or Box 2, Empire AFS, Michigan 49630.

WHEATON IL
FEB 13

The Wheaton Community Radio Amateurs will hold their 15th Annual Midwinter Swap & Shop on Sunday, February 13, 1977, from 8 am to 5 pm, at the DuPage County Fairgrounds on Manchester Road (near County Farm Road) on the west side of Wheaton, Illinois. Some tables will be provided, but bring your own if possible. WCRA invites anyone with an interest in buying or selling new or used electronic equipment to attend this hamfest, which will be inside large, heated buildings at the fairgrounds. Advance tickets (available until February 1) are $1.50, and tickets at the door are $2.00. Write Oran Hiscox WB9JJL, Ticket Chairman, Wheaton Community Radio Amateurs, P.O. Box QSL, Wheaton IL 60187. Commercial exhibitors should write Paul Sexauer W9JTO, at the same address.

GRIFFITH IN
FEB 19

The Lake County Amateur Radio Club's 24th annual banquet is Saturday, February 19 at 6 pm, at the Griffith Knights of Columbus Hall, 1400 South Broad Street, Griffith, Indiana. All the delicious home-cooked food you can eat, wine fountain, entertainment, guest speakers, special awards, door prizes, cash raffles and a dance band after. Tickets are $7.50 each: no door purchase. Write (prior to Feb. 3) to Herbert S. Brier W9AD (W9EGQ), 409 S. 14th Street, Chesterton IN 46304.

VIENNA VA
FEB 20

The Vienna Wireless Society annual Winterfest will be held at the Vienna Community Center. Indoor tables, sales, technical sessions, prizes and food. 8 am to 5 pm. Drawing at 3:30 pm. Admission is $3.00; tables $5.00. Information write Box 418, Vienna VA 22180.

NORWOOD MA
FEB 25

The Norwood Amateur Radio Club will be holding its annual auction on Friday evening at 7:30 pm on February 25, 1977 at the Norwood (Mass.) V.F.W. Post on Dean Street, Norwood. This is just off U.S. Route 1 south.

DAVENPORT IA
FEB 27

The annual Davenport Radio Amateur Club Hamfest will be held Sunday, February 27, 1977 at the Masonic Temple in Davenport, Iowa. Admission is $1.50 advance – $2.00 at the door. Talk-in on 28/88 and 52. Refreshments and tables are available. For info and tickets send SASE to Dick Lane WAØGXC, 116 Park Avenue, So. Eldridge IA 52748.

LIVONIA MI
FEB 27

The Livonia Amateur Radio Club would like to announce that the 7th Annual L.A.R.C. Swap 'n Shop will be held on Sunday, February 27, 1977, from 8 am to 4 pm, at the Stevenson High School in Livonia, Michigan. There will be plenty of tables, door prizes, refreshments, and free parking available. Talk-in on 146.04/.64 and 146.52. For further information, write Neil Coffin WA8GWL, c/o Livonia Amateur Radio Club, PO Box 2111, Livonia MI 48150.

LAPORTE IN
FEB 27

The LaPorte, Indiana ARC will hold its Winter Hamfest on the 27th of February, 1977, beginning at 8 am (Chicago time) at the LaPorte Civic Auditorium. Good food, plenty of free tables, 50 miles east of Chicago. Talk-in on 01-61 and 94, donation $2 at the gate. Information from LPARC, PO Box 30, LaPorte IN 46350.

MARSHALL MI
MAR 5

Michigan Crossroads Amateur and Computer Hobbyists Fleamarket, Junction I-94 & I-69, at the Marshall High School, Junction I-94 & I-69, Saturday, March 5 from 8 am to 4 pm. Forums and YL tours! Sponsors: WB8QQU (MHS "AMPS") and W8DF (SMARS, Inc.). For more information K8UCY – 616-781-3554.

STERLING IL
MAR 6

The Sterling-Rock Falls Amateur Radio Society will hold its hamfest on Sunday, March 6, 1977 at the Sterling High School Field House, Sterling IL. Contact Don Van Sant WA9PBS, 1104 5th Street, Rock Falls IL 61071 for tickets. Advance donations $1.50, door donations $2.00.

PHOENIX AZ
MAR 6

The Winter Hamfest will be held March 6 at South Mountain Park at the south end of Central Avenue, Phoenix. Featuring swap meet, eyeball and pot luck. Sponsored by the Amateur Radio Council of Arizona.

BRIDGMAN MI
MAR 6

Blossomland Amateur Radio Association will hold the 11th Annual Spring Swap-Shop, Sunday, March 6th at Bridgman Middle School gym, Lake St. at Tower, Bridgman, Michigan. Exit 16 on I-94. Expanded facilities, refreshments, prizes, and fun. Talk-in on 22/82 and 94. Table space restricted to radio and electronic items only. Advance ticket donation $1.50. Tables $2 Write: John Sullivan, PO Box 345, St. Joseph MI 49085. Make checks payable to Blossomland A.R.A.

WHITEWATER WI
MAR 20

The Tri County ARC (Whitewater, Wisconsin) Hamfest will be held March 20, 1977 in the Whitewater Armory. Donation: $1.50 in advance, $2 at the door. Reserved tables $2 in advance. Write Doc Walters WB9EMR, 81 N. Main Street, Fort Atkinson WI 53538.

MAUMEE OH
MAR 20

The Toledo Mobile Radio Association, Inc. is sponsoring its 22nd

Continued on page 48

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

"I have spent 15 years of my life getting what I consider a good operating repeater working and reliable and I can't stand to listen to it." These were the words of Burt Weiner K6OQK, licensee of the Los Angeles-Mount Wilson WR6ABE repeater (probably the world's busiest and most heavily populated open two meter repeater system), to one of his head control stations, Bob Thornburg WB6JPI. Burt continued, "Unless you want to take over the mess, I will turn it off forever."

The foregoing information was contained in an open letter mailed to almost a thousand users of the WR6ABE repeater explaining the reason that its new operations director, Bob Thornburg, would be removing WR6ABE from the air for a two month "cooling off" period and outlining what operation on the system would encompass when it returned to full time operation on the morning of January 1, 1977. Bob's letter continued to detail the reasons behind his decision. "Over the last several months (years), various techniques have been tried to correct the operating practices of certain individuals. None have been universally successful. At the present time, about 12 people dominate the repeater, almost all from base stations, and all operate without significant regard for other users. Not that their operation is grossly illegal in the FCC sense; they ID and will occasionally even let breaking stations through, but their conduct, language, and subject matter are, in general, deplorable and obnoxious, or at least selfish. The overall complaint could best be described by stating that these individuals use the repeater for their own platform. It is their only outlet for their mental frustrations (which appear to be extensive). They are parasites in that they use the repeater (and some users), rather than utilize the repeater to talk with its users."

From this, you might have a rough indication of the level to which things on ABE had deteriorated. While it's true you cannot be the biggest without expecting to suffer some trouble now and again, ABE was in the past few years getting more than its share. If one was at all observant over this time period, the continuing decay was easy to note. Trying to break, even to contact another station and QSY elsewhere, had become at times an impossible chore. Many of its regular users, a good number who had been a part of its operation from its days as WA6TDD, had gone elsewhere as the problem children began to grab hold of the system. This apathy on the part of a lot of amateurs, their unwillingness to stand and fight along with the licensee, was in my mind one important contributing factor to the overall decay. The unwillingness of the well-mannered operators to take on at least a part of the solution to this growing menace was still another.

By October of this year, typical day-to-day operation of WR6ABE had become a game of which high-powered duplex base station could capture whom, which one could best cover up the incessant and ever-present jamming and, in the end, which station could best monopolize the repeater's air time while saying the least. While technologically the finest open system to be found anywhere, operationally it had reached its lowest ebb.

Why, you may ask, did the licensee do nothing about the situation? You have to know Burt as I do to understand. He is one of those one in a million super nice guys whose path you are fortunate enough to cross during your lifetime. He sincerely cares about the feelings of others and wanted to have his repeater represent his personal attitudes. He wanted it to be an easy-going place where people could chat with one another, get to know one another, make friends, and above all, have fun with amateur radio. For many years, that's the way it was. I remember it being that way when I first moved here almost five years ago. No matter how busy, it was always a place where user respected user, and where pride ran high.

Then along came a new breed of amateur, the kind of amateur who believes a repeater is a gift from on high, put there for him to use as he wishes without any regard for his fellow human beings, be they other users or the system licensee. It takes only a few people such as these to wreak chaos on any repeater and such was the case here. However, Burt felt that the good would triumph in the end and placed his trust in the "good users" to clean up the system. Unfortunately, very few were willing to assume this responsibility. It was easier to just go to another repeater and let the "channel hogs" have their fun.

Without total public backing from the majority of the usership, which was not to be had, Burt apparently reached the conclusion that the best way to solve the problem was to take the system off the air and write off 15 years. That is, unless someone else was willing to try and solve the problem and clean up the mess. WB6JPI agreed to try. How? Bob's letter continues: "My first act is to remove the repeater from the air for 60 days. My analysis of our parasites has indicated that they need and require a host. Removing the repeater from the air will require them to seek another host. They will migrate to other repeaters and with luck they will like it there and stay there. (Editor's note: Virtually every other area repeater has a much higher degree of regulation and discipline and, in my opinion, a takeover of another system in a like manner to the ABE takeover is not likely. Not to say that it might not be attempted, but rather the likelihood of success is small.)

"The repeater will be forced to behave. A tight group of control operators will be trained and ordained. This group will have the power to enforce (by various means, including shutting off the repeater) certain rules on the operation and behavior that will be used on the repeater. Subject matter will be censored, as well as language and operating procedures. Freedom of speech and 'right to use' will have no precedence. The decision of the control operators is absolute and without appeal. If you don't like it, use some other repeater. This excruciating, difficult, arbitrary, and strict control will last for as long as it takes. It is hoped that out of the war will emerge a group of users with an attitude and behavioral pattern that will set a new standard for ABE. Those who are attracted to a tightly controlled repeater will survive and continue demanding from new users a high level of performance. Therefore, it is hoped that the tight control, censorship, and other direct user controls will only be necessary for a few months. It will be self-perpetuating. In a few years, the cycle may have to be repeated. It may not always work.

"Again, ABE is trying something new — user attitude adjustment. To my knowledge, it's never been done. We have a good 'handle' on jammers and jammer-related problems and I feel that Paul W6AOP and his team can thwart the threat of unidentified illegal and destructive use of the repeater. Tight control will be established to ensure that the 'legal' users will behave. If it doesn't work to my satisfaction, then indeed ABE will go dark."

User reaction on ABE as well as other repeaters was interesting to note. It ranged from, "This is a public utility and you have no right to do this" (editor's note — while this kind of statement might seem as absurd to you as it does to me, nevertheless it was indeed heard time and again as a reason why the owner was obligated to keep the repeater in operation), to "Maybe I'll sue; after all, I had to buy a special set of crystals to operate this repeater and now they're no good." It included, "We'll put up a repeater of our own on this channel pair," and, of course, "You can't tell me how to operate my station or what I can say on this or any other repeater; I'll say anything I like . . . it's my right." There were more; these are just a few of the ones that still stand out in my mind. It was quite obvious that those making these statements had never taken the time to read the rules and regulations; they failed to realize that this and/or any other repeater they would chance to operate was there through the benevolence of another amateur who, through the goodness of his heart and technological skill, had in effect invited other amateurs to share the use of his station. For indeed, what is a repeater other than another amateur's station there for you and me to use?

While many users did voice support for Bob's decision both on and off the air, a lot of times the tone of voice made you wonder if the gesture was half-hearted. When I would hear such statements, I would wonder why people had waited till now to make them. Why had they not taken affirmative action themselves long ago to remedy the situation before it had gotten this bad? Could it be that deep down inside they were mad about losing use of the system regardless of how bad operating procedure had gotten? I still wonder. Oh, there were some sincere "well-wishers," but they were far from the majority.

Reaction elsewhere on other systems was quite interesting. For a long time, other systems had considered ABE as the "jail" that housed the outcasts from two meter FM society. As long as ABE was there, everyone was safe. Now the "jail" no longer existed and a number of systems took interesting action. A few announced that they would be going either part-time or full-time tone access while others went to revised operating schedules. A number of previously 24 hour systems now shut down at midnight or thereabouts, when no control operator is present, while others have announced that control stations are continually on duty. While no one will admit that ABE's going away is the reason, it seems very coincidental. Anyhow, the amount of malicious jamming being suffered by various systems seems to have increased since ABE went dark. The jammers are not to be confused with amateurs who abuse the privilege of operating a repeater; they are two entirely separate entities, two entirely separate problems. These problem causers seem desperate to find new homes and new audiences, and to thwart this, a good number of systems have *"ordered"* their users to pay no attention whatever to this problem, thereby taking away the audience factor. In reality, this is the best and many times the only weapon to use against illegal malicious interference.

The big questions seem to be: Can the directorate of WR6ABE succeed in changing the operating habits of a large number of amateurs and instill in that group a sense of total pride and respect for their fellow amateurs? Also, do they have any right even attempting this? To answer the latter first, indeed they do. Their obligation is clear and that obligation is not only to amateur radio but to society in general. With the advent of the $9.95 public service monitor portable radio, there is no telling who your audience might be. We must always assume that someone without the understanding of amateur radio is listening and be aware that saying the wrong thing might offend and alienate that kind of person. We need friends, not enemies, and if this means that we must clean house once in a while, then it best be done.

Then, too, is the fact mentioned earlier that a repeater is not a God-given gift, but rather like one amateur inviting you into his shack to use his station. If you used his station in a manner he deemed improper, he

would ask you to stop. If you refused, he would probably pull the plug out of the radio rather than permit this transgression to continue. By the same token, there is no obligation on the part of any repeater to adhere to the will and directive of its usership unless it happens that the sponsor of the system is a club corporation and the membership comprises the shareholders. Then and only then do users have the right to voice any opinion in the operational parameters and guidelines of the system. In the case of the individual owner-licensee, there is no obligation to provide any form of service to anyone at any time. It's up to him to decide when it will be on the air and how it will be operated. It's what one might term a benevolent dictatorship. A repeater owner has zero obligation to users; however, users have specific obligations to adhere to the wishes of the licensee. After all, in effect you are in his home; you are using his station.

Now I can hear a lot of teeth grinding and see a lot of fists clenched by people who are saying to themselves, "How can he say that? He's selling users down the tubes; why, it's we users who are the most important aspect of any repeater; we support the repeaters; we are the people that by virtue of our use of a repeater give it a reason to exist." However, after this anger wears off, I ask you to sit and think as I did and ponder the following: Your license gives you the authority to operate an amateur station, your amateur station, on a certain portion of the electromagnetic spectrum. The portion of the spectrum you are permitted to operate is governed by the class of license you hold. No where in the rules and regulations that govern your license does it say that your license or mine gives us the right to walk into the home of another amateur, without his permission, sit down in front of his amateur station, and make use of his equipment against his will. If he does not want you in his home, he has a perfect right to tell you or me to get lost. Our licenses give us the right to respectfully share the allotted spectrum with others on a non-interfering hasis. Our licenses do not give us the right to operate a repeater just because it is there; we have the right only to use our radio to transmit on a given frequency, be it a channel set aside by local agreement as the input of a repeater or not, and there is nothing in the rules that states we must be repeated or relayed via a repeater. That is left to the sole discretion of an individual who happens to hold license on a repeater. As users, we have the right to own and use radios; being repeated is a privilege, unless you either own the hardware or part thereof or hold the license. You and I constitute a subculture known as the "repeater user," and our only "right" is the right to say thanks now and then to those providing repeaters as a service to us. It's a hard, cold fact of life, and one that you do not consider until the day that your favorite repeater goes away.

The next question: Can the concept of user attitude adjustment as outlined in Bob's letter succeed? Can the attitude of "me first" and "I have more right to be here than you" be replaced by a willingness to work together for a common good? Can the human nature of a few be changed to benefit many? When ABE comes back on the air, will it be greeted by a group of enthusiastic people, eager to build a new world with a goal of a new standard of excellence in repeater operation and thereby setting a new standard for a nation to emulate? Or will the promised vendetta of a few selfish people force the final decision to be made, the decision that would spell an end to more than 15 years of WR6ABE and possibly signal an end to open format relay communication elsewhere? Many repeater people, both owners and users, will be watching this experiment, and once more it looks as if Southern California is about to set another trend. Will it work? Only the future will tell.

Last month we introduced WR6AKG and Keith Glispie WA6TFD to you. Keith is the young amateur who saw a need to provide children of school age who happen to hold amateur licenses a place of their own to communicate. Out of this need WR6AKG has been born. As of this moment, November 20th, Keith is busy at work readying his PYE Communications Model FM-50 repeater for service. While the SCRA has yet to confirm a final channel pair for this endeavor, the inverted split-split channel pair of 146.925 in, .325 out looks like it will be AKG's home. This channel pair is currently occupied by a private system in Palos Verdes, the owner of which, I have been informed, has agreed to co-channel with the AKG project. The only thing holding up final test sanction is that the output of a privately owned remote-base also utilizes .325 as a two meter downlink, and unlike repeaters, remotes are not SCRA coordinated. An organization known as the Southern California Repeater and Remote Base Association handles coordination of anything on 60 meters and 450 on up. Therefore, it is necessary for SCRA to contact SCRRBA and in turn have SCRRBA contact the remote owner in question and request that he either also agree to co-channel with AKG or that he agree to re-coordination to another two meter channel. It is this final step that Keith now awaits. Will the remote agree to co-channel with what might become one of the area's busiest open repeaters from sunrise, well . . . to sunrise, I guess? We should know soon.

However, with things starting to look quite positive after almost two years of work, the following letter went forth to all school radio clubs within the Los Angeles Unified School District from DHART, AKG's sponsoring organization.

ATTENTION ALL AMATEUR RADIO CLUB MEMBERS, WHETHER LICENSED OR NOT!

The Dorsey High Amateur Radio Team (DHART) is proud to announce a new idea in amateur radio. The idea is to invite all members of Junior High, Senior High, and even Collegiate and Vocational Schools to join us on two meter FM. If you are saying to yourself the idea is not new, listen further.

A new repeater system, licensed to the Los Angeles Unified School District, through WA6TFD, will be in service within 2 months. Ah, but this is only part of it. About 2 years ago, DHART found that there was a valuable need to keep in touch with other radio clubs at other schools to keep up with the new ideas, projects, etc., that another club may have. So we talked to several other schools, who also agreed that there should be something done. Some schools had tried to give their young hams a chance to get into 2 meters and the idea of "repeaters." Amateurs already established on repeaters didn't exactly see eye to eye, so the newcomers felt rejected and lost interest in repeaters.

With all comments and ideas in hand, and with help from outside organizations such as PARC, members of DHART set out to find the solution, and that was to have a school "interlink" repeater system instead of just one channel talking directly to one school at a time. Since some schools are situated in remote portions of the county, simplex operation at times would be very difficult. With this in mind, we set out to build WR6AKG, a repeater which was built from bits and pieces from everywhere. It was finally completed after long hours of hard work.

We found that it would almost be impossible to find a repeater channel, but we went ahead and tried anyhow. We wrote the SCRA and told them that we wanted to put a repeater up on two meters and that it would be used as a school interlink system. They sent us a letter back saying that the band is quite full and that they would try to find something. About two days later, we received a call from the SCRA saying that they were trying very hard to find an open channel on which to put our machine.

They were pleased to finally see a repeater go up in this crowded system that finally had a purpose, and that purpose is to stimulate amateur radio interest and promote student communication between themselves and between schools.

This, in other words, is a pilot project which has never been tried before and will be the first of its kind anywhere. Fellow hams, this is *your* machine. It is provided for *you* to stimulate *your* interest in amateur radio. If you want to, set aside time for code practice, operating procedures, radio club rag chew, IC logic lingo, etc. The list goes on and on. Remote control operations, crossbanding, low band operations, field days, etc. Invite your friends who are not hams or even CBers to join you and find out what amateur radio is all about. Handled just the right way, your school can have more hams than you can deal with! You never know what can come about!

DHART hopefully will have WR6AKG in operation before December. The test location shall be in the Baldwin Hills area, with 50 Watts transmit power and .2 microvolt receiver sensitivity. We are trying to get the site atop Mt. Wilson at channel 58 for all-around coverage. The repeater frequencies at this time are unknown, but you shall be notified as soon as we are. If you would like to find out more about this program, give suggestive comments, or find a 2 meter FM radio for your school, contact the control operator of WR6AKG, Bryan Glispie WA6TFD, 3861 2nd Ave., Los Angeles CA 90008, (213) 295-0721 or DHART, 3537 Farmdale Ave., Los Angeles CA 90016, (213) 296-7120 Ext. 1.

If you have 2 meter equipment that may be used by other schools, please call DHART and we can list your school as a source for a radio.

If you have any suggestions or donations please contact us.

Yours truly,
Club Advisors
J.A. Martin
Traci Campbell

While amateur radio and amateur radio clubs have been around both public and private schools probably since the inception of amateur radio itself, this is the first time (to my knowledge) that it may play as important a part in children's education as now seems possible. The potential for the concept that the Dorsey High Amateur Radio Team is pioneering might just go down in amateur radio history as one of its finest hours. I personally suspect that it will be one quickly emulated elsewhere. My hat is off to Keith Glispie and DHART for finally giving a real purpose to amateur relay communication and thereby bringing amateur radio a bit closer to the non-amateur world. From this only both can profit.

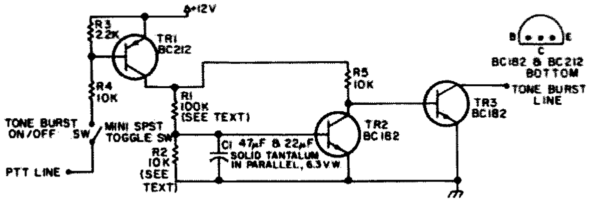
Calling all boats, calling all boats! Planning to sail or power your way into Los Angeles Harbour or Marina Del Rey? If so, it might pay to put 146.805 – 146.205 in your two meter radio. This inverted split-split channel pair is the home of WR6ACK, a newly redesigned repeater system whose purpose will be providing inter-boat and boat to land communication for aquatic oriented amateurs.

If you have been following Looking West for any length of time, you might remember a few years back when ACK was Los Angeles' first open autopatch and also the first open

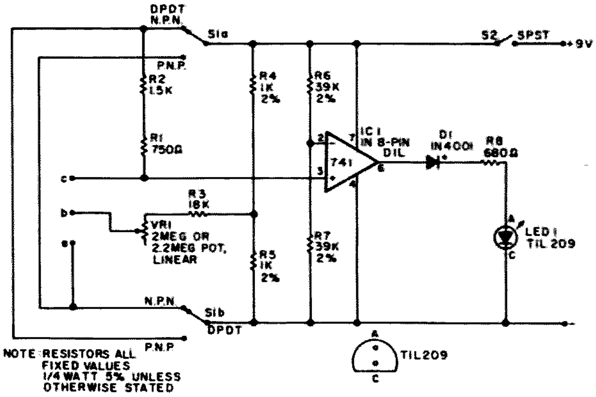
Continued on page 31

Circuits²

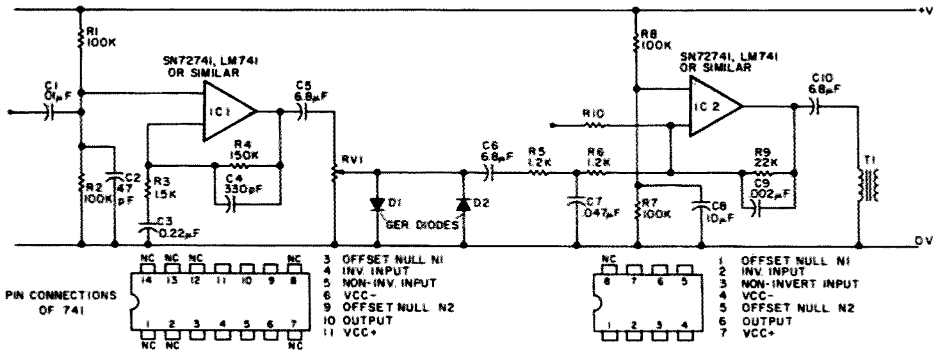
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice.



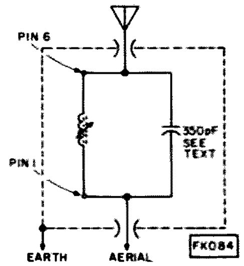
A tone burst timer for the Kenwood TR-2200A, with the length of the burst determined by the values of R1 and R2 so long as their ratio remains 10:1 (i.e., 100k:10k, 150k:15k, etc.). The burst length (with illustrated components) is about 400 milliseconds using a 12 volt supply. Reprinted from International Mobile News.



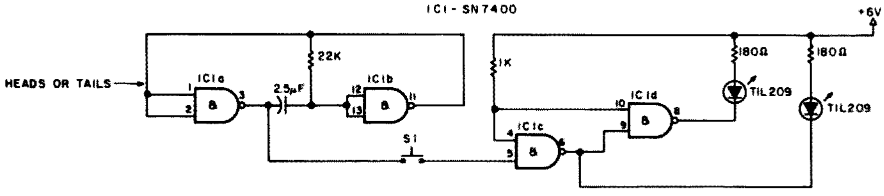
Simple transistor tester. Indicator lamp LED 1 is fed from the output of the op amp via D1 and current limiting resistor R8. D1 is included because the output of the op amp, when it is fully negative, is about 2 volts positive. Without D1 that would be just enough to produce a visible glow in LED 1, but with the voltage delay D1 produces, the LED is fully doused when the op amp output is negative. Reprinted from Practical Wireless, *England.*



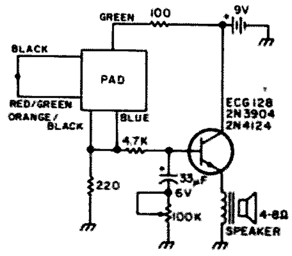
Speech-amplifier clipper using the 741 op amp. As shown, the unit will deliver about 30 V peak to peak output, but can be easily modified for less output by decreasing R9 and increasing C9. What's more, T1 can be eliminated to cut output to 15 V peak to peak. Reprinted from The Short Wave Magazine, *England.*



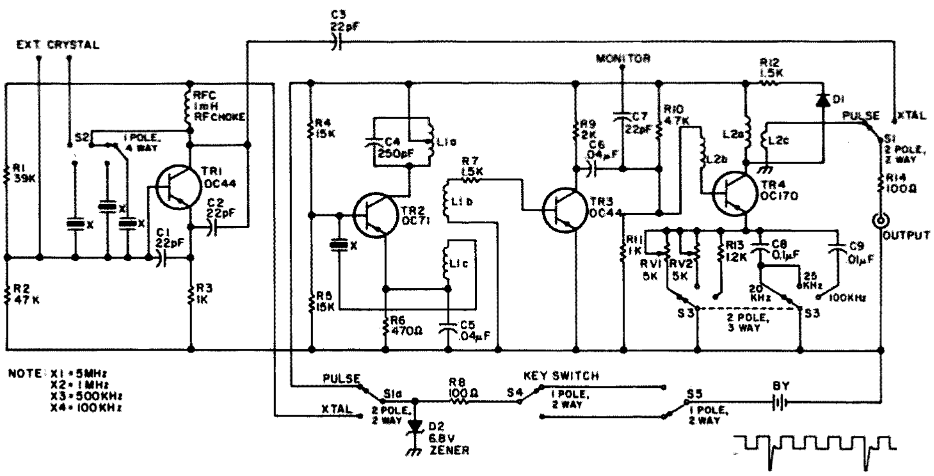
Tone cut control, for reducing the level of heterodynes. Also useful in compensating for deficiencies in small speaker systems. For best rejection of an unwanted signal, aim for minimum capacity and maximum inductance. Connect the trap as close as possible to the receiver antenna terminals for highest efficiency. Reprinted from Practical Wireless, *England.*



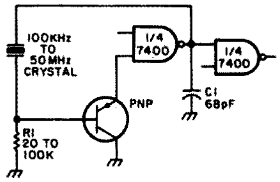
Low cost "heads or tails" game. S1 must be a push to make, release to break, switch. Thanks to D. Manoharan, Kuala Lumpur, Malaysia.



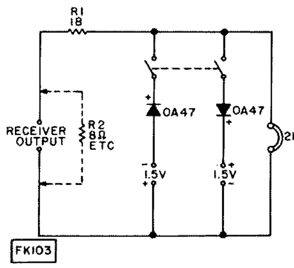
Hookup for an acoustical pad. Put the mike to the speaker and press the button. Not recommended for mobile use, as three hands are required. Reprinted from SCRAMSGRAM.



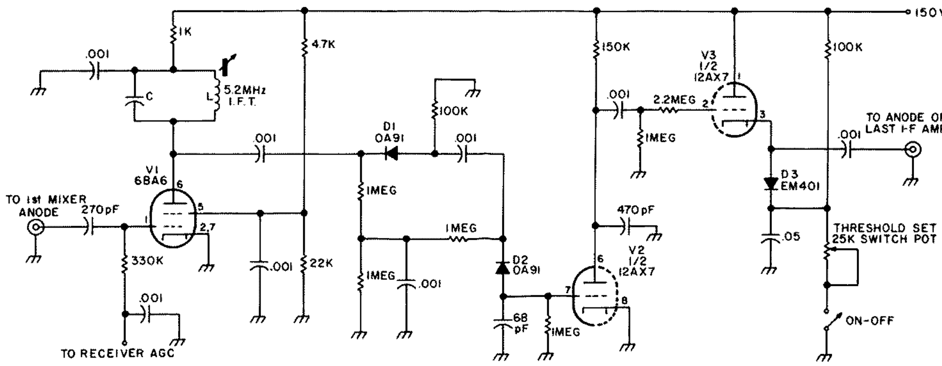
Crystal-controlled calibrator which generates pulse type signals at 20, 25, or 100 kHz. The unit covers the whole spectrum into the VHF region. Reprinted from The Short Wave Magazine, *England.*



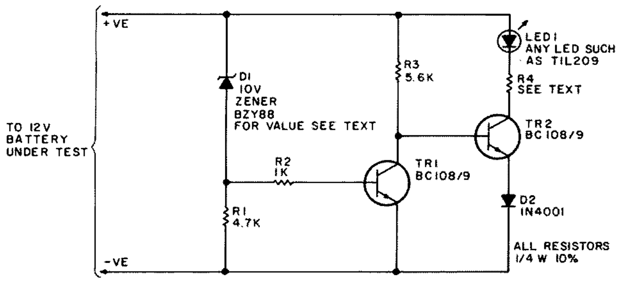
A TTL-compatible crystal oscillator. Adjust R1 for about 2 volts at the output of the first gate. Adjust C1 for best output. Thanks to Arvid Evans K7HKL.



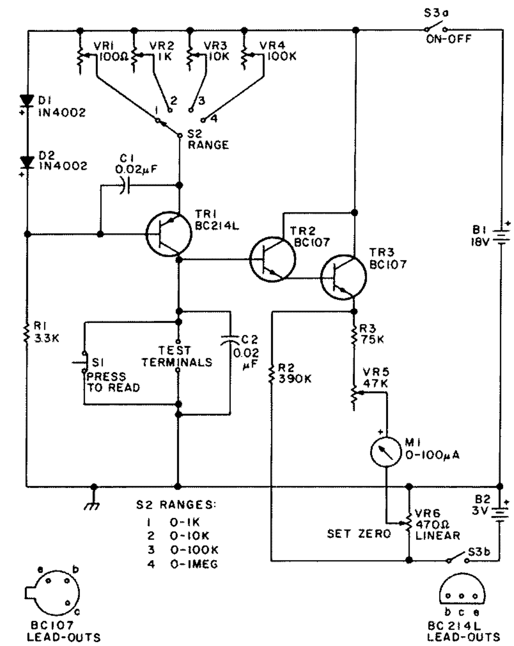
The basic noise limiter, for use with high impedance headphones. Very effective when your receiver is operating at maximum gain on a weak signal. Diodes must be germanium type. For receiver outputs of more than 15 to 80 Ohms, increase R1. If you're looking for a lower impedance load, use a 3 to 8 Ohm resistor across the input, as shown by the dotted lines. Reprinted from Practical Wireless, *England.*



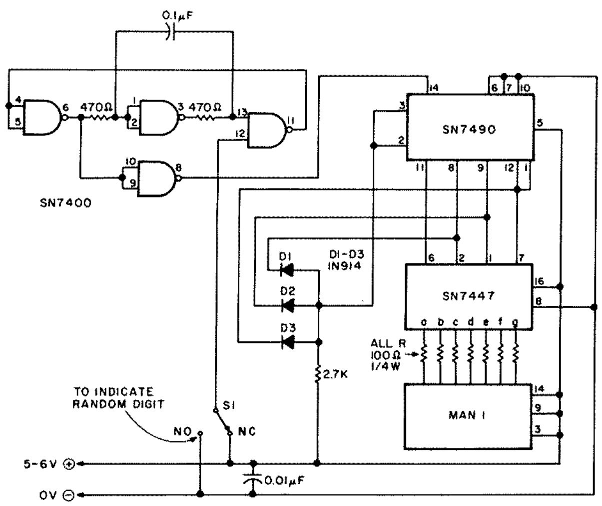
A cheap and dirty noise blanker, using tubes. FET conversion would be easy, as the circuit illustrates. Receiver oscillator line supplies 150 V, with AGC applied at V1. Circuit is especially good with FT-101 series. Reprinted from Amateur Radio, *Australia.*



Early warning circuit for battery discharge. Circuit shown is for 12 V operation, with zener D1 controlling low voltage cutoff. R4 = (voltage of zener diode)²/LED current. Reprinted from Practical Wireless, *England.*



Linear scale ohmmeter, designed to provide accurate measurement and a linear resistance scale at the high end. The circuit has four ranges, and another meter with a current range of 10 uA to 10 mA and sensitivity of 10,000 Ohms per volt is needed for setting up. Reprinted from Radio & Electronics Constructor, *England.*



Electronic digital dice game. Thanks to D. Manoharan, Kuala Lumpur, Malaysia.

...de W2NSD/1

NEVER SAY DIE

EDITORIAL BY WAYNE GREEN

from page 2

we are incredibly strong when we are able to come out ahead over a combo like that.

Some readers get bent out of shape when I enthuse over things which I find fun. I've always tried to share my enthusiasms with everyone I could, whether it be for a Porsche, FM and repeaters, RTTY (you probably won't believe how many years we had to fight the ARRL to try and get RTTY on the ham bands!), SSB, SSTV, travel, OSCAR operating, etc. I get much more enjoyment out of anything if I can share it and interest others in joining the fun. When I hear music I really like, I want to play it for everyone (it's a good thing it is illegal to play music over the ham bands!).

The Porsches are long gone, as are my plane, yacht, and Arabian horse. These days I'm lucky if I don't have to turn back a couple of items at the A&P at the checkout counter . . . one of the penalties of opting to "own" my own business instead of comfortably working for someone else. Now my employees own the planes, horses, and Porsches. That's the American way . . . right?

BUT DOES HE KNOW THE CODE?

From a clipping out of the *San Jose Tico Times* in Costa Rica (the sun never sets on the *73 Magazine* newspaper clipping input . . . with 100,000 readers watching papers all over the world for interesting items on hamming, CB, flying saucers, and who know what else?) . . . oh, yes . . . the clipping . . . it seems that Donald Nixon (nephew of guess who) got a ham ticket with the call TI2TT. He lives in Moravia.

I've gotten some interesting poop sheets (postmarked Hartford?) about retiring to Costa Rica and have been thinking of getting down there to see what is involved as a matter of interest to readers. I wouldn't be interested for myself until they improve the skiing facilities a whole lot.

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Give That Professional Look to Your Home Brew Equipment

- - win prizes

Have you ever built a project and then felt disappointed with its appearance after it was done? Do you admire the beautiful projects that grace the pages of most electronics magazines? Would you be interested enough to spend a little time learning how to make your projects look better, be easier to build and service, and perhaps work better? If you answer a resounding "yes" to these questions, this article is for you! One of the problems facing electronics people who like to build their own gear is that there is more emphasis on *circuitry* than on nuts-and-bolts construction. You see this whenever you pick up a magazine and read a construction article. All too often you get a lot of "how it works" theory, a few paragraphs of "connect the green wire to point C" construction, a "how to use it" section and a schematic. That leaves a lot of open avenues for construction – great for experienced constructors, but a stumbling block for less knowledgeable people. We are going to get you started with the basics in electronic construction, and well down the road to successful project building.

The photo is a shot of the author's test bench and shows some homemade equipment. Everything you see here was built over the past two years using ordinary tools and techniques about to be discussed. Granted, large and costly projects such as an oscilloscope and frequency synthesizer are beyond the abilities of most people, but this is just to show you what can be done at home! Why not build your next project like a pro using our methods?

Good tools are the most important part of electronic project building. They save you time (your time is valuable!) and temper by making the work easier. Here is a *minimum* list of tools you should have:

Needlenose pliers
½" blade diagonal cutters
Adjustable wire strippers
25 Watt soldering iron for ICs
100 Watt soldering gun or iron for wires
1 lb 60/40 rosin core solder
Screwdriver set
Nutdriver set (especially ¼" unit)
Heavy duty jackknife (for deburring holes)
¼" hand drill or drill press
Set of drill bits
12" square/ruler

Check over your tools and be sure that all cutting edges are sharp. If you have to add tools, get good quality ones. The extra cost of good tools pays off in the long run. They stay sharper and don't break as easily. You will probably have to add tools to your present ones to handle the demands of different projects (e.g., chassis punches, etc.), but this list represents the bare minimum.

Okay, we're ready to start. We'll take each stage of the construction process step by step. To highlight the process, we are going to assemble a 5 volt, 1 Amp power supply along the way. You are welcome to build one along with us if you want. A 5 volt power supply is a great addition to any lab that works with digital ICs!

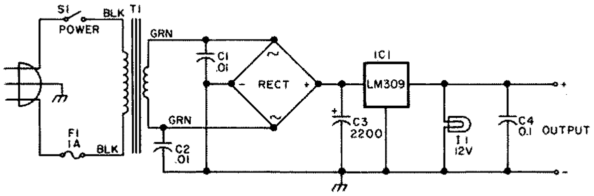

Fig. 1. A simple 5 volt, 1 Amp power supply. C1, C2 – 0.01 uF disc capacitor; C3 – 2200 uF 25 volt electrolytic capacitor; C4 – 0.1 uF capacitor; F1 – 1 Amp 3AG fuse and holder; I1 – 12 volt, 50 mA lamp and holder (Radio Shack 272-322 OK); IC1 – LM309K voltage regulator; RECT – 6 Amp, 50 piv bridge rectifier; S1 – SPST toggle switch; T1 – 12.6 volt, 1 Amp filament transformer; Misc – cabinet (LMB442 used in example), 3 wire cord and plug, binding posts, wire, etc.

Appraise the Project

The most logical way to start an electronic project is to appraise it for the best way to build it. When you find something you would like to build, you should start by looking over the circuitry and any method of construction that may be shown. If you are a newcomer to electronics, you may want to build a kit the first time out and then start building projects out of magazines and from schematics. This makes electronics a lot easier if you

start with a "paint by numbers" kit and gradually work up to more challenging projects.

Start by reading over the project (if it's out of a magazine) or by checking out the schematic. When you are reasonably familiar with it, ask yourself the following questions:

1. How am I going to assemble the electronics?
2. Am I going to build the completed project in a cabinet?
3. Are there any critical areas in the electronics that require special care, e.g., high gain amps?
4. Are there any special requirements in the mechanical construction, e.g., shielding?
5. Can I get all of the parts?

If you are building the project from a magazine article, you can answer the first four questions simply by copying the author's finished unit. The fifth question must be answered by you. If you can't get all the parts, or if they cost more than you can afford, don't build it. Instead, set the project aside, and tackle it in the future if you really have your heart set on building the item. If you are building your project from a schematic or custom building a magazine project, you'll have to answer these questions yourself and provide the solutions. Experience is the best teacher here. The schematic should give you some clues. Table 1 lists some pitfalls to watch out for.

Needless to say, the list could go on, but Table 1 is a sample. Make allowances for these things. Leave room for metal shielding, bypass capacitors, and heat sinks. Lay out parts carefully to keep input and output separate on high gain amplifiers (that includes i-f amplifiers) and leave space for heat sinks if necessary. Watch lead dress in logic circuits and VHF-UHF circuits, too. Good grounds are also very important. Keep these things in mind, along with anything else you can dig up on the project. All of the items mentioned here should influence how you build your project.

How would you like to sit down to a bench like this? This is part of the author's setup and all equipment is homemade. Shown from left to right are two stacked power supplies, a 0 to 60 MHz frequency synthesizer (signal generator), a frequency standard and digital multimeter on top, followed by a stacked function generator and counter. A triggered sweep oscilloscope is on the far right, and is topped by a digital alarm clock.

Collect the Parts

Now that you are reasonably familiar with what you are going to build, you can get the parts. There are many sources of electronic parts, of course, but you should start with your junk box. Don't have one? Start collecting old radios, TVs and other cast-off electronic devices and strip them for parts. You'll need hardware such as nuts and bolts (bought a box of screws lately?), so save all that you can get. Junk boxes are good for the basic stuff you need for a project. If yours is well equipped, you might be able to build an entire project, such as our power supply, but this is rare. For any ICs or other semiconductors and parts, you may have to turn to your local dealer, so get to know him well, if you don't already. Another parts route open to you is the surplus mail order dealer listed in the back pages of most electronics publications. If you haven't tried these dealers, you are missing out on some great bargains. But beware of reject or retested components. They can cause more problems than you would believe! Pros use quality, name brand parts – this one move often saves hours of troubleshooting later! All you have to do at this time is collect the electronic components. Leave the cabinet selection until later if you are "rolling your own" project, or buy the one called out if you are duplicating someone else's device.

Once you have all the parts, you can test them if you desire. Test any used parts that show signs of being hot; otherwise, this step is optional. Many people check all their components to save troubleshooting later, and that pays off with parts of poor quality, but this shouldn't be necessary if you use good quality parts as we recommend.

Select the Cabinet

Now that you have all the electronic components together, the time has come to select a cabinet to house your project, and perhaps a chassis as well. The secret of success in selecting the right housing for your equipment is *advance planning.* The idea is to get a cabinet that is large enough to house all of the parts of your project, plus allow room for easy servicing and future modification. You do not want the cabinet to be too large; this is an unnecessary expense, and oversize cabinets mean excessive bulk. Here's how to select the box or chassis that is right for you with a minimum of fuss.

The first step is to visit your dealer and find out what cabinets and chassis are available to you. You might also want to write the manufacturers listed at the end of this article for catalogs – this will help in your selection. Next, lay out the parts that normally mount inside the cabinet on a table. This normally includes circuit boards, large caps and transformers. Lay out the parts like you were assembling the unit into a cabinet. Allow at least 1" clearance around the circuit board (if used) and any adjacent parts. Separate heat producing parts such as transformers, power resistors, and power transistors at least 2" from any other parts. The back cover is a good place for resistors and transistors, while the transformer may be mounted toward the rear. This is just a "first fitting," so you don't have to place the

Pitfall	Solution
High gain amplifier or tuned amplifiers	Extra shielding may be required.
High gain amplifier or tuned amplifiers	Inputs and outputs well separated.
High gain amplifier or tuned amplifiers	Power supplies remoted or shielded.
AF or RF oscillators	Good shielding and bypassing of power leads.
AF or RF oscillators	Sturdy mounting of coils and capacitors.
Digital logic ICs	All power supply leads must be kept short and well bypassed with capacitors.
VHF-UHF circuits	All leads must be kept short.
Power supplies or power handling circuits	Good heat sinks for all power devices.
Power supplies or power handling circuits	Heavy wire where necessary to minimize losses in power.

parts exactly. Measure the height, width, and depth of the layout and you have the *minimum* case dimensions. Consider what components you have to add to the front and rear panels. If they would interfere with the parts layout you made, add more space to the *minimum* dimensions. Meters and speakers are great space hogs in this respect! Continue to add parts to the front and rear panels, making corrections to your minimum dimensions as necessary. Be conservative in your estimates. A little extra room in the layout makes construction and servicing much easier. Also, you may suddenly discover the space for shielding, as in the case of a radio receiver project. Consider using chassis in your more complex projects. You can mount your PC boards on top, over a suitable sized cutout, and this will make construction and servicing a snap. Chassis are also used as shielding boxes – this may be necessary in a project where many sensitive circuits must be placed in the same case. Our frequency synthesizer is a project in point: It uses 6 fully enclosed chassis boxes to isolate the many VHF frequencies the circuits generate from each other.

Finish up your case or chassis selection by taking your dimensions and selecting a box to fit. Since you will probably have some oddball dimensions, you may have to look for a larger box or an odd sized one. With practice, selecting a case can be done quickly, with just a few measurements and the catalogs.

Build the Electronics

This is the largest step you'll probably have to make, but we are going to simplify things a bit. Because of space limitations, we can't fully discuss the wiring phase of a project. Instead, let's look at the highlights of electronic construction.

To start with, there are three basic ways to assemble an electronic circuit. You can use a PC board, a perfboard, or mount all the components on the project's cabinet. Often two of these techniques are combined, as it is common to mount small components such as caps, resistors, or transistors on a PC/perfboard and then mount large components such as transformers and speakers on the cabinet. So which construction method is best for you? The choice is fairly easy – if a PC board is available, or if you feel you can make one, use it. PC boards are also recommended for complex digital circuits (about 10 chips or more) and critical circuitry such as high gain amplifiers. Perfboard construction is a handy method of construction for simpler, less critical circuits. Construction may be a little harder than a PC board because you have to figure out the placement of each part as you wire it up. On a PC board, the designer has determined layout for you and assembling a PC board (nicknamed "stuffing") is often like building a kit – easy! Another method of construction is assembling all the parts on the project's cabinet and wiring them up. This method works fine when there are few parts and most of them are made for chassis mounting. Small parts are often mounted on terminal strips to keep them from touching the chassis. You will often see this method used in power supplies (such as ours) and other simple projects.

Laying out your circuitry isn't necessarily difficult if you don't try to rush construction. Just take your time and use some intelligent planning and the results should be good. If you are using a commercial PC board, you can skip this part; just stick the parts in as per the pictorials and solder them! But if you are working with perfboard, or *laying out a PC board,* follow our hints to ease your job.

The schematic, and any other circuit information available, has the most powerful influence on how a circuit should be built. For example, if pictures or drawings are available, you might get by building your circuit from these. Or, at the very least, these illustrations can give you ideas on how to lay out the circuit to suit your own needs. So it goes without saying that you should read over any texts and illustrations available on your project before starting! There just might be enough information available to skip this section! Also you want to look for "problem areas," parts of a circuit that are sensitive to component layout. Examples of this area: grounds in HF to VHF circuitry, power supply bypassing around digital or linear ICs, component lead lengths, and so on. A good author will point these things out and probably more, so when a suggestion is made to handle these problems, take heed! *Caution:* If you see many problem areas in a project and you aren't sure you can handle them all, get a PC board if available, or drop the project. This can save you grief!

But suppose you are building a project from just a schematic. Now you have a challenge! But here's the basic way to go about building the circuitry: First, select a board large enough to hold all of the parts, then refer to the schematic. You can often lay out the parts on the board just like the schematic – you might consider this. This makes complicated circuits easier to trace, but a well-drawn schematic is required. Otherwise, try this: Stick the major parts (e.g., transistors, ICs, etc.) on the board. Then stick in the smaller components around the pins of the IC or transistors they would connect to. Try to position the parts for shortest lead length. And remember how you appraised the circuit to begin with? Try to account for any pitfalls you found at that time. You may do this technique for just one stage at a time, as in complicated circuits, or do an entire circuit at once! Some tips to use in your layout and construction: Leave plenty of room for all parts, avoid "layered" construction, or the placement of, say, resistors on top of capacitors, and always use sockets on ICs. When you have a layout that satisfies you, wire up the parts. Use #18 to #24 bare tinned copper wire for all grounds and power supply leads if possible. When you are done, check your work and plug in any ICs. You might be able to check out the board to see if it works, too.

Tackling the Cabinet

Now you get to lay out, machine, and label the cabi-

net. And in the bargain you'll get some exercise! Start by laying out the cabinet. You should have a general idea of what goes where in the cabinet from the section on its selection. Now improve on that by collecting the parts that would mount on the front panel. Oh yes, don't forget the box you selected! Play "chess" with the parts by placing them on the outside of the box and moving them around until you get an arrangement that looks aesthetically pleasing. Some tips to aid you: Lay out controls in a symmetrical manner – that means in a straight line (if you have many controls, stagger them). Balance them so they are neatly centered between the ends of the box. If possible, group the controls by function. Mark all hole locations. Masking tape works well here. Then follow the same procedure for the bottom and back of the box. Be sure that there is still room for all of the parts. If you need ideas for your cabinet layout, why not check out some commercial gear? This can be very helpful if you are stuck.

Once you have the locations marked, you can start drilling them. A center punch is recommended to punch all hole locations for greater accuracy, but this is an option. When you have all cabinet holes drilled, use the knife to deburr them. Then tackle special holes, such as square ones for displays or round ones for meters. You can cut these either by drilling holes around the inside edge of the cutout, punching out the slug and filing to size, or by using a chassis punch. A sabre saw could also be used, but it would mark up a painted panel. The choice is up to you! After you are done, deburr any leftover holes and wash the box. Use detergent and water if the box is painted, or a scouring pad and detergent if it is bare aluminum. Finish up by drying the box thoroughly.

You might want to paint the box. For best results, warm up the box to about 30 to 40° C. Then use your favorite color of aerosol spray to do the job. Follow the instructions on the can and you should get good results. (Incidentally, it is often cheaper for you to buy an unpainted box and paint it yourself!) Let the box dry in a warm dust-free place overnight. Then, take it and apply a light coat of clear acrylic spray; this will make application of the labels easier. Let it dry several hours.

Now you can apply decal labels to the cabinet. If you don't have any, you should be able to get them from the larger electronics distributors or perhaps by mail order. You can also get alphabet sets from most drafting suppliers for low cost. Typical names for decals are Letraset® or Technilabels®, and they come in sets for experimenter, ham, etc. Common words are already spelled out for you and they are very easy to use. The drafting alphabet sets have names such as Paratipe® and Zapatone® and have only letters – you must make up the words yourself. Applying these labels to the cabinet is easy – they just rub on with a blunt pencil. If you get a word or letter in the wrong place, it easily comes off by placing a piece of cello tape over it, rubbing it, and pulling it off. Be sure that you allow plenty of clearance for the knobs when you apply the labels. After you label the front you may wish to label the rear, too. This will complete the professional appearance of your equipment! Spray the outside of the cabinet with clear acrylic spray when it is labeled to your satisfaction and let the box dry.

Final Assembly

I can imagine that you are getting pretty excited by now, because you are in the homestretch! Now you get to connect up a lot of loose parts and see if the project really works.

Complete the final assembly by mounting all the parts on the front panel. Install the knobs (did you get good-looking ones?) when you finish. If you did everything well so far, the project should go together like a kit – fast and easy! This is something to shoot for. Continue with the rear panel, too. Then mount the circuit board in the bottom of the box (if a board was used) with ½" or longer metal spacers. Use at least 4. Mount any other parts as necessary, and the mechanical construction is done.

Complete the wiring and you are home free. Refer to the schematic for details. I should warn you that it may be necessary to loosen or disassemble parts to wire them, so you might want to keep this in mind. Despite the best plans of mice and men, this problem crops up from time to time, so keep a screwdriver handy! Note the power supply.

Checkout

The moment of truth has come! You plug it in and there is a very good chance your project will show signs of life. Our power supply sure did! If so, congratulations on a good job! If not, you'll find a carefully built project much easier to troubleshoot than a haywire rig with a maze of carelessly laid out wires and components. You really gain with a properly built project; it is more likely to work, it is easier to service, and it looks a heck of a lot better to boot! Isn't it about time you got on the bandwagon?■

Some Cabinet Manufacturers

Bud Radio, Willoughby, Ohio
California Chassis Co., 10636 Midway Avenue, Cerritos, Ca. 90701
LMB Company, 725 Ceres Ave., Los Angeles, Ca. 90021
Ten-Tec, Inc., Highway 411 East, Sevierville, Tenn. 37862.

***Note:* This list is by no means complete. Check with your dealer for others.**

Looking West

from page 25

autopatch to fail due to user abuse. Since that time, ACK has taken a few steps in its evolution, including a frequency change to make way for the Baja repeater. Now, with the formation of the Marina Repeater Association to sponsor it, it has come up with a new objective as well.

While the prime objective is to provide the aforementioned type of communication, I foresee another important aspect to both ACK and MRA, that of being in the right place at the right time should an emergency on water manifest itself. By its very nature, the organization will be composed of amateurs who are adept at the many aspects of seamanship and will have a goodly number of vessels as part of its flotilla. Should an emergency requiring instant communication manifest itself, this group will be in a position to provide it, as well as handle other aspects of such situations. Again, it's skilled amateur operators adding another direction to amateur relay communication – another repeater with a purpose.

Now, as if all that were not enough, there is still one more important aspect to MRA, according to organization President Al Ezor W6QOG and its Vice President Bill Hawley W6ZRZ. MRA also intends to publicize amateur radio as a communications agent augmenting the pleasure of boating through various boating magazines and thereby interesting would-be amateurs in taking that all important first step. In the LA area, it plans to operate and sponsor the necessary classes to provide this training, which could result in a goodly number of new combination amateur radio/pleasure boating enthusiasts.

So, if you are planning to sail the Pacific coast between Oceanside and Ventura, keep an ear on .205 for the ID that reads WR6ACK. It may have been there for a long time, but now that ID holds a whole new meaning. For more information about this project, contact the Marina Repeater Association, PO Box 9894, Marina Del Rey, California 90291.

A few months back, *73* published a letter to the editor from a Northern California FMer directed toward us about the night to day differences between FM up North and that which we practice down here in the Southland. Is there that much of a difference between North and South? What is FM relay operation like in the Bay Area? Next month, Looking West takes a drive to San Francisco to tell you first hand all about it. See you then.

You Already Have an Atomic Frequency Standard

-- here's how to use it

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Whenever a frequency standard is brought up, usually the discussion turns to the National Bureau of Standards' shortwave broadcasts on station WWV, but using these transmissions at any distance from Fort Collins, Colorado, where the transmitter is located, is difficult when reception is poor.

If you service CB radio equipment, commercial transmitters or amateur radio gear, an accurate means of measuring frequency is essential. If you are an experimenter or radio amateur who has a frequency counter, perhaps you have either not calibrated it or let its calibration slip because you did not realize that an atomic frequency standard was as close as your color television receiver.

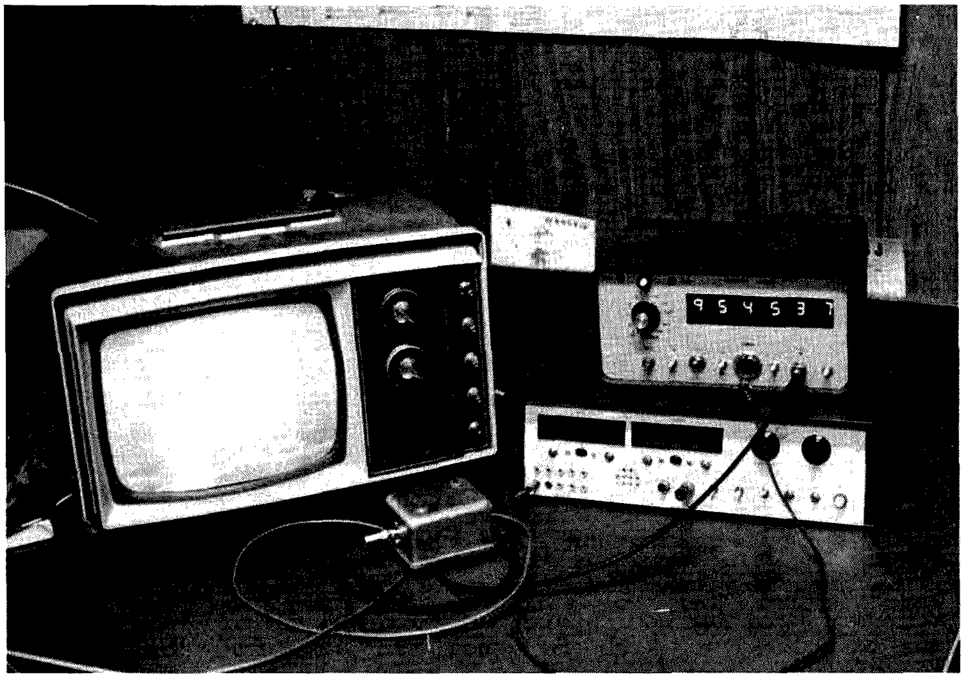
For some time now, NBS has been pushing the color TV burst frequency as a method of frequency dissemination, and once you use the system it will become apparent that it is both very accurate and inexpensive to implement.

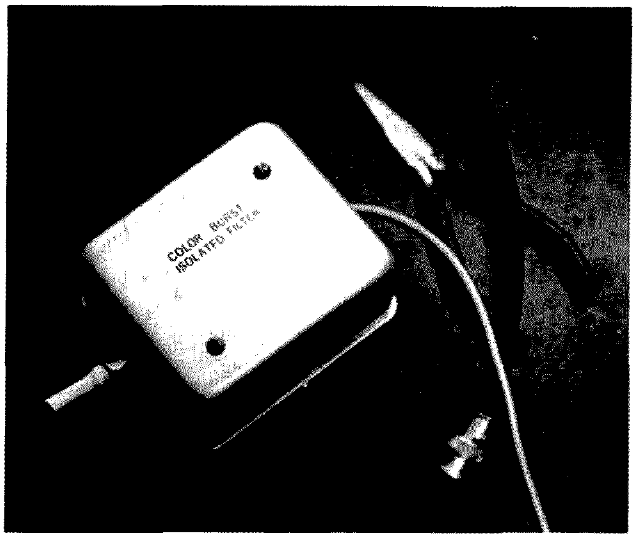
The basic idea is that all three major TV networks use atomic oscillators to produce the 3.57954545454 MHz color subcarrier frequency which is used to code and decode the color information in the video signal. This subcarrier frequency, or more exactly a piece of it, is broadcast with the video which is then used by the color receiver to regenerate a continuous carrier in the set for decoding purposes. The continuous frequency generated by the set is locked in frequency and phase to the transmitted piece of carrier or "color burst" as it is called, which thus produces an exact replica of the output of the network's atomic oscillator. While there may be minor phase shifts due to path length changes from network switching, the frequency stability is basically that of the generating source.

Thus, your access to an atomic frequency standard involves two simple steps:

1. Bringing the color burst frequency out of a TV and into your counter.
2. Waiting for a network program to come on. (Local stations use crystal oscillators which, while good, can be a couple of Hertz off frequency.)

The tapping of the color burst frequency in your set may take a little imagination, since each set is a little different. Receiver subcarrier regeneration systems fall into two broad categories: phase locked oscillators and ringing tuned circuits. To get into the right territory, look for the color burst crystal on your set's schematic diagram. Examine the circuit around the crystal to determine which type of system you have. If the crystal is an oscillator, then you have the phase locked type and it is the *output* of that oscillator





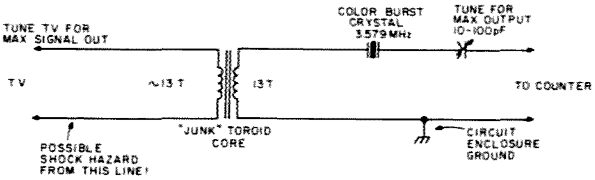


Fig. 1. Color burst isolator and filter.

that you want to bring out of the set. If the signal seems to pass through the crystal as a filter, then you have the "ringing" system and it is the output of the amplifier stage following the crystal that you should tap. Do not try to take an output from the crystal itself, as this can lower its Q and could stop oscillations altogether.

In either case, look for a good low impedance output point. Careful probing about with a scope should turn up a nice clean waveform you can use. Some set schematics have waveform pictures that can often be helpful clues. A word of caution is needed to remind you that many portable receivers have no power transformer, so the chassis could be 115 volts *hot!*

For this reason I have used the circuit of Fig. 1 on my portable set. The toroid transformer isolates the set from the line, and I have included an additional color burst crystal to peak the waveform into nice clean sine wave and filter noise pulses. This circuit easily drives my counter, which is not particularly sensitive. You may find that the "tint," "color" or "fine tuning" controls on the set, as well as the trimmer on the isolator circuit, may need to be used to peak your output waveform.

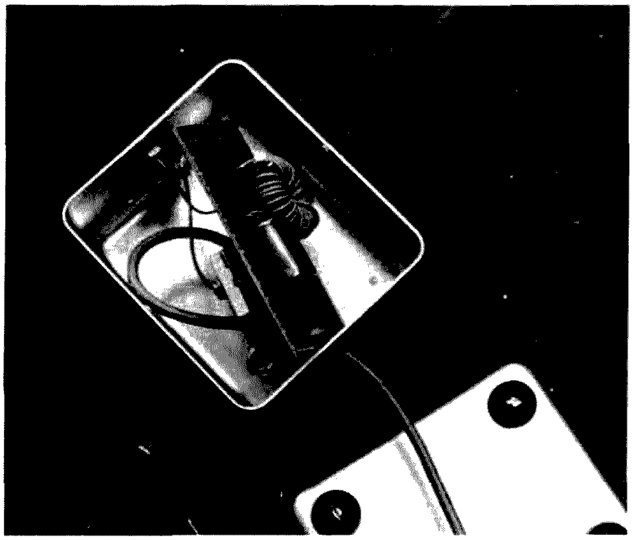
I've found that the tap-off circuitry tends to affect color reception, so you may want to have a jack to remove your output circuit when you are not using the set for calibration purposes. An alternative is to only use the set as a frequency standard. This may sound expensive, but my little set was free! It lost one of its colors in the picture tube and was deemed not worth fixing by the owner. This is a very common occurrence. Since you really need only one color to tell if a program is network (you could probably get by with just sound), so long as the color burst section is working, you have your atomic standard.

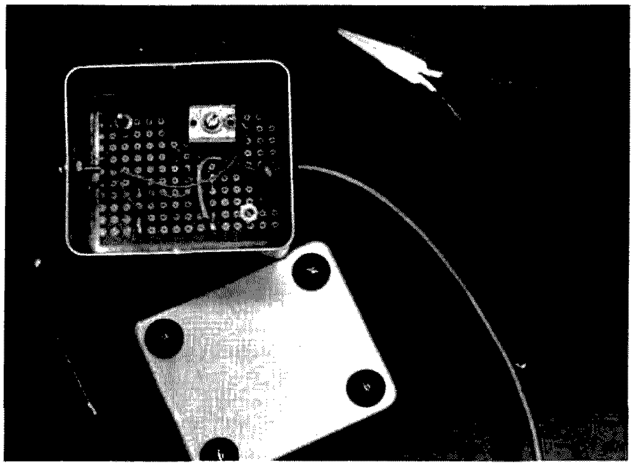
My home-built counter has a timebase that can be set as long as 100 seconds, which means that the counter, when adjusted, can read color burst frequencies to .01 Hz (or has an accuracy of .1 Hz at CB frequencies or .4 Hz at 2 meters). If your counter reads with a 1 second timebase, you can only set it to 1 Hz at color burst frequencies, giving you an accuracy of 10 Hz at CB and 40 Hz at 2 meters when calibrated.[1]

To calibrate the timebase oscillator on your counter, just feed the color burst frequency from the set into your counter and read its frequency with your maximum resolution setting. Now adjust your timebase oscillator trimmer until the display reads 3,579,545.35 Hz. The reason for the .35 Hz rather than the "ideal" .45 Hz is that all network frequencies are slightly offset due to a change in the international frequency standard after the oscillators were installed. You should measure with a good clear stretch of network programming and look out for commercials that may be local. Greatest timebase accuracy is attained when your counter is left on continuously, and in any event you should remember to allow a good warm-up period before calibration.

While the network frequencies have been 3,579,545.35 Hz for years, if you really want to stay on top of this situation you can subscribe to the NBS monthly time and frequency services bulletin, which lists the exact offsets for each network on a weekly basis. It is free on request, the only

[1] Notice that if you use the 15,734 Hz sweep frequency rather than the 3.579 MHz color burst to set your timebase, an error of reading ±1 Hz translates to an error of ±9000 Hz for 2m.





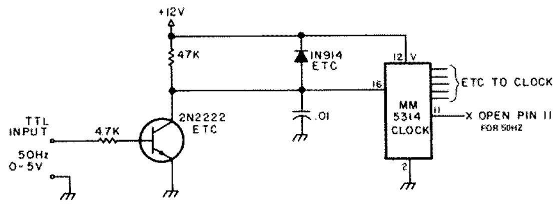
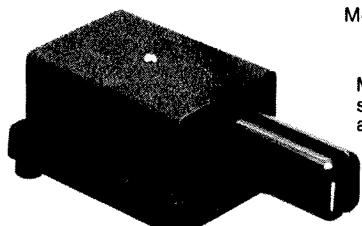


Fig. 2. Driving clock chip from timebase TTL output.

"cost" being a questionnaire they ask you to fill out about once a year asking which NBS service you use (WWV, TV data, etc.), how often, and why (ham radio, CB service, hobby, etc.). With the bulletin, great accuracy can easily be achieved. Those of us with clock and frequency standard hobbies have found the TV system to be a tremendous boon to obtaining synchronization of our secondary standards with little effort or expense. For extreme precision, a beat-frequency method can be used (but it is more complicated than the direct count method described here).

If you choose to leave your counter running continuously, you may wish to consider dividing your timebase to 50 Hz and building one of the numerous clock kits available today. Set your digital clock chip to run from 50 Hz, and feed the timebase signal into the circuit where it previously was connected to the power transformer. (The 60 Hz line is still used for power.) The simple interface circuit of Fig. 2 is an example that has worked quite well with the popular MM5314 clock chip.

The combination thus will give you a laboratory-accurate frequency meter and standard time source for your bench or radio shack. ■



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9503 Gambel's Quail
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Give the Hamburglar Heart Failure

-- car alarm system

With the theft rate of ham rigs on the rise, an alarm system should be installed by anyone who wants to protect his car and rig. Although an alarm system won't keep thieves from breaking into your car, it does make it much more difficult to do so unnoticed. After looking at the many, many alarms on the market, and their terrific prices, I decided that there must be a better and cheaper way. Many articles have pointed out the need for a "different" sounding alarm such as a bell, siren or similar device. But, for the money, the automobile horn is still hard to beat. After all, every car has one.

CMOS integrated circuits are a natural choice for use in automobile intrusion alarm systems due to their extremely low power dissipation. A sophisticated alarm circuit has been designed around two CMOS packages incorporating multiple time delays. The alarm circuit is armed by a hidden switch located inside the car. This design uses delay times to advantage. There is a delay from the time the operator turns on the alarm to when it actually is armed. There is also a delay from the time the intruder opens the door to when the alarm is actually sounded (this allows the operator to disable the alarm). In addition, there is a fixed time when the alarm is actually sounded, thus not running down the car battery more than is necessary. When the alarm is finished sounding, the circuit automatically resets itself, ready for another intrusion. In order to use the car horn as an alarm device, I decided to pulse it at a rate of 60 times per minute. This way people will not confuse it with a stuck horn. The circuit can either drive a relay, which in turn drives the horn relay, or it can drive a power transistor. The method depends on how much current the horn relay draws. The door switches are used as intruder sensing switches; other switches may be added on the hood or the trunk as considered necessary. All of the time delays are adjustable by changing several resistor values.

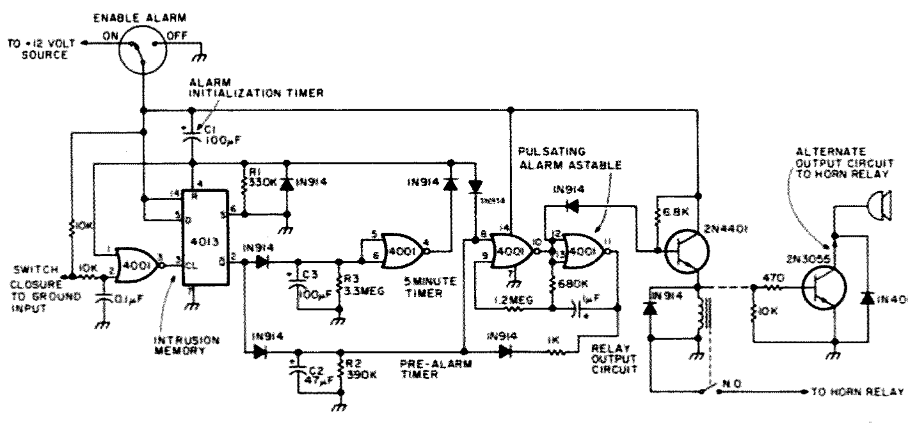

Fig. 1. This CMOS alarm circuit uses only two integrated circuits, yet provides a high degree of flexibility in its use. Delay times are provided to aid in the arming and disarming of the alarm. Once the pulsating alarm is sounded, it resets itself automatically after several minutes. $C_1 = 2C_2$; R_1C_1 – initialization reset timer (30 sec); R_2C_2 – pre-alarm timer (15 sec); R_3C_3 – alarm sounding timer (300 sec); ground 8, 9, 10, 11 on 4013.

Fig. 1 shows the schematic of the alarm using a quad NOR gate and a D flip-flop. The input to the alarm is taken from the door switches which control the dome light. When the doors are opened, these switches short to ground. The input signal to the alarm is normally 12 volts and goes to ground when the doors are opened. The driver enables the alarm by a hidden SPDT switch which connects 12 volts to the circuitry. Resistor-capacitor combination R_1C_1 develops a reset command signal to the intrusion memory when the alarm is enabled. This time delay permits the driver and passengers to exit the automobile prior to the arming of the flip-flop. Once the reset time delay expires, the flip-flop is ready to detect a switch closure to ground at the input. Once a closure to ground occurs, a positive going signal clocks the "D" flip-flop. Capacitors C_2 and C_3 were initially charged to 12 volts during the reset interval and they begin to discharge. R_2C_2 discharges below the NOR gate input threshold first, causing the 1 Hz astable oscillator to turn on. This astable oscillator is used to drive a small relay or transistor which turns on and off the horn relay in the car. R_3C_3 discharges below the NOR gate input at a much later time, generating a reset command to the intrusion memory. Thus, the complete process can repeat itself if another intrusion is detected.

The complete circuit can be built on a small vectorboard. IC sockets should be used for the CMOS circuits or a grounded tip soldering iron

should be used if soldered. Layout is not critical at all. For those who wish to duplicate the prototype, a 2" x 4" printed circuit board is being made available.[1] The circuit board can be mounted under the dash or under the seat. In one installation, the board was mounted in the trunk. The on-off switch for the alarm should be hidden, but within easy reach from the driver's seat. I would say where mine was hidden, but then it wouldn't be hidden anymore! Most horns use a horn relay located either near the fuse box or near the horn. The relay normally requires a switch closure to ground to sound the horn. If this is the case, then the transistor or relay output from the PC card can be used to connect to the horn relay. Since only four wires are needed to connect this alarm circuit, installation is very easy.

When the driver enters the car, the alarm is turned off, but will be initialized instantly if turned on again. In practice, a time delay of 30 seconds was chosen for the R_1C_1 time constant. R_2C_2 was chosen to be 15 seconds and R_3C_3 is 300 seconds. Either a relay or NPN transistor may be used to trigger the horn relay in the car, depending on how much current must be controlled. Since only two CMOS ICs are used, the circuits will easily fit on a small circuit board and mount under the dash. If the trunk or hood switch is paralleled with door switches, then it too will trip the alarm.

It is comforting to know that your car is being protected against intrusion. Since the alarm is controlled from the inside of the car, it is much more secure from intrusion. ■

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[1] A 2" x 4" single-sided printed circuit board is available from I/O Engineering, 9503 Gambel's Quail, Austin TX 78758. Drilled $4.75; undrilled $3.75. Postpaid USA.

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Contest Special Keyer

- - has short but adequate memory

Due to requests for the circuit of my keyer, displayed at the club home brew night, I decided to present the circuit, as well as a technical description, for those who might want to add it to their own setups.

The keyer portion is of straightforward TTL design.

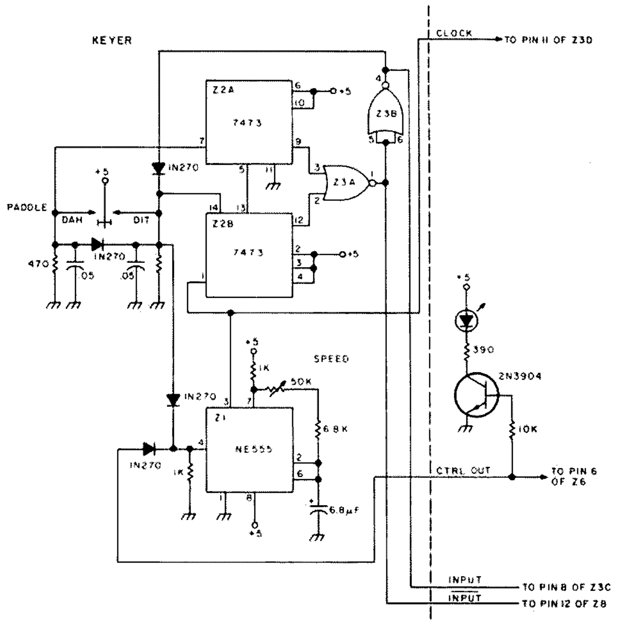
Reprinted from *The Link*, Bulletin of the Buffalo Amateur Radio Repeater Association, Inc., May, 1975.

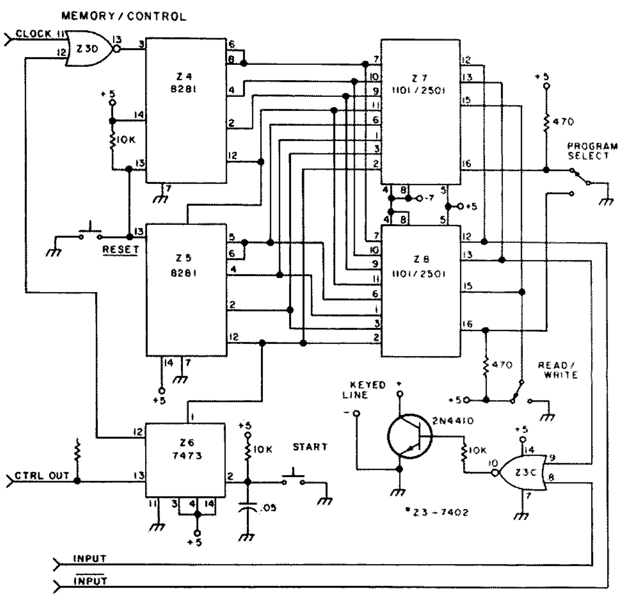
The clock, Z1, is an NE555 timer because of its stability, low cost, speed range and ease of operation. My keyer ranged from 5 to 35 wpm. Flip flops Z2a and Z2b form a counter in which the clock pulses are counted to provide dits and dahs with spaces. Z3a combines the outputs of the flip flops and Z3b inverts this. The diodes connected to the paddles provide self-completing dits and dahs.

Now the memory/control section. ICs Z4 and Z5 are two 4 bit binary counters which act as the "addressing" for the memory, composed of Z7 and Z8. Flip flop Z6 is the memory control. The clock from the keyer is gated with the control flip flop at Z3d to form the clock for Z4. This automatically stops the memory from writing over data just read in from the keyer. The LED gives a visual indication of the state of the control flip flop, telling you that the thing is through. The input to the memory comes from the keyer section. Gate Z3c combines the outputs from the keyer and the memory, allowing you to store and send over the air at the same time. The output of that gate keys a high voltage transistor, which should key any grid-blocked keyed rig. The control output is used to turn the clock on and off in the keyer.

Here's some information on the memory ICs used in the keyer. The 1101 is a static 256 x 1 bit random access memory (RAM). A dit takes 2 bits (dit-space), a dah takes 4 bits, and a space takes 3 bits. The total number of bits you can store is 255. To program this keyer, all you have to do is choose and switch the memory into *write* mode. Hit the *start* button and send the message on the keyer paddles. To send it back, change the mode switch and hit the *start* button. *Reset* will clear the address counter so you can start over if you goof. The address counter counts clock pulses and increments on the negative edges of them. Changing the message takes as long as it takes you to resend it.

This keyer works great, and I use it to send all my CQs and to ID the station when on RTTY. To those who build it, I wish you luck and much success.■





Henry H. Cross W1OOP
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Needham MA 02192

The Chintzy 12

- - a junk box wonder

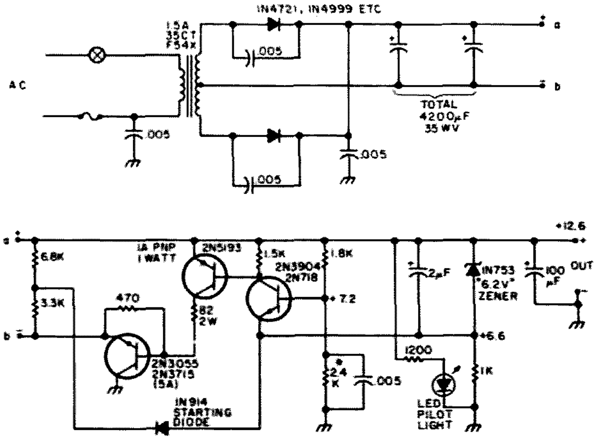

*Fig. 1. 3 A regulated supply (12.6 V). (a) Rectifier. (b) Regulator. The capacitor on the output is a tantalum slug type, of any value over 10 uF. The 3 A unit will carry a typical 10 or 15 Watt 2m transceiver. The 82 Ohm resistor constitutes the short circuit protection. *Adjust to set output voltage.*

This *is* a "how-to-build-it" article, but it also includes some hints in the "how-to-select-parts" area.

The problem with most "how-to" articles is that nobody ever has exactly the right parts. That's what keeps the kit business going. However, assuming that you do have some parts, how do you find out if they are appropriate? If you can find a suitable transformer (mine is sufficient for the cycles you may encounter outside the U.S.) and enough filter capacitance, the rest is sort of flexible.

I built my FM power supply inside a 4" x 8" x 2" aluminum chassis. Getting the transformer into the 2" dimension was a tight squeeze; 2½" would have been better, and 5" x 10" x 3" would have been spacious. The cord, switch, LED pilot light, output socket, fuseholder and the T0-3 power transistor went on one 2" x 4" end, leaving five faces blank. Inside, after finding room for two surplus electrolytic capacitors and the transformer, I wired the circuit on a couple of Cinch-Jones 2012 terminal strips. No sweat; no PC board. Save that jazz for complicated circuits!

Using a bigger transformer or more (thousands of) microfarads could only improve things. The power transistor was bolted directly to ground and the aluminum box provided adequate cooling. If you use a steel chassis, however, you may need some sort of heat sink, but remember that a silicon transistor will work all right even when its case is uncomfortably hot.

Fig. 1 shows the schematic of the 12 V supply. The transformer is nominally 35 V at 1.5 Amps, center-tapped. It weighs about one kilogram. An 18 V, 2.5 Amp unit of about the same weight and size, used with a bridge rectifier, would probably be satisfactory. I wouldn't try to use a 12 V transformer, as there isn't enough reserve for low line voltage. Instructions on checking out the alternative transformer you have on hand are given later in this article.

With the F-54X at a line voltage of only 100 V, the supply put out 3 Amps before losing regulation; at 105 line volts, 4 Amps; at 110 V and up, 5 Amps. For continuous service, two Amps is probably the limit, but since FM transceivers spend most of the time on receive, the low current works OK. The above figures are for 12.6 V out. For higher outputs, the transmit power will increase, but the current capability at any particular

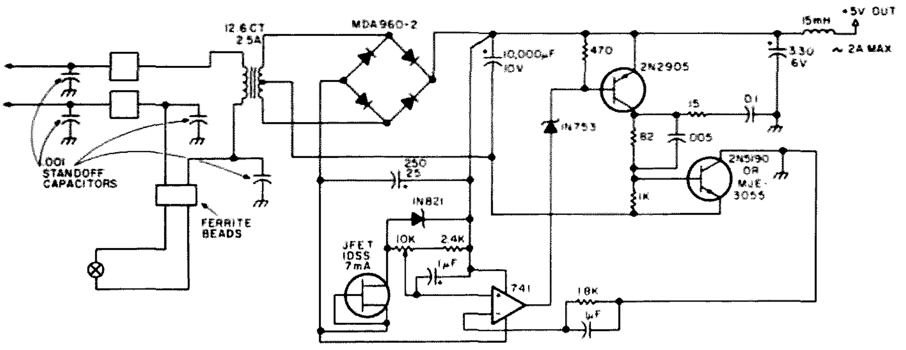

Fig. 2.

primary voltage will be less.

Each diode specified is rated for 300 Amps surge, 3 Amps average and will stand a short circuit long enough for the primary fuse to blow. No heat sinking is needed.

The filter capacitors may see more than 30 V, so you need capacitors rated at either 35 working volts or 25 working volts/40 V surge rated. They should have at least 2000 uF per Amp of rated load (more is better).

The pass transistor I used was a 2N3715 (similar to a 2N3055). The plastic MJE 3055 (or any one of the many T0-3 size silicon NPN power transistors) should be satisfactory.

Although the regulator circuit is simple, it continues working down to less than a volt between input and output – this is unusual. To keep the voltage drop down, the pass transistor is driven from the regulated output voltage, but this means that a separate starting circuit (two resistors and a diode of no particular type) is needed to turn things on initially. Once the starting diode has disconnected (during operation, its cathode is more positive than its anode), the regulator is unaffected by the magnitude of the unregulated input voltage – which is why it wouldn't start without the extra circuit.

Multistage regulators may oscillate. Stabilize this one by putting 10 uF or more (tantalum type preferred) on the output. I used a CS13AE 101K (100 uF, 20 V), because I had a lot of them.

The PNP driver could probably be a 2N2905, but the 1 Amp plastic power transistor (2N4918) I used is harder to blow out and has good gain down to 1 mA. I mounted it inside the chassis with a 4-40 metal screw using the mica washer provided. The 82 Ohm, 2 Watt resistor protects both the transistor and the power supply in the event of a short on the output. If you use higher resistances, you'll get a lower maximum base drive to the pass transistor and less short circuit current.

Depending on the actual voltage of your reference (zener) diode, you may have to adjust the voltage divider in the base of the NPN amplifier. I prefer setting things up with a soldering iron and putting a high resistance across one or the other divider resistor. In this case, I used a 24k Ohm across the 2.7k Ohm, because the 1N753 had only 5.9 V drop at 6 mA. If you put a 1000 Ohm pot between the two resistors, with the 2N3904 base hooked to the arm of the pot, it will still work. The capacitor still goes from base to ground.

Connect a capacitor across the reference diode. I've tried everything from 1 to 40 uF, so the size is not critical.

Place ceramic disc bypasses across the diodes (right across – with very short leads) to reduce hash picked up on AM broadcast sets. A number of commercial supplies, as well as automotive alternator diodes, can cause this sort of interference.

In wiring high current supplies, it is good practice to run wires from diodes and the power transformer directly to the big filter capacitors and then run additional wires from the capacitors to the regulator. Run the input leads together to keep the stray field down – those wires are carrying 10 Amp pulses. In a ham station, it is also smart to filter all leads for rf; audio rectification in a transmitter power supply can give some strange feedback.

A design-it-yourself program is as follows:

a. Measure the output voltage. In this case, given 12.6 V, I added 1 V for regulator variations and 15% for power line variation, for a total of 15.6 V minimum instantaneous (dc minus ripple) input to the regulator at 115 V.

b. Measure the load current and calculate ripple. For 2 Amps, given 4200 uF (that was what I had), peak-to-peak voltage = 2 x 1/120 x 1,000,000/4299 = 3.97. On that basis, required dc is 17.6 V and rectifier load R is 8.8 Ohms.

c. Using a VOM, check the power transformer for the following values: line voltage = 115 V; secondary, no-load voltage = 39 V (10% higher than nominal); ratio of primary to half secondary = 5.9; dc resistance of primary = 9 Ohms. Primary resistance reflected into half secondary is then 9 divided by $(5.9)^2$ = 0.26 Ohm. Measured secondary resistance = 1.1 Ohm; half of that = 0.55 Ohm. Thus the series resistance of the transformer is effectively R_S = 0.55 + 0.26 = 0.81 Ohm. At 20 Amps instantaneous, the diodes I picked have a 1.2 V drop with a slope equal to 0.01 Ohm at that point for a total of 0.82 Ohm.

Referring to the curves,* I put in the ratio R_S/R = 0.81/8.8 = 0.093 and C x R x 2π f = 13 with a result of 20.9 V. From this, I deducted the 1.2 V dropped in the diodes to get 19.7 V dc. Since I needed 17.6 V, this worked, leaving an extra ten percent to take care of transformer heating (the resistance increases when the windings get hot) and nonsinusoidal power line waveforms.

In applications where noise and ripple requirements are moderate, a grounded collector pass transistor is often convenient. Fig. 2 shows the 5 V supply I built for a receiver frequency counter that used LED readouts. The display added a strobed 1 Amp load to the other drain, putting the requirements out of reach of the usual IC units. The circuit, as shown, fit the parts I had on hand and performed well enough down to below 90 V from the power line. I used a compensated reference diode, but a 1N753 will do as well. The FET current regulator (if you have one with I_{DSS} around 7.5 mA) is an improvement over a 1200 Ohm resistor, and of course a 741 is one of the best op amps you can buy for forty cents. The driver and pass transistor are treated like the equivalent parts of the 12 V regulator. (Refer to previous discussion.) The power transformer was a Triad F-26X, 12.6 CT at 2.5 Amps. The 10,000 uF filter is no bigger than necessary. ■

*Originally from O. H. Schade, *PIRE*, July, 1943, but can also be found in the *Radiotron Designer's Handbook* and, with some modification, on p. 108 of the 1976 *Radio Amateur's Handbook*.

You Can Sound Better with Speech Pre-emphasis

-- a simple circuit which will work wonders

73 Magazine *Staff*

This article describes a very useful single transistor stage peaking filter together with a low noise, rf protected preamplifier stage. One of the main features of the circuit is that the overall gain of the filter stage remains essentially constant except at the frequency which is to be peaked. The peaked frequency can be continuously increased in gain up to about 20 dB as compared to the overall frequency response (about 200 to 4000 Hz).

The main application of this filter is to improve speech intelligibility for any mode of modulation, particularly for those of us who tend to be rather bass-heavy. Simple high pass filters can, of course, remove bass frequencies, but that is all they can do. A peaking filter, on the other hand, can be used to emphasize the so-called "presence" effect as hi-fi enthusiasts know it. This means a soft peak in the overall frequency response of a system around 1500-2000 Hz, which adds a great deal to the improvement of speech intelligibility. By choosing a good communications type microphone which normally attenuates frequencies below 300 Hz, and with the aid of a peaking filter, most base-heavy amateurs can achieve a good, solid, communications speech response without sounding unnatural or distorted. The variable gain feature of the filter at the peaking frequency allows one to adjust the filter to suit individual voice characteristics.

A secondary use of the peaking filter circuit in receiver application is as an audio-type CW or SSB filter. Admittedly, there are sharper, single frequency IC designs available for such filters using also only RC components, but the filter design to be shown can be made both variable in frequency (over a narrow range) and variable in peaking amplitude. Thus, by connecting in series two such filter stages which tune 500-1500 Hz, one can peak a single audio frequency with both stages with sharper selectivity, or any one of two audio frequencies independently with variable gain, depending upon how QRM conditions vary.

The circuit of the combined preamplifier and filter stage is shown in Fig. 1. The microphone preamplifier is especially suited for low to medium impedance dynamic microphones, but it will work well with almost any impedance microphone. The ferrite beads, a low Q 1 mF electrolytic coupling capacitor, the 10k resistor and the 200 pF base to emitter bypass in the input stage all are designed to keep rf out. Assuming the preamplifier and filter stage are mounted in a separate shielded enclosure, no rf problems should be encountered. The 200 pF base to emitter bypass is a nominal value. For 2 meter usage, a 100 pF with very short leads is better. For 80 meters, the capacitance might be increased up to 330 or 470 pF. The rest of the preamplifier stage is designed for low noise amplification with a gradual roll-off below 200 Hz and above 4000 Hz. If a still sharper roll-off is desired on the low frequency end, try reducing in value the 1 mF input coupling capacitor to the filter stage. But, keep the

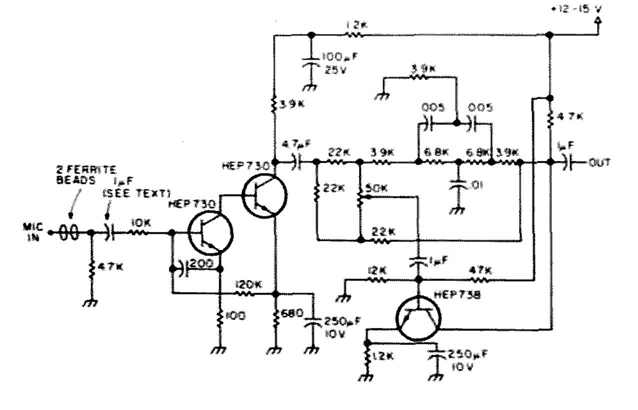

Fig. 1. Circuit of the complete unit. First two stages are a low noise preamp followed by a constant gain peaking stage.

input coupling capacitor an *electrolytic* type. The low Q of such type capacitors offers better protection against rf feedback effects than disc ceramic or paper types.

The HEP 738 peaking filter stage makes use of a parallel T network (R1-R3 and C1-C3) as its primary element with the rest of the circuitry arranged around it to provide a feedback arrangement for peaking while the overall stage gain remains essentially constant. The values shown will produce a peaking frequency of about 1500-2000 Hz. The exact peaking frequency for transmitting application does not seem to be too important if it fails within this range. Thus, nominal 10% tolerance components for the network elements will suffice. If one wants to use the filter stage as a selective filter for receiving purposes, component tolerances should be held to 5% or less. The peaking frequency can be raised or lowered as desired by adjustment of the values in the basic T network. The formula for the peaking frequency is equal to:

$$\frac{1}{2\pi \times C1 \times R2}$$

where R2 equals R3, R1 is half the value, C1 equals C3, and C2 is twice the value.

The 50k peaking frequency amplitude potentiometer will allow adjustment from a flat response (microphone plus preamplifier shaped response) to one where the approximate 1500-2000 Hz range is boosted from 0-20 dB. The determination of how much peaking effect to use is necessarily a subjective one. Probably the best method to use is to make a tape recording using good quality equipment at different peaking levels and request on-the-air comments. Make the receiving operator, however, reduce the af or rf gain on his receiver to a level where you are just intelligible under ordinary modulation conditions. The use and proper adjustment of the filter will not make the difference between a marginal and a solid QSO, but in most cases it will definitely add a noticeable degree of intelligibility and communications "punch" to the audio on any phone transmission. The reason why? There is no simple answer to this, although textbooks such as *Reference Data for Radio Engineers*, Fifth Edition, Chapter 35, will provide all sorts of interesting data on human hearing versus frequency of transmission. Perhaps one of the most interesting charts is that shown in simplified form in Fig. 2. It shows equal loudness contours versus intensity for different frequencies. The curve is generalized, of course, because of the variations in hearing with age, etc. But notice the marked sensitivity of the ear around 2000 Hz. Raising the level of sound transmission at this frequency, where the normal ear is most sensitive, will create the effect of a louder and more intelligible signal. ■

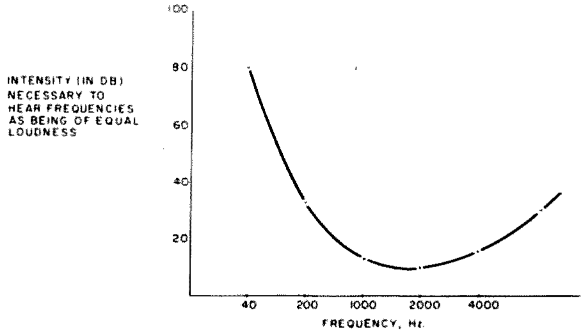

Fig. 2. The reason why boosting the frequencies around 1500-2000 Hz gives the effect of better intelligibility to voice communication circuits.

BE MY GUEST
visiting views from around the globe

from page 11

the transmitters, the Scandinavian countries were especially hard hit by the noise with their radio communications being almost completely wiped out. They poured a continuous stream of complaints into the Soviet Union.

A source at the State Department called the Soviet statement "encouraging," but declined to speculate on the reason for it. He said that despite the admission, the formal complaint was sent.

Articles about the noise appeared in newspapers throughout the world. Government sources were surprised about the great degree of publicity that was generated.

The "Big Noise" is only the tip of the iceberg regarding interference. FCC files currently contain over 300 pending cases of alleged international interference.

Whether the noise will be gone for good is a fact that remains to be seen. Propagation study or transmitter test, the foibles of international politics are involved. We may not have heard the end yet.

Stan Miastkowski WA1UMV
Associate Editor

HF-Texas Style

As reported last month, a series of raids in the Baltimore area late in October netted over sixty-five thousand dollars worth of radio equipment. The engineer-in-charge of the Baltimore FCC office, Robert Mroz, told *73* that, of 19 HFers raided, criminal charges were brought against 18 by the US Attorney's office. Each was charged with between 9 and 33 counts of illegal use of radio transmitters, punishable by fines of up to $500 per day, per violation. One of those involved was a General class ham. Administrative action has been taken against his license.

Early in December, a single raid in Delaware resulted in the confiscation of HF equipment worth $1200, as well as a CB unit that was illegally modified for 40 channel use. FCC engineer Mroz said the office of the US Attorney is helping the Commission catch the illegal operators through cooperation with FCC authorities. In the case of the Delaware raid, a search and seizure order was issued the same day the HFer was located by an FCC monitoring station.

In mid-November, two FCC agents, six US marshals, and ten police officers raided a home in Houston TX. They confiscated 20 linear amplifiers ranging in power from 250 Watts to a *6000 Watt* homebuilt unit using television transmitter tubes. At press time, charges were pending against three men in connection with the raid. Houston engineer-in-charge Allan Kantrall said that it was believed that one of those facing charges was selling the linears to fellow HFers. He added that a group of neighbors applauded the confiscation, as television reception in the neighborhood had been disrupted.

Kantrall told *73* that the Houston office faces an extremely severe problem in dealing with illegal activity because the Texas area has the highest concentration of CBers in the country. The city of Houston has the greatest number of CB licenses of any city in the United States, according to the FCC. Kantrall said his "greatest headache" is the use of linears. A few years ago, power levels of one to two hundred Watts were common. But with the increase in activity, illegal operators have had to go to higher and higher power in an effort to drown one another out.

Along with the out-of-band activity and linears, the FCC engineer added there has been a huge increase in profanity and threats over the air, which has resulted in beatings, stabbings, shootings and even murder.

Kantrall hopes that a large public service effort on the part of the Houston office will help to educate the public about FCC enforcement operations and the results of illegal activity. In one recent case, FCC personnel spoke to a gathering of over 5000 CBers.

Despite a shortage of enforcement officials and monitoring equipment, FCC officials do not intend to let the illegal activity continue. Raids and prosecutions are expected to continue. In fact, after the recent raids in Baltimore, FCC engineer Mroz said that as of year's end there were "no HFers operating in the state of Maryland."

Warren Elly WA1GUD
Associate Editor

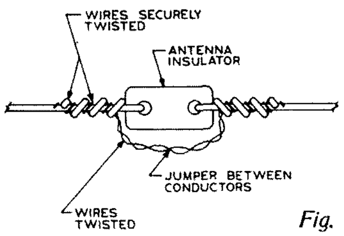

Fig. 1. Splicing technique.

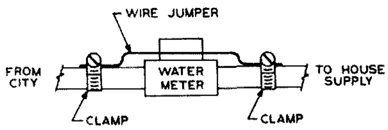

Fig. 2. Grounding technique.

Are You Really Insured?

-- time to read the fine print

Amateur radio operators are familiar with Morse code, but how many have taken the time to learn the National Electrical Code (NEC)? The purpose of this article is to familiarize you with the provisions of the NEC and how they apply to the amateur radio station and to give you some common sense applications of these rules. Compliance with these rules, by the homeowner ham, could prevent the loss of both home and fire insurance. Many insurance policies contain the clause that, if fire occurs and the investigation shows NEC violations, benefits payable under the policy may be disallowed. Ignoring the insurance requirements, the NEC provides for a safe and efficient installation and should be given serious consideration by the ham.

ANTENNA SYSTEMS – GENERAL

Material

To comply fully with the NEC, the antenna must be comprised of hard-drawn copper, bronze, aluminum-alloy, copperclad steel, or other high strength, corrosion resistant material. Soft-drawn or medium-drawn copper may be used for lead-in conductors where the maximum span between points of support is *less* than 35 feet. Table 1 shows the required size of conductors for amateur receiving and transmitting antenna systems. As you can see, most spans will require at least number 14 wire.

Outdoor antennas and lead-in conductors (including vertical antennas and dipoles) shall be securely supported. The antenna must *not* be attached to any electrical service mast or pole (this includes utility and telephone poles). No antenna can be mounted on a pole or similar structure carrying electrical light or power cables of more than 250 volts. The antenna and its supports should be located far enough away from the various power lines that in the event that the antenna or support falls, contact with these power lines will be avoided.

To apply this rule for, for example, a 21 foot vertical, locate your antenna so that if you were to visualize it as the center of a circle with a radius of 21 feet, at no point in that circle would you find a power carrying cable. If you are able to find a clear 21 foot radius, you have found the best location for your mast.

A sturdy mount and enough guy wires to provide the necessary strength to withstand ice and wind loading conditions should be installed. The guy wires should be located well away from overhead conductors of electrical light and power circuits.

Avoidance of Contact With Other Conductors

Outdoor antenna and lead-in conductors from the antenna to a building should not cross over electric light or power circuits and should be routed well away from these power lines to preclude accidental contact. If proximity to power service conductors carrying *less* than 250 volts cannot be avoided, there must be at least two (2) feet of clearance.

The code recommends that these antenna conductors be installed in such a manner that they neither cross *over* nor pass *under* power carrying conductors. The reasoning is sound: In the event that your conductor was above the power line and fell, it would short the power cable and impress high voltages into your antenna system and allied equipment. Conversely, if your cable was below the power line and it fell, the power conductor would short to your system and again impress a voltage on your system, causing a safety hazard.

Splices

Any and all splices on the span should be made with approved splicing devices and offer a firm mechanical joint. Soldering may ordinarily be expected to weaken the conductor. One method is to use an antenna insulator (as shown in Fig. 1) and jumper between the two sides. This will provide a firm mechanical connection as well as an

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electrical path. Several layers of electrical insulating tape may be applied to the splice if desired.

Grounding

The NEC requires that masts and supporting structures be permanently and effectively grounded with no splice or connections made to the ground wire. The easiest method of providing a good ground is taken from the telephone company and requires that a conductor of at least AWG 12 (copper) or AWG 8 (aluminum) be run from the mast to the cold waterpipe. The lawn sprinkler faucet located on the outside of many homes is a good termination point for our ground.

In order to use this system, you must first verify that there is a direct metallic path through the cold water pipes. A visual inspection will show you if you have metal or plastic pipes. Assuming that you have metal pipes, follow them to the water meter.

Use your ohmmeter to verify an electrical path through your water meter. This is necessary because certain water meters have an insulated coupling. If you do not have a metallic path through the meter, refer to Fig. 2 and sand or file an area at least two inches wide around the pipes. Coat this shiny area liberally with Vaseline and install two grounding clamps (one on each side of the meter). Run a conductor of at least AWG 14 between the two clamps and connect the ends of this wire to the clamps. You have now made a metallic path, and can use the outside faucet fitting for your ground termination point. Prepare this pipe in the same manner as you prepared your water pipe bridge and fasten your ground wire securely to the ground clamp.

Alternatively (in the case of plastic water pipe), drive a ground rod into the ground and connect the ground wire firmly to the rod. Because of the differences in soil resistance, the water pipe method of grounding is recommended wherever feasible.

Lead-in Conductors

Lead-in conductors for amateur radio stations shall be at least as large as the antenna conductor shown in Table 1. For example, a long-wire antenna fed with a single wire should carry the same sized conductor for the antenna and the lead-in (150 foot antenna – AWG 14).

Material	Minimum Size of Conductors When Maximum Open Span Length is Less than 150 feet	Over 150 feet
Hard-drawn Copper	14	10
Copperclad steel, bronze, or other high strength material	14	12

Table 1. Amateur station antenna conductors.

CONNECTIONS TO BUILDING AND SYSTEM

Clearance on Buildings

The antenna conductors, if attached to the building, should be firmly mounted clear of the surface. These standoff insulators must provide three inches of space between the wall of the building and the conductor. In the case of a permanently and effectively grounded wire enclosed in a continuous shield (coax), the three-inch requirement is negated.

Entrance to a Building

Except in the case of coaxial feedlines, all lead-ins should enter the building by one of the following methods:

1. Through a rigid, noncombustible insulating tube or bushing.
2. Through an opening provided for that purpose in which the entrance conductors are firmly secured to provide a clearance of at least two inches.
3. Through a drilled window pane.

Safety and Protection

Protection Against Contact: Each conductor of the outdoor antenna should be located in such a manner that accidental contact with them is difficult or impossible.

Lightning Arrestors – Transmitting Stations: Each conductor of an outdoor antenna should be provided with some method of static charge drain (either a switch or lightning arrestor). The only exceptions to this requirement are as follows:

1. Where the conductor is protected in a continuous metallic shield (coax) and is permanently and effectively grounded.
2. Where the antenna is permanently and effectively grounded.

System Grounding Requirements

Grounding systems for the transmitter and the receiver follow the same basic rules set forth in the section on antenna grounding. However, the size of the conductor must not be less than AWG 10 (copper) or AWG 8 (aluminum).

Interior Installations

It is advisable to have a separate power line for radio transmitting equipment. Ideally this should be run in separate conduit or Bx (consult local electrical code) and separated from the normal house power wiring by at least four inches. This circuit should be fused and the conductors capable of carrying the rated current load. Past experience in installations has shown that if one takes the entire current requirement and allows about a 25% safety factor for future expansion, this total figure will give a much more realistic guideline to the choice of conductors. For example, if we calculate that our total current drain is 15 Amps and we allow an additional 5 Amps for future expansion, we arrive at a figure of 20 Amps. The wire table shows that the best choice of wire size for this load would be AWG 12. Fusing should also allow for this current level but should not exceed the current carrying capacity of the wire chosen.

Transmitters – General

The transmitter should be enclosed in a metal frame and have a barrier (either panel or mesh) separating the inner works from external contact. (The transmitter cabinet fulfills this requirement.)

All external metallic handles and controls accessible to operating personnel should be effectively grounded.

No circuit in excess of 150 volts should have any controls or parts which carry this voltage exposed.

All access doors should be provided with interlock switches which will disconnect voltages in excess of 350 volts when these doors are opened.

SUMMARY

We have explored the code and seen that many of its requirements are founded on safety. It would be wise to abide by the dictates of the NEC. This will increase the safety and efficiency of your operation. Using common sense, a grounding rod and interlocks on your transmitting equipment will help avoid injuries and enhance your enjoyment of amateur radio.

Before implementing these rules, check with your local electrical inspector and get a copy of your local electrical code. There may be some deviations from the NEC, and, in order to be safe and legal, you must be aware of all local as well as national electrical code requirements as they apply to amateur radio stations.

Remember, the code complying station is a safe station . . . so let's code it. ■

Getting a Patent--

Is It Really Worthwhile?

--how to do it, if you really want to

George A. H. Bonadio W2WLR
373 East Avenue
Watertown NY 13601

Because of the very nature of our amateur hobby, we have more inventors per banquet table than at any other conventions. Inventors bring up the idea of patents. Patents bring up thoughts of publications from the Commissioner of Patents, like: "Rules of Practice," "Answers to Questions Frequently Asked About Patents," "Patent Laws," "General Information Concerning Patents," "Office Consolidation of the Patent Act," "Guide for Patent Draftsmen," and so on, little of which I want to mention here.

Besides completing a course on patents and their management, I have seven patents, an eighth applied for, several abandoned, one infringed and the usuality of none producing an income.

What Is A Patent?

Your patent is a legal document proving that you first made public a "new and useful device, process or plant" and therefore can legally go to court and "start an action" against someone else who refuses to recognize your monopoly rights so granted. In this court action you are alone. The government will not help you.

Your patent (and its rights) is a thing which you can sell entirely, or in part, or license out under any kind of restrictions, or keep all to yourself. It lasts 17 years from its "date of issue."

What Does It Entitle Me To?

For 17 years, if you do not dispose of it, it entitles you to charge all the traffic will bear upon all those who will commercially use your patent. It lets you spend a fortune in each court "action." If you are "small" and it is "big," you can expect some legal rough-and-tumble action with it before the end of 17 years. You can sue up to triple damages on infringers, who will be ready for you. They may counter with a suit that proves that your patent is invalid, for some little oversight. Then you are entitled to pick up the heavy court costs.

How Do I Proceed?

Be sure that you have something which is "new and useful." Send $3.25 to the Superintendent of Documents, Washington, D.C. 20402, for a copy of "Patent Attorneys and Agents Available to Represent Inventors Before the U.S. Patent Office."

Find the nearest several patent attorneys, who do not advertise, and write or call each, asking, "Do you handle electronic patent applications for private inventors?" Do not use an attorney who discourages a preliminary visit by you.

You will have to trust this attorney in many facets. Be sure he has a good reputation. Inquire around. Ask him who he has worked for in the past and talk to them.

You cannot assay the market for your item by yourself. You are too biased. You must use friendly advice. I'll tell you now that it will be darker than your outlook. Companies spend heavily to introduce new items. Is yours worth it?

Is It Patentable?

A "search" by your attorney's agent in Washington will cost up to $100. It will pop up with patents back to the last century (which were better than your idea) or a diagram from the pages of *73 Magazine* which is completely unrelated, you point out.

I "invented" a terrific navigational device for the last 200 feet of a plane's descent onto a runway (using 7 kHz and 9 kHz whole field loops) only to find it had been "issued" the very day I "invented" it. (Yes, I'm good at ESP, giving demonstrations at conventions.) However, the real inventor has not gotten it onto the market. It is simple, foolproof, unobstructive, workable in a power dead plane, inexpensive, and on and on, but it expired in 1961, unused.

Is It Competitive?

If your invention costs more and does less, you are dead. If it costs less and does more, you still have only a fighting chance. It has to be much better on the market than what is there now, or you will not even get a hearing. Even if it is good, who is going to risk his present profits to see if the crazy consumers will do him much better on your item?

Who Will Market It?

A company with back orders now may tell you to go away. A weak company may tell you that it cannot afford the big risk to tool over to your invention. A speech compressor company doesn't care about your new antenna system.

Your best marketer is your own company, and the best patent is one developed for your own company to advance on from its present successful position.

Patents from outside a company are immediately suspect. They are not in line with plans. They can embarrass the company engineers. The claims may not be well-written for their uses.

Where Is A Patent Attorney?

He is on the other end of your phone or letter, or in court. If he does not go to court for his clients, he may not be able to help when you most need someone who understands all of your patent.

He is in there working with you on your selling or licensing agreement (in his office, not yours). Your regular lawyer is not very informed on patents. Patent laws are in a world by themselves.

If you cannot spare a thousand dollars and a hundred hours per patent application, don't start. There are filing fees, artist fees, attorney fees, and final fees, at least, on top of mail and phone and travel in business hours.

Less than one quarter of one percent of patents "issue" on the first "action" by the Patent Office "examiner." However, my Box Diagonal Antenna did, and this saved me, perhaps, $200 in additional fees. My attorney and I would have had to argue around the examiner's "action" with a new "response" material, if I could, or "abandon" the whole thing. Sorry, no refunds.

The attorney, if he is experienced in working for corporations, can do an excellent job for you. If he is an advertising attorney, he cannot show you that one half of one percent of his inventors have ever made a profit on any one of their patents. Most of the corporate patents are credited with netting $1, or more. Think about it.

What Do I Claim?

Your attorney will have to rewrite what you claim in language you can scarcely understand. What you display, but do not claim, is gone. What you claim, but which the examiner "disallows" or "rejects," is lost.

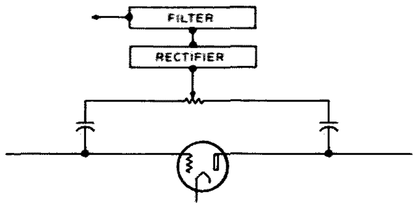

Fig. 1. The Bonadio Automatic Distortion Control, Patent #2,634,339. The tap position is at the null of detection, with distortion-free output. Any distortion will produce a detected signal at this setting, and can be used for automatically controlling the distortion level.

When your claims are long and have many conditions, they are "narrow" and cost more for attorney's fees than they are worth to you or anybody else.

The only test of a patent is in court, which you would rather not invite. A good patent is in a newer field, like electronics, rather than mechanics, and has no near misses in the "search," no near collisions with the "examiner's actions," has a few adjustments of the "claims" to satisfy the examiner, and covers all possible variations by an "omnibus claim," which covers the field like a tent.

How Secretive Must I Be?

Ask your patent attorney. On a simple patent, he may have you out hawking it after it has been filed for three months or, if it is a complicated patent, after six months from filing date. After you file an application, a later similar filing, by another inventor, produces an "interference." The later inventor must prove that he was "diligent" in getting his application filed, even while he must also show that he actually invented it, or "reduced it to practice" before you did. He's got troubles.

My fastest invention took months to prepare for filing, only 23 months in the Patent Office, and issued July 1, 1969. It had no extra "actions" and "responses," which could extend a few years its time while "pending."

After your patent attorney has notified you of your filing date and number, you must, in public, refer to your invention as "patent applied for," either by a note in the text or by putting that phrase on the item for sale, or you can lose your rights.

Later, after the examiner has allowed one or more claims, you must refer to it as "patent pending." Actually, you may obtain more claims many months later, and then "issue" six months or more after that.

As soon as you conceive it, or even before, you can contract to sell it, say, to your employer, as part of keeping your good job. Have your patent attorney do all the contract paper work, even if your company has its own patent attorney. Yours will earn his pay for you.

If it's a company patent, you may get a guaranteed first option on any job in the company for which you can qualify, during the life of the patent. You might extend this to your child, and even to your family, if the patent is valuable in keeping the company going. This type of payment can be a bigger reward than any cash outlays that the company can afford.

This department is where your patent attorney's talents will show up – trust him.

What's An Interference?

It's a signal that two minds are on the same idea and filed patent applications at nearly the same time. If you filed second, save your money. Abandon it right there.

If you filed first, and the other party is in a company which was planning to use it, you have a captured audience. Have your attorney contact them at once to see about improving the claims to satisfy them and to license the application to them the best way your attorney can.

What If My Claims Are Rejected?

Then you have wasted considerable time and money. Forget it. Abandon it. A true inventor has more good ideas than he can afford to try and probably has an application brewing at all times.

Should I File?

This question finally has to be answered. If you are working in, for, or with a company which will use the patent, by all means, yes. If you have a financial backer, whom you do not have to repay (by a contract approved by your patent attorney), again, yes. However, if you are like the 220 private inventors who attended an inventors' convention in Cleveland, who all agreed that none, representing about 400 patents, had made a profit on any one patent, the answer is no.

The typical private patent covers an invention which not enough people either need, want, will pay for, or will switch over to. This typical home invented patent does not fit in with any manufacturer's planned progression.

If your patent, like my Automatic Distortion Control (Patent #2,634,339), can be buried in a large electronic device, forget it as a private invention. I can show how I was invited by the military to sue for damages; they even gave me the contract numbers. Two manufacturers, whose names you know, have used the ADC. Possible royalties are not worth the tens of thousands of dollars I would have to risk to fight the cases.

The Bonadio Automatic

Distortion Control is the ultimate in electronic simplicity, a desirable patent trait. In Fig. 1 there is a blocking capacitor, or two; a bridging resistor between input and output of a tube, valve or transistor; a tap on that resistor leading to a detection unit, such as a diode; and a filter. Without distortion it detects no signal, the tap being at the null. As distortion increases, the null point moves away and useful output develops, which can be used to reduce both the gain and the distortion. For example, on a transistor radio it would hold the audio output to all the quality output possible, even following a dying battery down in output. Imagine all transistor radios with no audible distortion!

Unless you are a big manufacturer, you cannot police infringers on this size device. I can't. An infringement suit could cost me $40,000 if I lost, to say nothing of the years of anxiety involved. One's health has quite a value, too.

As long as a manufacturer knows that I cannot afford to sue him, he knows that he can use it without fear from the patent owner. He will never buy it from me under these conditions.

His only fear would be that I might put it into profitable use myself, and then be able to sue him. While this hope, on my part, is futile for my ADC, it could happen with something wholly covered by patents and harder to bury, such as my several antennas. However, he can see my operations and calculate my actions years in advance and prepare to negotiate, fight or abandon the device. He knows that no other manufacturer will be foolish enough to pay for what he, too, can have free, especially in a small device.

What's The Success Ratio?

Aiming to increase my success ratio, my latest patent applications and patents have been in units entirely covered by a patent, not just a small bit circuit in a huge monster assembly. Not only that, but they stand exposed outdoors – for all to see, instead of buried, as in the ADC.

I estimate my first antenna patent possibility of producing a profit at about one in 500! With the related second patent I probably improved my chances to one in 50. Now, with the third, a "continuing patent," I believe that my chances are as good as one in five! I have had some encouraging results on one more patentable advance on these. If it works out, some years from now I should be able to negotiate.

How Do I Negotiate?

You negotiate through your attorney, at about $25 per hour. You don't make a move without his approval. He will probably let you advertise to your heart's content after you have been filed for three months or more.

Your problem is to find someone who can be convinced that he cannot afford to ignore your patent – and to convince him of this fact. I found that antenna companies receive about a dozen offers a year. Compare this with the number of really new antennas on the market each year.

Nobody Wants Them?

I mailed 157 notices to antenna companies. Seven addresses were returned as "unknown." Five gave useless responses. Then I mailed a series of three hard hitting letters to 19 likely manufacturers. Four (a splendid response) inquired further. None want to test under the conditions I recommend.

Although I warned that my antenna "effects" happen only in the ionosphere, one turndown referred to a computer test and another to an all earth test range. No company has tried them in the ionosphere yet.

A small, friendly manufacturer, whom I phoned, told me that he could not sell his patents either, so he and his wife struggled for ten years and now are doing fine as a manufacturer. He suggested the same route for me.

Use Them Or Lose Them?

Because of the fast moving electronic advances, patents are generally estimated to have a 5 year profitable life, out of their 17 year legal life.

Like anything else, if you don't use them, you lose them, and I estimate that I have spent over 1,000 hours on these few.

What Should Be Done?

Don't become like the neurotic inventor, who produces a patent that only he could love and then spends the rest of his life wasting his time, money and health trying to force it on a world which won't have it.

Don't deprive your family of its needs in order to obtain a $1,000 patent. The odds are over 200 to one against getting your money back.

Don't expect a patent sales agent, to whom you are fair game, to sell your patent any better than you can, for his price. He doesn't sell 1% of his customers' patents.

Don't keep an invention buried until you can afford a patent. Name the circuit after yourself and sell a story about it to the editor. He will pay you for the story. If the circuit is continuously usable, you will have your name hung on it, and you will be immortal. That's better than an expensive dead patent which you might, helplessly, see infringed under another name (my ADC infringements were under two other descriptive names) after you paid for a patent to have your own name known.

Do ask the editor to spell your name right, like B-O-N-A-D-I-O's ADC. ■

Social Events

from page 22

Annual Ham Auction, Sunday, March 20, 1977 at the Lucas County Recreation Center, Maumee (Toledo), Ohio. Auction, flea market, commercial displays and good eyeball QSOs. Time: 8 am to 5 pm. Admission: $2 advance, $2.50 after March 1, 1977 or at the door. Talk-in on 52-52 and all Toledo area repeaters. Send SASE, Toledo Mobile Radio Association, Inc., Box 7548, Oregon OH 43616.

COLUMBUS GA
APR 2-3

The Columbus, Georgia Hamfest will be held April 2 and 3, Palm Sunday weekend, at the Fine Arts Building at Fairgrounds, 9 am to 4 pm daily. Flea market, ham auction, prize drawing at 1:30 pm Sunday, talk-in 28/88, 3975 kHz, buffet dinner Sat. at 8 pm. For more information write K4JNL. Advance tickets: K3MTY/4, Rt 5, Box 750, Phenix City AL 36867.

GRAND RAPIDS MI
APR 2

The Third Annual Swap and Shop will be held at the Northeast Jr. High School, 1400 Fuller Ave., N.E., Grand Rapids, Michigan, on Saturday, April 2 from 9 am to 5 pm in the cafeteria. Featured will be: CBs, monitors, ham equipment and electronic parts. For further information contact Grand Rapids React at the above address.

ST. CLAIR SHORES MI
APR 3

The South Eastern Michigan Amateur Radio Association is holding its Nineteenth Annual Hamfest on April 3, 1977 from 8 am EST to 3 pm EST. It will be held at the South Lake High School in St. Clair Shores, Michigan, 21900 Nine Mile Road and Mack Avenue. For further information contact Dorothy Spilski WB8PRJ, Secretary S.E.M.A.R.A., 11906 Riad Avenue, Detroit, Michigan 48224, 313-521-6646.

PLAIN CITY OH
AUG 14

Hamfest 77 is to be held on Sunday, August 14, 1977 at the Plain City Fairgrounds, Plain City OH. Talk-in on 146.16/76 or 146.52. Advance tickets $1.50 – gate $2.00. For additional information or reservations, write UCARC, 13613 U.S. 36, Marysville OH 43040, or call Gene Kirby W8BJN 513-642-9861.

J. A. Kvochick WB8AZP
169 West Overdale Drive, Apt. A
Tallmadge OH 44278

Keeping the Wind Down

-- timer for your mobile rig

"Timing a repeater out," as the jargon goes, may not seem to be a significant event for the user, but it can generate a fury of activity on the part of the control station. With the addition of the timeout timer/alarm shown here, one can help minimize repeater timeouts.

The timeout timer/alarm does essentially one thing — keeps track of the length of time that your transmitter is on, and if it has been on longer than its timing period, deactivates it and sounds an audible alarm in the rig's own speaker. Resetting the circuit is accomplished by releasing the PTT button. If transmissions are made of durations shorter than the timing period, the normal operation of the transceiver is not affected.

The circuit operates in the following manner: Under normal conditions, point D on the schematic (collector of Q2) follows point A (base of Q1); that is, grounding point A provides a transmitter PTT ground output at point D. Generation of the warning tone and elimination of the PTT signal only occurs when point C is low and point B is high. This condition only exists if the PTT button is held in after the timer A1 has disabled the transmitter. The warning tone generated by timer A2 produces a tone in the transceiver's speaker at this time. Once again, resetting the circuit by removal of the PTT ground at point A instantly readies the rig for normal operation — until you talk too long again!

Construction is relatively simple, and should probably begin with the selection of R3 and C3, the main timing components. These values can be selected from the table or by calculation (Fig. 1). A potentiometer could be substituted for R3, but in my prototype I was interested in conserving space. My prototype was constructed on a 1" by 1.5" board and was installed in an Icom IC-230.

Hookup of the circuit requires that you break the normal PTT line, reconnecting it to points A and D, attaching the free end of R7 to the positive speaker terminal, and applying +12 volts and ground.

This circuit has already proven itself useful on more than one occasion, and I hope others will find it handy in helping to prevent unnecessary repeater timeouts. I would also like to thank Bruce Bechtol K8VAK for his assistance in the circuit's design. ■

1 Megohm Resistor

Time in Seconds	Capacitor in uF
30	27
60	54
90	81
120	109
150	136
180	163

1.5 Megohm Resistor

Time in Seconds	Capacitor in uF
30	18
60	36
90	54
120	72
150	90
180	109

2 Megohm Resistor

Time in Seconds	Capacitor in uF
30	13
60	27
90	40
120	54
150	68
180	81

Fig. 1. R and C for timeout timer. $T_{(seconds)} = (1.1\ R3C3)$.

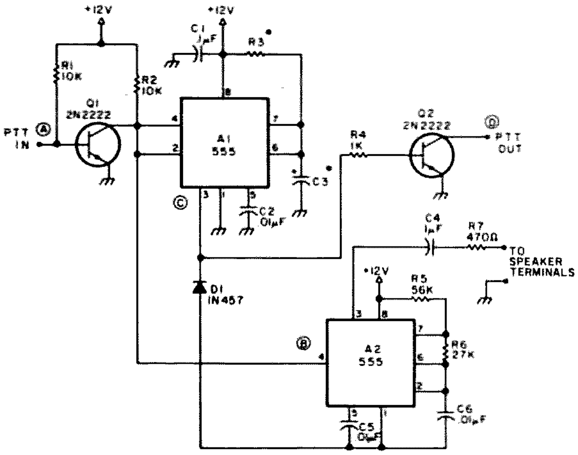

Fig. 2. Timeout timer with audible alarm. C1 — .1 uF disc; C2, C5, C6 — .01 uF disc; C3 — see text; C4 — 1 uF 12 volt capacitor; R1, R2 — 10k Ω, ¼ Watt; R3 — see text; R4 — 1k Ω, ¼ Watt; R5 — 56k Ω, ¼ Watt; R6 — 27k Ω, ¼ Watt; R7 — 470Ω, ¼ Watt; D1 — 1N457A diode; Q1, Q2 — 2N2222; A1, A2 — NE555V.

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SSB: The Third Method

- - bet you can't even name the first two

I first ran across this particular method of SSB generation some years ago when involved in a communications course. At the time I was deeply involved with getting a phasing type SSB generator on the air and only gave this method a casual glance. Never having heard of this method in the amateur journals, or of a commercial unit using this type, I was inclined to write it off as an impractical method, as I am sure many others have done before and since. This assumption couldn't be further from the truth, as the Third Method is in direct competition with the filter method. It requires neither sideband filter, nor wideband audio phase shift network (as in the phasing method), does not require critical adjustment, and any misadjustment results in interference to the user only.

As you can see, this method has much to offer the radio amateur and indeed the commercial user. The original paper on this subject was by D. K. Weaver, Jr., titled, "A Third Method of Generation and Detection of Single Sideband Signals," *Proceedings of the IRE*, December, 1956. At present this method is used in commercial equipment manufactured by Redifon Telecommunications, England, and has been since a unit was introduced in 1960.

Enough of the selling job on the Third Method – let's get into the circuit description. If you will refer to the block diagram of Fig. 1, you will note that we have four balanced modulators. These can be of any configuration. Balanced modulators A1 and B1 are operating at audio frequencies, so layout is not too critical. The circuit also requires phase shift networks. Since these are operating at only one frequency, obtaining an exact phase shift is no problem and even RC networks can be used. This application also lends itself well to digital schemes, one of which is shown in Fig. 3. The low pass filter (the one from the original paper is shown in Fig. 4) is also operating at audio frequencies and can be constructed using LC networks. It is also possible to use active audio filters.

The input audio consists of 300 to 3,000 Hz, the normal bandwidth of speech communications. When these frequencies are mixed (in balanced modulator A1) with the 1800 Hz oscillator, the modulation products that appear in the output are as shown in Fig. 2(b). In particular, note that the lower sideband is "folded" over. This results from the choice of carrier frequency. The carrier frequency is actually in the middle of the audio spectrum to be transmitted. As an example, consider an input audio signal of 500 Hz. When it is mixed with the carrier frequency of 1800 Hz, the modulation products (sum and difference components) are 1300 Hz and 2300 Hz. Next consider an input audio frequency higher than the carrier frequency, for example, 3100 Hz. When it is mixed with an 1800 Hz signal, the modulation products are 1300 Hz and 4900 Hz. Thus at the output of balanced modulator A1 we have a lower sideband which has the audio frequencies higher than 1800 Hz folded back on top of the lower audio frequencies – and all this is contained in a bandwidth of 1500 Hz. An upper sideband also extends from 2100 Hz to 5100 Hz. The upper sideband is then filtered out by the low pass filter, leaving only the lower sideband as shown in Fig. 2(c).

This "folded" lower sideband is then applied to balanced modulator A2, where it is mixed with the rf carrier.

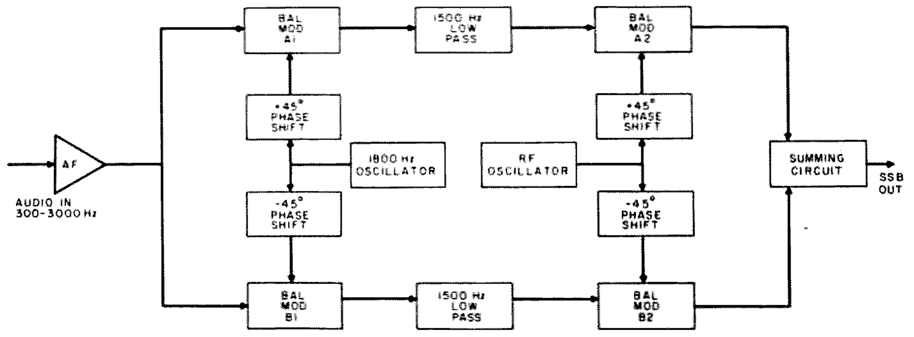

Fig. 1.

The rf carrier may be the operating frequency, or a lower frequency which is then heterodyned to the operating frequency. The output of this balanced modulator is shown in Fig. 2(d). It consists of the 0-1500 Hz "folded" sideband from modulator A1 as two double sidebands of the rf carrier, which is balanced out in A2. A careful analysis of this diagram will reveal that we are once again back to our original bandwidth of 3,000 Hz. Also, because there are both high and low original audio frequencies represented in both the resultant sidebands of balanced modulator A2, we will have both inverted and direct speech contained in the 3,000 Hz bandwidth of Fig. 2(d).

It has been shown by the phasing method of SSB generation that by using two modulator chains of the proper phases we can generate two sets of sidebands, which when added together result in cancellation of the unwanted sideband and reinforcement of the wanted sideband. Much the same technique can be used here, with the Third Method. By using two modulator chains, as shown in Fig. 1, and the proper phase shift networks (quadrature), which as stated before are for only one frequency and can be made to exhibit the exact phase shift needed with little trouble, and then adding the output of these two chains, we can reinforce the wanted sideband and cancel the unwanted sideband. The result is illustrated in Fig. 2(f). For additional clarity, the outputs of modulator chains A and B are shown in Fig. 2(e). Note that both sidebands occupy the same frequency spectrum, as well as the 180 degree phase difference between the lower sidebands.

It can be seen in Fig. 2(f) that the carrier frequency of the SSB signal, in this case for upper sideband, appears 1800 Hz below the rf oscillator frequency of the generator. This means that the carrier frequency of the sideband signal is actually not generated (due to the use of the folded sidebands). Therefore, any misadjustment of the final balanced modulators will result in the rf carrier appearing in the middle of the sideband spectrum and causing an 1800 Hz tone to be heard on the receiving end. The important fact is that no out-of-channel interference will occur. Only the user will suffer from misadjustment. Another important fact is that if there is incomplete sideband cancellation, again no out-of-channel interference will occur. The unwanted sideband will appear in the same spectrum as the wanted sideband, causing interference to the user only.

This method of single sideband generation has some very positive advantages over both the filter method and the phasing method of single sideband. I have included some sample circuitry of various parts of the Third Method SSB generator. If you are considering building an SSB generator, I hope that you will give serious consideration to the Third Method. Though it is rather complex, the construction and alignment is simplified, due to the fact that most of the circuit is at audio frequencies. The advantages are many. If anyone is interested in a more detailed and mathematical description of the circuit operation, any of the references listed will be of help. Good luck with

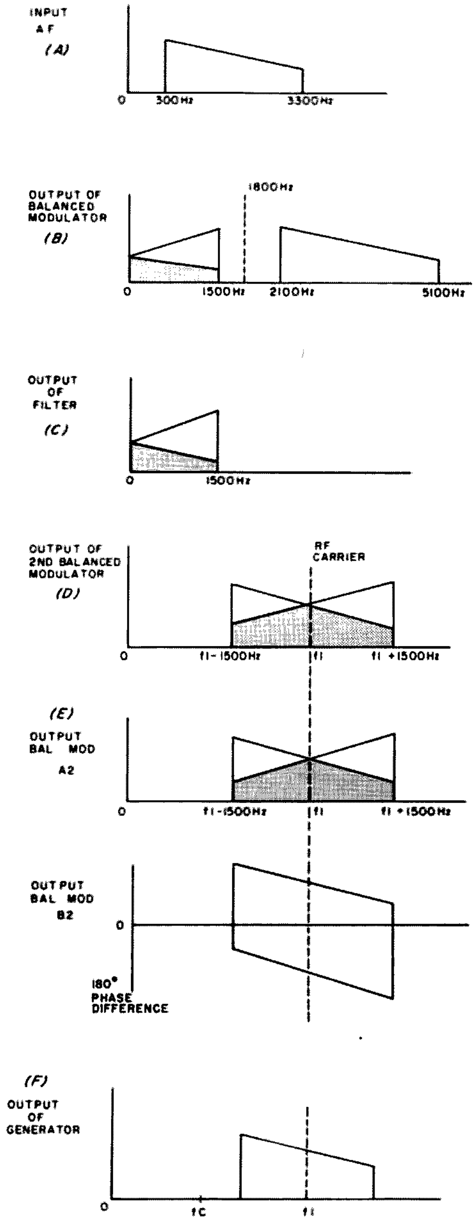

Fig. 2. (a) Represents average speech power distribution. (f) $F_C = F_1 - 1800$ Hz (upper sideband output).

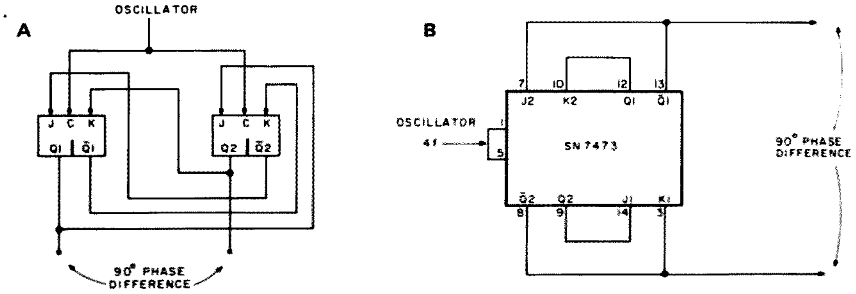

Fig. 3. (a) Using two JK flip-flops to obtain a 90° phase shift for use in Third Method generators; oscillator frequency must be four times the desired output frequency, i.e., for 1800 Hz output, oscillator frequency is 4 x 1800 = 7200 Hz. (b) 90° phase difference network using dual JK master-slave flip-flop 7473.

building a Third Method generator, and I hope to hear many of you on the air. ■

References

D. K. Weaver, Jr., "A Third Method of Generation and Detection of Single Sideband Signals," *Proceedings of the Institute of Radio Engineers,* 1956, p. 1703.

J. F. H. Aspinwall, "The 'Third Method,' " reprinted from *Wireless World*, January, 1959, courtesy Redifon Ltd., England.

Pat Hawker G3VA, *Amateur Radio Techniques*, Fifth Edition, Radio Society of Great Britain, 1974, pp. 40-41.

George Kennedy, *Electronic Communication Systems*, McGraw-Hill Book Company, 1970, pp. 144-147.

Capitol Radio Engineering Institute, Washington, D.C., "Single Sideband I," copyright 1958, McGraw-Hill, 1974 Edition, pp. 33-38.

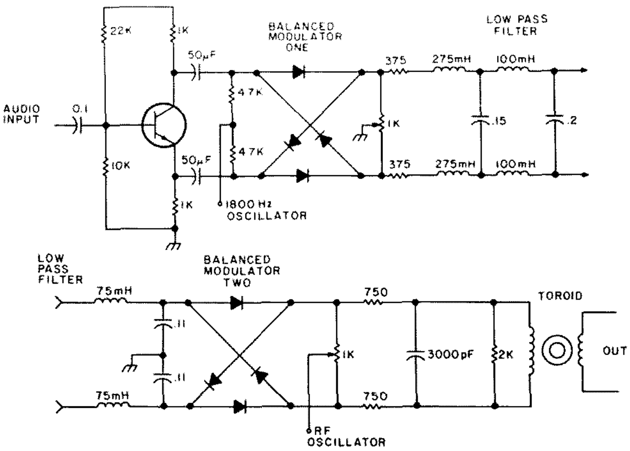

Fig. 4. Example of modulator-filter chain for Third Method generator. Two are required for complete generator. All diodes: 1N34. Any NPN transistor is suitable. Summing of both modulator chains can occur at toroid.

The TTL One Shot

- - another digital building block

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Many amateurs are afraid to build projects using integrated circuits, either because they do not know what is going on inside the chip, or because they think that they need a room full of test equipment to get the project working. What follows is a description of four types of TTL (Transistor-Transistor Logic) monostable multivibrators, or one shots, along with some simple circuits that are useful and easy to get working. No special components or printed circuit boards are needed, and most of the necessary supplies may be found in hobby-type electronics stores.

The one shot is a nifty device that can find many uses around the shack. Basically, the one shot will put out one pulse of a specific length, regardless of the shape or duration of the input signal. A retriggerable one shot is one that may have its output pulse extended by supplying one or more additional signals at the input before the end of the output pulse. The output pulse will end after the normal time interval after the last input. Example: If you have a non-retriggerable one shot that has been set for an output pulse width of one second, and you apply a very short input pulse to it every three-quarters of a second, you will get a string of 1 second pulses out with a space of ½ second between each pulse. If the same input were applied to a retriggerable one shot, you would get a continuous output until 1 second after the last input pulse.

Fig. 1 shows the pin assignments and function tables for the 74121, 74122, 74123, and 74221 monostable multivibrators. The inputs labeled A on the pin assignments diagram are the negative-transition triggered inputs. A signal at these pins will trigger an output pulse when it transitions from a high level to a low level if all other inputs are high. The inputs labeled B are the positive-transition triggered inputs, and will cause an output pulse to begin when the input at these pins goes from a low level to a high level as long as any other B inputs are high and at least one A input is low. For these TTL devices, a high should be between 2 and 4.5 volts and a low should be from 0.8 to 0 volts.

The outputs from these one shots are complementary: The Q output is normally low and goes high when the input is triggered, the $\overline{Q}$ (pronounced Q-not) output is normally high and goes low. The length of the output pulse is determined by an external resistor and capacitor connected to the pins marked Rext/Cext and Cext for each one shot. The length of the output pulse may be determined from some involved equations provided on the manufacturer's data sheet for each type of one shot. For amateur purposes, the pulse length may be approximated by

$$T = K \cdot Rext \cdot Cext$$

where:

T is the pulse length in milliseconds
Rext is in k Ohms
Cext is in microfarads
K = .7 for the 74121 and 74221, .32 for the 74122, .28 for the 74123

The 74121 and 74122 have internal fixed resistors, marked Rint on the diagram, which may be used as all or part of Rext. The value of Rint is 2k for the 74121 and 10k for the 74122.

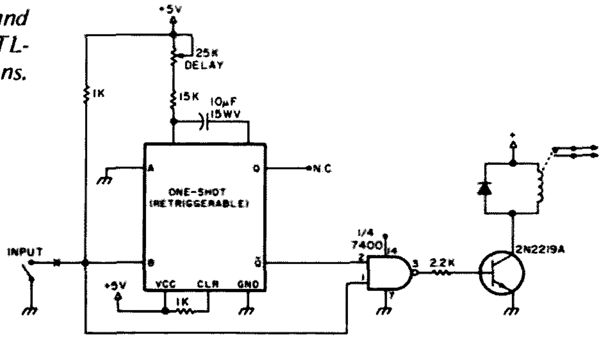
Perhaps the best way to become familiar with these one shots is to build some small practical circuits. Fig. 2 is a simple T/R switch (or VOX, COR, etc.). This circuit uses a single retriggerable one shot and one NAND gate.

The output of a NAND gate is high unless both inputs are high. In this circuit, the input and the $\overline{Q}$ output of the one shot are both normally high and hold the output of the NAND gate low, so the transistor will be off and the relay will be de-energized. When the input goes low (during key down, speech, or whatever), pin 1 of the 7400 goes low and pin 3 goes high, causing the transistor to conduct and closing the relay. When the input returns high, the positive transition at the B input of the one shot causes the $\overline{Q}$ output to go low for the period determined by the DELAY potentiometer. This keeps pin 2 of the 7400 low and pin 3 high for the time between dots or dashes and will time out and cause the relay to de-energize if another input signal does not occur before the end of the delay period. Either the 74122 or ½ of a 74123 retriggerable one shot may be used in this circuit, but the input must be kept compatible with the TTL devices (between 0 V and 4.5 V). Unused B inputs should be tied to Vcc through a 1k resistor. Unused A inputs should be tied to the A input that is used. This is true for all of the circuits described here.

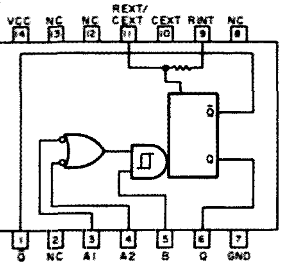
A square wave generator or pulse generator is shown in Fig. 3. The 25k dual pot will give an almost symmetrical output waveform. Two single pots may be used if the up time and down time of the output are to be adjusted independently. When the switch is in the OFF position, the A input of A1 is held high and prevents any output. When the switch is moved to the ON position, the negative transition at the A input causes the Q output of A1 to go high for the time T_1 determined by the setting of the FREQ pot. Then, when this pulse falls, it triggers the A

Technical data and pin assignments diagrams for this article were taken from the *TTL Data Book for Design Engineers*, First Edition, published by Texas Instruments, Dallas TX.

Fig. 2. A simple T/R switch using a retriggerable one shot and one NAND gate. Switch may be removed and other TTL-compatible input applied at point X for practical applications.



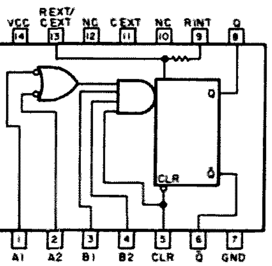
A



FUNCTION TABLE

INPUTS			OUTPUTS	
A1	A2	B	Q	Q̄
L	X	H	L	H
X	L	H	L	H
X	X	L	L	H
H	H	X	L	H
H	↓	H	⊓	⊔
↓	H	H	⊓	⊔
↓	↓	H	⊓	⊔
L	X	↑	⊓	⊔
X	L	↑	⊓	⊔

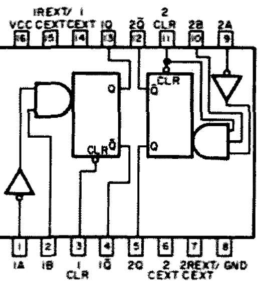
B



FUNCTION TABLE

INPUTS					OUTPUTS	
CLEAR	A1	A2	B1	B2	Q	Q̄
L	X	X	X	X	L	H
X	H	H	X	X	L	H
X	X	X	L	X	L	H
X	X	X	X	L	L	H
X	L	X	H	H	L	H
H	L	X	↑	H	⊓	⊔
H	L	X	H	↑	⊓	⊔
H	X	L	H	H	L	H
H	X	L	↑	H	⊓	⊔
H	X	L	H	↑	⊓	⊔
H	H	↓	H	H	⊓	⊔
H	↓	↓	H	H	⊓	⊔
H	↓	H	H	H	⊓	⊔
↑	L	X	H	H	⊓	⊔
↑	X	L	H	H	⊓	⊔

C



FUNCTION TABLE

INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⊓	⊔
H	↓	H	⊓	⊔
↑	L	H	⊓	⊔

D

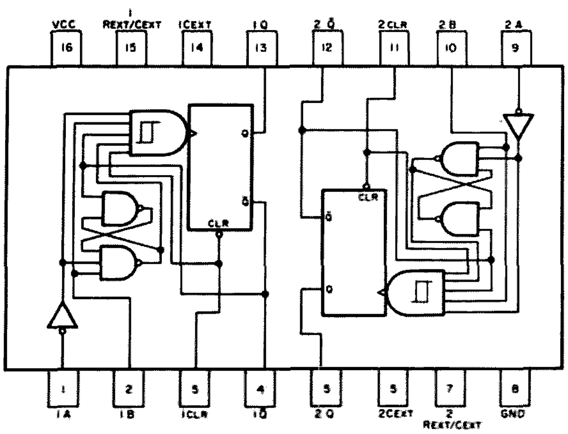


Fig. 1. H = high level (steady state), L = low level (steady state), X = irrelevant, = transition from low to high level, = transition from high to low level. (a) 74121. Rint = 2k, Rext min = 1.4k, Rext max = 40k, Cext max = 1000 uF, output pulse max = 28 sec. (b) 74122. Retriggerable monostable multivibrators with clear. (c) 74123. Dual retriggerable monostable multivibrators with clear. Rext min = 5k, Rext max = 50k. (d) 74221.

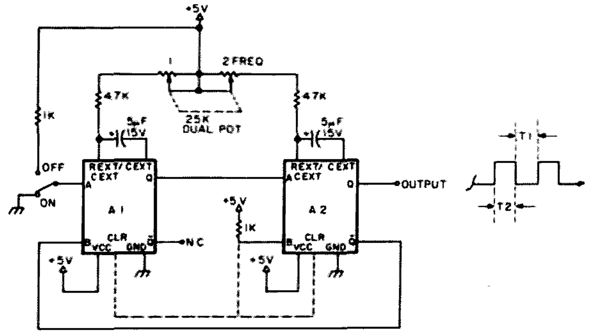


Fig. 3. Square wave generator using two single or one dual one shot. Dotted lines from CLR inputs are not used with chips that do not have clear inputs.

input of the second one shot, A2, and the output is taken from the Q output of A2. The Q̄ output of A2 rises at the end of time period T_2, and triggers the B input of A1 to start another sequence. This will continue until the switch is turned OFF.

With the short pulses encountered in TTL logic, an oscilloscope is almost a necessity, but a good oscilloscope may cost a small fortune. Fig. 4 shows a gadget that is useful for "viewing" the workings of TTL logic if you do not have an oscilloscope available, and can be a handy accessory even if you do. The one shot is used here to light LEDs when transitions of the input are detected. Even very short pulses are visible on the LEDs, since the one shot "stretches" the pulse length. One half of a 74123 is used to detect positive-going transitions and light D1. The other half detects negative-going transitions and lights D3. D2 will light any time the input is at a high level. If the input is a constant high level, D1 will blink on and then go off because of the positive transition when you first apply the input, and D2 will come on for the duration of the high level. When the input is removed, D2 will go out, and D3 will blink on and then go off because of the negative transition. If the input is a series of pulses, the LEDs will either blink in sequence or stay on all the time, depending on the pulse width and

FUNCTION TABLE (EACH MONOSTABLE)

INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⊓	⊔
H	↓	H	⊓	⊔

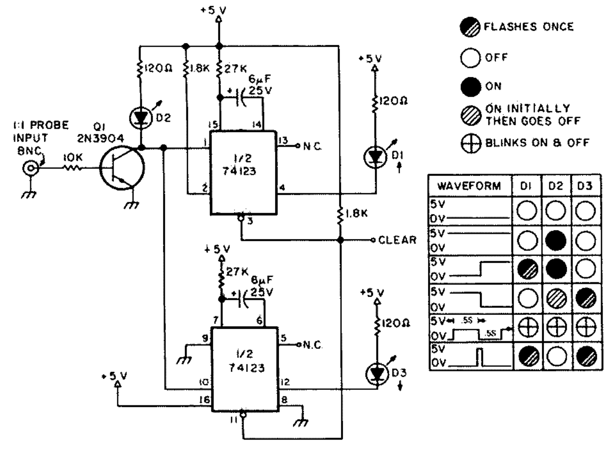


Fig. 4. A logic checker for TTL circuits.

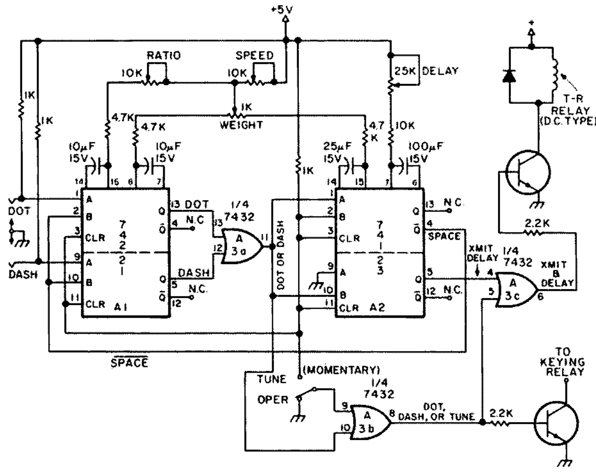


Fig. 5. An electronic keyer that provides for control of the T/R relay.

repetition rate. The Rext resistors may be made variable for more flexibility.

With a little experience in using this device, you can get a pretty good idea of how the circuit under test is performing. Of course, a scope would give an even better idea, but you get what you pay for.

The keyer of Fig. 5 looks fairly complex at first glance, but it is really only a combination of the circuits of Figs. 2 and 3. It uses only three integrated circuits and provides control of the T/R relay for break-in operation. The entire circuit was built on two experimenter boards that were purchased at the local hobby electronics store. The 74221 forms the dots or dashes. This part of the keyer works like A1 of Fig. 3, except that the paddle selects which side of the IC will put out the pulse. Pin 1 of the 74123 acts like the A input of A2 in Fig. 3, and this half of the 74123 makes the spaces between the dots or dashes. The remaining half of the 74123 and A3b and A3c are similar to the T/R switch of Fig. 2. OR gates are used here instead of a NAND gate, and the Q output of the one shot is used instead of the $\bar{Q}$ output, but the circuit is basically the same.

The information presented here should give you an idea of what one shots do and how to hook them up. If you haven't tried using ICs yet, why not get started by trying a few projects using one shots? ■

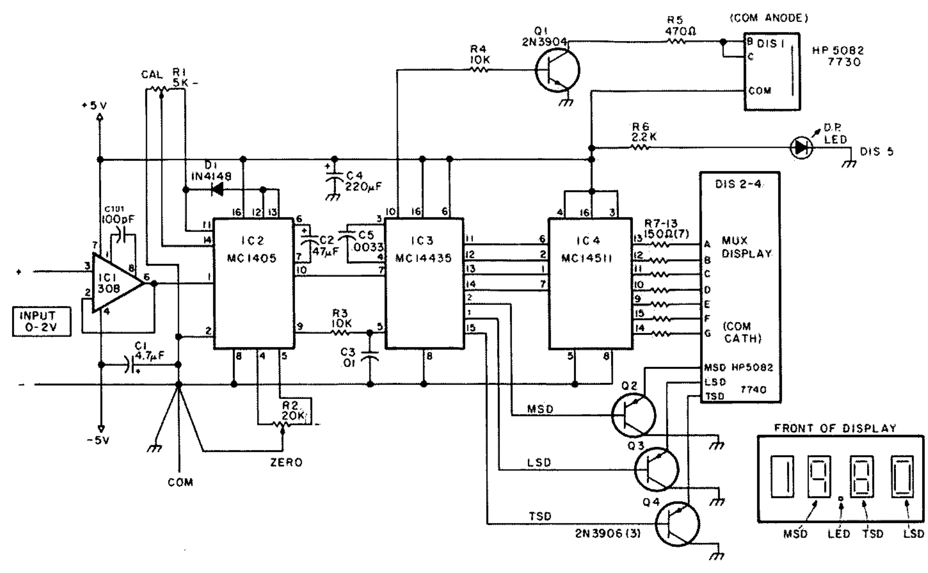


Fig. 1. Basic meter.

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DVMs Get Simpler and Simpler

- - wait'll you see the MC-1405!

With all of the interest in digital electronics, and with prices of the related parts dropping, it seems natural to me that much of the equipment in our labs and shacks could be "digitized." The result would be that equipment would be much easier to read (no analog meters to interpret) and perhaps the readings would be more accurate. This is part of the rationale I used to justify starting this project – to design a digital voltmeter so cheap and easy to build it could be included in my power supplies, communications gear, etc. It would also be nice to have a digital multimeter, too. So with that I got started.

You may be aware of the fact that many semiconductor houses offer *digital voltmeter* chip sets. These consist of an analog to digital converter chip and a digital counter array chip. All you have to add, at the most, are a power supply, a system clock, a reference source and a display system. That can easily mean six chips and up! This means high cost and lots of construction. I know because I built several voltmeters this way, and that includes a so-called "One Chip Voltmeter!" But there is a better way.

Motorola has introduced a chip set that requires only a power supply and a display system. It's easy to work with and easy to calibrate. And the best part is that it's available and cheap (under $18 for the set), too! Accuracy is rated at 0.05% and that is probably worst case! Your voltmeter accuracy will depend upon the accuracy of the standard you use. I'll show you how to build a good one. This is the system our "Cheap and Dirty DVM" is based on!

I feel I should mention some of the disadvantages of our DVM, to be fair. The first one is that it won't measure negative voltages. You have to reverse the input leads for that, like on an analog VOM. The second disadvantage is that the chip set has an input impedance of 4k Ohms, but this is changed to 10 megohms input with a $2.00 op amp in our unit. None of these problems are serious – the first requires a quad op amp and some parts. The second has already been taken care of. I'll discuss the solution to the polarity problem in a future article *and* show you how to measure ac volts and Ohms at the same time. If you want to read further about the Motorola chip set, call or write them for the data sheets and ap notes listed at the end of this article.

Construction isn't too difficult, but there are several areas to watch. Probably the biggest problem you will have is finding a box to house the finished unit. If you want a general purpose meter to be used around the shack, a minibox will work fine. However, if you are like me and want to build a digital panel meter to be installed permanently in a piece of equipment, you are in a sticky situation, as digital panel meter cases are very hard to get! I finally found a few in surplus, but I can't get enough to share the wealth. Let me suggest you use a small minibox if you're stuck. Cut a rectangular hole in the

Photos by Roger Wilcox

front of the box and put a red filter behind it. Then cut and bend aluminum stock into two L brackets, large enough to fit on the ends of the box. You could then cut a hole large enough to accommodate the box front in your panel and use the L brackets to secure it. A possibly better way would be to make up an aluminum plate larger than the front of the box and use it to secure the box to the panel. You would have to duplicate the display cutout in the plate, of course, but the result could look pretty neat!

If you have never built a digital voltmeter before, you are in for some interesting construction! If you have, the construction hints I am about to give will sound familiar. The layout isn't too critical, and the parts may be placed nearly anywhere. However, I would like to suggest that the heat generating power supply be located as far away as possible from the MC-1405 chip. In fact, try to get it in a separate module. The layout for one of my digital panel meters, despite the close proximity of the power supply components, hasn't caused any problems, but you never know. Why the caution? Heat may cause drift of calibration if it is great enough. By the way, this circuit draws around 100 mA from the +5 volt line. Also, when you wire up the LM-308 and the MC-1405 circuitry, the grounds are critical. Improper grounding causes calibration errors, drift, and other problems. You'll notice how all grounds come together at one point on the schematic; this is the way to wire your unit! Remember that this voltmeter can be a laboratory quality instrument if you follow my simple precautions.

I built up six different units and I built them pretty much alike. First, I assembled the display board. Three HP 5082-7740 LED readouts were used for the multiplexed part, and an HP 5082-7730 readout was used for the 1 on the display. Note that the 7740 readouts are *common cathode* and the 7730 is *common anode*. You could use all 7740s if you wish. Or even Data Lit 704s; you name it in common cathode! A separate LED was used for the decimal point; this makes for easier reading at a distance. The three 7740s were wired up for multiplex operation; this means that all A segments were wired together, all Bs and so on. Homemade L brackets were used to attach the completed display to the rest of the electronics board.

The next part of this project is to get the electronics built and running. Fig. 1 shows the schematic of the basic meter. This is the circuitry that is recommended by Motorola for their chip set, so you'll find it well described in their ap notes and bulletins. The illustrations show one of my first meters – a panel meter in a power supply. Both the schematic and the illustrations should help you get your unit built and on the air, pronto!

I built my first units on scraps of copperclad perfboard, known as "ground plane" board. This method of construction works fairly well, because the grounds are very easy to make, but extra time is required to drill out the copper from holes where parts are going to be mounted. Regular perfboard works fine, though, and you are welcome to use this method. It's also cheaper and you don't have to worry about shorting IC pins to a copper ground plane. I started building my units by installing the IC sockets and wiring up the grounds. On the non-ground plane boards, I brought the grounds from all ICs to one point – pin 8 on IC2. The #24 bare wire I used for all connections worked just fine. Then with the hard part over, I wired up the rest of the unit. Note that the pin numbers on IC1 are for the TO-5 can. If you use the DIP version of the LM-308, you have to look up the new numbers. The driver transistors, Q1 through Q4, are not critical. Almost any silicon NPN unit with a beta of 100 or better will work for Q1. And any silicon PNP units with betas of 100 and up will work for Q2 through Q4. I suggest 2N3904 and 2N3906 because they have given me the most consistently good results. If you can't easily buy the ICs, try Circuit Specialists, PO Box 3047, Scottsdale AZ 85257. They can help. The MC1405L is $8.95, and the MC14435VP is only $7.95. The LM308 is available from Radio Shack. Yes, the parts are available for this project!

As you finish up the electronics board, I would like to make a comment about the pots you use for R1 and R2. Don't try to squeeze by through subbing single turn pots. They will be very hard to adjust and you probably

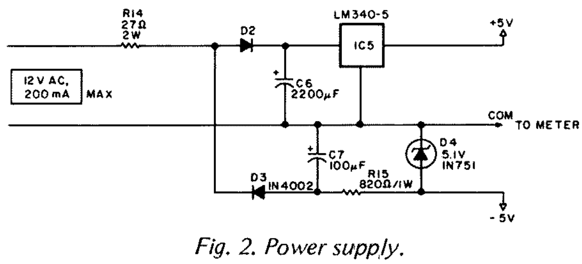


Fig. 2. Power supply.

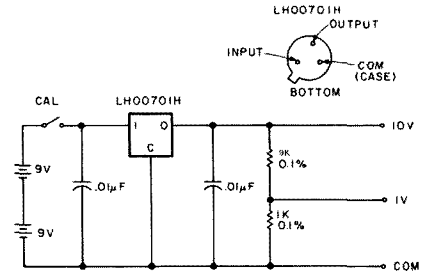


Fig. 3. Calibrator.

won't be able to calibrate. Always use 10 turn wire wound units, or better yet, 20 turn units if you have the space. I found mine for 50 cents each at Poly Paks. The exact resistance values aren't especially critical, so you can sub pots fairly easily. Another thing you can do with the pots is to "remote" them by mounting them off the electronics board and attaching them with wires. You'll notice that I went this route with the unit in the photos. Be safe and bring out separate ground wires for each pot. As before with the other wiring, terminate them at pin 8 of IC2. I finished up by attaching the display board to the electronics board with homemade L brackets on my units. Use resistors R7 through R13 to attach the display segments to IC4 and save yourself some wire.

You may need a power supply. You'll need plus 5 volts at about 100 mA, and minus 5 volts at about 10 mA. You might be able to borrow these voltages from other equipment if they are regulated. If not, build the optional power supply shown in Fig. 2, and power your voltmeter from a 12 volt filament transformer. I did this with the unit shown; one of the power supply's internal transformers had an extra 12 volt, 250 mA winding, so I used it. You could also use one of those line plug transformers used for calculators, if you open the case and remove the diodes that are usually there.

You might want to add a range switch to the input of your new meter, or perhaps just change ranges. As built, it measures 0 to 2 volts. Fig. 4 shows some ideas for attenuators, both simple and deluxe. I built the simple one into the power supply voltmeter. I needed a 0 to 20 volt meter, so I made a x10 divider. R_B was 10k, 1%, and R_A was 100k, 1%. Ideally, these resistors should add up to 10 meg, the standard digital voltmeter input resistance, but in a power supply, these resistances aren't critical (no loading problem!). Also, I had these values! You can use whatever precision resistors you have for x10, x100, or even x1000 dividers. If you don't need a divider at all, connect a 10 megohm resistor across the voltmeter input to cut zero drift when the test leads are open. The deluxe divider shown is what you would use in a digital multimeter. It features 10 megohms input resistance and overload protection. For best results use 0.1% resistors throughout. You will also want some kind of decimal point switching on the display; that will mean another deck on the range switch and two more LED/dropping resistor combinations.

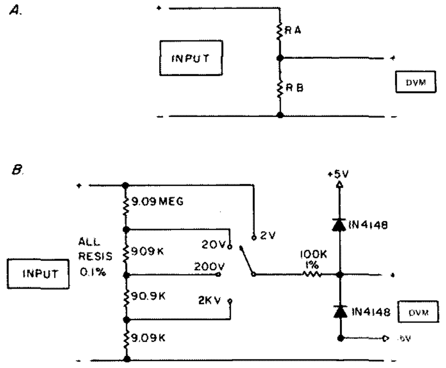
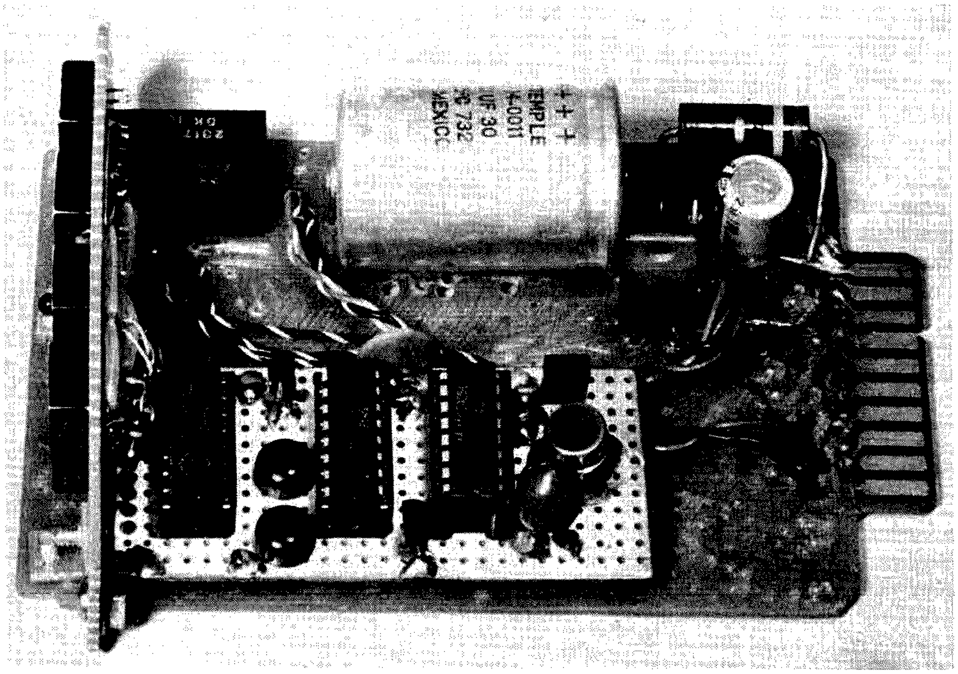


Fig. 4. Input attenuators, simple (a) and deluxe (b).

Calibration is quick and easy once you are set up. Beg, borrow or ? a dc voltmeter calibrator that is at least 0.01% accurate. Or, lacking that, you can build the calibrator shown in Fig. 3. It is designed around the National LH0070IH 0.01% 10 volt reference, which sells for about $5.00. Circuit Specialists might be able to get one for you. Power is supplied by two 9 volt batteries. Lacking this calibrator, you can either calibrate your voltmeter against another DVM, or (shudder) with a 1.34 volt mercury battery. The battery is a last resort, because you might be able to get only about 1% accuracy or so, depending upon the condition of the battery (it should be fresh and unused).

With that out of the way, connect up the voltmeter and apply power. Let it settle down for about 20 minutes or so and then short the input leads together. Adjust the zero pot, R2, for a 000 reading. You'll see the meter read something like 087 – 093 – 097 – 098 – 099 – 000 – 001 – 002 if all's well.

Once the zero is adjusted, apply either +2.000 volts

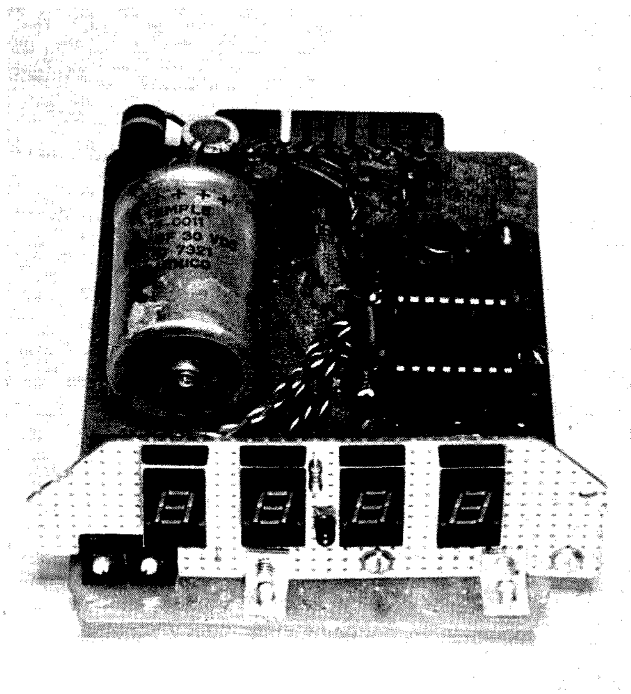


from the commercial calibrator (preferred) or +1.000 volts from our calibrator. This is assuming you have the basic 0 to 2 volt unit; for other units increase the input voltage by x10, x100 or whatever. Then tweak R1, the calibration pot, for a 1.999 to .000 reading (or 1.000 with a 1 volt calibrator). Go back and short the input leads to check the zero; if it is necessary to adjust zero, recheck the calibration, too. These adjustments interact somewhat.

I hope you like your new "Cheap and Dirty Digital Voltmeter." It really adds a touch of class to have equipment in the shack with digital readouts. The price is right, too; you probably spent about ¼ as much for your meter as you would have for a commercial unit! ■

References

Motorola AN-748, "Applications of MC1405/MC14435 in Digital Meters."
Motorola EB-55, "A Battery Powered 3½ Digit Multimeter."
Motorola EB-35, "Autopolarity Circuits for the MC1405 Dual Slope A/D Converter System."
Motorola MC1405L Data Sheet.
Motorola MC14435VP Data Sheet.



Parts List

C1 – 4.7 uF, 10 volt electrolytic cap
C101 – 100 pF disc cap
C2 – 47 uF, 10 volt tantalum or electrolytic cap
C3 – 0.01 uF disc cap
C4 – 220 uF, 10 volt electrolytic cap
C5 – 0.0033 uF disc cap
C6 – 2200 uF, 25 volt electrolytic cap
C7 – 100 uF, 25 volt electrolytic cap
D1 – 1N4148 diode
D2, D3 – 1N4002 diode
D4 – 1N751 zener diode, 5.1 volts
IC1 – LM308 Radio Shack
IC2 – MC1405L Circuit Specialists
IC3 – MC14435VP Circuit Specialists
IC4 – MC14511P Circuit Specialists
IC5 – LM340-5 Circuit Specialists
Q1 – 2N3904 transistor
Q2-Q4 – 2N3904 transistor
R1 – 5k trimmer
R2 – 20k trimmer
R3 – 10k resistor
R4 – 10k resistor
R5 – 470 Ohm resistor
R6 – 2.2k resistor
R7-R13 – 150 Ohm resistor
R14 – 27 Ohm, 2 Watt resistor
R15 – 820 Ohm, ½ Watt resistor
All resistors ¼ Watt unless noted
DIS 1 – HP 5082-7730 Common Anode Display
DIS 2 to DIS 4 – HP 5082-7740 Common Cathode Displays
DIS 5 Man 5024 LED
Misc: Case for meter, perfboard, assorted wire, etc.

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Instant PC Boards

-- using new Color-Key technique

More people would make printed circuit boards by the photographic method if they weren't discouraged by the chemical processes and darkroom requirements that are necessary to produce a film negative from their positive artwork master. Although I have a complete darkroom setup for developing and printing black and white and color film, I have never actually

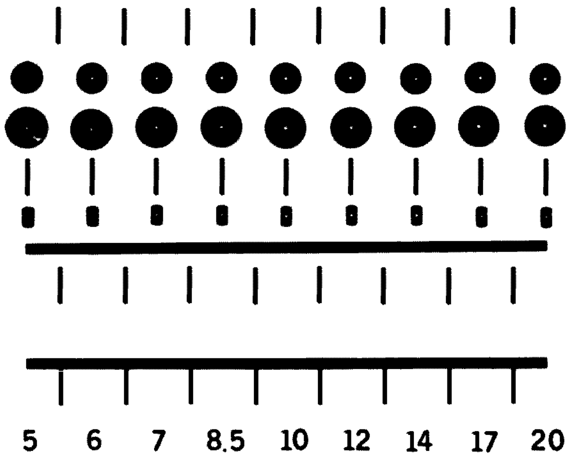

Fig. 1. Color-Key exposure test artwork.

used a photographic film for making printed circuit negatives because there is a material called Color-Key that is far more convenient to use and does not require the array of chemicals, trays and accessories demanded by photographic film.

While a darkened area is necessary during the time the positive artwork and the Color-Key negative material are placed together in some type of holder before the exposure, it doesn't have to be a darkroom. It can be any room or closet lighted by subdued artificial light. A sunlit room cannot be used as the Color-Key material is sensitive to ultraviolet radiation.

After exposure, the Color-Key material needs only to be developed to make an excellent printed circuit negative. The developing step is very simple and doesn't even require a tray, just a flat surface to lay the material on while applying the liquid developer to the sensitized side. No trays, shortstop, fixer or temperature control; you even work in normal room light. After development, just hold the negative under the cold water faucet for a few seconds to wash away the residue and hang the negative up to dry.

Color-Key contact imaging material, as the manufacturer identifies it, is a product of 3-M. It is supplied in several colors and as a negative material or as a direct positive material. It is sold in boxes of 25 sheets and the smallest size is 8½ by 11 inches. I have been purchasing it from a large photographic supply store. It's also available at some art and drafting supply stores as it is used in the preparation of ads by some advertising agencies.

I have been using the type identified as black opaque negative acting material. When exposed and developed, it gives a solid black and clear transparent image, just what is needed for printing a sensitized board.

The developer for Color-Key material is sold in ready-to-use liquid form. It is identified as negative acting developer for Color-Key material. A quart of developer is sufficient to develop a box of 25 sheets of the 8½ by 11 inch size.

As the name suggests, the material is intended for contact printing; that is, the positive artwork is placed in contact with the material during the exposure. Ultraviolet radiation must be used for exposure, in the same manner that sensitized printed circuit boards are exposed. Direct sunlight is a source of ultraviolet radiation, but a more practical source for making negatives (and PC boards) is an ultraviolet lamp. While the same exposure setup can be used for printing negatives and boards, the exposure time is

not necessarily the same for each.

I have been using a small 15 Watt ultraviolet fluorescent tube which I bought complete with fixture for less than $20 for exposing negatives and boards. The lamps and fixtures are sold at large self-service hardware and variety stores.

I use an 8 by 10 inch photographic contact proof printer to hold the positive artwork in contact with the Color-Key material during the exposure. Lacking a contact printer, a small piece of window glass from the hardware store could be used to weight down the positive and negative material. The Color-Key material has a natural curl so it must be flattened during the exposure.

The sheets of Color-Key material can be cut to match the size of the artwork before making the exposure. You can work in a fair amount of artificial light without exposing the Color-Key. I have a bare 15 Watt bulb plugged into an outlet about 3 feet away while cutting the material and placing the negative material and the artwork positive in the contact printer. Once the contact printer is loaded, I turn on a 60 Watt overhead fixture which remains on during the exposure and development steps.

Like photographic film, the Color-Key material has a shiny and a dull side. The dull side contains the sensitive material while the shiny side is the transparent base. Exposure is made through the shiny side, which requires the dull side to be placed down in the contact printer and the artwork positive placed right side up over the Color-Key material in contact with the shiny side.

When the exposure is completed, the Color-Key material is ready for its single processing step, development. Unlike film which is soaked in a tray of developer for a specific time, Color-Key material is developed by laying it on a flat surface, dull side up, and rubbing a small amount of the liquid developer over it until the image is formed. The black material that is removed to form the image comes off very quickly in the form of a sludge.

I use a piece of window glass about 14 by 20 inches for the flat surface. The exposed material is placed dull side up on the glass and a small amount of developer is poured over the negative. The natural curl of the material aids in keeping the developer from running off the negative. The instructions suggest the use of special pad and pad holder to rub the developer over the negative, but a piece of facial tissue works very well and costs much less. The developer is rubbed over the dull side with the tissue until the image is complete. This takes only a few seconds and since the overhead light is on during development, the image can be seen forming as the black is removed. When the image is complete, the negative is washed under cold running water for a few seconds to remove the residue and then hung up to dry.

Rubbing too hard or too long will remove some black material from areas where it should remain. You can avoid rubbing to excess with a little care, since with the light on you can see the image appearing. If an area doesn't seem to respond to development, add a little developer liquid instead of rubbing harder.

It is possible to develop the negative so quickly that the first rub with the tissue will reveal the image. I run hot water from the faucet over the glass developer plate for several minutes while the exposure is finishing, stopping the hot water a minute before the exposure is completed. The glass plate is placed on several folded newspapers to retain the heat. The warm glass plate under the negative activates the developer so much that development takes place before you can pick up the tissue and begin to rub. Developing the Color-Key on a warm plate seems to produce better negatives as the black material left on to form the image appears to be bonded to the base much more tightly than when the development is accomplished at room temperature. The developer itself should not be heated as it may exhaust itself, although it may be warmed slightly if it has been stored in a cold location.

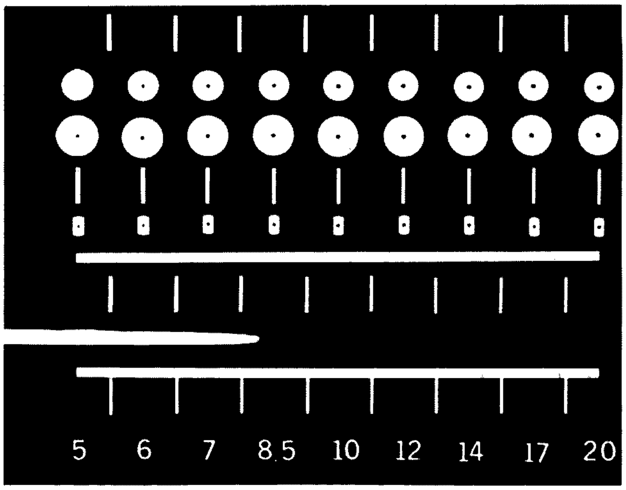

Fig. 2. Color-Key exposure test negative.

Exposure time for each ultraviolet lamp and film holder has to be determined by test. Exposure depends on the amount of ultraviolet radiated by the lamp, the distance the radiation has to travel to reach the sensitized material and the attenuation of the glass in the contact printer or film holder. My ultraviolet lamp is positioned 8 inches above the glass in the contact printer and my exposure time is 14 minutes. Lowering the lamp would reduce the exposure time, but could cause the exposure to be insufficient at the edges of large pieces of the negative material as the rays have to travel a greater distance from the lamp to reach the edge than to the center of the contact printer. If I felt a need to shorten the exposure time, I would add a second lamp as the most practical way to do it.

Finding an exposure time that will work satisfactorily is fairly simple. It can be done by using a test positive that has been made to aid in determining the correct exposure time. Since our prime use for the Color-Key material is to make printed circuit board negatives, I made a test positive using printed circuit decals for solder pads, lines and IC pads. Fig. 1 is the test positive 1 used to determine exposure time for the Color-Key material in my exposure setup.

The test positive is divided into nine sections as identified by the numbers at the bottom. The number 20 at the far right means that section will be exposed for 20 minutes. The four items in the section above the number 20, an IC pad, a short thin line and two solder pads, are the items to be exposed and examined on the negative to determine the exposure time for Color-Key negatives.

Each numbered section contains the same four items, and the section number is the time in minutes the section should be exposed to ultraviolet radiation. After exposing and developing the negative, the section which shows the best reproduction of the items will be selected as having the correct exposure time. The various lines separating the sections are

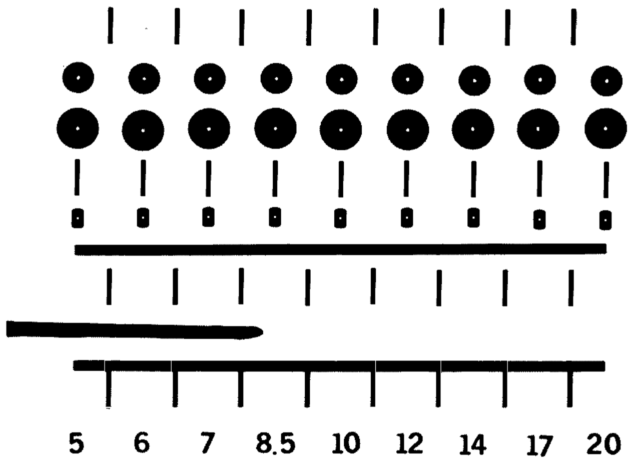

Fig. 3. Color-Key positive made from test negative.

guidelines for exposing the negative and cannot be used for evaluation of the negative.

Exposure is made by placing a piece of Color-Key material and the test positive in the contact printer or film holder that will always be used for making Color-Key negatives and placing a piece of dark paper or cardboard on the contact printer so it covers the sections that have received their allocated exposure.

To begin, place the cardboard over the section numbers at the bottom, leaving all the sections uncovered, and place the contact printer under the ultraviolet source. After a 5 minute exposure, remove the cardboard from over the section numbers and use it to cover the section marked 5. The numbers at the bottom and sections 6 through 20 should be exposed for 1 minute. Note that the bottom numbers are not covered again after the 5 minute exposure. They are to receive all subsequent exposures. After the 1 minute exposure, slide the cardboard to the right to cover section 6, leaving section 5 covered. After a 1 minute exposure of sections 7 through 20, move the cardboard to cover section 7. Expose sections 8.5 through 20 to the ultraviolet radiation for 1.5 minutes. The slide the cardboard to the right to cover section 8.5 and expose sections 10 through 20 for 1.5 minutes. After 1.5 minutes, move the cardboard to cover section 10, keeping the previously exposed sections covered and expose sections 12 through 20 for 2 minutes. Then cover section 12 and expose sections 14 through 20 for 2 minutes. Slide the cardboard to the right and cover section 14. Expose sections 17 and 20 for three minutes. Slide the cardboard over section 17 and expose section 20 for three minutes.

When the test exposure is completed, each section of the negative will have received a total exposure in minutes equal to the number of the section and the numbers at the bottom will have been exposed for 15 minutes. While performing the exposures it is not necessary to turn the ultraviolet lamp on and off. The cardboard can be repositioned in less than a second and the resulting exposures will probably be more accurate than if you try to control the radiation by switching it on and off. Be sure your cardboard is large enough to cover sections 5 through 17, that it will not be obstructed by nearby objects and that you use a small weight to hold it in position if it extends past the edge of your film holder or contact printer.

After developing the negative, each section should be carefully examined to determine the best exposure time. My test negative, Fig. 2, shows that it was badly underexposed at 5 minutes. The dot is missing in the small solder pad, the other pad dots are too small and some of the black near the large pad came off because of the underexposure. Fig. 3 is a positive made from the test negative and perhaps may be more easily read. Sections 6 and 7 are better but are still underexposed as the holes in the pads are undersized. This shows very clearly in the IC pads. Section 8.5 is much better, while sections 10 through 17 look very good. Section 20 is overexposed, as can be seen by the slight enlargement of the pad holes. This is more easily seen in Fig. 2, the negative, as overexposure is easier to determine by noting an increase in the size of dots.

The clear strip that begins at the left edge of the negative and runs through section 10 was caused by the edge of the cardboard used for masking off the sections and should not be considered in evaluating the negative.

Fourteen minutes was chosen as the correct exposure time, as that results in a negative where the subjects are the identical size as on the positive. While this is difficult to see from examining the figures with this article, you will find when you make your own test negative the easiest way to evaluate the results is to place the test positive over the developed negative and align the items in each section. You will discover that the underexposed negative subjects are larger than the positive ones, as the positive items will not completely cover the negative subjects in the sections that were underexposed. In the overexposed sections, the reverse is true. The subjects on the positive are larger than their negative images in the overexposed sections. The closest size match between positive and negative images is in the section that has received the most nearly correct exposure to the ultraviolet radiation.

The positive in Fig. 3 was made by exposing the test negative for 14 minutes. This has always been about the correct exposure time for my untraviolet lamp and contact printer when spaced 8 inches apart. These exposures were made recently and duplicate the results of the test I made four years ago when I began using Color-Key material. Apparently the ultraviolet radiation from my lamp hasn't changed after several hundred hours of use.

If your first test negative is completely under- or overexposed, multiply the exposure time for each section by 2 if underexposed or by 0.5 if it was overexposed and print a second negative.

If your exposure time is much longer than anticipated, the problem could be the glass used in the contact printer or film holder. Some types of glass block out ultraviolet radiation fairly effectively. The glass in my contact printer is ordinary plate glass, as I had to replace the original glass which shattered from the heat of a 500 Watt bulb, my first source of ultraviolet.

While practically any source of ultraviolet radiation also emits some visible light, the amount of ultraviolet cannot be judged by the quantity of visible light. Ultraviolet radiations are not visible and can be harmful in large doses. You can be "sunburned" by large amounts or even have your eyes affected just as can happen by excessive exposure to the sun. The ultraviolet radiation from the sun causes the sunburn. The 15 Watt fluorescent lamp should cause no problems, but if one is tempted to obtain a more powerful source of ultraviolet radiation, he should also buy a pair of goggles specifically designed to block ultraviolet radiation.■

by Wayne Green W2NSD/1

I/O EDITORIAL

GETTING STARTED

The chances are that you may be thinking about maybe getting a microcomputer. With many of them appearing to be in the $300 to $500 price bracket, it isn't something where you are going to send away a check blindly. And you're probably still asking a lot of questions about what you are going to be able to do with it if you do get it.

There are a discouraging number of alternatives, so perhaps if I lay down some guidelines it will help. I'd make specific recommendations, but that would upset some manufacturers . . . and let us not ignore them as is paying the bills for the magazine.

The heart of a computer these days is the chip of your choice: 8080, 6800, 6502, Z-80, etc. This is nestled in the central processing unit (CPU). Each chip has its clique and there are enough pros and cons for each to bring on a fistfight in the most peaceful of computer clubs. The proponents of the Z-80 have some persuasive arguments, since it is a sort of super 8080 contraption, with some of the charm of the 6800 thrown in to confuse Motorola fans. Having given you little real help with this aspect of your system (the key to the whole thing), we can pass on to less substantive matters.

In addition to the CPU, you'll be needing a good sturdy power supply and a nice cabinet. None of the manufacturers have yet caught on to the Star Trek type of computer . . . the one with the thousands of flashing lights and brilliant colors . . . and we all know way down in our subconscious that any real computer is going to look like that. Who wants a box with a switch and pilot light on the front? That's not a computer!

Now, about that power supply. You'll either start out with a heavy duty supply or you will rue the day and end up modifying it or adding more supplies later on. A little research will give you a good general idea of how much power you are going to need. Figure on a CPU, at least 16K of memory, a couple I/O boards, a PROM board, character and graphics generators, etc. Once you've added up the current needs of all that, you might as well double it, because you will hardly ever be cutting down on your system . . . there will always be some new and exciting gadget which will plug in to let you do something else . . . it might be generating full color art . . . writing music . . . some special games such as Tank . . . you don't know what. Looking up the specifications for the many boards available (over 150 are now designed for the Altair Bus) will help you get familiar with this new world.

Memory. It's expensive and you're going to want to buy as little as you can to save money . . . and as much as you can afford to make your system work better. Your presently available systems will generally support a maximum of 64K of memory. I doubt if your pocket will. Mine doesn't. You can't get along with much less than 12K since most of the BASICs take 8K of that and need some elbow room to be used. There are some Tiny BASICs which only use 4K, but I doubt if you will be satisfied with the restrictions of Tiny for long.

You'll need input/output (I/O) boards to permit you to communicate with the CPU. You get into a lot of complication with these things with serial vs parallel, baud rates, parity bits, and all that other stuff which you'll eventually learn via articles in the magazines. You can hook a lot of different things into your system . . . a Teletype, a CRT (also known as a television typewriter, TVT, or video display terminal, VDT, or just plain "tube"), a cassette recorder, a paper tape system, magnetic tape . . . etc.

You should be aware that all of the Teletype compatible I/O boards are 20 mA systems which are designed to match the ASR-33 and 35, and these machines start around $800 or so. That Teletype you have in the shack is probably a Model 15 or 19 and it needs 60 mA to operate, so you'll have to build an interface between the two. Your machine speaks Baudot code and the I/O talks only ASCII, so you need a converter for that . . . or a program in lieu of the hardware. It probably won't be long until there is a Baudot I/O board for 60 mA machines available, but I haven't seen one yet.

The VDT is probably the handiest way of communicating with your computer. The selection of these available is very limited so far . . . with the Southwest Tech CT-1024 being the most used. This comes in kit form (it is fun to build) and requires you to use a black and white television set for the display. Since TV sets are selling for under $100 brand new these days, it is a reasonable path. The HAL keyboard and character generator also use a TV set. Many of the surplus keyboards are fine, but be wary of some of the complete VDTs in surplus . . . some of them take a lot of know-how to convert and I've been unable to get much in the way of articles on them so far.

Once you have your CPU, the power supply, a beautiful cabinet, a VDT, and plenty of memory, you are ready for the big leagues. Your system will be capable of doing an amazing number of things . . . like keeping the log, keeping track of OSCAR, translating CW or RTTY, playing a hundred or so games, running many business programs, etc. Note that I said "capable." The fact is more like it will be a fantastic coffee table conversation piece until you get software. There are few other instances where a hobbyist is able to spend so much money and time and end up with something which is in perfect working order and still is totally unusable.

If you've invested in a CPU on the basis of hype and color pictures, you could join a not insubstantial group of hobbyists way up at the end of a very familiar creek. There are some people who live and breathe to program computers. It is unlikely that you are one of these . . . or even know one. This cat does not even get close to such as us, and if he did, we wouldn't be able to talk with him. All too late many hobbyists have begun to realize that all that bunk about hardware only being half of a computer may have some basis in fact. Don't say I didn't warn you.

Okay . . . programs. How do we get programs? Firstly, you make sure that the system you are going into has software available . . . and available where you can get it. You'll want to be sure they have BASIC on hand, and while Tiny BASIC is a lot of fun, this will limit you in the number of published programs you can get running. Make sure you will be getting an 8K or better BASIC. If you have that, you will be able to use programs published in books and hobby computer magazines to go the rest of the route.

Eventually there will be other languages available . . . FORTRAN is certain to come soon. In the meanwhile, you'll soon get used to BASIC and enjoy writing many of your own programs. Without a language such as BASIC, you are stuck with machine language . . . which is no language at all. With this you have to put in every single step of the program in binary. Some experienced computerists may love machine language; however, I suspect that this is a love which requires considerable cultivation . . . and not a little masochism.

A little while back I briefly mentioned cassettes. I was covering up a lot of confusion with vagueness in the process. The fact is that the microcomputer industry definitely does not have its . . . er . . . act together when it comes to cassette systems. If you want to get a heated argument going, just walk up to a group of computerists and say you think such and such a cassette system is best . . . and stand back. You can fill in the blank with Tarbell, Kansas City, Mits, Digital Group, National Multiplex, etc. They're all different and all have *something* in their favor. Your best bet, for the time being, is to go with whatever system the CPU manufacturer likes at the moment and figure that you're going to have to change before long.

There is much to be said for going with the most popular systems. Along this route you'll find more help from fellow sufferers . . . more peripherals . . . more options . . . more articles . . . and a whole lot more programs.

So what's the most popular system? No one in the industry is giving out any sales figures, but I've looked carefully into my crystal ball and I think it works out about like this . . . at least for the hobby computer market . . .

System	*My Guess*
Altair 8080	2650
Imsai 8080	1025
Other 8080 type	515
Z-80 type	525
8008 type	550
Southwest Tech 6800	600
Sphere 6800	140
Other 6800 type	600
OSI 6502	230
Kim 1 6502	450
All other hobby systems	1825

Yes, I realize that the total comes to a bit over 9,000 hobby systems, but that's what I see out there. You can bet I'll be running polls in *KB* to keep tabs on what systems are selling and what peripherals are being used with them. The above does not include the microcomputer systems which have been sold to firms for later resale . . . called original equipment manufacturer (OEM) sales.

Since we're projecting a readership of about 35,000 for the third issue of *Kilobaud*, it is obvious that the great percentage of computer hobbyists have yet to buy hardware. I doubt if they would be subscribing to *KB* if they weren't serious enough about computers to want their own, so we're looking at a considerable market among the *KB* readers for hardware. This is probably one of the best times in history for the entrepreneur to put a product on the market and build up a company . . . but I digress, as usual.

Why do I keep hearing you mumbling about cost? This is a *hobby* . . . like sports cars . . . flying . . . blondes . . . and, as you know, the difference between a man and a boy is the price of his toy. You can add up all the components for yourself, but it is unlikely that you are going to have much going for under $2000. I counted up the claimed investments in hobby computing of about five hundred subscribers to *KB* and it

Continued on page 160

Computerized Satellite Tracking

-- the needed software

Satellite tracking — a subject that I would think could get pretty sticky for us non-whiz-kid math types. Bob Henson presents the subject in such a manner that the math seems almost incidental (i.e., he doesn't get bogged down in the details like many authors would have a tendency to do). Another neat feature of his article is the fact he offers some suggestions for modifying his BASIC program so that it can be rewritten and run on other BASIC interpreters. — John Craig.

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To date, several articles have appeared in ham publications describing graphical techniques for calculating antenna aiming data for amateur and weather satellites. While these methods provide results that are accurate enough for most satellite communications purposes, the inconvenience involved in the preparation of the necessary charts and graphs is not particularly appealing, leaving one with the notion that there must be a better way. Those particularly adverse to the graphical approach will inevitably look to the application of the digital computer to relieve them of these computational chores. Formerly limited to a fortunate few who had access to large, expensive computers, the advent of the microprocessor and subsequent development of low cost hobby computer systems have put the computerized approach to satellite tracking within the reach of many.

Even with the computer hardware now available at an affordable price, one necessary element is still missing: namely, the software, or program, to perform the calculations. This article will describe such a program. While the intent is to provide sufficient background information so that the reader can modify and execute the program on any computer in any language that he might have available, a listing of a version written in BASIC will be presented, since it appears to be the current "standard" with hobbyist systems.

Without attempting any rigorous mathematical derivations, equations necessary to afford a solution will be presented. If desired, more detailed information on these equations can be gleaned from the references listed at the end of the article and from the many handbooks and textbooks dealing with spherical trigonometry. Since the program to be described is a minimal operating configuration, performing only the most basic tasks required by a tracking program, suggestions for extensions, modifications, and enhancements will be presented at the conclusion of the article.

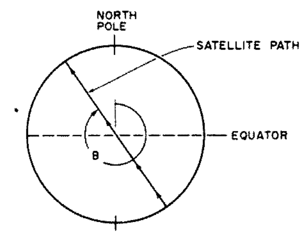

Fig. 1. Bearing of the satellite sub-point path at EQX (represented by the angle B).

Background

Several excellent articles have been published presenting the fundamental concepts of satellite tracking. Rather than reiterate the information in those articles, I will instead summarize only those orbital characteristics with which we need concern ourselves in developing a satellite tracking program. Those who need a "refresher" are urged to read the articles referenced at the end of this article.

To begin with, let's define the information that we want the program to calculate for us:

1) The time of each EQX (northbound equatorial crossing by the satellite sub-point). Satellite sub-point — the point on the Earth's surface that would be intersected by a line connecting the center of the Earth and the satellite.
2) The longitude of each EQX.
3) The azimuth (degrees clockwise from true North) of the satellite position with respect to the station

Elapsed Time (minutes)	Latitude (degrees)	Longitude (degrees)
0	0.0	0.0
2	6.13	1.79
4	12.26	3.60
6	18.38	5.48
8	24.49	7.46
10	30.59	9.57
12	36.66	11.93
14	42.70	14.59
16	48.69	17.72
18	54.61	21.52
20	60.40	26.43
22	65.98	33.33
24	71.15	43.51
26	75.48	60.03
28	78.02	85.82
30	77.60	116.25
32	74.46	139.48
34	69.84	153.92
36	64.53	163.05
38	58.89	169.33
40	53.06	173.94
42	47.12	177.54
44	41.11	180.51
46	35.07	183.12
48	28.99	185.40
50	22.89	187.48
52	16.77	189.40
54	10.65	191.27
56	4.52	193.07
58	-1.62	194.19

Table 1. Latitude and longitude of OSCAR 7 at two minute intervals after an EQX at 0 degrees longitude.

versus elapsed time from EQX.

4) The elevation (degrees above the horizon) of the satellite position with respect to the station versus elapsed time from EQX.

5) The distance in statute miles between the station and the satellite versus elapsed time from EQX.

The orbital parameters of the satellite that we need to know in order to calculate this information is:

1) The altitude at which the satellite orbits above the Earth's surface. For OSCAR 7, this is approximately 910 statute miles.

2) The satellite orbital period in minutes (the number of minutes it takes the satellite to make one complete orbit about the Earth). For OSCAR 7, the orbital period is 114.9458 minutes.

3) The bearing of the satellite sub-point path at EQX (see Fig. 1). For OSCAR 7, this bearing is 348.23 degrees.

4) The difference, in degrees of longitude, of the satellite sub-point at consecutive EQXs. Each EQX of OSCAR 7 is 28.73625 degrees west of the previous EQX.

5) The time of the EQX of a reference orbit of the satellite. This can be obtained from reference data available from AMSAT or from one of the ham publications.

While most of the examples presented will be based on the orbital parameters of OSCAR 7, the program will be developed for general use for tracking satellites with the following orbital characteristics:

1) Constant orbital height (circular orbital pattern).

2) Constant orbital velocity.

3) Non-synchronous orbital pattern (the satellite sub-point is not stationary).

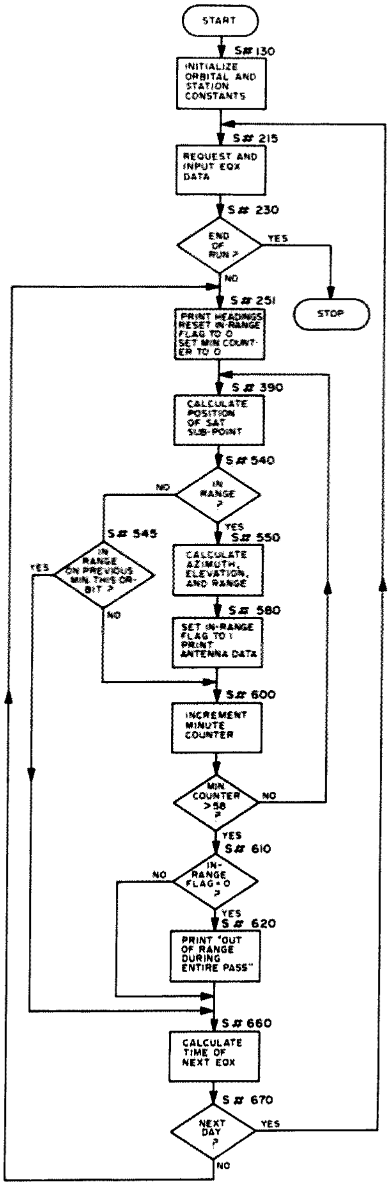

Fig. 2. A flowchart of the satellite tracking program.

Mathematics

The necessary equations to describe the orbital characteristics listed above are contained in the appendix. Without attempting any derivations or providing any lengthy explanations of the origins and ramifications of these equations, let's instead concentrate on what information the equations provide for us, and how we can utilize them in a computer program.

The first problem that we must tackle is that of pinpointing the location of the satellite sub-point at a given instant in time, knowing only the orbital characteristics of the satellite and the location of the satellite at a reference moment in time (such as at EQX). Equations 1 and 2 give us this means. It should be noted that the latitude of the satellite sub-point versus time depends only on the orbital constants of the satellite, and is not dependent on the longitude of the sub-point at EQX. However, the longitude of the satellite sub-point with respect to time is dependent on the longitude of the sub-point at EQX.

Equations 3 and 4, derived from general equations 1 and 2, are applicable only to OSCAR 7. Table 1 is a com-

Fig. 3. A listing of the BASIC version of the satellite tracking program.

```
OSCAR       10/11/76

10 REM-------------------------------------------------------------
11 REM--------   DIMENSION LAT. AND LONG. TABLES   ------------
12 REM-------------------------------------------------------------
20      DIM Q(30),V(30)  'Q IS LAT TABLE ----V IS LONG TABLE
21 REM-------------------------------------------------------------
22 REM-------- FOLLOWING ARE PRINT USING STATEMENTS ------------
23 REM--------    FOR FORMATTING THE PRINT OUT      ------------
24 REM-------------------------------------------------------------
30: EQX AT ##:##:## GMT AT ###.## LONG
40: MIN AFTER EQX       AZIMUTH       ELEVATION        RANGE
50:      ##             ###.##          ##.##          #####
55: ORBIT NO. ##
100 REM------------------------------------------------------------
110 REM----    ORBITAL CONSTANTS AND STATION LAT AND LONG ------
120 REM------------------------------------------------------------
130     P=114.9458            'ORBITAL PERIOD IN MINUTES
140     K0=101.77             'ORBITAL INCLINATION AT EQX (IN DEGREES)
150     T9=28.73625           'MOVEMENT WEST ON EACH SUBSEQUENT EQX
160     A0=910.0              'ORBITAL ALTITUDE IN STATUTE MILES
170     E0=41.536             'STATION LATITUDE
180     K1=93.658             'STATION LONGITUDE
185     MAT READ Q,V          'READ SAT. LAT. AND LONG. TABLES
187     P9=6.283185/360       'DEGREE TO RADIAN CONVERSION FACTOR
188 REM------------------------------------------------------------
189 REM--  CALCULATE THE MAXIMUM ANGULAR SEPARATION BETWEEN   ----
190 REM--     SATELLITE AND STATION WHILE STILL IN RANGE      ----
191 REM------------------------------------------------------------
192     X2=3957/(A0+3957) 'RAT. OF DIST. OF STAT. TO SAT. FROM CENTER OF EARTH
193     GOSUB 9000            'FIND THE ARC COSINE OF THE RATIO
194     M0=X7                 'STORE IN M0
195 REM------------------------------------------------------------
196 REM-----------  INPUT EQX DATA FOR REF PASS   --------------
197 REM------------------------------------------------------------
215     T=0                   'INITIALIZE ORBIT COUNTER
216     PRINT
217     PRINT
218     PRINT
220     PRINT "ENTER EQX TIME FOR REF PASS (HR,MIN,SEC)"
222     PRINT "ENTER 99,99,99 TO STOP PROGRAM"
223     PRINT
224     INPUT T1,T2,T3
225     PRINT
230     IF T1=99 THEN 9995'STOP IF 99 ENTERED
240     PRINT "ENTER EQX LONG."
245     PRINT
250     INPUT,L0
251     FOR I=1 TO 15
252     PRINT
253     NEXT I
260 REM------------------------------------------------------------
270 REM-------------- PRINT TABLE HEADING  ----------------------
280 REM------------------------------------------------------------
285     T=T+1                    'INCREMENT ORBIT COUNTER
286     PRINT USING 55,T         'AND PRINT HEADING ON OUTPUT
287     PRINT
290     PRINT USING 30,T1,T2,T3,L0
300     PRINT
310     PRINT
320     PRINT USING 40
330     PRINT
340     F=0                      'INITIALIZE IN-RANGE FLAG
345     B=0                      'INITIALIZE TABLE POSITION COUNTER
350     FOR I=0 TO 58 STEP 2 'BEGIN STEPPING THROUGH TIME FROM EQX
355     B=B+1                    'INCREMENT TABLE POSITION COUNTER
360 REM------------------------------------------------------------
370 REM----------- CALCULATE SATELLITE SUB-PT -------------------
380 REM------------------------------------------------------------
390     S0=Q(B)        'PICK LAT. FROM SAT. LAT. TABLE (STORE IN S0)
400     GOSUB 3000     'FIND LONG OF SUB-PT (STORE IN S1)
410 REM------------------------------------------------------------
420 REM-- CALCULATE GREAT CIRCLE DEG BETWEEN STATION AND SUB-PT --
430 REM------------------------------------------------------------
432     IF S1<=180 THEN 440
434     S1=S1-360
440     L5=K1-S1                  'FIND DIFF OF SAT AND STATION LONG
450     IF ABS(L5)<=180 THEN 500  'CHECK ABSOLUTE VALUE OF DIFF
460     IF (K1-S1)<0 THEN 490     'IF LESS THAN 180 NO MOD REQD
470     L5=L5-360                 'IF MORE, SUBTRACT 360
480     GO TO 500                 '     OR ADD 360
490     L5=L5+360                 '          TO PUT IN PROPER RANGE
500     GOSUB 4000                'DEG NOW IN D (0 IF OUT OF RANGE)
510 REM------------------------------------------------------------
520 REM----------- PRINT DATA ONLY IF IN RANGE  ----------------
530 REM------------------------------------------------------------
540     IF D<>0 THEN 550          'JUMP TO 550 IF IN RANGE
545     IF F=1 THEN 660           'IF PREVIOUSLY IN RANGE, STOP CALC.
546     GO TO 600                 'IF NOT, CONTINUE CHECKING
550     GOSUB 5000                'CALCULATE AZIMUTH (STORE IN C)
560     GOSUB 6000                'CALCULATE ELEVATION (STORE IN E)
570     GOSUB 7000                'CALCULATE RANGE (STORE IN R)
580     PRINT USING 50,I,C,E,R    'PRINT DATA
590     F=1                       'SET IN-RANGE FLAG
600     NEXT I
610     IF F=1 THEN 660
620     PRINT "OUT OF RANGE DURING THIS ENTIRE PASS"
630 REM------------------------------------------------------------
640 REM----    CALCULATE TIME AND LONG OF NEXT EQX   ------------
650 REM------------------------------------------------------------
660     T8=T1*3600+T2*60+T3+P*60 'CALCULATE NEXT EQX IN SEC
670     IF T8>24*3600 THEN 215   'EXIT LOOP IF LAST PASS OF DAY COMPLETED
680     T1=INT(T8/3600)          'CALC NEXT EQX HR
690     T2=INT((T8-T1*3600)/60)  'CALC NEXT EQX MIN
700     T3=T8-T1*3600-T2*60      'CALC NEXT EQX SEC
710     L0=L0+T9                 'CALC NEXT EQX LONG
714     IF L0<360 THEN 720
716     L0=L0-360               'IF REQ'D,SUBTRACT 360 TO KEEP IN 0-360 RANGE
720     GO TO 251               'LOOP BACK FOR NEXT PASS CALCULATIONS
730 REM------------------------------------------------------------
732 REM----    DATA FOR SAT. LAT. AND LONG. TABLES   ------------
734 REM------------------------------------------------------------
800     DATA 0,6,12,18,24,30.5,37,42.5,49,54,60,65,71,76,78,78,75,70
810     DATA 65,59,53,47,41,35,28,22.5,16,11,5,-2
820     DATA 0,2,3.5,5.5,8,10,13,15,18.5,22,27,32,44,62,86,115,140
830     DATA 154,164,170,174,178,181,183.5,186,188,190,192,193.5,195.5
2950 REM-----------------------------------------------------------
2960 REM----    SUBROUTINE TO FIND LONG OF SAT SUB-PT   ----------
2970 REM-----------------------------------------------------------
3000     S1=V(B)+L0              'LONG = TABLE VALUE + LONG AT EQX
3005     IF S1<360 THEN 3020
3010     S1=S1-360               'SUBTRACT 360 IF REQ'D TO KEEP IN 0-360 RANGE
3020     RETURN
3950 REM-----------------------------------------------------------
3960 REM--SUBR. TO FIND G.C. DEG BETWEEN STATION AND SAT SUB-PT --
3970 REM-----------------------------------------------------------
4000     X2=SIN(E0*P9)*SIN(S0*P9)
4010     X2=X2+COS(E0*P9)*COS(S0*P9)*COS(L5*P9)
4020     GOSUB 9000
4030     D=X7
4040     IF D<=M0 THEN 4060     'CHECK IF IN RANGE
4050     D=0                    'RETURN A VALUE OF ZERO IF NOT
4060     RETURN
4950 REM-----------------------------------------------------------
4960 REM----  SUBROUTINE TO FIND AZIMUTH TO SAT SUB-PT  ----------
4970 REM-----------------------------------------------------------
5000     X2=SIN(S0*P9)-SIN(E0*P9)*COS(D*P9)
5010     X2=X2/(COS(E0*P9)*SIN(D*P9))
5020     GOSUB 9000
5030     C=X7
5032     IF L5>=0 THEN 5040
5033     C=360-X7
5040     RETURN
5950 REM-----------------------------------------------------------
5960 REM----    SUBROUTINE TO CALCULATE ELEVATION     ------------
5970 REM-----------------------------------------------------------
6000     E=(A0+3957)*SIN(D*P9)
6010     E=E/((A0+3957)*COS(D*P9)-3957)
6020     E=ATN(E)
6025     E=90-360*E/6.28315
6032     RETURN
6950 REM-----------------------------------------------------------
6960 REM----      SUBROUTINE TO CALCULATE RANGE     --------------
6970 REM-----------------------------------------------------------
7000     R=((A0+3957)*COS(D*P9)-3957)/COS((90-E)*P9)
7010     RETURN
7950 REM-----------------------------------------------------------
7960 REM-------   SUBROUTINE TO CALCULATE ARCSIN     --------------
7970 REM-----------------------------------------------------------
8000     IF X1>=1. THEN 8081
8001     IF X1<=-1. THEN 8083
8002     H9=90.0
8003     H1=-90.0
8010     H1=-90.0
8020     X8=(H1+H9)/2
8030     IF ABS(SIN(X8*P9)-X1)<0.0001 THEN 8090
8040     IF SIN(X8*P9)>X1 THEN 8070
8050     H1=X8
8060     GO TO 8020
8070     H9=X8
8080     GO TO 8020
8081     X8=90
8082     GO TO 8090
8083     X8=-90
8090     RETURN
8950 REM-----------------------------------------------------------
8960 REM-------    SUBROUTINE TO CALCULATE ARCCOS    --------------
8970 REM-----------------------------------------------------------
9000     IF X2>=1.0 THEN 9082
9001     IF X2<=-1.0 THEN 9084
9002     H9=0.0
9010     H1=180.0
9020     X7=(H1+H9)/2
9030     IF ABS(COS(X7*P9)-X2)<0.0001 THEN 9090
9040     IF COS(X7*P9)>X2 THEN 9070
9050     H1=X7
9060     GO TO 9020
9070     H9=X7
9080     GO TO 9020
9082     X7=0.0
9083     GO TO 9090
9084     X7=180.0
9090     RETURN
9995     END
```

pilation of the latitude and longitude of the OSCAR 7 sub-point versus elapsed time from an EQX at 0 degrees longitude. As previously stated, the latitude of the satellite sub-point versus time can be taken directly from the table regardless of the longitude at EQX. However, to determine the longitude of the satellite sub-point versus time, we must add the longitude of the sub-point at EQX to the value given in the table. For example, the longitude of the satellite sub-point 26 minutes after an EQX at 43 degrees longitude is 60.03 degrees (from the table) plus 43 degrees, equaling 103.03 degrees. The latitude at that moment, read directly from the table, is 75.48 degrees.

Now that we have the means of determining the position of the satellite at any given moment in time, we can employ equation 5 to find the angular separation in degrees of great circle arc between the satellite sub-point and the station for which we are calculating the antenna aiming data. While this intermediate result is of no value as it stands, it is required for the remaining calculations.

Equation 6 gives us the bearing in degrees from true North of the satellite sub-point from the station. Equation 7 then gives us the final piece of information we need for accurately aiming the antenna — the elevation in degrees from horizontal that the satellite appears above the horizon. The final equation, equation 8, allows us to calculate the distance in statute miles between the station and the satellite.

In all cases, the unit of distance is statute (not nautical) miles, and the angular units are degrees rather than radians. Equations 1, 2, 5, and 6 are applicable to any satellite with the previously mentioned general orbital characteristics. Equations 3 and 4 are specialized versions of equations 1 and 2, applicable only to OSCAR 7. As presented, equations 7 and 8 are also applicable only to

OSCAR 7. However, they can easily be modified for use with other satellites by replacing the constant 4867, which represents the sum of the Earth's radius and the altitude that the satellite orbits above the Earth's surface. For example, to modify the equation for a satellite that orbits 950 miles above the Earth's surface, simply replace the constant 4867 with 4907, the sum of the Earth's radius (3957 miles) and the orbital height of 950 miles.

While these mathematical manipulations are not exactly formidable, they are certainly not trivial. A great deal of number crunching is necessary to calculate antenna aiming data for just one moment in time, and even with the aid of a scientific calculator, the task of calculating an entire day's worth of aiming data would take hours of tedious effort. Fortunately, solving the equations is a snap for the digital computer.

Flowchart

Unfortunately, computer technology has not yet evolved to the point where computers program themselves. While eagerly awaiting this development, we are faced with devising our own problem-solving algorithms, and with the often tedious task of programming and debugging the software implementation of these algorithms.

Even with an adequate set of mathematical equations to solve the problem, such as those just discussed, they must still be arranged into a logical and orderly framework from which the computer can proceed. This is often an iterative process, a matter of trying many ideas, and determining by trial and error the most expedient (not necessarily the best) method of realizing a solution. Perhaps the easiest way of explaining the final choice of the algorithm is with a flowchart. A flowchart for the satellite tracking program is depicted in Fig. 2. Statement numbers have been affixed to the flowchart symbols, referring to the BASIC program statements of the listing in Fig. 3.

Beginning at statement 130, the fixed data for the program is initialized. Note that the latitude and longitude of the satellite sub-point versus time for an orbit with an EQX at 0 degrees longitude is stored in the program in two arrays (or matrices) and initialized at this time in statement 185. At statement 220, the computer asks for data for the reference pass (time and longitude of the first EQX of the day, as published monthly in *73* and other sources). If a 99,99,99 is typed in at this time, the program will halt (statement 230).

At statement 340, the in-range flag and minute counter are reset to 0. The in-range flag is a means by which the program can keep track of whether the satellite was ever within range of the station during a particular orbit. The minute counter is a register where the program remembers the minutes that have elapsed since EQX.

Beginning at statement 390, the program calculates the position of the satellite sub-point for the time stored in the minute counter. If the satellite is in range, antenna aiming data is calculated and printed (statement 550) and the in-range flag is set to 1, which will later remind the program that the satellite has been in range during at least one moment during the orbit. If the satellite is not in range, the program checks to see if it was in range during a previous minute of that particular orbit. If so, it knows that the satellite will not come into range again until the next orbit, and it branches to statement 660. If the satellite has not been in range during a previous minute of the current orbit, the program branches to statement 600, and after incrementing (adding 1 to the current value) the minute counter, checks whether over 58 minutes have elapsed since EQX. If so, the program prints an appropriate message and calculates the time of the next EQX. If 58 minutes have not elapsed, the program loops back to statement 390 to calculate the position of the satellite sub-point at the next checkpoint in time (two minute intervals in this case).

At statement 660, the time of the next EQX is calculated. If that time is still in the current day (before 24:00:00 GMT), the program loops back to statement 340 and repeats the entire process for the next orbit. If the next EQX occurs during the next day (after 24:00:00 GMT), the program loops back to statement 220, giving the

```
OSCAR        17:04CDT     10/11/76

ENTER EQX TIME FOR REF PASS (HR,MIN,SEC)
ENTER 99,99,99 TO STOP PROGRAM

? 0,26,54
ENTER EQX LONG.

? 56.6

ORBIT NO.  1

EQX AT  0:26:54 GMT AT  56.60 LONG

MIN AFTER EQX        AZIMUTH        ELEVATION       RANGE

      8              116.89           6.24          2436
     10              108.20          13.35          2063
     12               95.79          21.93          1718
     14               79.24          27.46          1545
     16               53.85          30.61          1462
     18               33.71          28.28          1522
     20               15.12          21.28          1740
     22                5.36          14.41          2015
     24              355.61           6.45          2424

ORBIT NO.  2

EQX AT  2:21:50 GMT AT  85.34 LONG

MIN AFTER EQX        AZIMUTH        ELEVATION       RANGE

      4              170.42           6.24          2436
      6              173.14          14.38          2016
      8              180.00          25.00          1617
     10              187.47          41.10          1245
     12              220.09          60.94          1012
     14              283.14          64.10           990
     16              319.71          43.61          1205
     18              328.54          29.58          1498
     20              334.38          17.35          1899
     22              338.07           9.68          2245
     24              340.40           1.22          2752

ORBIT NO.  3

EQX AT  4:16:47 GMT AT 114.07 LONG

MIN AFTER EQX        AZIMUTH        ELEVATION       RANGE

      6              231.04           3.45          2605
      8              242.27           6.76          2406
     10              255.51          10.03          2227
     12              271.11          10.93          2181
     14              284.10          10.87          2184
     16              298.78           8.42          2312
     18              309.72           5.42          2484
     20              319.03           1.49          2733

ORBIT NO.  4

EQX AT  6:11:44 GMT AT 142.61 LONG

MIN AFTER EQX        AZIMUTH        ELEVATION       RANGE

OUT OF RANGE DURING THIS ENTIRE PASS
```

Fig. 4. Sample output from the satellite tracking program.

APPENDIX

Equation 1

A general equation for calculating the latitude of a satellite sub-point versus elapsed time from EQX.

$Lat(T) = \sin^{-1}(\cos(\text{sub-point bearing})\sin(360T/P))$

T = the elapsed time in minutes from EQX

P = the satellite orbital period in minutes

Sub-point bearing = the bearing of the satellite sub-point path at EQX (see Fig. 1)

Example — Given a satellite with an orbital period of 100 minutes, and a sub-point path that has a bearing of 330 degrees at EQX, find the latitude of the sub-point 10 minutes after EQX.

$Lat(10) = \sin^{-1}(\cos(330)\sin(360 \times 10/100))$

Lat(10) = 30.60 degrees North

Equation 2

A general equation for calculating the longitude of a satellite sub-point versus elapsed time from EQX.

$Long(T) = \cos^{-1}(\cos(360T/P)/\cos(Lat(T))) + (0.25T) + L_0$

T = the elapsed time in minutes from EQX

P = the satellite orbital period in minutes

Lat(T) = the latitude of the satellite sub-point as calculated with Equation 1

L_0 = the longitude of the satellite sub-point at EQX

Example — Given a satellite with an orbital period of 100 minutes, and a sub-point path that has a bearing of 330 degrees at EQX, find the longitude of the sub-point 10 minutes after an EQX at 100 degrees longitude.

$Long(10) = \cos^{-1}(\cos(360 \times 10/100)/\cos(30.60)) + (0.25 \times 10) + 100$

Long(10) = 122.46 degrees

Equation 3

An equation for calculating the latitude of the OSCAR 7 sub-point versus elapsed time from EQX.

$Lat(T) = \sin^{-1}(0.9790\sin(3.1319T))$

T = the elapsed time in minutes from EQX

Example — 10 minutes after EQX the latitude of the sub-point would be:

$Lat(10) = \sin^{-1}(0.9790\sin(3.1319 \times 10))$

Lat(10) = 30.590 degrees

Equation 4

An equation for calculating the longitude of the OSCAR 7 sub-point versus elapsed time from EQX.

$Long(T) = \cos^{-1}(\cos(3.1319T)/\cos(Lat(T))) + 0.25T + L_0$

Lat(T) = the sub-point latitude as calculated with Equation 3

T = the elapsed time in minutes from EQX

L_0 = the longitude of the satellite sub-point at EQX

Example — 10 minutes after an EQX at 20 degrees West longitude, the sub-point longitude would be:

$Long(10) = \cos^{-1}(\cos(3.1319 \times 10)/\cos(30.590)) + 0.25 \times 10 + 20$

Long(10) = 29.569 degrees West

---

operator a choice of requesting data for another day's orbits or for stopping the program.

Program Listing

The listing in Fig. 3 has been thoroughly annotated. The following comments should provide additional insight into the inner workings of the program and will hopefully expedite the process of implementing the program on other computers:

1) All the modifications required to use the program for calculating tracking information for other satellites are made in lines 130-180 and 800-830. Station location data is entered at lines 170 and 180.

2) Few will probably wish to leave the program exactly as it is once they get it running on their machine. An attempt has been made to keep the program structure modular so that new features can be easily added. Some of the following modifications and enhancements that might be made are:

a) Print out in local time rather than GMT (or UCT).

b) Print out orbital data in smaller or larger time intervals than 2 minutes.

c) Print out when both the local station and another station of interest are within range of the satellite.

d) Calculate the Doppler shift of the received signal.

e) Suppress printout during specified hours of the day.

f) Interface the program to an assembly language program to perform real-time control of the antenna during satellite passes, providing automatic operation.

3) Anyone who has had experience in trying to implement a "canned" program on any computer system has undoubtedly been faced with the task of converting certain non-standard code of the "canned" program to code that his particular system would accept. This consideration applies to both large and small systems, even in languages such as FORTRAN and COBOL, where there are generally accepted standards to promote program portability. Since the microcomputer field is still in its infancy, it should come as no surprise that the BASIC interpreter available from any particular manufacturer is more than likely different in at least some respects from the BASIC interpreter supplied by any other manufacturer. To my knowledge, there is not yet a standard on what features comprise the "4K", "8K", "12K", and "extended" BASIC interpreters being marketed by the various manufacturers and systems houses.

Without making a thorough study of the BASIC interpreters available on the market today, I would guess that the program as listed in Fig. 3 will run with very few modifications on most of the interpreters billed as "12K" or "extended." To execute the program on the more elementary interpreters, some or all of the following modifications will be required:

a) Delete the latitude and longitude tables from the program and add subroutines to directly calculate the satellite sub-point latitude and longitude each time it is required. The essence of the required mathematics for this conversion is contained in equations 1 and 2 in the appendix. The Q and V matrices can then be eliminated from the program, allowing the program to be executed by interpreters that cannot support matrix variables. This modification will have the effect of minimizing the amount of memory required, but will measurably slow down the execution of the program.

b) Substitute iterative routines and approximations for the library trig subroutines in the program. There are a number of handbooks on the market that describe techniques for performing trigonometric and other transcendental functions on simple four function calculators. These techniques can be utilized in developing simple subroutines to provide approximate function solutions that will be accurate enough in this application. This will allow the program to be executed on machines that cannot support trig functions.

c) Delete the "PRINT USING" statements from the program. They are used to format the output in a particular fashion, but are certainly not essential to the program. The output can then be formatted in

Equation 5

An equation for calculating the angular separation of a station location and a satellite sub-point.

$D = \cos^{-1}(\sin A \sin B + \cos A \cos B \cos L)$

D = the angular separation in great circle degrees of arc between the station location and the satellite sub-point

A = the latitude of the station in degrees

B = the latitude of the satellite sub-point in degrees

L = the station longitude minus the sub-point longitude. If the algebraic difference is outside of the range of -180 to +180 degrees, add or subtract 360 degrees, whichever will result in a value in the range of -180 to +180 degrees.

Example – Given that the station is at 39 degrees N. latitude and 77 degrees W. longitude and the satellite sub-point is at 23 degrees N. latitude and 63 degrees W. longitude, the angular separation is:

$D = \cos^{-1}(\sin 39 \sin 23 + \cos 39 \cos 23 \cos 14)$

D = 19.95 great circle degrees

Equation 6

The equation for calculating the true bearing from a station to a satellite sub-point.

$\text{Bearing} = \cos^{-1}((\sin B - \sin A \cos D)/\cos A \sin D)$

A = the latitude of the station in degrees

B = the latitude of the satellite sub-point in degrees

D = the angular separation of the station and sub-point as calculated in Equation 5

Bearing = degrees clockwise from true North of the position of the satellite sub-point with respect to the station. If the value of L in Equation 5 was negative, the bearing is (360 - bearing).

Example – For the conditions in the example of Equation 5:

$\text{Bearing} = \cos^{-1}((\sin 23 - \sin 39 \cos 19.95)/\cos 39 \sin 19.95)$

Bearing = 139.23 degrees from true North

Equation 7

An equation for calculating the antenna elevation for tracking OSCAR 7.

$E = 90 - \tan^{-1}(4867 \sin D/(4867 \cos D - 3957))$

D = the angular separation calculated in Equation 5

E = the angle above the horizon of a straight line between the station and the satellite

Example – For the conditions in the examples of Equation 5 and Equation 6:

$E = 90 - \tan^{-1}(4867 \sin 19.95/(4867 \cos 19.95 - 3957))$

E = 20.41 degrees

Equation 8

An equation for calculating the distance from a station to OSCAR 7.

$M = (4867 \cos D - 3957)/\cos(90 - E)$

D = the angular separation calculated in Equation 5

E = the elevation calculated in Equation 7

M = the distance in statute miles between the station and the satellite (its true position, not the sub-point)

Example – Using the same conditions as for the examples in Equations 5-7:

$M = (4867 \cos 19.95 - 3957)/\cos(90 - 20.41)$

M = 1771.93 miles

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other ways by the user.

Conclusion

The intent of this article has been to present sufficient information on a satellite tracking program so that the interested individual can implement the program on any computer he might have at his disposal. While the version presented here is admittedly a minimal configuration, the additions or refinements to enhance operating convenience should not be difficult. I will gladly assist anyone who encounters difficulties if the questions that arise are submitted along with an SASE. ■

References

"Shoot OSCAR With a Satellabe," K2ZRO, *73*, July, 1975.

"Where's OSCAR?", W3HUC, *73*, July, 1975.

"CQ OSCAR 7," W3HUC, *73*, Feb., 1975.

"How to Find the Satellite," WB8DQT, *73*, Jan., 1975.

"Bearing and Distance Calculations By Sleight of Hand," K1PLP, *QST*, Aug., 1973.

Building the Polymorphics Video Board

-- the voice of experience

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For someone who is primarily a software-oriented person, I seem to do a lot of hardware building. In September, 1974, I started building TVT-I. I got it working in December and had it connected to my Altair 8800 in December, 1975. A friend, also with an Altair, built TVT-II and it was so much faster and better designed that I sold my TVT-I and built a TVT-II. I didn't keep detailed notes on the construction of these two projects, but I learn from my mistakes. When another friend showed me his Polymorphics video board, I knew I was doomed. This video board plugs directly into the Altair or IMSAI bus, eliminating a large boxfull of power supply, TVT-II, and cables, and frees the parallel I/O port I used with the TVT-II. This time I kept notes on the subject. The kit is of good quality and there should be no more than the normal problems putting it together; nevertheless, there are some pitfalls. This article will explain the ones that I encountered and how to solve them.

The video board appears to the program to be a block of random access memory which is constantly displayed on your monitor or modified TV. The display has sixteen lines which may be either 32 character lines ($185) or 64 character lines ($210). The 32 character lines will probably work with a modified TV which has a bandwidth of 2.5 MHz, but the 64 character lines may require a monitor, as they need a bandwidth of 5.5 MHz. The memory uses 91L11 chips and acts as a normal memory. It can be used for program or data storage in addition to its normal uses. Data may be entered into any of its memory locations at any time, giving the capability of scrolling, paging, columns, fixed format entry, or any other display mode you would like to use. This flexibility requires suitable programming – more on this later!

An 8-bit parallel input port is built into the video board so that a keyboard may be attached, thus giving both input and output from one board. Unfortunately, there is no corresponding status port for this input port, so the program must check the data to see if it has changed in order to know when new data is available – again, more programming overhead.

The 6572 character generator chip provided with the kit gives 128 ASCII characters, including upper and lower case, numbers, and special symbols. Lower case Greek letters print in place of the ASCII control characters. Other chips in the same series may be substituted, giving different special symbols instead of the Greek letters. The graphics display is handled external to the 6572 chip. The character space is broken up into six spaces – three rows of two blocks each, giving 64 possible graphics characters. The blocks cover the entire character space so that the entire screen may be made light with no spaces between characters.

Buying The Kit

When I decided that their kit would satisfy my needs, I called Polymorphics and asked them to send me a kit.

I've learned several things from the boards that I've already built. I use sockets for all ICs (sockets come with the Polymorphics video board) and I test all of the parts that I can test. These two things can save hours of time later in the project when it doesn't work.

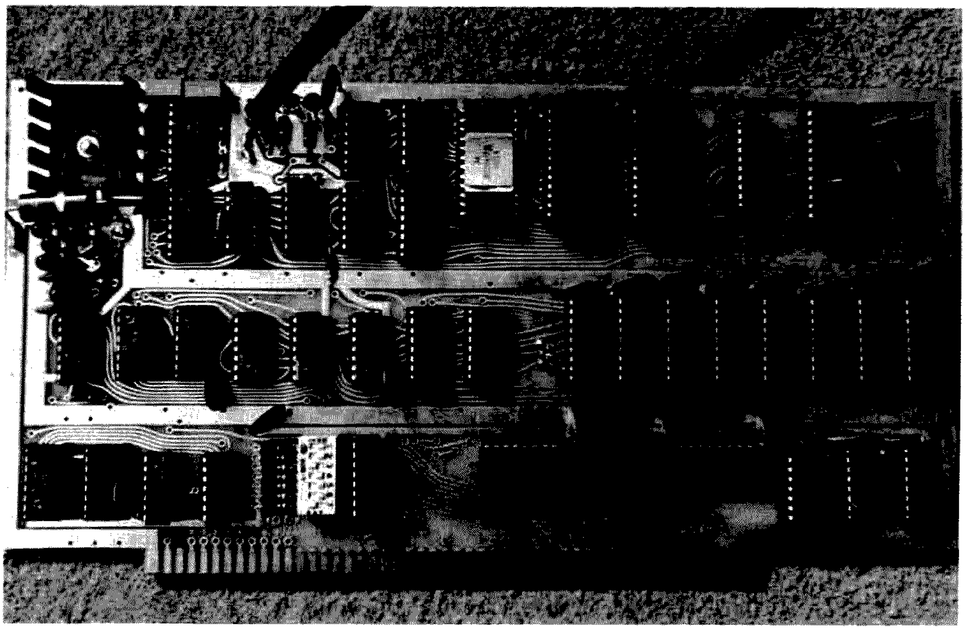
The first thing I did when I opened the box was to look at the instruction book. This is an impressive manual of about 72 pages and covers assembly, theory, troubleshooting, and software. The section on troubleshooting is especially impressive as many kits have no such section. Polymorphics devoted 16 pages to troubleshooting, arranged in a logical manner. Hopefully you won't need it (I didn't), but it's nice to know that it's there and reading it will help give you a better understanding of the circuits involved.

Building The Kit

The first part of kit-building is checking the parts supplied against the parts list. I was missing a 27 pF capacitor and a 150 Ohm resistor, but it turned out that neither part was used in the kit. A 1N759 12 V zener diode was also missing, but a 78L12 was supplied instead. An extra 10 uF electrolytic capacitor was included and was used in the kit.

Having determined which parts were supplied, the next

step was to test all that I could. It is much easier to find a shorted capacitor, for example, when you have not yet mounted it than it is to find it when you discover that your board doesn't work! The resistors supplied with my kit were all within tolerance, but I found that one end of one 10k Ohm trimpot was open. I was able to use it for R22, so it caused no problem. I checked the capacitors for shorts and observed the charging of those over .01 uF. All capacitors tested good. All diode and transistor junction resistances (forward and backward) were good. By inspection I found a solder bridge on one of the ICs. This is not uncommon and can cause a lot of grief if it isn't found before the IC is mounted.



Getting It All Together

The assembly instructions are aimed toward the person who has had some prior kit-building experience. A drawing of the board is given showing the locations of the various parts. Each part is listed with a space to check as each is soldered in place. The drawing in my manual was smeared in places so that I couldn't read the parts labels. I was able to get the needed information from a friend with a Polymorphics video manual with a clear drawing. There were also two pages missing from my manual which I was able to copy from his. Further confusion can arise from C25, which is labeled .01 uF on the schematic but is given as 4700 pF in the assembly instructions (4700 is correct). The polarity is not given for one of the electrolytic capacitors and is shown reversed on the schematic for one of the others. It may be obvious to everyone but me, but I still think that a note should be included telling which way to orient the trimpots so that they can be adjusted while the board is in operation. I also think that instructions on connecting the video output cable should be included.

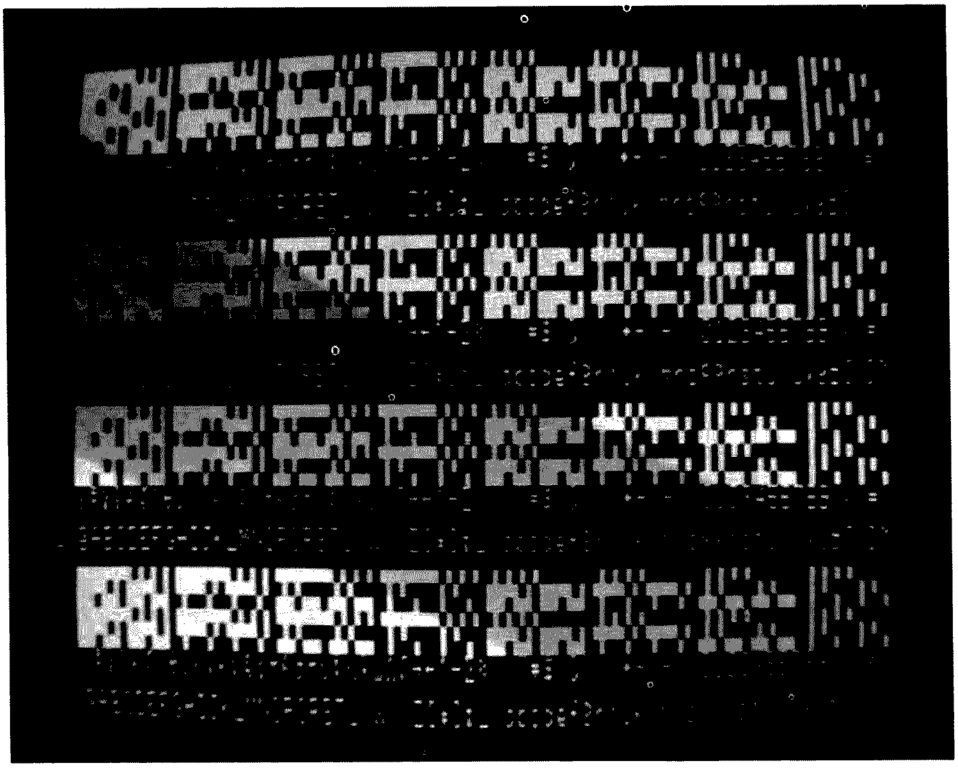
In all, construction time was probably well under 10 hours, but it is hard to tell when the time available to work on it comes in blocks of 30 minutes or less. In any event, the moment of truth finally came. I plugged it in and turned power on. A few quick adjustments of the horizontal and vertical controls on my monitor and voilà – a screen with funny-looking characters on the left side of the screen and wavy lines running from top to bottom. The characters didn't look too good either. A quick voltage check: Yipes! 6.6 volts instead of 5.0. Replacing the 7805 regulator brought the voltage down to an acceptable 5.06 volts. I decided that it is worthwhile to test voltage regulators also! Somewhat afraid that, after the 6.6 volts, I now had a board of write only memory, I tried again. No ripple this time and the voltage was good, but the characters were still all at the left side of the screen and still looked funny. I could enter characters or change them but they looked like negative images. Enter my friend again. I had used twinlead to connect the board to my monitor because I didn't have any coax handy. (No cable is supplied with the kit.) My eagle-eyed friend pointed out that I had reversed the connections to the monitor, thus reversing the video. This also caused the monitor to sync on the first white square (black in the negative image) on each line, thus preventing me from centering the display. Changing the cable restored a positive image and fixed the sync. The board now worked just fine with respect to hardware.

Apparently there is a problem with some monitors due to the fact that the video board operates at 17.094 kHz, which is above the normal horizontal sweep frequency. Instructions are given to lower the board's frequency if required. It is also possible to use an onboard crystal to obtain any desired sweep frequency. Normally the signals are divided down from the 2 MHz clock on the CPU board. This modification was not needed with my Sanyo VM-4092 monitor.

Software – The Last Pitfall

Because the board is so versatile, the software to control it is complex and lengthy. For paging, the control software must determine where the character is to be put, control a cursor if desired, and watch for end of page. Line feed and carriage return instructions must be intercepted and handled as well as any optional commands you wish to implement, such as backspace or backline, etc. One problem which could have been avoided is the fact that the board looks at the most significant bit to determine whether to display an ASCII character or a graphic character. If the bit is a 1, the ASCII is displayed. Most packaged software, such as MITS BASIC, will mask this bit to a zero so the video control software must also fix this bit.

Polymorphics includes a listing of a program to control their board. It allows for input from their keyboard using interrupts to determine when data is valid. The program offers quite versatile control of the display. Home, erase, right, left, down, delete character, insert character, etc., as well as optional paging or scrolling, are available under software control. The video control routine is 455 bytes long and is given as an assembly listing in hexadecimal. It uses memory locations Ø through 44 and 1DØØ through 1E83. The board is assumed to start at memory location 88ØØ hex. This is a



lot more overhead than a simple I/O port which might use 20 bytes. The best idea is to put the driver routine in PROM. Another disadvantage is that this video output will not be compatible with other packaged software such as MITS BASIC, although such programs can be modified to call the video driver.

Another program listing is included in the manual. This one plays the "game" of LIFE. LIFE loads into memory locations Ø through Ø1Ø6 hex and also uses blocks of memory starting at 3ØØ and 8ØØ hex.

Since I work in octal, don't have an assembler operating, and these routines overlay my control programs, I don't have either of them loaded yet. Both are well-documented with comments, though neither appears to use structured program techniques. It should not be difficult to get them running.

Summary

Overall, the kit seems well-designed. Except for a bad part (the voltage regulator) and my own stupidity (the reversed video cable), the board would have worked the first time. Even if it hadn't, the troubleshooting section seems well thought out and requires no test equipment but a voltmeter and your monitor. I built it and I'm glad I did. ■

RTTY Goes Modern

-- using microprocessors

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Today's RTTY amateur has available a choice of equipment and techniques that allow him to develop sophisticated radioteletype-computer links which were only dreamed of several years ago. Moreover, with the ever-increasing usage of RTTY on VHF repeaters, the feasibility for radio-linked computer programming from a central computer is not only plausible, but is on its way to becoming a reality.

This article provides a general introduction into amateur RTTY as well as a chronological background of RTTY developments over the past 15 years. This article should familiarize non-RTTY amateurs and computer hobbyists with the early developments and how they have influenced the current state of the art. Finally, I have taken the liberty of predicting what the marriage of microprocessors and RTTY will bring in the future. So pull up your easy chair, relax, and follow me as I take you down the evolutionary path of amateur radio TTY.

Amateur RTTY – What Is It?

Amateur radioteletype, or RTTY for short, started in the early 1950's when many of the military surplus teleprinters and associated equipment became readily available at reasonable prices. In addition, in 1953, the FCC allowed amateurs to use RTTY on all frequency bands above 3.5 MHz.

In the early days of RTTY, activity on the ham bands was split between groups who primarily worked the frequencies below 30 MHz and those who were content to use VHF frequencies. One group desired long distance RTTY communication while the others used RTTY for local net-type operation.

In those days RTTY was, and still is, transmitted in one of two ways on frequencies below 30 MHz. The first method, called frequency shift keying, or FSK, involves changing the carrier frequency each time a mark or space pulse is encountered during a character's transmission. Using FSK, a constant carrier is transmitted for a mark pulse, with a space pulse causing the carrier to shift down by 850 Hz. More recently, common practice has changed the shift to 170 Hz due to the increasingly crowded ham band signals which cause interference within the wider 850 Hz shift. The other common method of RTTY transmission utilizes audio frequency shift keying, or AFSK. With this method, a pair of audio tones is fed into a single sideband system, utilizing a well-suppressed carrier and operating in the lower sideband mode. The shift of the audio tones, usually generated with 2125 (mark) and 2295 (space) Hz signals, again presents a 170 Hz signal to a copying receiver. On the receiving end of things, both FSK and AFSK generated signals sound exactly alike, and it is unlikely that you could tell them apart. On VHF, the audio tones are usually fed into an AM or FM transmitter using either 850 Hz or 170 Hz shift, depending upon which shift is being used in the particular area.

The AFSK signal generation used in RTTY is similar to the AFSK used in most computer-telephone-modem links except for the frequencies of the tones. Another obvious difference is the transmission media, which is radio waves instead of telephone wire pairs. The RTTY speed of 60 wpm (45.5 baud) is also somewhat slower than conventional modems which operate at 110 or 300 baud. The code used for RTTY is the common 5 level Baudot code which has 32 characters in the "letters" mode and another 32 in the "figures" mode; however, not all characters are used.

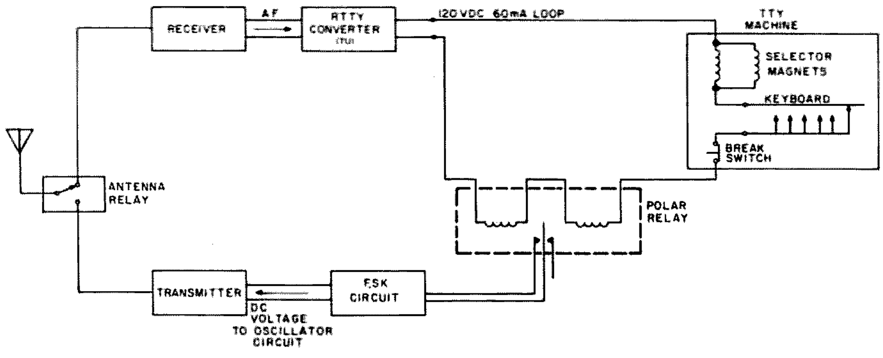

Fig. 1. Early RTTY FSK system.

The similarity between modems used on computers and modems for RTTY, which are called terminal units, also exists on the reception end. Most common of the terminal units are ones with tone selective filters which respond to 2125 and 2295 Hz tones taken from the receiver speaker terminals. Additional circuitry is often incorporated to compensate for selective fading of signals and space-only or mark-only copy. The terminal units basically function as tone decoders which drive a tube or transistor keying stage adjusted for 60 mA of printer loop current. A typical receiving system is shown in Fig. 1.

In this setup, the converter (TU) connects to the audio output of the receiver, and modulates (keys) a 120 V dc "loop" adjusted for 60 mA of current required by the selector magnets of the teleprinter. The keyboard of the teleprinter is also connected in series with the loop supply; consequently, whenever a key is depressed, it breaks the loop in a predetermined sequence, which causes the printer to print that character. In addition, when the transmitter is on, depressing a key will cause the Baudot encoded character to be transferred through a polar relay into an AFSK generator which can modulate the transmitter.

Transmitting and receiving are conceptually easy to understand although, depending upon the accessories that are hooked into the system, the switching circuitry can get quite complicated.

Many amateurs started with simple setups as shown in Fig. 1; however, they soon learned that adding accessories could significantly enhance both receiving and transmitting operations. Early in the RTTY game, most additions to the RTTY station were mechanical in nature. Paper tape perforators and transmitter distributors (tape readers) were probably the first added luxuries. These items allowed you to punch a tape for transmission later at full speed. It is common practice to punch a tape while the other person is sending to you, so that when he is done, you can immediately start sending back to him. Another mechanical feature which proved to be quite popular was the stunt box available in the Model 28 machines. This mechanism allowed the printer to decode or "recognize" certain characters or combinations of characters in such a manner that a switch closure (or opening) could take place. This feature, in conjunction with an option called answer-back (part of an item called a WRU or who are you?), allowed a person's machine to answer or transmit back a programmed message when queried with a preprogrammed recognition sequence. Some Model 28s are even equipped with back space and reverse line feed so you can "roll up" what has already been typed. Imagine coming home to a spindle of paper all rolled up and printed!

Many of the above mechanical features were coupled with a very popular option called autostart, which is short for automatic starting. This feature allows your TU to be activated by a steady mark tone lasting a given duration (usually about 3 seconds or more). Although employed to a limited extent on the low bands, autostart TTY is used quite extensively between club or net members using the VHF bands for local communications. The principle involved with autostart is simple. As an example, suppose you have a receiver monitoring your favorite channel and while you are out at a swapmeet, one of your friends calls you on the radio to leave you a message. When he transmits a continuous mark tone for 3 seconds, your TU responds by turning your printer motor on and subsequently prints your friend's message and shuts itself off again ... all automatically. When you arrive home, the message is there waiting to be read. This feature is obviously very useful, and many amateurs monitor a given frequency 24 hours per day in order to be in constant communication with their friends.

Glossary

POLAR RELAY:	*A springless relay built by winding a magnetic core with two equal but opposite windings. The armature stands theoretically in the middle of the two windings. This kind of relay permits the operation of a RTTY circuit that has a current flow in one direction for mark and in the opposite direction for space.*
POLAR SIGNALS:	*Signals in which the current in the transmission line is reversed in polarity in changing from marking to spacing.*
NEUTRAL SIGNALS:	*Signals sent in the form of direct current pulses for marks and an absence of current for spaces.*
REGENERATIVE REPEATER:	*A circuit which samples incoming signal pulses and retransmits them with perfect timing and no distortion.*
DIDDLE:	*Automatic transmission of letters or figures characters by the TU if no characters are ready for transmission (most often used with a FIFO or memory).*
BAUDOT:	*Five level code used primarily by amateurs in RTTY communication. Only code allowed by FCC without special waiver.*
ASCII:	*American Standard Code for Interchange of Information (commonly used in computers).*
TU:	*Terminal unit or amateur RTTY version of a modem.*
QSL:	*Written acknowledgement of two-way radio communication.*
FIFO:	*First In, First Out stack. Used for storing data for retransmission (communication applications).*

The 1960's

These mechanical marvels were quite the state of the art in the mid and late 1950's. But around 1960, with the ever-increasing use of the transistor by amateurs, many of the functions previously performed by mechanical means were being performed by electronic circuits.

Probably one of the first mechanical items to give way to electronic circuitry was the ubiquitous polar relay. This relay was used in the polar circuitry of terminal units where current flowed in one direction for space and in the opposite direction for mark. Thus the relay could key a local loop supply for a teleprinter when driven by tone decoders. This electronic "advancement" in modern technology, utilizing such components as SCRs and switching transistors, got rid of noisy clicking relays which often got out of adjustment or were plagued with dirty contacts. More importantly, however, it also sparked the beginnings of the evolution of solid state technology in RTTY applications.

It is interesting to digress for a moment and reflect upon the paths taken in the "evolution" I have just mentioned. First of all, it was a dual affair, with the VHF RTTY folk applying solid state technology to AFSK methods and terminal units in the early 60's. The other concerted effort was made by the lower frequency RTTY men who seemed to lag behind technologically, prob-

ably due to the more severe reception problems associated with static noise, signal fading, and changing atmospheric conditions. The progress of both groups can be put into perspective by observing Fig. 2, a time line showing RTTY evolution derived from a study of articles published in *73, QST, CQ, Ham Radio,* and the *RTTY Journal* during the 60's.

It is easy to draw several conclusions from Fig. 2. First, we observe that transistorized TUs are introduced early in the 60's but are used primarily on VHF where receiving conditions are almost identical to modem reception over telephone lines. On the other hand, FSK terminal units were still built primarily with tube circuits without bandpass filters but using clunky polar relays. However, in 1965, FSK RTTY really got a push due, in most part, to a one-man effort by Irv Hoff, who published no less than ten articles in *QST* covering all aspects of RTTY. He also shared the design credit for the Mainline TT/L FSK demodulator which, for FSK, was the state of the art even though it used tubes. During the rest of the 60's, solid state and digital technology continued to be used primarily in VHF with the introduction of such items as a digital Selcal (selective calling unit similar to a mechanical stunt box), crystal controlled AFSK generators, and IC RTTY converters. In contrast, tube circuitry was still being used in the TT/L-2, an improved TU for LF described in a 1969 *QST* article. However, autostart techniques were catching on in the LF spectrum and diode FSK circuits were in common use.

Overall, it was rather apparent, during the 60's, that VHF RTTY amateurs were closer to using state of the art digital technology than their LF RTTY compatriots. The reason for this difference is not quite clear, although it may be due to the fact that VHF RTTY amateurs, by virtue of continually talking (printing) with the same people on net frequencies, generated more ideas and techniques than the LF hams who tended to have less frequent contacts in a more or less hit and miss fashion. However, in the 1970's the technological difference between the two groups has become less and in fact may have become equal.

1960	
	Polar relays used extensively
	Tube converters for low frequency (LF)
1961	
	Simple VHF transistor TU
	Transistorized AFSK
1962	
	Garden City TU (LF)
	FSK without polar relays
	Introduction of bandpass audio filters for RTTY
1963	
	Chemical City TU (LF, mark only, space only copy)
1964	
	Crystal controlled FSK
	More transistorized TUs – VHF with autostart
1965	
	UJT AFSK OSC – VHF
	RTTY articles by Irv Hoff
	FSK with SSB transmitters used extensively
	Mainline TT/L FSK Demod (First good LF TU using bandpass filters and all other previous TU features and new innovations – tube TU!)
1966	
	Diode FSK circuits
	High performance RTTY filters
1967	
	Autostart RTTY – low frequency
	More solid state VHF TUs and AFSK gen.
1968	
	First RTTY Selcal introduced – digital ICs – VHF
1969	
	Mainline TT/L-2 – improved TU for LF (Tubes)
	IC RTTY TU and AFSK (ICs introduced to RTTY – VHF)
	Crystal controlled AFSK – IC technology

Fig. 2. RTTY Evolution – 60's.

The 1970's

The 1970's have brought us not only a digital revolution in consumer and industrial products, but also in RTTY, both for low frequency and VHF application. Fig. 3 illustrates this evolution in both areas of RTTY operation.

In the 70's, LF FSK circuitry quickly began to catch up with VHF RTTY circuitry. In 1970, the ST-3 and ST-5 terminal units were pioneered by Irv Hoff. Although designed primarily for VHF, they have been used extensively for LF also. In 1971, the ST-6 was born. This TU represents a solid state attempt to incorporate the circuitry developed in the TT/L-2 in the late 60's. It incorporated mostly op amps of the 709/741 series. Even today this TU is the most popular and widely used on the LF bands.

Very few major technological differences have taken place in LF RTTY TU technology since the advent of the ST-6. Most changes have involved accessories which interface with the ST-6 and provide more convenient operation. In 1971, speed converters using discrete components were introduced, as were preprogrammed digital message generators. In 1973, a crystal controlled digital audio synthesizer was described for AFSK generation with SSB transmitters. 1973 also brought several new accessories to the RTTY community, including video displays for Baudot, digital keyboards, digital autostart units, and Morse code to RTTY converters using discrete TTL circuits. 1974 was also a good year for technological developments in digital LF RTTY and the introduction of UARTs in RTTY circuitry.

Lest we not forget VHF during the 1970-74 period, it should be mentioned that the phase lock loop (PLL) was used in several TU designs taking circuitry ideas modeled after the PLLs used in computer modems.

It was in 1975, however, when the RTTY technology really exploded, just shortly after the introduction by MITS of the Altair 8800 microcomputer. In 1975, several articles described programmable RAM message

Year	Development	Notes
1970	Mainline ST-3,4	VHF TUs of modern design
	Mainline ST-5	
1971	Mainline ST-6	First good low band TU
	Digital MSG gen.	
	Speed Converters	Digital accessories come into wide use
	Digital AFSK gen.	
1972	PLL TU-VHF	PLL technology used
	Audio digital synthesizer	
1973	Hal video display	
	Digital keyboards	
	Morse to RTTY Converter	
	Digital autostart	
1974	Prom memory for RTTY ID	
	RTTY MSG gen.	
	Using UART	
1975	MITS introduces Altair	
	Programmable RAM MSG gen.	
	UT-4 (FIFO)	
	PLL TU	
	Solid state TTY keyboard	
	uP control of RTTY STN	
1976	DT-600 Digital ST-6	
	Hal MP unit	Morse to RTTY – uP
	Digital Time Clock	ASCII/BAUDOT
	Baudot/ASCII	WACC Winner – RTTY Station
	Digital Selcals	
1977	RTTY used with uP	
	Intelligent terminals	
	uP control of repeaters	
	uP controlled RTTY stations – wide use	
	Computer oriented repeaters with A/D converters for time, weather, termperature, etc.	
1978	Universal magnetic tape use for RTTY	
	uP controlled receivers and transmitters	
1979	Floppy disks and RTTY joined	

Fig. 3. RTTY Evolution – 70's.

generators. Also UARTs and FIFOs were becoming very popular among the LF gang (principally those monitoring 3612.5 MHz on the West Coast). It finally looked like LF and VHF techniques had caught up with each other! In late 1975, we began to observe the influence of microprocessors as evidenced by several articles which outlined microprocessor controlled RTTY stations both on VHF and LF.

This exciting trend has continued to accelerate at an increasing pace as the availability of hardware and software technology becomes more widespread. Hal Communications has introduced an 8080 based RTTY terminal; digital Selcal circuits are springing up everywhere; ASCII to Baudot and Baudot to ASCII code converters have been written up in several magazines with commercial units now available; and, to top it all off, the grand prize winner at the World Altair Computer Conference was a computer controlled RTTY station! We have certainly come a long way from the days of polar relays and tube converters!

So here we are in 1977, the year of the microprocessor in RTTY; where to go now? Let's look back for a second and envision a typical advanced RTTY station of 1976. With a microprocessor you have the capability to send and receive Morse code (at any speed), send and receive RTTY in Baudot or ASCII (for OSCAR satellite work), look like a super FIFO/UART combination, perform as a stunt box, Selcal, regenerative repeater, digital autostart, diddle and antididdle device, automatic logging unit, RY generator, memory box for contests, callsign lookup and recorder, or any other digital device you can dream up and interface to your microcomputer.

OK, so what's left, you may ask. If you let me take the liberty of gazing into my crystal ball, here is what I see. First, I can see quite clearly the ever-increasing use of micros like the 4040, 8008, 8080, 6800, 6502, SC/MP, etc., in amateur designed circuits dedicated to RTTY. By mid-1977 the majority of RTTY amateurs should have some type of micro in use in their station, even if only to look at! Many of the micros will be used to provide intelligent terminals which can be used for text editing before transmission and for preparing data for storage on a tape cassette.

It is also reasonable to expect microprocessor controlled radio repeaters in 1977 for both RTTY and voice applications. These will be interfaced with A/D converters which could give time, temperature, weather reports, etc., when certain access codes are received by the computer. In addition, I foresee more sophisticated remote monitoring of repeater technical parameters, where voltages, temperature, and currents are transmitted in ASCII, when inquiry codes are received by the repeater. In the late 70's it is also likely that RTTY repeaters will be linked across the state, or country, thus allowing the computer amateur to converse with others thousands of miles away.

I also can see the increased use of magnetic tape for file storage of RTTY pictures and other information generated on the computer. Five level tape will become more and more scarce as cassette tape standards begin to dominate the scene.

Also, in 1978, "canned" software for your favorite computer routines will be readily available from your ham or computer dealer. RTTY computer repeaters will also be very popular and will feature computer software for circuit calculations, antenna bearings, QSL information, and other applications. As costs come down on floppy disks in late 1978, early 1979, more amateurs will be using them for DX contest record-keeping, QSL info, magazine indexes, and personnel accounting records.

In addition, with the widespread use of video disk and video terminals, more computer amateurs will be transmitting and receiving video messages and symbols. Image processing and computer graphics will be fully developed on the RTTY frequencies. Who knows, your computer may be talking to my computer by 1980 and all I will have to do is lick the stamp on the QSL! Who said we're not a push-button society?

As you can see, we have come a long way over the past 15 years and we still have a long way to go. The journey of the future will be just as exciting as the one we have recently finished. You can take part in the evolution to whatever extent you desire. I know I will be there building microcircuits, reporting them to you in future articles and enjoying every minute of it.

So come on! If you missed the last 15 years, it's still not too late; you can start now on the next 15 years and maybe you'll be the one to write the next evolution of RTTY article in 1991. ■

Bibliography

Green, Wayne, *RTTY Handbook*, TAB Books, Blue Ridge Summit PA.

Kretzman, Byron H., *The New RTTY Handbook*, Cowan Publishing Corp., New York NY.

Tucker, Durward J., *RTTY from A to Z*, Cowan Publishing Corp., New York NY.

QST Magazine, American Radio Relay League, Newington CT.

Ham Radio Magazine, Jim Fisk, Editor, Greenville NH.

CQ Magazine, Richard Ross, Editor, Port Washington NY.

Popular Electronics, Ziff-Davis Publishing Co., New York NY.

Radio Electronics, Gernsback Publications, Inc., New York NY.

BYTE Magazine, Carl Helmers, Editor, Peterborough NH.

Creative Computing, David Ahl, Editor, Morristown NJ.

LETTERS

from page 10

got any suggestions?

And last, you've got a great mag. You've got 3 times the articles and twice the quality of the next best mag. I haven't read a *QST* in months. I only wish my subscription had run out this summer so I could take advantage of your 3 year/$17.76 offer!

Eric Unruh WB0RYN
Newton KS

WASTED PAGES

Obviously you are still experiencing some negative feedback regarding the involvement of *73 Magazine* in the subject of computers. I would like to comment. I submit that you have not yet presented the computer in such a way as to attract the greatest number of your readers. This is assuming that you have readers from age 14 through 65 years, and that they do not all have strong technical backgrounds. Or it may be that to many, although employed in some field of electronics, it's not necessarily digital electronics. (Many linear cats find the conversion to a digital world to be a painful process.) It should be clear that if an article on computers is written at a level for computer engineers, then for hundreds of ham subscribers who are oriented differently, that material represents 4 or 5 wasted pages in their magazine. Therefore, I propose that you seek and publish articles telling us why we should all be interested in the subject of computers. We should be told exactly what a computer will do for us. We should be told why it is necessary to "program" a computer, with simple elementary examples of "storage," "retrieval," and "processing." This should be written in simple definitive English, avoiding the use of professional programmer's terminology.

Let us move ahead on the subject of computers in *73 Magazine*, but starting at the appropriate point. Leave the advanced material to such publications as *Byte, Kilobaud, Megabyte*, etc.

I would like to emphasize that the foregoing does not apply to your many other fine articles involving digital techniques. These I regard as excellent for hams. I have just completed my own functional frequency counter built by me using information from at least 5 or 6 different articles published in *73*.

Harry D. Minshew W6ZOW
Hemet CA

Sorry, Harry, But Kilobaud *won't have that advanced material you mentioned any more than the I/O section of* 73 *will. I understand, and can relate to, your remark about how difficult it is to make the conversion from the "squiggly lines" to the world of "1s and 0s." Keeping this in mind, I am constantly trying to get material for the I/O section for beginners. On the other hand, there are a number of hams who have been in this for awhile and would like to see some good applications material. My job is very simple . . .just make everyone happy (hi). — John Craig.*

THE PRICING GAME

I just received the Holiday 1976 issue of *73*. After my first scan through (I generally make several passes), I noticed an ever-increasing trend by manufacturers to eliminate the price of equipment from their advertising. Why do they do this? It is difficult to compare similar products by different manufacturers if the reader has no idea if the price range is the same. How can the prospective buyer know which rig is best suited for his individual situation?

For example . . . Kenwood has a number of full page ads, back cover, 2, 67, 70. No prices on any piece of equipment. Ditto KLM's full page inside front cover. Same goes for Icom . . . 5, 42, 43, 55. How about Hy-Gain on page 7 and Ten-Tec on page 30? Even my friends at Klaus Radio on page 133 refrain from price quotations. Why all this secrecy? Are manufacturers afraid they will scare off prospective customers?

It is my belief that if suggested prices were once again part of the ad, a better comparison could be made by the reader. Also, I feel that some prospects are turned away because they "think" a piece of gear is more expensive than it actually is.

I would like to see price of equipment on each and every piece of gear that is advertised to the ham market. This does not mean that the prices would have to be firm. Everybody knows that individual dealers can make their own deal within the limits of sound business practice, so why not give the consumer a few guidelines?

Generally speaking, a dealer in amateur equipment will sell more than one product line. For example, a given jobber will sell both Kenwood and Icom. If he can vary from the suggested list price on Kenwood, he can do the same on Icom. The buyer can decide which rig he wants, assuming they both cost the same, judging strictly by product performance. Assuming there is a vast difference in price, he can decide whether the additional features are worth the additional cost.

A couple of years ago I sold my 1971 Vega. I put a "For Sale" sign on it along with the price and parked it in my driveway. Anybody who called already knew how much I was asking for the car. What they wanted to know was the particulars of the car itself.

About the same time, my friend sold his car. He failed to put the price on the "For Sale" sign. He got a lot of calls, but the first question was always "how much?" The answer was usually "too much." In this case, not listing the price turned away prospective buyers.

If all the ads in *73* had prices listed, I, for one, would be relieved of all kinds of doubt. That's all I have to say.

Ken Piletic W9ZMR
Streamwood IL

THE BYTE DEBACLE

Just read your December editorial: Someone doesn't like any part of computers, they want to keep *73* purely ham radio oriented. Fine, but there is at least one other side.

Wayne, I got the call W6ESV in 1948 and hammed to beat the devil for a few years; then gradually it pooped out. But doggone it, this computer technology has brought me out of the woodwork.

For the first time in years, I am excited about electronics again; my dream of a coat pocket portable QRP rig will get some more attention, but mostly I am plunging into the computer part right now. In the next few weeks, I'll be getting a simple system and putting it on the air as my subscription service computer, but that's only the excuse. I really want to get in there and have a lot of fun with that rascal whenever we are not running labels.

But you should know that it was *73* which was responsible for this change in me and *Byte* before that. I had liked that magazine, but the change in staff slipped by me until the editorial treatment got too far away from what I've come to think of as Green style. I discovered then that you were filling the gap which had begun to exist for me with the I/O pages of *73*, so I switched. Your hints in the editorial say there is something less than a perfect relationship between you and *Byte*.

What happened? Was it a property settlement as a result of divorce, did someone beat you out of it . . . what happened? If divorce, there are probably one or two of us out here who've been through it so you can use the word out loud and not shock us. If otherwise, get some code words together; we who read you a lot will read through. Point is, lots of people

Continued on page 116

I/O REPORT

by John Craig

On November 14, 1976, a friend of mine and I loaded my station wagon up with all of the "junk" we've accumulated over the last few years and headed off to the local swap meet. That evening we returned with 95% of all the "junk" we've accumulated over the last few years. The problem, which we suffered through all that day, was simply that the people who came to that swap meet didn't appreciate all the fine electronic and computer goodies we had to offer. In a rare stroke of brilliance, I came up with a solution. Why not hold a swap meet just for electronic enthusiasts, hams, and computer hobbyists? So I did. And it was neat!

Now, most hams are familiar with the "problem" I mentioned (regarding conventional swap meets), and that's why they save their stuff to sell at hamfests. But I think I may have come up with some ideas for turning people on to computers and ham radio, also. At first I was thinking small and started off by asking the members of our local computer club (during a meeting) if they would be interested in having a swap meet. Every hand in the room went up. Then I thought of all the other clubs in the area, the stores, the hams, and the electronic experimenters. If you're going to do something like this, it doesn't take that much more effort to do it right! So . . . I simply ran off some flyers on the ol' mimeograph machine and proceeded to mail them out to all the stores (computer stores, ham radio dealers, Lafayette, Radio Shack, etc.) and clubs. One of the most significant things I did to spread the word was tell some of my ham friends about it. Two meters was really jumping with the word! The swap meet was held on December 11, 1976.

I had three objectives in putting together *The First Annual Central California Electronic/Computer Hobbyists Swap Meet.* Number one, I wanted to sell all of that "junk" I mentioned earlier (only now, I needed to sell it to pay for the expense of putting on the shindig, and the $2.50 seller's fee didn't help much). Number two, I wanted to get a lot of people with common interests together for a good time. What a success that was! Number three, I had hoped to get some newcomers turned on to computers. I arranged to have several computers up and running with the idea of attracting the attention, and interest, of those who had never seen a home system before. Although we did manage to snare two or three newcomers . . . I didn't view that particular aspect of the operation as a major success. And I've got some ideas on how to improve it.

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 *or* Kilobaud *in exchange for a spot on your ham or computer club newsletter mailing list. Deal?*

First of all, I think something like this should be put on by a ham radio or computer club (instead of an individual). Notices about the clubs and when they meet should be displayed at the swap meet, too. It could be a good fund-raising project if, for example, everyone donated a certain percentage of their proceeds to the club. But I really think one of the most important objectives should be to try to introduce personal computers to as many people as possible. It's going to be necessary to make sure the laymen of the community hear about your affair and are attracted to it, but it's going to be just as important to make sure that some worthwhile demonstrations are set up.

In retrospect, I feel I should have set one whole area of the room aside for personal systems demonstrations (instead, I had two or three demo systems scattered around). These systems need to be doing *something* besides playing games. Now don't get me wrong (I have plenty of games on my home system . . . and we all enjoy them very much). I think games are fine as far as getting someone's attention in a situation like this goes, but if that's *all* they see, you can hardly blame them for walking away shaking their heads and wondering why anyone would shell out over a thousand bucks for a "game player." No — more is needed. Some educational programs should be up and running . . . demonstrations of how the computer works in a home security system . . . ham radio demonstrations . . . recipe file and modification programs . . . home accounting . . . etc. And, a real biggee would be to have some small business programs going . . . or at least some small routines which would demonstrate what the computer could do *if* the software were finished. Just having the computer print out statements for use in billing is quite impressive (especially when you tell people that the response time and willingness to pay is substantially increased when computer-generated invoices are sent out — customers don't want to get a bad rating "in the computer system").

The prime objective of this whole thing is to hold a computer/ham/electronics swap meet. Therefore, you're going to be trying to attract people with those interests (which won't be hard) and they will be the easiest to get interested in computers and ham radio. But why not try to get others to come out and see what personal computer systems and hamming are all about? Spreading the word through as many civic organizations (Lions, Rotary, etc.) as possible, along with classified ads, should go a long way in accomplishing the objective.

Along with having a computerized ham station, why not have another station (without a computer) set up and handling traffic (perhaps another local station could be generating dummy messages to eliminate inactive periods)? My gosh! Think of it! There would be CBers to convert, too! There aren't many ways I'd rather spend a Saturday than hanging around with a bunch of people who are as enthusiastic as I am about personal computers. Everyone really had a good time, and the general consensus was that it should definitely be a quarterly or semi-annual affair. Therefore, I think we'll do it again in May. (It was also suggested that more than two weeks notice might bring in more people and not having it so close to Christmas might loosen up the pocketbooks some.)

THE FIRST WEST COAST COMPUTER FAIRE

Last month I mentioned the possibilities for making an impact at this convention with amateur radio applications . . . and this month we're going to take a look at some of the other areas the convention will be covering:

1) *Personal Computers for Education.* Kind of mind-boggling when you consider the immense area that topic covers . . . from every grade school in the country up through junior high, high school, and college (and of course, let's not forget the home). Every school in the country could afford to have computers for teaching now. And, it would be just great if they would get rid of the ridiculous red tape that makes it so hard to get them!

2) *Computers and Systems for Very Small Businesses.* I'm going to be giving a talk in this area, and as you may have guessed from previous I/O Reports, it's one of my favorite subjects.

3) *Program and Data Input via Optical Scanning of Bar Coded Information.* Sounds like something some magazine should get behind and support. They might even run a series of articles on how it works and how programs can be read directly into the computer from the magazine page. Hmmm . . . an interesting idea. I'll have to look into that. (In all seriousness, I think it's a fascinating idea, and I'm looking forward to seeing how it develops. There are other interesting — and super inexpensive — methods of getting data into our home systems . . . and I'm looking forward to their development, also. Would you believe using the home phonograph and a 33-1/3 LP record which has your library of games, applications programs, language processors, and anything else prerecorded on it?)

MISCELLANEOUS

At a recent meeting of our local computer club, the president took a survey of the members to see who was subscribing to which of the various hobby computer magazines. At the conclusion, someone asked, "Hey, what about *73?*" (It was on the list . . . he just hadn't asked about it.) Well, folks, I'm happy to report that *73* polled the highest of them all!

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How to Use Those Old Teletypes

-- computer operation with a 60 mA machine

Several months ago I purchased an 8080-4BD microcomputer kit from The Digital Group and described my efforts in assembling and testing the unit in *73 Magazine*. During the period of getting acquainted with the Tiny BASIC Extended program that is supplied by The Digital Group Software Systems, I determined that what I needed was some way to make a hard copy of those programs I had so laboriously keyed into the machine's memory. Being able to store them on a cassette tape was fine, but what I needed was a method of writing them out on paper so that I could look them over and find the bugs and note changes. I also wanted a means of making a hard copy of the Biorhythm program output that is available in cassette form from The Digital Group Software Systems. The original tape just displayed only 14 days on the TV readout. I wanted to make a hard copy of the graph plot and run it for any length of time selected by the operator.

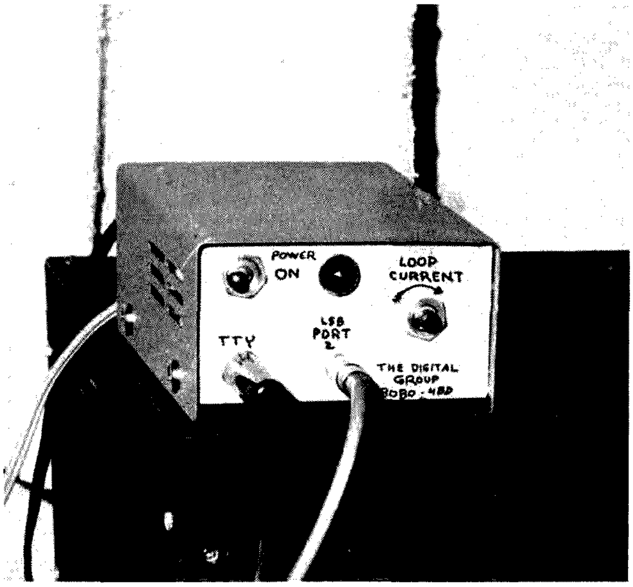
After several lengthy phone calls to Dr. Suding of The Digital Group, a new cassette program was released that is called Biorhythm Baudot. This program permits the operator to run the Biorhythm plot both on the TV screen and on a TTY machine, providing it is properly interfaced to the computer. The program also provides the operator with a capability of printing out programs that have been written in Tiny BASIC Extended. The results of some of the games that are available to The Digital Group equipment users may also be printed out on the TTY machine. The following article is a description of the interface unit I built to use with my 8080-4BD microcomputer, and how I use it to print out listings of my programs and Biorhythm charts.

Circuit Description

The circuit as shown in Fig. 1 consists of a loop power supply and a transistor driver circuit to permit the computer to drive a TTY machine. This unit is designed to stand alone and does not require any external dc loop supply for the TTY machine. The loop current adjust control is adjusted for a loop current of about 60 mA. I have found it will key the machine with as low as 30 mA without errors. The TTL logic signal from output port #2 LSB feeds a high voltage switching transistor, which in turn keys the TTY loop supply and keys the magnets on the machine. The IN-4005 across the output of the transistor is to keep transient spikes from causing troubles in the circuit.

Construction

The unit shown in the photographs is built in a



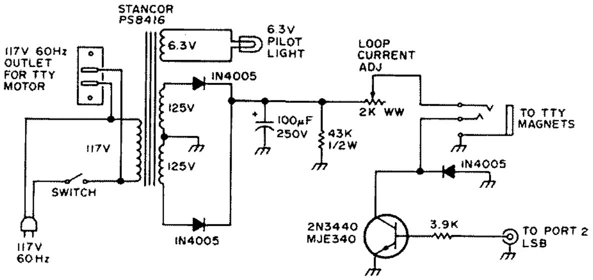


Fig. 1. TTY interface unit: The Digital Group 8080-4BD to Model 15/28.

Radio Shack equipment cabinet #270-252. It is 4" wide by 2-3/8" high by 6" deep. The outlet connector for the TTY motor power is mounted on the back of the cabinet chassis, along with the power cord fitting. The transformer is bolted to the back flange of the chassis. The filter capacitor is strap-mounted to the bottom of the chassis. The front panel is fitted with the power switch, loop circuit jack, port #2 LSB connector, pilot light, and loop current adjustment control.

Operation

The unit installed with the equipment is shown in the overall photo view of the microcomputer system at K7YZZ. It is seen sitting on top of the left-hand side of the computer unit, just above the computer power outlets. A twisted pair shielded cable is run from the TTY output connector to the selector magnets of my Model 28 KSR. The power cable from the Model 28 KSR is plugged into the rear of the interface unit. A single conductor shielded cable is run from the output port #2 LSB to the jack on the front of the unit.

To put the unit into operation, the microcomputer system is initialized with the Biorhythm Baudot cassette tape recording and the power on the interface unit is then turned on. The TTY machine motor is turned on and, if a run of Biorhythm is desired, the operator keys in 6 on the keyboard and then keys in RUN. The TTY machine will then begin to print out the Biorhythm instructions. The TV screen will also print out the same information at the same speed as the TTY machine. It should be noted that the system is set for a 60 speed machine. If the operator desires a listing of more than 14 days, the statement at 073 must be changed to give the desired number of days to run. For example, it would read 073 LET P = 60. This would make the TTY machine print out 60 days' worth of Biorhythm data.

If the operator desires to use the loading as a TTY readout of a program, then he should hit the RESET button and key in 6. Typing in the word NEW will erase the Biorhythm data from the memory but will leave the Baudot output undisturbed. Now the operator may key in or cassette load any program in Tiny BASIC Extended format. When finished, a listing of that program may be obtained on the TTY machine by typing in LST, and keying the RETURN button on the keyboard. This will cause the system to begin typing out a listing of the program entered into the memory from the keyboard or cassette. I usually set my TTY machine on double space during a listing run. This provides sufficient space between each line to make corrections to the program.

In attempting to play some of the games that are available from The Digital Group Software Systems, I have found that if the program's listing includes any TAB (0) statements, they must be deleted before they are run on the TTY machine. A TAB (0) statement makes the TTY machine print 16 lines of blank spaces and wastes time and paper. It is used in the computer mode to clean the TV screen and works fine there, but it is too slow on TTY.

Conclusion

This little unit works very nicely with the 8080-4BD system, and has been most useful in getting a good copy of the program listings for bug shooting. My friends have also really appreciated the fine Biorhythm runs I have made on the TTY machine. ■

Drive More Safely with a Mobile Dialer

-- hold 4 or 8 phone numbers in a PROM

William J. Hosking W7JSW
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Shortly after arriving in the Phoenix area, I acquired the means (a Ma Bell pad) to use our autopatch. Shortly thereafter, having narrowly missed a little old lady while I was attempting to make a call on the patch and drive at the same time, I decided that an automatic dialer for commonly used numbers would be handy.

I had surplus 512 bit TTL PROMs on hand which seemed perfectly suited for the job. I started the design job about a year ago and, within a couple of weeks, had everything up to the actual tone generator working satisfactorily. At that time there were only about two options available for tone generation: one was a hybrid chip selling for close to $30 and another was the 566 PLL function generators. For size and economy reasons I chose the 566 route. After several weeks of less than spectacular success attempting to switch the 566s with TTL logic and maintain tone frequencies, I shelved the project and subsequently forgot about it. Motorola introduced a touch-tone generator in their CMOS line, the MC14410, which shows great promise. The tone switching can be CMOS, TTL, or just plain switches, and the output is approximately a sine wave. As soon as I got my hands on one of the chips, I pulled my automatic dialer off the shelf, ripped the 566s out, and wired in the 14410. It worked perfectly the first time.

Memory Arrangement

Since I had the 512 bit memories available, I had plenty of room to use a simple code. The basic memory is organized as 64 bytes, each eight bits long. I stored each digit of a telephone number in a byte location as

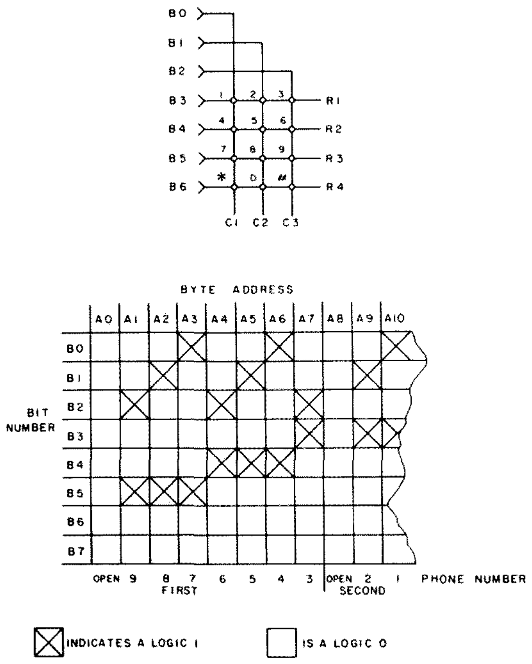


Fig. 1. Programming and coding for the four number dialer. Also shown is a sample program for the phone number 987-6543.

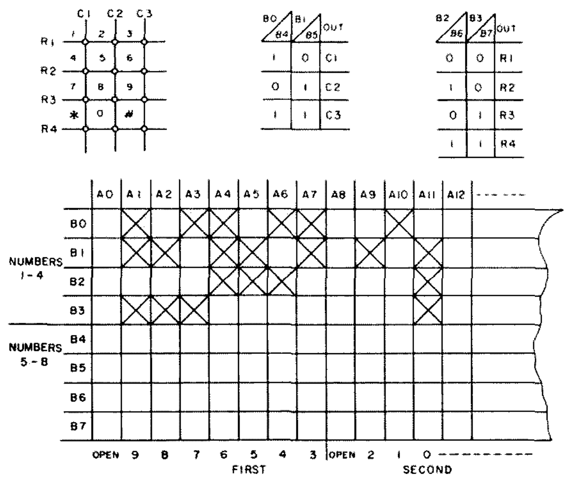


Fig. 2. Programming and coding for the eight number dialer. Also shown is a sample program for the phone number 987-6543.

a combination of a row and a column bit. An example of the coding is shown in Fig. 1. Each phone number requires seven digits (seven bytes) and, since the memory breaks down conveniently into address groups of eight bytes, that is the way I programmed it. This approach allowed eight phone numbers to be stored in a 512 bit memory and be selected with a BCD code.

A perusal of the surplus ads shows that 512 bit PROMs are not readily available but 256 bit ones are — and they are reasonably priced (around $5). The drawback, of course, is that a memory of half the size can only store half as many numbers (four). In order to store more telephone numbers in a smaller memory, a more complex coding system is necessary.

A scheme I developed later to achieve the higher density coding is shown in Fig. 2. Using this coding, a phone number would be stored in the first four bits of seven bytes and another phone number in the last four bits of the same seven bytes. A data selector chip selects which four bits out of each byte are to be used. With this scheme the first four telephone numbers are stored in bits B0-B3 of words 0 through 31 and the second four stored in bits B4-B7 of the same bytes.

Circuits

Circuits for the four number and eight number units are shown in Figs. 3 and 4 respectively. Everything up to the output of the memory is the same for both units.

A 7400 gate is cross-connected as a start/stop flip-flop. When the start button is pushed, it sets the F-F, which starts the 555 clock generator. The clock generator feeds a 7493 counter and a 74121 monostable through an inverter. The counter counts the clock pulses and puts out a binary address to the memory. For each clock pulse, the monostable puts out a pulse which gates the selected tones on for a short period. The inverter after the clock causes the gating to start with address position A1 instead of A0. This allows time for your transmitter and the repeater receiver to be fully on before the first tone comes along. The outputs of the counter are decoded with a 7411 gate whose output stops the start/stop F-F when a count of seven is reached. The two remaining memory address inputs are selected by a BCD coded switch.

For the four number model the memory outputs go through NAND gates to the tone generator. The monostable strobes the NAND gates, letting the selected row and column information through.

For the eight number model, the memory outputs feed a 74157 data selector which selects outputs B0-B3 or B4-B7, depending on the select input from the BCD switch. In this version the data strobing is done with the 74157 instead of with the NAND gates. The NAND gates and an added 7404 hex inverter are now used to

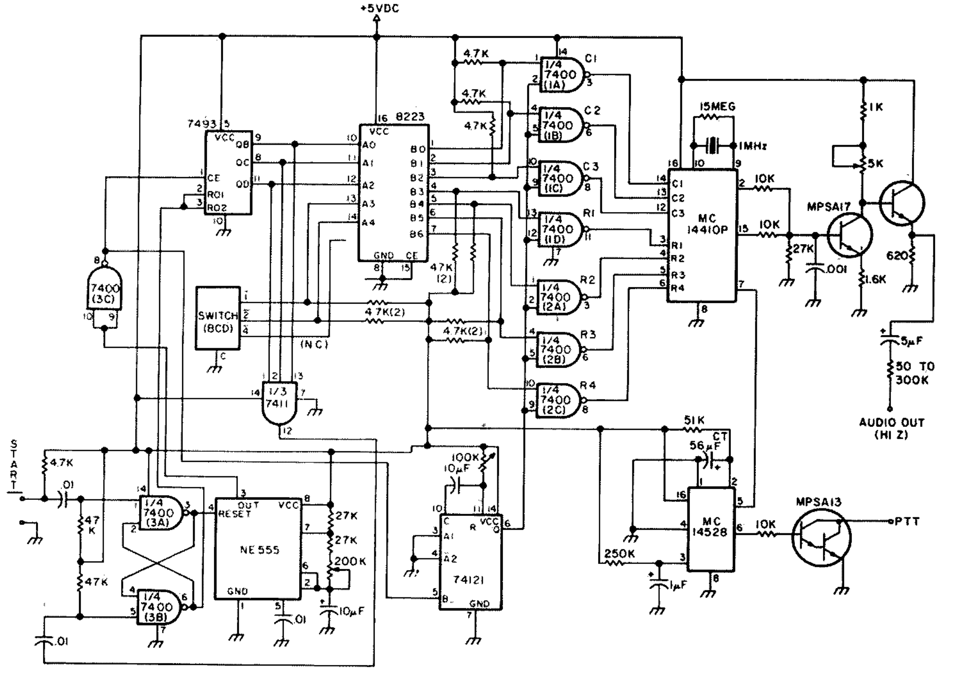


Fig. 3. Schematic diagram of the four number automatic dialer.

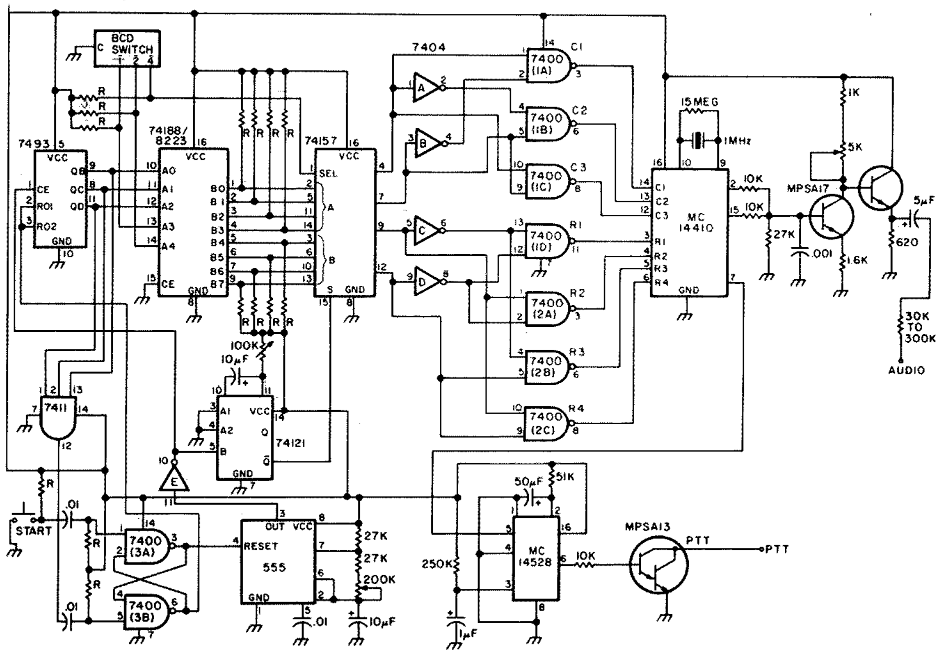
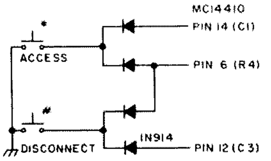


Fig. 4. Schematic diagram of the eight number automatic dialer.

Fig. 5. Schematic of the added switches for access/disconnect.



decode the 74157 outputs to give proper row and column inputs to the tone generator.

In both cases the NAND gate outputs put a logic low on the appropriate row and column inputs of the MC14410 to produce the desired tones. The output of the tone generator is filtered and buffered, and a level control provided. My schematics show a high value of series resistor, since most of my radios have a high impedance input.

Pin 7 of the 14410 is a pulsed logic output which is used to trigger a 14528 monostable which, through a Darlington transistor, operates the transmitter PTT line. The delay on the PTT line with the parts shown is about one second. Capacitor C_T can be varied to change the hold time.

In both Figs. 3 and 4 the BCD switch is shown wired for complemented outputs. This means that a switch is open when selected rather than closed when selected. If a complement output is not available, the 4.7k resistors must be changed to 470Ω and connected to ground instead of +5. Also, the common then connects to +5 instead of ground.

All of the above takes care of the actual phone number once the patch is accessed, but in our case it takes a " * " to access and a " # " to disconnect the autopatch. To do this I added two pushbuttons and 4 diodes to directly turn on the proper row and column tones. The connections I made for this purpose are shown in Fig. 5. Not shown is an LM309K 5 volt regulator I use to provide the five volts from the 12 volt line.

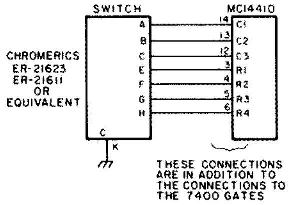
Operation

Operation is simple. I used a BCD coded thumbwheel switch for the number selection. I select the number, push the access button and, when I get the dial tone, push the start button.

Conclusion

The circuit works perfectly as is and the current drain isn't excessive. It seems a shame to use CMOS devices (14410, 14528) with the power hungry TTL devices, but one must use what is in the junk box. I expect I'll build one using CMOS soon, although a memory might be a problem. A friend suggested a RAM instead of the PROM, since the field PROMs, once programmed, contain the same information forever. Although the RAM would allow reprogramming, it would also require a continuous power supply, however small, to maintain memory. Anyway, it's something to consider.

Fig. 6. Connections for adding a touch switch such as the Chromerics ER-21623 or ER-21611 to the dialer.



To make the unit more versatile, a switch such as the Chromerics ER-21623 or ER-21611 could be wired in the way I did with the access/disconnect pushbuttons, to allow the unit to function as a normal touchtone pad. The connection is shown in Fig. 6. If this is done, the switches of Fig. 5 are not needed.

I didn't include programming information on the PROM, as it is fairly readily available. However, I'll be glad to help anyone having trouble finding information (SASE please, though). ■

CONTESTS

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ARRL DX COMPETITION

Phone
Starts: 0001 GMT Saturday, February 5
Ends: 2359 GMT Sunday, February 6
Starts: 0001 GMT Saturday, March 5
Ends: 2359 GMT Sunday, March 6
CW
Starts: 0001 GMT Saturday, February 19
Ends: 2359 GMT Sunday, February 20
Starts: 0001 GMT Saturday, March 19
Ends: 2359 GMT Sunday, March 20

These rules were taken from last year's contest. Please check the December issue of *QST* for complete rules and any last minute changes.

Briefly, the rules are as follows: All fixed station amateurs, worldwide, are invited to participate. All amateurs in the 48 states and Canada will try to work as many stations in other parts of the world as possible. All other stations will work only W/VE stations. Entries may be in either the CW or phone section; each is scored independently. Entries are further classified as single or multiple operator stations. Single transmitter multi-operator stations will be recognized as a distinct category from multi-transmitter, multi-operator stations. Two transmitters on the band at the same time are prohibited. Single operator stations may enter in either the all band, high band, or low band categories. High band is 20, 15 and 10 meters, while low band is 160, 80 and 40 meters. Operating on a band not allowed in your class is permitted but those points will not be counted toward your total score. Crossband and crossmode contacts are not allowed.

EXCHANGE:

W/VE stations will send RS(T) and state or province. All others send RS(T) and power. KH6 and KL7 are considered DX.

SCORING:

Score 3 points for each completed QSO. Each station may be worked once on each band on each mode for contact and multiplier credit. Final score is the total number of QSO points times the total number of countries on each band (for W/VE stations), or the total number of continental states plus VE/VO licensing areas worked on each band (for DX).

AWARDS:

A plaque will be awarded to the highest single operator DX phone and CW station (non-W/VE) in each continent. On both phone and CW, a certificate will be awarded to the highest scoring station in each category and classification in KL7, KH6, each ARRL section, and each country where a valid entry is received. Also, a certificate will be awarded to each non-country winner DX entrant making 1000 or more QSOs on either mode. ARRL-affiliated clubs may also participate in club competition as described in *QST*.

LOGS:

A summary sheet, log sheets, and DX check-off sheet for each band used is required from all W/VE entries. DX entries must submit log sheets and a summary sheet. Separate logs, summaries, and check sheets are required for each mode used from all entries (no check sheets for DX). Logs and forms are available from ARRL, 225 Main St., Newington CT 06111.

CALENDAR

Jan 22 - 23	CD Party — Phone
Feb 5 - 6	ARRL DX Contest — Phone
Feb 5 - 13	ARRL Novice Roundup
Feb 11 - 13	QCWA QSO Party
Feb 12 - 13	10-10 Net Winter QSO Party
Feb 19 - 20	ARRL DX Contest — CW
Feb 19 - 20	YLRL YL-OM Contest — Phone
Mar 5 - 6	ARRL DX Contest — Phone
Mar 5 - 6	YLRL YL-OM Contest — CW
Mar 13	South Dakota State QSO Party
Mar 19 - 20	ARRL DX Contest — CW
Mar 26 - 27	CQ Worldwide WPX SSB Contest
Mar 26 - 28	BARTG Spring RTTY Contest
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest — CW
Apr 16 - 17	CD Party — CW
Apr 23 - 24	CD Party — Phone
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest — Phone
June 11 - 12	ARRL VHF QSO Party
June 18 - 19	WVA QSO Party
June 25 - 26	ARRL Field Day
July 2 - 3	QRP Summer Contest
July 4	ARRL Straight Key Night
July 9 - 10	Bicentennial Celebration Plus One (ARRL)

Included are a few late-comers from overseas and the official dates for ARRL contests.

ARRL NOVICE ROUNDUP

Starts: 0001 GMT Saturday, February 5
Ends: 2359 GMT Sunday, February 13

The contest is open to all amateurs in any ARRL section. Operating time must not exceed 30 hours total during the 9 day period while off periods may not be less than 15 minutes at a time. Times on and off must be entered in your log. Crossband contacts are not allowed. Novices may work anyone while non-Novices must work Novices only. Each station may be worked only once regardless of band.

EXCHANGE:

RST and ARRL section.

SCORING:

Each completed QSO counts one point. The total multiplier is the number of ARRL sections and foreign countries worked. VE8 counts as a separate section. The final score is the number of QSO points plus your ARRL code proficiency credit (15 wpm = 15 pts.) times the total multiplier.

AWARDS:

Certificates will be awarded to the highest scoring Novice in each ARRL section. Multi-operator or higher class licensees are not eligible for awards, but the top ten scores will be listed in the results.

LOGS:

Use official ARRL forms available from: ARRL, 225 Main St., Newington CT 06111. All entries should be sent to this same address.

Please check the January issue of QST *for any last minute changes in rules or operating times.*

QCWA QSO PARTY

Starts: 2300 GMT Friday, February 11
Ends: 2300 GMT Sunday, February 13

Every contact with another QCWA member will count; contest is only open to members. Briefly the rules are as follows.

EXCHANGE:

QSO number, QTH (state, province, or country), name, and QCWA membership number.

SCORING:

Each contact with another QCWA member counts 1 point. Any foreign QCWA member except Canada, Mexico, and US possessions count 5 points per QCWA QSO outside their own country. Count a multiplier of 1 for each state, province, US possession, country, or political sub-division designated by a callsign prefix. Final score is QSO points times multiplier as usual. A contact with the QCWA memorial station W2MM/6 counts for 2 points. Each station may be worked only once regardless of band or mode.

FREQUENCIES:

Phone — 1805-1825, 3940-3960, 7240-7260, 14240-14260, 14280-14300, 21340-21360, 28640-28660.
CW — 1805-1825, 3540-3560, 7040-7060, 14040-14060, 21040-21060, 28040-28060.

Contacts made on net frequencies are not valid!

LOGS:

Identify each sheet with name, call, QCWA number, address, city, state, and zip. Number pages and staple them together. Logs should show all exchange info plus band, mode, time, date, and duplicate check columns at right. Compute score and include with logs. Logs must be mailed not later than February 20th to: Ralph Cabanillas, Jr. W6IL, 2359 Creston Dr., Hollywood CA 90068.

TEN-TEN NET WINTER QSO PARTY

Starts: 0000 GMT Saturday, February 12
Ends: 2400 GMT Sunday, February 13

The contest is sponsored by the Ten-Ten International Net of Southern California, Inc., and is open to all amateurs — but only 10-10 members are eligible for awards. All contacts must be made on 10 meters, any mode, and a station may be counted only once.

EXCHANGE:

Name, QTH, and 10-10 number.

SCORING:

1 point for each contact plus 1 point if with a 10-10 member. Maximum of 2 points for any one contact.

LOGS:

Logs should include date and time of each contact as well as the required exchange information.

AWARDS (for 10-10 members only):

Certificates to first and second place winners in each US district, Alaska, Hawaii; each VE district; Central America and Caribbean; South America; Europe; Africa and South Atlantic; Asia and Northern Pacific; Australia, New Zealand and South Pacific. Send logs to Grace Dunlap K5MRU, Box 445, La Feria TX 78559, by March 31. For complete results, see the *10-10 Net Summer Bulletin*. To become a 10-10 member, work any 10 members and send a list of those contacted along with $3.00 to the manager in your district.

YL-OM CONTEST

Phone
Starts: 1800 GMT Saturday, February 19
Ends: 1800 GMT Sunday, February 20
CW
Starts: 1800 GMT Saturday, March 5
Ends: 1800 GMT Sunday, March 6

Sponsored by the YLRL, the contest is open to all licensed operators throughout the world. All bands may be used but crossband operation and net contacts are not permitted. Phone and CW contacts will be scored as separate contests, so please submit separate logs. A station may be contacted no more than once in each contest for credit.

EXCHANGE:

QSO number, RS(T), and ARRL section or country.

SCORING:

One point is earned for each station worked, YL to OM or OM to YL. Multiply the number of different ARRL sections and/or countries worked. Contestants running 150 Watts input or less on CW and 300 Watts PEP or less on phone may multiply the score by 1.25 (low power mult).

LOGS:

Entries in your logs must show band worked at time of contact, time and date, and transmitting power. Please remember to submit separate logs for phone and CW. Send logs to: YLRL Vice President, Beth Newlin WA7FFG, 826 W. Prince Road – 06, Tucson AZ 85705.

A cup will be awarded to the first place YL and OM on both phone and CW. Second and third place winners in each contest will receive certificates. Certificates will also be awarded to the high score phone and CW winners of each state, VE call area, and each country.

CW COUNTY HUNTERS NET AWARDS PROGRAM (net meets Mon 2400Z/3575, Wed 2300Z/7055, Sat 1400Z & 2000Z/14070 and Sun 1430Z/7055)

Basic awards are $1.00 with endorsements for band, mode or mixed. Seals and endorsements free at time of issue; thereafter SASE, list and award number required. No date limits, all confirmed contacts count – mobile, portable or fixed. Honor system – no signers needed but awards manager reserves right to request any one or all QSLs at applicant's expense. Send list of required info to: Awards Manager, George Levensalor W1DPJ, 399 Buck St., Bangor ME 04401.

THE UNITED STATES OF AMERICA COUNTIES AWARD BY CALL AREAS

12 separate awards for confirmed contacts with stations operating in counties of the 12 US call areas, 1 through 0, Alaska and Hawaii. Classes: A = all counties in call area; B = 2/3 counties; C = 1/3 counties. Anyone holding all 12 awards Class A (all counties in US) issued free trophy!

RESULTS

RESULTS OF THE 1976 WASHINGTON STATE QSO PARTY

Washington County Winners:

County	Call	Score (pts)
Adams	W7GHT/m	486
Asotin	W7GHT/m	204
Chelan	W7KWT	4012
Clark	W7FQE	4329
Columbia	W7GHT/m	360
Cowlitz	WA7PMW	12006
Douglas	WA7WET	2375
Ferry	WA7WET/m	231
Franklin	W7GHT/m	352
Garfield	W7GHT/m	247
Grant	W7GB	9336
Grays Harbor	W7FGD/m	25
King	WA7UQG	47503
Lewis	W7FGD/m	30
Lincoln	W7GHT/m	459
Mason	W7FGD/m	72
Okanogan	WA7WET/m	251
Pacific	W7FGD/m	32
Pend Orielle	W7GHT/m	90
Pierce	W5QQQ/m	6
San Juan	K7NCG/7	1250
Skagit	W7IEU/7 + WA7FKM	4080
Skamania	W7FGD/m	108
Snohomish	K7UWT	9156
Spokane	K7TAK/7	1755
Stevens	K7KFY/7	7320
Thurston	W7FGD/m	15
Wahkiakum	W7FGD/m	171
Whatcom	W7VRO	51597
Whitman	W7GHT/m	1

Out of state winners:

State/Prov.	Call	Score (pts)
AL	K4ZGB	2160
AK	WB8GLO/KL7	720
AZ	AA7HRE	5916
CA	KØGJD/6	13530
CO	ADØQIX	2772
CT	W1JTD	1672
DE	WA3WPY/3	100
FL	WB4OGW	3600
GA	AAØDGL/4	1050
IL	W9WR	1088
IN	WB9OUX	650
IA	WØPRY	3312
KS	WBØIAQ	1036
KY	W4KFB	144
LA	W5WG	2040
MA	AC1AQE	1292
MI	WB8PFB	550
MN	WBØLNO	936
MS	AB4WHE/5	784
MO	WBØOTA	594
NE	WBØHEU	306
NJ	WA2EJZ	140
NM	W5TIL	815
NY	W2NCI	850
NC	W4OMW	676
OH	AD8MLO	462
OK	K5DEC	650
OR	WA7WHW	14104
PA	AC3ARK	1260
RI	K1QFD	72
SC	K4OAQ	40
SD	WAØBZD	100
TN	AB4WFT	1536
TX	WA5KQD	1240
UT	K7SQD	70
VA	W4JUJ	306
WI	WB9NDO	1800
Manitoba	VE4SW	1248
Ontario	VE3EJK	156
Japan	JR1NRP	270

RESULTS

RESULTS OF THE TEN-TEN INTERNATIONAL NET SUMMER QSO PARTY, AUGUST 7-8, 1976

WA1UAD	394/723	WBØQHV/Ø	716/1277
WA1KOC	354/662	WBØNHD	468/846
K2ARO	464/850	KH6IAA	97/177
WB2WRT	324/605	KH6ILF	83/151
WA3DAL	607/1090	VE1ABR	195/362
WA3TRI	605/1082		
		VE2XL	113/209
W4OZF	658/1151	VE2EGH	100/181
W4GKF	573/1017		
		VE3AHN	210/387
WB5FII	709/1307	VE3FAK	141/270
WB5EHF	621/1125		
		VE4VV	135/250
WB6PXP	740/1306	VE4UL	72/139
WB6MQA	290/531		
		VE5SM	19/35
K7PXI	358/654		
WB7AEB	291/551	VE6BCC	48/91
		VE6BAS	38/72
WB8FAG	439/808		
WA6PRL/8	448/803*	VE7SR	134/240
WB9USW	450/816	YV4BDB	109/204
WA9ASZ	265/508	LU6DWZ	10/20

HP1GD	100/188
JA3XOG	25/40
ZL1ARO	17/30
ZL2BAO	12/22

* Multi-Op. Station

Chapter Scores:

Gateway Chapter	3261/6139
LIARS	3050/5758
Delaware Valley	2238/4100
Colorado	2189/4043
Houston	2132/3992
Devil's Triangle	2193/3991
Bay Area	1725/3259
Michigan Robins	1662/3173
S. N.E. Nutmeg	1483/2781
Thunderbird	1426/2672
MoKan Teners	1243/2364
Cypress	1266/2344
Milwaukee	1101/2104
Sky Blue Waters	1099/2043
So. California	1074/1993

Ken Cole W7IDF
P.O. Box 3
Vashon WA 98070

Talk About DX-- WOW!

-- you just never know

Twenty meters seemed unusually quiet after listening to locals and heavy static crashes on eighty for an hour, but it was late and the middle of the week. When I had changed bands and flipped the antenna coax switch under the desk, it sounded as though propagation had been cancelled for the evening. The swr checked out at a normal 1.2 to 1.0 so I assumed the antenna was still up and connected. CQ brought no reply, and a careful headphone search across the band for another diehard was fruitless. Inactivity was at a peak.

Patience and a hundred Watts into a vertical verge on fantasy when you need a kilowatt and a four element quad, but with freaky conditions you just never know, so I persisted. Nothing. A few hours before I had been fascinated by the fine quality of the pictures from the Viking on Mars – a low power TV transmitter 250 million miles away. Irony. Finally I parked the transceiver on 14.225, set the Scanalyzer sweep width on 50 kHz and idly sorted through the QSL file, musing on yesteryear's hard-won souvenirs of youth, all-night vigils, forty Watts and a good Zepp.

Just as I was thinking about shutting down I heard a clear "Hello, hello." Precisely on frequency, nice audio. Nothing on the scope, and the S meter didn't move, but I recalled fiddling with it earlier in the evening when eighty was so noisy. And on a quiet band the Yaesu was notably kind to the most minute signals.

"Hello, hello" again, then silence. "W7IDF, near Seattle," I said hopefully. "Name's Ken. You're very weak but perfectly readable."

The reply was prompt. "Thank you. I could use a little help here. Are you busy?"

"Okay. You are the only signal I've heard on the band in the last half hour. Good quality, just weak, and I didn't get your call."

"Thanks. This is AC25OLS. Alpha Centauri Twenty Five Outer Limit Survey. If you don't mind, I'd like to ask you a few questions."

"That's a fascinating call, old man. Been watching a lot of 'Star Trek' re-runs lately?"

"You lost me there, but never mind. This is a routine solar systems check and we appreciate your cooperation. By the way, you're only the third response I've had from this planet; the first two were W6s and initially helpful with information about your society structures, but after a bit they indicated definite hostility. Something to do with the ARRL Countries List. Now then, I'll just run down this form and we'll fill in a few blanks. Okay?"

"Listen, if you guys are having a party over there, that's fine, and good luck, but why don't you just let the rig cool off and play a little poker? Or spin-the-bottle if it's YL night. This ain't old-timey CB, good buddy."

"Please, I'm allowed only eight hours scanning and two hours after entering synchronous orbit here, so, if you don't mind . . ."

"Great. I suppose you're going to tell me next that you learned English at U.C.R.A. What are you guys really up to?"

"Language is irrelevant, obsolete for aeons. We're communicating by the standard process of heterodyning brain waves. It's simple but obviously you wouldn't understand. No offense. Now, how about some answers?"

"Okay, I'm game. Up to a point. AC25OLS from W7IDF, and if anyone wants to break in I'd be grateful. Go ahead."

"Well, the main assignment: Is there intelligent life on your planet? What I got from those W6s pretty much confirmed my suspicions."

"Don't jump to conclusions; California's another world, and your contacts probably were in L.A. to boot. Did they leave you a little confused?"

"I mentioned that we had opened a file on your recent upper atmosphere nuclear explosions and asked if they could give me any explanation. What they told me was depressing – this business of you guys killing each other in wholesale quantities every generation, and killing other life forms for fun. You got off on the wrong foot some-

where. And all that stuff about racial antagonism, fortified political fencing all over the planet, parochial language structures perversely blocking communication – weird, man! Any comments?"

"About intelligent life on Earth? I used to think there was, but by the time I got into long pants I was very doubtful. Haven't seen much evidence of intelligence lately, but I may have missed something."

"I see. Let's try to get something specific here, so who would you say is the wisest man on the scene today?"

"Hope nobody is taping this. Well, you asked a tough one, and I really don't know what to say. Woody Allen, I suppose. I would have said Stan Freberg a few years ago – and I didn't know how to spell his name then either – but he's kept a pretty low profile since that business of painting airliners to look like locomotives."

"I don't get it."

"Some PR assignment from Western Airlines I think. They wanted a scheme to make people think their planes were as safe and reliable as trains. That was before Amtrak."

"I think we're getting off on the wrong track here. Another item – we've noticed some miscellaneous junk orbiting Mars, and now you've got a primitive sensor device set up on the surface there. How about that?"

"Alfa Charlie Two Five Oscar Lima Sierra from W7IDF. This is going to look great in the log, Al. About the Mars lander, I cannot tell a lie; we done it. I think it was timed to celebrate two hundred solar orbits under our own flag, without a failure. Going around, I mean."

"Curiouser and curiouser. Your planet already has about 560 million orbits in the records at the main office, so what's so great about two hundred? Never mind, I'll just put down 'responsibility accepted' and you probably won't hear anymore about it. But off the record, what was the real reason?"

"Beats me. We have a lot of problems right here we can't seem to solve. I heard some rumor about dumping our nuclear waste products on uninhabited planets, but who knows? Just curiosity I suppose."

"Whaddya mean, who knows? You said it was your lander."

"Well, our technologies are symbiotic and accelerating. The result is we're already up to our trifocals in astonishing inventions, horrifying weapons and new taxes. Those pictures from Mars are great, but I don't know where we're going really, or why. Guess that's what I mean. I'm dumb; go ask a scientist."

"Sounds worse than I thought, but cheer up – you guys are new at the game. A recent check at this station reported no activity at all, just random life forms too elementary to allow communication. Let's see now – a simple question about your interplanetary probes: How are they powered?"

"Chemicals. Hydrogen and oxygen for the rockets, maybe, and to produce them I suppose some nuclear plant output is involved, but most production is still based on fossil fuels. And some hydroelectric wattage – courtesy of gravity. But the big money's in fossil fuels."

"Figures. The same old natural resource rip-off, but don't get discouraged – you'll soon be into solar energy. Anyway, no sweat for the galaxy. Certainly you haven't broken the speed-of-light barrier yet."

"Doubt it. Maybe on the freeways now and then. Why don't you check with Caltech or somebody? Like I said, Al, it's moving so fast us peasants don't know up from sideways anymore. Hey fellas, any breakers?"

"Don't apologize if science isn't your bag. As a matter of fact, all the significant data are being collected and banked automatically; it's just nice for me to have a contact now and then. Sometimes this job gets on my nerves. Oh yes, one bad thing about all these sensors: They're totally insensitive to motivation phenomena. With immature social systems that tend to go off in kinky directions, it can get hairy for our prognosis processor, so tell me what's behind the emphasis on life-destructive devices. Why all the fancy weaponry?"

"AC25OLS and anyone else who would please join us, from W7IDF. I don't think that was a very nice thing you said there, Al, about immature social systems. But to answer the question: I really don't have the faintest idea. In my lifetime there have been four major wars, and yet I've been all over this planet and rarely met anyone I didn't like. Also, don't get the idea that we're not law-abiding folks – just take your clothes off publicly and unless you're getting paid to do it, I guarantee you'll find yourself in the pokey before you can say Buck Rogers. About the ICBMs and red telephones, I'd level with you, but I'm as much in the dark as you are."

"See what I meant about you guys being a little weird? Sounds like science fiction and makes less sense. Well, time's running out but thanks for the chat. I'd like to stick around but I have to get to the next solar system. You know how it is, 'promises to keep, and miles to go before I sleep.' Bet that surprises you."

"Not really, Al. Nothing surprises me much anymore, and also I noticed that when I thought I was switching to the twenty meter antenna, what I did was put the rig on the dummy load. Anyway, it's long past midnight, so have a nice day." ■

An Automatic BC Squelch

-- another use for your 2m squelch

Hubert E. Minchow
1065 Lynnwood Avenue N.E.
Renton WA 98055

If you have ever wished you could listen to your car's commercial broadcast receiver without missing a call on your transceiver or scrambling to twist volume controls when a ham signal pops in, the QRM Zapper is the answer to your problem. The QRM Zapper will silence the broadcast receiver whenever your transceiver picks up a signal and then restore the broadcast receiver a few seconds after the transmission ceases. The Zapper also silences the car radio while you transmit, so you can enjoy a QSO without being QRMed by the news.

While the original Zapper was designed to be used with an Icom IC-22A, any transceiver is capable of furnishing the two trigger signals required to make the Zapper work. The triggers have to be negative going, so the transmit trigger is obtained from the microphone switch by connecting to the hot (ungrounded) side of the switch. In the Icom IC-22A, the receive trigger is taken from the emitter of Q26. Q26 drives the receive signal lamp when an incoming carrier breaks the squelch, so the emitter voltage drops to near ground potential and satisfactorily serves as the source for the receive trigger.

For transceivers without the carrier lamp feature, the receive trigger can be picked up from some point in the squelch or AGC circuits where the voltage swings from near 5 V or higher to ground potential with an incoming signal. If necessary, a simple transistor switch can be added to invert a voltage from one of these sources and amplify its swing to meet the requirements for the receive trigger.

The QRM Zapper is designed around a 555 integrated circuit, and it silences the broadcast receiver by switching off the battery voltage to the broadcast receiver. Either trigger from the transceiver starts the action of the timer. Triggering the 555 removes the car battery source from the broadcast radio. The battery is reconnected a few seconds after the end of the trigger signal. A new trigger applied while the 555 is timing out stops the rundown of the timer, cancels the elapsed rundown time and causes the battery to remain disconnected, so QSOs free of QRM from the broadcast receiver are enjoyed by electronic means rather than manual adjustments.

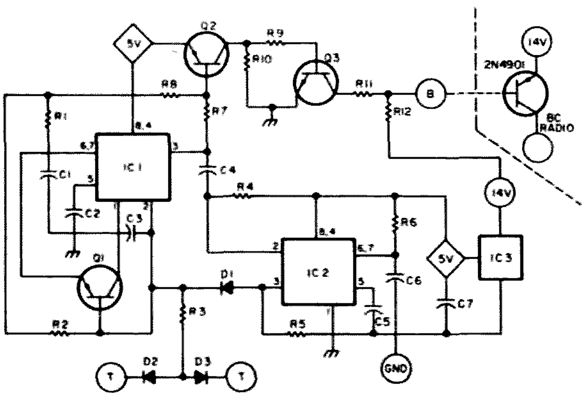
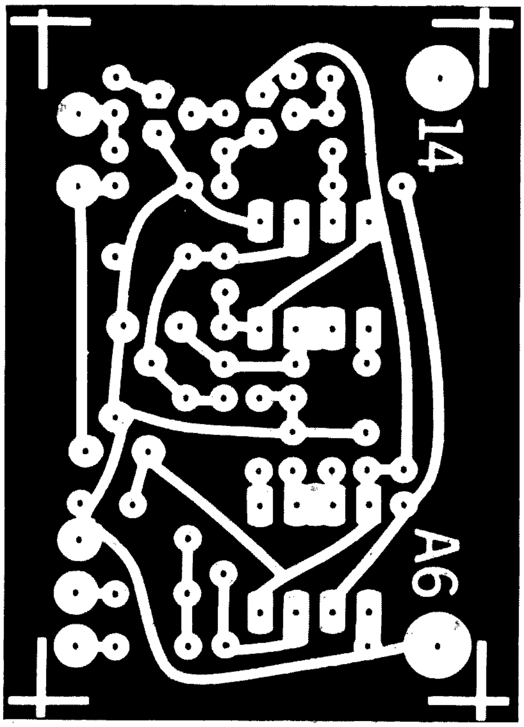


Fig. 1. Schematic of the QRM Zapper.

The 555 timer is operated in the missing pulse detector circuit shown in the 555 data sheets (refer to Fig. 1). Q1, a small PNP transistor, prevents the RC timing circuit R1-C1 from charging until the trigger applied to the base of Q1 is removed. This forces the 555 timer IC1 to begin its timing action after the carrier ends or the microphone switch is released; it delays the connection of the car battery to the broadcast radio for the few seconds necessary for the RC circuit to charge. The beginning of the negative going trigger at pin 2 of IC1 causes the output pin 3 to go high and remain in this state until the RC timing circuit has charged to a certain level. The output at pin 3 of IC1 controls a 2N4901 transistor switch which is in series with the broadcast radio battery source. When pin 3 is high, the switch is open. When pin 3 is in the low state, the switch is closed and the broadcast radio is on. Therefore the Zapper silences the broadcast radio for the duration of the trigger signal plus the time it takes to charge the RC timing circuit.

The trigger signals connect to the cathodes of the two 1N4001 trigger diodes, D2 and D3. The diodes isolate the transceiver circuits from the Zapper and from each other while coupling the trigger signals to the trigger pin of IC1 and the base of Q1. IC2, a 555 in a monostable circuit, is triggered by the end of the output pulse of IC1. IC2 generates a 0.1 second holdoff voltage in the trigger circuit immediately following the timed period. The holdoff voltage prevents any switching disturbance in the broadcast radio battery circuit from retriggering IC1.

Originally the Zapper was operated with the car battery voltage on the ICs, but IC1



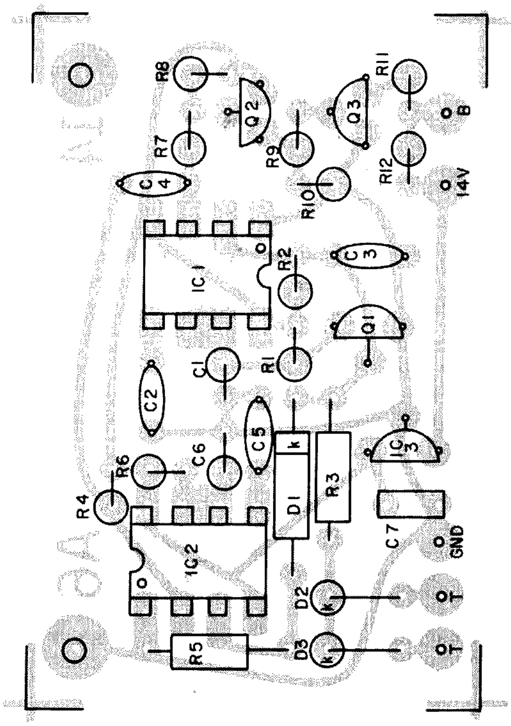


Fig. 2. Component layout of QRM Zapper printed circuit board.

would intermittently self-trigger the broadcast radio and sometimes silence it continuously. Several brands of 555s were tested but they all performed the same. The solution was to operate the 555s at 5 V. IC3, a 78L05 miniature voltage regulator, supplies the 5 V. A pair of small transistors, Q2 and Q3, are used to interface between the 5 V output of IC1 and the 14 V level of the 2N4901 switch. The 2N4901 transistor is used instead of a relay and is capable of handling 5 Amps.

The three ICs and the three small transistors with their circuit components are mounted on a small printed circuit board. The single sided board measures 1.2" x 1.9". The 2N4901 transistor and heat sink are mounted separately. A Wakefield 6103 heat sink was used, but any small heat sink for T0-3 style transistors can be substituted since there is very little heat developed by the 2N4901 transistor.

One wire runs between the PC board and the 2N4901 transistor, connecting the solder pad marked "B" on the PC board to the base terminal of the transistor. The emitter of the 2N4901 connects to the car battery positive source, and the collector is wired to the broadcast radio positive battery lead. This places the transistor switch in series with the car battery and the broadcast receiver.

The QRM Zapper can be assembled in its own box or preferably installed inside the broadcast receiver case. The small size of the printed circuit board should make it easy to find mounting room inside the radio cabinet. The 2N4901 transistor on its heat sink can be installed inside or outside the radio by drilling a pair of mounting bolt holes through one of the vertical sides of the heat sink. Number 4 machine screws are large enough to hold the transistor. The metal transistor case is the collector connection, so the 2N4901 has to be insulated from the heat sink with a mica insulator.

Before installing the printed circuit board inside the radio case, remove the wire(s) connected to the cold side of the broadcast radio's on-off switch and connect the wires that were removed to the collector of the 2N4901. This places the radio load in the switched output of the Zapper. Then solder two wires to the vacated lug of the on-off switch and connect one of these wires to the emitter of the 2N4901. Solder the other wire to the pad marked "14 V" on the printed circuit board. These wiring changes enable the broadcast radio on-off switch to also control the power to the QRM Zapper.

Two wires for the triggers are installed from the transceiver to the solder pads marked "T" on the printed circuit board. The Icom IC-22A has an accessory socket at the rear which was used for the trigger wiring so the transceiver could be disconnected and removed from the vehicle. If a socket

Parts List

C1, C6	4.7 uF, 20 V tantalum capacitor
C2, C3, C4, C5	0.02 uF, 50 V ceramic capacitor
C7	20 uF, 6 V tantalum capacitor
D1, D2, D3	1N4001 diode
IC1, IC2	555 IC
IC3	78L05 voltage regulator
Q1, Q2	3638A PNP transistor
Q3	2N3904 NPN transistor
R1	2.2 megohm, ¼ W resistor
R2, R4, R9	22 k Ohm, ¼ W resistor
R3	1 k Ohm, ¼ W resistor
R5	4.7 k Ohm, ¼ W resistor
R6	120 k Ohm, ¼ W resistor
R7	2.2 k Ohm, ¼ W resistor
R8, R12	560 Ohm, ¼ W resistor
R10	820 Ohm, ¼ W resistor
R11	100 Ohm, ¼ W resistor

The QRM Zapper board 14A6 etched and drilled is available from the CRS Company, P.O. Box 1125, Kent WA 98031 for $3.00. Completely assembled and tested boards are $10.00 from the same supplier.

Additional parts required: 2N4901 transistor, T0-3 socket, Wakefield 6103 heat sink, mica insulator, hardware, box and wire.

is not available on your rig, it would be wise to provide some practical way of disconnecting the trigger wires, such as installing a plug and socket or mounting a screw type terminal board at the transceiver.

The QRM Zapper can also be installed in its own case. A small box similar to an LMB number 00Z which measures 2-5/16" x 2-1/8" x 1-3/4" or a Radio Shack #270-235 box of slightly larger dimensions will easily contain the printed circuit board and the 2N4901 with its heat sink. If the broadcast radio has an in-line fuse holder, a Radio Shack #270-1281 in-line fuse holder can be used to connect the Zapper in series with the broadcast radio battery source. Connect the fuse holder leads to the 2N4901 transistor socket in such a manner that when the fuse holders are mated, the car battery is connected to the emitter and the broadcast radio lead connects to the collector of the transistor. Then connect a wire from the 2N4901 emitter to the 14 V solder pad on the printed circuit board. Connect the ground solder pad on the printed circuit board to the vehicle ground system.

All components, including the three ICs and the three small transistors, are soldered directly to the printed circuit board. Component locations are shown in Fig. 2. Most of the diodes and resistors are installed vertically, with one end of the body placed against the PC board and the other lead bent back along the body and inserted into its solder pad hole. The printed circuit board can be mounted with two #2 machine screws in the upper corners. Holes for this purpose are indicated in the foil pattern and shown in Fig. 2. The foil side of the board must be separated from any adjacent metal by at least 0.2" by the mounting hardware to avoid shorting out the Zapper. ■

LETTERS

from page 86

out here are maybe confused as to how come you ain't at *Byte*. If anyone asks, they are concerned, and if anyone is concerned, then maybe they have some feeling of bias for you; you won't lose anything by levelling.

Now, about *Kilobaud*: I think dividing off some of this really great I/O stuff from *73* and making two magazines is a mistake. In all fairness, I should say I've called the last five presidential elections wrong, excepting that I picked McGovern over Nixon. So much for batting averages. But here's my check for $12; you have and are doing a lot for ham radio and I sure want to see what is next out of the Wayne Green typewriter.

Hang in there; not many of us in the silent majority ever speak up, but we do write checks and buy magazines from newsstands and pull for the guys we *know* are wearing the white hats.

Arnold Senterfitt W6ESV
San Diego CA

If you're really interested, write Byte *about it . . . and I'll sure want to see what kind of an answer you get. I wonder how they can explain to readers what they did. — Wayne.*

THE LF-VLF CAPER

First I want to congratulate you on publishing such a fine magazine as *73*. The technical articles are written in first class style, and the advertising is well laid out and in good taste. The letter written by the fellow in Little Rock (the VLF caper) prompted me to comment on his discussion of the VLF frequencies. First of all, there is nothing secret or mysterious or "out of this world" about the LF or VLF frequencies. I have been doing solar flare propagation work at LF and VLF for about 5 years. Most of our studies are at 24 kHz and 27 kHz for the S.E.A. (Sudden Enchantment of Atmospherics) and at 18 kHz for S.E.S. (Sudden Enhancement of Signal). I have monitored and recorded every frequency between 15 kHz and 600 kHz with my RBA-7 equipment and have yet to hear recorded voice transmissions that speak no known earth language, or dogs barking at each other. What I do hear are military, commercial navigation, omega, and standard stations throughout the world. As far as the lack of design in VLF, the solar flare patrol division of the A.A.V.S.O. (The American Amateur Association of Variable Star Observers) has been using solid state receivers (home built) for years. We still rely on miniature miller coils, and have even designed an S.E.S. receiver for 18 kHz using a ceramic filter with an associated chart recorder interface. As for the lack of commercial gear available, I could list dozens of receivers that can tune "below the broadcast band," not to mention the Drake DSR-2 or the National HRO-500. If he really wants to know what the LF and VLF frequency spectrum is all about, he can purchase a copy of my book, *Propagation and Solar Flare Recording Handbook For The Ham, SWL, and Radio Astronomer*, which will be published in early spring by Tab Books. Again, keep up the good work.

Carl M. Chernan WA3UER
Tarentum PA

WRAPPERS

Having been an avid reader of your magazine for the past couple of years, I have not had need to write. I wait impatiently every month for each issue.

I wish to state unequivocally that I disapprove your dropping the brown wrappers that PROTECT the magazine. If they cost extra, please send me a bill. My latest copy arrived with the corner torn off on the bottom, and with bent corners on both the top and bottom that go through the whole magazine. This may seem picky, but my three year old back issues are all in better condition than my new magazine.

I also am complaining about the mailing label being pasted on the front, along with a postal sticker defacing the cover.

I hope sincerely that you print this, as I would like all those who agree that the practice of not protecting the magazine should stop, to send Mr. Green a letter.

Thank you for letting me get on the soapbox; I really hope you change your policy.

John P. Steiner
Worthington MN

Sorry OM, but a printer's strike forced the Holiday issue to be mailed without wrappers. Things will soon be back to normal; sorry again for the inconvenience. — Ed.

THREE MORE YEARS

The Holiday issue of *73* is great! I just got it yesterday and got an idea for my car's two meter antenna.

The article on the "Frumious Hexadecimal" is interesting but incomplete. I've been programming on IBM equipment for a living for about three years now, and in our shop, hex numbers come in many sizes: X, H (this one the author knows), F, and D. These are all indicative of the amount of storage taken up by the hex number. X indicates a single byte, a value from X'00' to X'FF' (0 to 255). H is a half word, or two bytes, and the numbers go from H'0000' to H'FFFF' or 0 to 65,535. F is for a full word, four bytes long, and D is a double word, eight bytes long. I have never seen anyone use just the quote marks to indicate that a number is hex, but it's an interesting idea.

In the same article, the author misses one of the neater properties of hex numbers. He takes the number H'39BD' and laboriously converts it to 14,781 decimal, then remarks how difficult the conversion into binary would be. Translating from decimal to binary is no picnic, but hex to binary is a natural. Simply take each hex digit and write it as a four digit binary number (to match hex 0 through hex F). Here, 3 becomes 0011, 9 becomes 1001, B is 1011, and D is 1101 for a translation from H'39BD' to B'0011100110111101' in less time then it takes to write this. (The B stands for binary.)

Also in this issue, I find someone willing to charge $4 for a deck of 25 cards in FORTRAN. Surely anyone with half an ounce of typing skill (even myself!) and access to a keypunch could punch these up in ten minutes or less. Let's see now, my installation figures that each card costs it 1.7¢, call it 2¢ with the "labor" involved. Prices may vary, but I see a 400-800% profit on each sale. How do you reconcile this exorbitant fee for such a simple function? Heck, I'll do it myself for half price. Send check or money order to Joe Larson, 1983 Strongs Avenue, Stevens Point WI 54481. Do I hear a dollar? Hang around a university computer center and you can probably do it even cheaper.

Now, if that $4.00 included the computer run of 15,000 pages or so, it would probably be well worth it.

Aside from all this, keep up the good work, Wayne. I've enjoyed *73* as long as I've been a ham, since 1964. Put me down for three more years.

Joe Larson WA9NDV
Stevens Point WI

TO FCC — NUTS!

Chairman of the FCC
York Street
Gettysburg PA

Dear Sir,

I am extremely interested and disturbed about the amount of time the Commission takes to process all amateur radio licenses. I have been licensed since 1961 1961 and I can understand, with the increased num-

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Briefs

from page 17

minute period would eliminate the problem of false alarms caused by test transmissions and accidental activation of the ELTs.) Postlethwaite told *73* that a major aircraft company has agreed to make all of their used tube radios available to repeater sites throughout the nation.

Once the ELT signal is detected, a low cost direction-finding unit designed by Postlethwaite is used to pinpoint the location. As a plus, this DF unit can be used by repeater groups to locate illegal transmitters and jammers. Watch future issues of *73* for articles on the Happy Flyers and a construction article on the DF unit, which can be built for under $50.

The Happy Flyers are seeking members and attempting to form groups throughout the country. At present, there are no squadrons east of Oklahoma. Anyone who is interested in their proposals is welcome to join, with no requirements of being either a ham or a pilot. There are no dues or membership fees. For further information, write to *Hartley Postlethwaite WB6CQW, Electronic Search Education and Coordination, 1811 Hillman Ave., Belmont CA 94002.*

An "administrative delay" at the FCC in Washington has resulted in a two to three month holdup in the implementation of multiple choice code comprehension exams at regional FCC offices. Two high-placed spokesmen confirmed reports of a delay in the process of putting the duplication of new exam tapes out for bid.

At press time, the FCC estimated all offices will have the exams by the beginning of March. They will consist of a five minute "typical" QSO. After the copy is sent, applicants will be given a ten question multiple choice exam. The passing grade is 80%.

In September, a Denver resident visiting Colorado Springs and the Pikes Peak area drove to the 12,500' level of the auto highway on the Peak to do some hiking. Heavy clouds obscured the mountain and, in hiking, he stumbled and fell to a ledge located on the upper portion of the Bottomless Pit drop-off — a sheer cliff of 1300 feet. Unable to move, the hiker lay for 2½ days with a compound fracture of the leg, frostbite, and in shock, without food. Water he obtained by soaking a handkerchief in snow, and then squeezing it out.

The victim was rescued by the El Paso and Arapahoe Counties Search and Rescue Teams in cooperation with the US Army Medical Helicopter teams from Fort Carson CO, after being found by two members of the Pikes Peak Radio Amateur Association. The amateurs were members of the S&R Team and, with other area amateurs, had been in on the "manhunt" since it began. Communications were provided by the PPRAA repeaters on 16/76 and 37/97 (highest amateur repeater in the world) and by the Telestar 87/27 repeater.

It required three rock climbing rescue teams to lower themselves by ropes 1000' to the stricken man, after which a further descent of 800' was necessary in order to permit a helicopter to transport the patient to the hospital. Lake Erie ARA *Newsletter*, Lakewood OH.

Conflicting reports abound on how the new 40 channel CB rigs are doing in FCC tests. *Electronic Engineering Times* reported most of the units submitted had failed to pass the new emission standards tests. But *Communications Retailing*, reporting on a CB symposium held during October in New York, quoted FCC Engineer Ed Schafer as saying better than 50% of the units submitted for test were meeting cabinet radiation specifications. At the FCC labs outside Washington, spokesman Frank Caperidge told *73* the tests show about 53% failing and 47% passing. Caperidge says there are six tests, with the cabinet radiation test a major stumbling block. Local oscillator radiation is measured with a field strength meter at 3 meters, and Caperidge says most of the 40 channel units that are failing can't meet the 5 mV specification. The FCC lab, at press time, was working overtime on the 500 units submitted for inspection, with 106 certified, and less than a month to go.

Northglenn CO has banned amateur radio towers. According to the Pueblo Ham Club Bulletin *Grid Leak*, an appeal is underway, after a lower court judge upheld the ordinance. Twenty-five witnesses appeared against the law, but the city government called no one. Despite the testimony supporting amateur radio and the need for towers, Judge Clifford Goebbel found against the hams. The appeal is expected to take at least a year.

In April, 1779, a group of mutineers took over the HMS Bounty . . . sending the Bounty's captain William Bligh and 18 crew members loyal to him on a 3 thousand mile journey to Timor, and back to England. The descendants of those who stayed with the ship are still on Pitcairn Island, a South Pacific land mass of 2.5 square miles, off the main sea-lanes, with a very poor anchorage so boats are infrequent. The only reliable means of communication with the outside world is amateur radio, through VR6TC, which is operated by Tom Christian. The main generator recently blew up and burned leaving the 150 islanders with small auxiliary generators, and a real energy crisis. Bert Moser W6HS is running a fund drive to buy a new generator for Pitcairn, and you can help by sending a contribution. Bert's address is 2153 Lyans Drive, LaCanada CA 91011. Thanks to *Overmodulation*, Bulletin of the Poinsettia ARC, Ventura CA.

The Concord Brasspounders Club, New Hampshire's oldest, helped 15 Novices get their licenses this fall. The Brasspounders were the first club to use *73*'s new *Novice Class Study Guide* and Code Tapes as part of a program designed to gain FCC certification for the *73* materials. Club secretary Nate Sanderson WA1RWP reports quick responses from Gettysburg, several father-son and husband-wife teams, and more classes in the works. (It's efforts like these that are making New Hampshire contacts a lot easier to come by. — Ed.)

If you're lucky enough to find yourself in Hawaii this winter, check out the amateur radio news being transmitted Monday nights over the state repeater system. KH6GQW puts the news together, and transmits starting at 8 pm local time over 28/88 Diamond Head, 34/94 Haleakala, and 22/82 Mauna Loa. "And that's the way it is . . ."

The FCC has suspended *all* license fees, after a US Court of Appeals ruling which invalidated the Commission's fee schedules. In a suit brought by broadcasting interests, the court found that the FCC had to justify all of its fees based on the cost of any given service. An FCC spokesperson told *73* the Commission decided it had no alternative but to suspend the fees effective January 1st, and launch a study into the legal and administrative implications of refunding fees collected under the current schedule. Following a US Supreme Court decision in 1974, the Commission established a new set of fees, while at the same time requesting legislative action to correct deficiencies in the laws that enable it to collect them. The FCC position, at press time, was that without an act of Congress, it could not collect *any* fees. It could then be some time before ham or CB license applications will require the $4 fee. As for refunds, most of the pressure is coming from broadcasters, whose license fees run into the thousands of dollars. The FCC budget is not expected to suffer, since the fee money goes into the general fund, with a separate budget for staff salaries and operating expenses. The plaintiffs in the case included the National Association of Broadcasters, the National Cable TV Association, the Electronics Industry Association, and Capital Cities Communications.

Obtaining insurance coverage for mobile rigs is becoming an exercise in frustration in many areas of the country. With the proliferation of rip-off artists coming on the heels of the CB boom, many insurance companies are refusing to insure mobile radios, at any price.

Until recently, automobile radios were covered under comprehensive policies as another item in the car. However, in most areas of the country, this has changed. Many automobile insurance companies are including clauses which specifically exclude 2 way radios from coverage. Depending on where you live in the country, you might be able to add an endorsement to your policy to cover the rig. This is completely up to the state insurance commissions (if the companies wish to offer it). In New Hampshire, an extra five dollars covers 2 way radios completely. Down in Massachusetts, which has the highest rate of automobile theft in the country, coverage can't be bought at any price.

Most policy endorsements carry requirements that the rigs be securely fastened to the automobile. (Quick-release mounts are *not* considered secure mounting.) Another requirement is that the car be locked. What this means is that in order to have your claim paid, it's necessary that the car show signs of forcible entry. If the thief who ripped off the rig had a master key or even put a coat hanger through a gasket, chances are that nothing will be collected since no signs of forcible entry will be evident.

The best way to get around these requirements used to be the personal property floater policy, which insured just the radio as a piece of property. *73* talked with several insurance companies who no longer offer them for two way radios. They draw no distinction between CB rigs, business band radios, or amateur units. Spokesmen at the companies pointed out that from the thief's eye view, they all look the same, as many hams will attest to after having their rigs ripped off or hearing "breaker 19" on the local repeater.

It's expected that if radio theft and the CB boom continue at their present pace, virtually no insurance will be available within the next couple of years for 2 way rigs. In the meantime, the best precautions that hams can utilize are locking cars, engraving driver's license numbers on rigs, hiding antennas, or, best of all, removing the rigs completely from the car when leaving it for any period of time.

More than a half dozen petitions have recently gone into the FCC hopper, with two others bounced. A proposal to force SSTV out of the phone segments on 20 meters was dismissed, along with a request that AM be banned below 10 meters. Both actions are not interpreted to mean actual death of the proposals, but instead the FCC's judgment that they can be covered under existing dockets, probably 20777 (bandwidth).

Other pending petitions include RM-2767, which asks for multiple trusteeship of club stations; RM-2768, to allow concurrent holding of Novice and Technician class licenses; RM-2769, requesting formation of a

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Tune Up a Random Wire

- - world's simplest antenna for 80-15

A problem encountered by most apartment-dwelling amateurs is that of radiating a good signal on all bands, without causing TVI, when facilities are available only for a wire antenna of random length. We have achieved this very successfully by adaptation of an antenna-tuning circuit previously used by VK6ZEH in commercial installations.

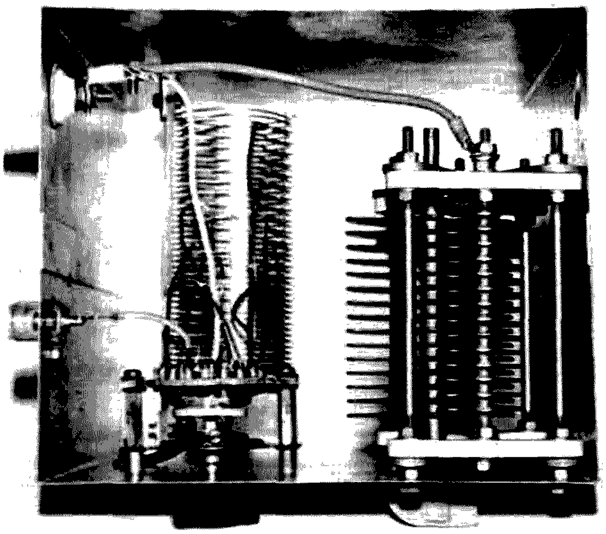
D. L. Smithdale VK6DX
12/10 Walter Road
Inglewood WA 6052
Australia

H. E. Christensen VK6ZEH
21 Pollard Street
Glendalough WA 6016
Australia

The necessary components were obtained as shown in Fig. 1 and the tuner assembled with the exception of the taps from the switches. A point worth mentioning here, in construction, is that the coil should be accessible to enable taps to be soldered on at any point around it.

It is essential that a good ground is available. Fortunately, at the 6DX apartment, the water system was all copper and its grounding properties good. Adjacent to the apartments was a filling station, with a very convenient tree at the back of the block. Permission was obtained from the flat owners, and, with the cooperation of the service station proprietor, 125 feet of wire became airborne at around 30 feet up. The length of wire is of no importance; anything more than 30 feet can be made to work on bands 80m to 15m. It is essential that the wire is placed in position and the end brought to the point where the tuner will be located. Any subsequent rearrangement will upset the system.

Reprinted from *Amateur Radio*, Journal of the Wireless Institute of Australia, October, 1974.



The photo clearly shows the construction and the heavy duty components used.

Tuning Procedure

The 80m band should be adjusted first. Place the capacitor in half mesh, the input tap about 10 turns up from the cold end, and the transceiver at midband. Feed a signal from a loosely coupled signal generator and run the top tap down the coil until a maximum S meter reading is obtained, then solder the tap in place. Now place an swr meter between the transceiver and tuner, using 50 Ohm coax. Apply low power from the transceiver and check for minimum swr. If it is necessary to move the capacitor considerably, re-center and adjust lower tap until the minimum swr is achieved. This can be done two ways: by switching off, moving, and rechecking, or by holding the lower tap with *well* insulated pliers and running up and down the lower section of the coil until the exact spot is found (WARNING – high voltages can be expected here; proceed with caution). Once the optimum position is found, by a very slight adjustment of the condenser, an swr of near 1.0 can be had from one end of the band to the other. If this cannot be achieved, select the lowest possible and readjust the top tap half a turn either way as necessary to lower the swr. When operating at the extreme end of the band, the swr should be no more than 1.2 and can be reduced by a slight adjustment of the capacitor.

The remaining bands are tuned in a similar manner. 28 MHz has not been included, as it is felt a suitable separate antenna can be erected and a separate tuner using smaller capacity and inductance constructed.

Features

One of the advantages of the tuner is that it can be adjusted to match any impedance offered by the long wire. It should be noted that in some instances, e.g., ours on 20m, the input tap is above the output tap due to the impedance being less than 50 Ohms.

No specific tap positions can be given as they are entirely dependent on the length, height and properties of the antenna. With a little

patience, the ultimate can be achieved, all your signal generated being radiated and not wasted heating up the antennas.

Good construction practices should be followed, using heavy duty switches and a variable capacitor. The wiring should be bare copper wire and firm enough not to sag. Plastic covered wire, if touching, and the wrong tap selected for tuning up, will result in fusion of the wires together. The whole assembly should be enclosed in a well bonded and *grounded* metal box. By leaving off the ground, the swr will rise to as much as 2.5 to 1.

The system can be used to match a vertical antenna in the same way. Tests to date have shown the system to work very well, and the comment of DX stations is often of surprise when they hear that the antenna is only a long wire. Working portable in the NW, Europe has been worked with ease using a 60 foot wire 12 feet up and a fair ration of DX using a 125 foot wire 30 feet up. Good DX! ■

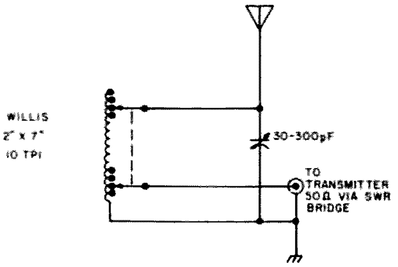


Fig. 1.

LETTERS

from page 116

ber of applications, how the time it takes can be multiplied. What I cannot understand is (since this process has been computerized) the time it takes to receive a license back from the Commission has not changed. In fact, it has increased!

When I got my Novice license in 1961, I waited six weeks from the time my test was mailed until my license came back. I am at present waiting for my Advanced class license (I was tested 10 Nov. 76) and I was informed by the examiner it would take about six weeks for my new license to come to me. This is the same amount of time it took to get my Novice back in 1961. HOW CAN THIS BE??

I would like to know how the routing and processing of the applications go when they leave the district office. Also I am interested in (since he has already proven himself by passing the exam and if he has a license), why can't the applicant be authorized to operate with the new privileges on a temporary basis until the new one has been issued?

There is no need to rush on a reply to this letter, because I will not be looking for an answer for the next six weeks.

Richard L. Swain

Here is a letter I sent to the FCC. The reason for doing the complaining should be rather obvious.

I am not trying to attack the entire FCC and say it is behind the times, because it is not. The fact is that the administrative section which does the actual processing and issuing of the licenses is GROSSLY inefficient and most likely is lacking in proper supervision.

I am a fourteen year veteran of the system (I am a member of the USAF), and I think I know how most government agencies work in their administrative sections.

I think the FCC could issue a temporary license at the field office or examination point for those who already have a license and callsign. Nothing makes most people madder than to order something pre-paid and have to wait two or three months for it to get to them.

I have discussed both subjects with several other amateurs and they agree all the way with me. What we would like to see is all others who have had the same problems voice their grievances or opinion on both.

Richard L. Swain K8AIT
Sawyer AFB MI

INSPIRATION

This is my first letter to any magazine, but the story on the five year old ham inspired me to write a few lines.

The first thing I might say is that my CB call is KET-5238, so this letter is not to cut down CB. It might step on a few toes in the ranks, but if the shoe fits, wear it.

It would seem that if a five year old can pass a Novice ham test, the people who want us to give up our standards as hams, by dropping the code and/or making the test simpler, should take another look.

I agree that we need new blood in the ham ranks, but we also must keep our standards high! If someone doubts this, they should look at other countries' licensing. Not every country has Novices for instance. So when a Novice goes to Germany, they do not license him at all. Can you or anyone else imagine a person with a "Communicator" license going to any country trying to get a license? It would probably be like going to another country with a CB license asking for an amateur license with General privileges.

Robert H. Partigianoni
WB5JZP/DA1PQ
APO NY

PHOOEY!

I must say "phooey to hams" in reference to those who don't acknowledge uP byters. My subscription to *73* started soon after I found I/O. It's a shame that a few people can't see past their ham dials, and into a world of logical bits. But of course everyone to their own — and mine is uPs. However, keep up the good work in *73* on both sections and maybe a few byters might just cross over and hit the airways.

To the byters I must pass the bytes on — while flying Delta over Georgia, an interesting gentleman (from TI) introduced me to TI's TMS9900 16 bit uP having a 3 MHz cycle time. With 17 vectored interrupts, full 16 bit capability on both A & D bus lines. And no special memories or ICs for system interfacing are needed.

The data sheets I have sure look like the PACE, 8080, and 6800 uPs have got a bigger brother. The cost of the 9900 is more but you save with the I/O and interrupt interfacing, program development, and program execution time.

Oh! And a new bipolar memory SN54S400 (S400) 4096 bit static RAM having a 75 ns R/W cycle.

Wow! Sure looks like '77 is going to be "heaven, next stop."

Francis T. L. Dossey
FPO New York

WIMU

Many thanks for the prize subscription to your magazine you contributed to the WIMU Hamfest. I won it in a 2 meter hidden transmitter hunt.

As a former president of this hamfest (when I was a K7 from Wyoming), I realize the difficulty of getting support and prizes to put on an event such as this. It is sometimes difficult to put on a good get-together without the generous support of ham dealers and the magazines. I want to extend to you my personal thanks for the subscription and for your support of our hamfest.

The WIMU Hamfest is for the hams in Wyoming, Idaho, Montana, and Utah. It is the largest and oldest hamfest in these western states. This year's event at Mack's Inn, Idaho was the 44th year it was held. We broke an all-time attendance record this year with a registration total of about 365. Perhaps a hamfest of this size is not too big by eastern standards, but considering the sparse ham population of these states, and the distances involved, the attendance is pretty remarkable. Some hams travel over 800 miles every summer to come to the hamfest.

Hal Bergeson WØMXY
Colorado Springs CO

FEEDBACK

I enjoyed reading the two part article about commercial marine radiotelegraph operators in the Nov. and Dec. issues. However, before any *73* readers get the wanderlust and strike out for such a career, a couple points should be made. First, there are about four times more operators available than ships. The Radio Officers Union is tighter than a drum and chances of more bodies entering in and thinning out the ranks are very poor right now. Also, on page 160, Dec. issue, the Coast and Geodetic Survey is listed as a source of employment. C&GS was done away with in 1965. National Ocean Survey in Seattle may be helpful. Also, MSA is not correct — should be MSC, Military Sealift Command. One in SF is called MSCPAC. I don't know the address.

Cliff Appel WB6AWM
Orangevale CA

TRIGGERED

I, too, was shot by Trigger Electronics, Dec. 21, 1974. I ordered high pass and low pass filters, and I was strung along until I got tired and

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Novice Q&A

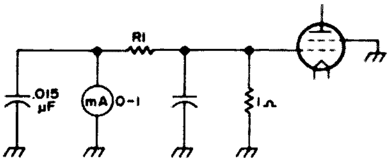
This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.

Q. What is the correct procedure to use when measuring the grid current of a cathode-driven amplifier?

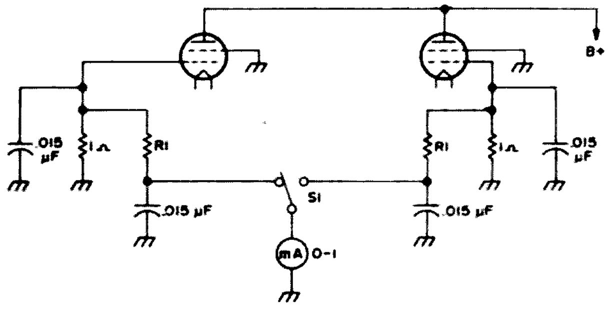
A. Measuring the grid current of a cathode-driven amplifier can be a delicate task, since it is a ticklish job to unground the grid sufficiently to permit a metering circuit to be used, yet still hold the grid at rf ground potential. The inherent inductance of most bypass capacitors permits the grid circuits to "float" above ground at some high frequency and, as a result, the amplifier exhibits instability and parasitics. This problem can be avoided with the metering circuit of the figure (A). The control grid is grounded with a 1Ω composition resistor, bypassed by a .015 pF disk capacitor. The voltage drop generated by the flow of grid current across the resistor can easily be measured by a millivoltmeter which is calibrated to read in terms of grid current. Individual grid current for each of a parallel pair of tubes may be measured by the circuit of (B) in the figure.

The internal resistance of the 0-1 dc milliammeter plus the series resistor E1 determines the maximum current in the order of 60 mA. This is very convenient, as the reading of the meter scale can easily be multiplied by 100 to obtain the actual value of current. When 100 mA flows through 1Ω, there exists a potential of 0.1 V across the resistor. The meter should read 0.1 V full scale to correspond to a grid current of 100 mA.

For example, with a Triplett #221-T (which has an internal resistance of 55Ω), the voltage drop across the meter itself is 0.55 V when 1 mA flows through it. To convert the milliammeter to a voltmeter reading 0.1 V full scale, a series multiplier must be added. A voltage drop of 0.1 V exists across a 100Ω resistor when one mA of current flows through it. The difference between 100Ω and 55Ω or 45Ω must therefore be added in series with the meter to convert it to read 0.1 V, full scale. On the other hand, placing the meter itself across the 1Ω resistor without the series multiplier will result in a full scale reading corresponding to 55 mA. Thus, if maximum grid current is below this latter figure, no series resistor is required for the meter. Conversely, high values of grid current produce greater voltage drop across the 1Ω resistor and larger values of series multiplier resistance are needed.



"A"



"B"

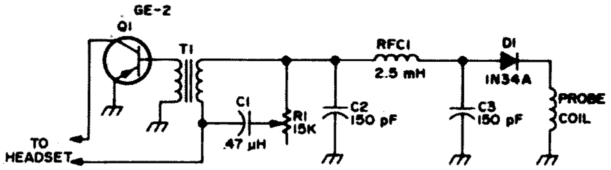
Q. What is a microwave radiometer and what does it do?

A. The microwave radiometer is a receiver of electromagnetic energy used to measure thermal radiation in the rf spectrum. Typical sensitivities of the order of 140 dBm are made possible by comparatively long post-detector integration time and provision for cancellation of receiver gain variation in the period of one observation.

These devices are mostly used in radio telescopes for measuring extraterrestrial radiation and for passively detecting and identifying military targets (both ground and airborne).

Q. Is there a very simple, one transistor circuit for a CW monitor?

A. Yes, see the figure. For the tone desired, adjust potentiometer R1. Place the pickup coil anywhere near or in the transmitter. If the gadget doesn't "take off" immediately, reverse the primary winding connections of the transformer, which, incidentally, is a Lafayette TR-110.



Q. When operating a transmitting set containing a fan, must all covers be closed?

A. This depends on the design of the ventilation system. Large transmitters containing two or more air blowers are designed for "closed cover" operation within the ventilation system. Removing the covers allows the air (in some cases) to flow helter-skelter without maximum effect. On ham transmitters, especially SSB units of short duty cycle, there is generally no problem.

Q. Is it unusual that the final tubes of a transmitter must be replaced every four months? If so, what should be checked?

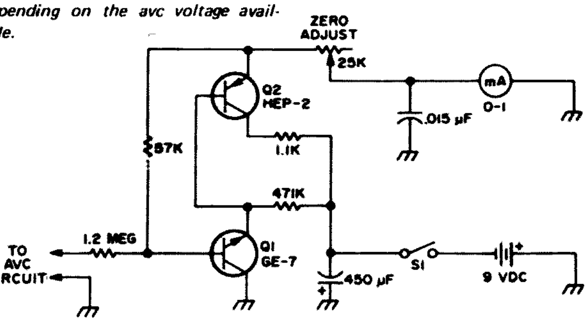
A. Yes, frequent tube replacement is unusual. First measure the bias to the final in accordance with the manual or a tube data sheet. Next measure the final plate voltage. If these do not check out (or are way off), then review your method of tuning. Running a transmitter into a poorly matched antenna, with its attendant high swr, does not help the final tube much. Overdriving the final tube is another way to shorten power tube life. Therefore, check the drive to the final, too.

Q. Is it possible to add a transistorized S-meter to an all-band Japanese-made receiver?

A. The circuit in the figure works well on most receivers and it is easy to connect. For O1, the following transistors may be used: GE-7, SK-3011, NR5, TR-10, DS75.

For Q2: HE-1, SK-3005, TR-06.

The value of the input resistor, shown as 1.2 MΩ in the schematic diagram, may have to be adjusted depending on the avc voltage available.



Q. What modifications should be considered when modernizing a receiver?

A. First, replace the rf amplifier with a high-gain tube like the 6BZ6 — a new socket may be needed. The rectifier (5Y3GT) can be eliminated with a silicon plug-in replacement. Stabilize the voltage on the bfo (6J5) with a separate VR tube or zener diode. Add a product detector.

Q. When used in SSB work, the detector is usually referred to as "product detector." What is the reason for this?

A. Because the detector has an output amplitude which is proportional to the mathematical product of the amplitudes of its two inputs, carrier and modulating signals.

Q. Is there any way to use 90Ω coax cable with a vertical antenna which requires a 50Ω match?

A. Cut two parallel pieces of the 90Ω coax cable. Make sure they are the same length. By paralleling them the result will be 45Ω or so.

Q. Can #18 shielded wire be used to connect a doublet?

A. No. First, the doublet's 72Ω impedance does not match that of the wire. Second, shielded wire is not the same as coaxial cable. Finally, capacitance per foot is much higher with shielded wire than with coax.

Furthermore, because the shield is not uniformly spaced over the wire, the capacitive distribution will be uneven.

Q. What is the difference between a direct probe and an isolation probe for a scope?

A. Just as the name implies, a direct probe is a test probe which is connected to a piece of shielded cable without series resistance or capacitance. The isolation probe can be either capacitive or resistive — or both — and serves to present a higher impedance, a lower capacitance or higher resistance (less load) to the circuit under test.

Q. What can be used in an emergency to check circuit continuity?

A. Use your receiver and two test leads — one connected to the receiver's antenna terminal and the other terminated directly to the antenna. You'll notice continuity — and varying degrees of such — by the resultant increase in receiver gain on the S-meter. Tune to a station that is fairly weak without the antenna connected.

AMSAT

QSL BUREAU

AMSAT maintains a QSL bureau for confirming satellite QSOs. Any US or VE member or satellite user can maintain a few cases on file and will receive cards confirming contacts with other satellite users. Any AMSAT member can also send out cards confirming satellite contacts by means of the AMSAT bureau. There is no cost for cards destined to W, K or VE stations, and a flat rate of 6¢ a card to all other countries.

I recently had a chance to peruse the dead cards (cards at the bureau for which the recipient has no envelope on file). There are DX cards, rare states and special event stations cards. Some people nearly have enough cards for an OSCAR or Satellite 1000 award waiting for them at the bureau. These cards will have to be returned to the senders or destroyed in the near future. If you use the satellites but do not have a case on file at the AMSAT QSL Bureau, send at least one in today. If you are an AMSAT member, you can also send out cards at the same time. You may be pleasantly surprised as to what you will find in your first returned case. The address is: AMSAT QSL Bureau, Dennis Grinerod WA1EHF, Manager, 564 Stillman St., Bridgeport CT 06608.

TWO SATELLITES IN ORBIT

We have marked the fourth anniversary of the launch of AMSAT-OSCAR 6 and the second anniversary of the launch of AMSAT-OSCAR 7. It is important that the lifetimes of the spacecraft not be foreshortened by the use of excessive uplink power. The QRP days have shown that modest amounts of rf can put good signals into the spacecraft. Less than 10 Watts of radiated power is all that it takes to put a strong signal into A-O-7 Mode B, and less than 100 Watts will do the same for Mode A on both spacecraft, provided that there are few QRO operators. Please, do not use or encourage high power operation via the satellites. If you have trouble hearing yourself, don't increase your uplink power, but examine your receiver. If you CANNOT hear the beacon signals from AMSAT-OSCAR 6 on an overhead pass, you need to improve your receiving capabilities.

TWO SATELLITES TO COME

AMSAT is currently building two spacecraft. The Phase III spacecraft has a launch date in December, 1979. The European Space Agency (ESA) has agreed to provide a place on the second ARIANE launch vehicle flight. This will be the first non-US launch of an OSCAR spacecraft. AMSAT is also working on a Phase II spacecraft. This spacecraft is known as A-O-D, and is destined for launch in late 1977. It is a joint venture of AMSAT, Project OSCAR and JAMSAT. It marks the first time that Project OSCAR and AMSAT have cooperated on building flight hardware. A-O-D will contain two transponders: a 145/29 MHz unit built by AMSAT in Washington DC, similar to the one flown on AMSAT-OSCAR 6, and a 145/435 MHz transponder being built by the Japanese AMSAT Association. A prototype of this transponder has been tested on Mount Fuji in Japan with promising results. One unique aspect of that transponder is that it uses a power FET in the final.

The frequencies to be used by A-O-D are as follows:

UPLINK (MHz)
145.85-145.95, 145.9-145.95
DOWNLINK (MHz)
29.4-29.5, 435.1-435.15
BEACON (MHz)
29.4, 435.095

Note that the 145/435 transponder bandwidth may be slightly narrower than shown and incorporates passband inversion (cf. A-O-7 Mode B).

This satellite is primarily designed for the educational program to provide the capability for satellite demonstrations and communication through to 1980 and the launch of the first Phase III spacecraft.

SPONSOR A SOLAR CELL

Building two spacecraft is an expensive business. The cost of the solar cells alone is estimated to be in the tens of thousands of dollars. AMSAT just does not have that kind of money, so those funds have to be raised somehow. When a terrestrial FM repeater is put on the air, the users normally contribute towards the cost of establishing and maintaining the repeater in operation.

Spaceborne transponders are many times more expensive than terrestrial repeaters (A-O-7 cost us $60,000, an identical commercially built unit could have cost $2,000,000). AMSAT is in the middle of a "sponsor a solar cell" campaign. If you can contribute at least $10.00, help in administering the program or have any constructive ideas on the subject, contact Tom Clark WA3LND at AMSAT, or send in your tax deductible sponsoring donation. All solar cell sponsors will receive a certificate attesting to their status.

THINKING AHEAD

Almost every day a new call is heard through the downlink of AMSAT's OSCAR 6 and 7. When the Phase III spacecraft is in orbit, the situation will change drastically. No longer will we be limited to 5000 miles, for a whole hemisphere will then come into range. For the first years of operation, any station in the Northern Hemisphere will be able to communicate with any other in that hemisphere for up to 15 hours a day, as well as with Southern Hemisphere stations for part of the time. This communication facility will be there irrespective of the state of the sunspot cycle, solar flares and most other phenomena that upset conventional HF band communications.

Consider what that will mean in terms of QRM!

On a "typical" HF band such as forty meters, a number of QSOs can take place on one frequency at any time, because depending on the time of day, two stations located in, say, Europe can work each other without hearing two stations in North America also working each other on the same frequency. It would also be possible for more QSOs to take place on the frequency causing minimal QRM as long as those other stations are well separated or within the dead zone (skip effect). In fact, this is normal for forty meters.

Now consider two meters. 144.12 MHz is a typical SSB frequency. At any given time, many QSOs could take place on that frequency, without causing any QRM at all to each other, because of the geographical spacing between the stations in QSO and the line of sight properties of 2 meter propagation.

What would happen if the characteristics of forty meters were suddenly superimposed onto the two meter band? Instant QRM! Stations all over half a world would suddenly start hearing one another on the frequency. Local QSOs could take place, simply by covering up more distant stations on the same frequency. DX work would be possible only if no locals appeared on the frequency at either end. Now take away the dead zone, and let the band be open to everywhere at the same time. Everyone is now a "local," and can be heard anywhere else.

This is what may happen to part of two meters (and 70 cm) when the Phase III spacecraft is in its final orbit. It is up to us to plan ahead to try and control the QRM so that QSOs can take place.

A two meter FM repeater puts a station in contact with any other one within, say, 60 miles or so for up to 24 hours a day.

Oscar Orbits

Oscar 6 Orbital Information

	Orbit		Date (Feb)	Time (GMT)	Longitude of Eq. Crossing °W
NA	19652	BTN	1	0101:52	74.5
	19664	Q	2	0001:48	59.5
N	19677		3	0056:44	73.3
NA	19690	BTN	4	0151:39	87.0
N	19702		5	0051:35	72.0
S	19715		6	0146:31	85.8
N	19727		7	0046:27	70.8
NA	19740	BTN	8	0141:23	84.5
	19752	L	9	0041:19	69.5
	19765	L	10	0136:14	83.3
	19777	L	11	0036:10	68.3
N	19790		12	0131:06	82.0
S	19802		13	0031:02	67.0
N	19815		14	0125:58	80.8
NA	19827	BTN	15	0025:54	65.8
	19840	Q	16	0120:49	79.5
N	19852		17	0020:45	64.5
NA	19865	BTN	18	0115:41	78.3
N	19877		19	0015:37	63.3
S	19890		20	0110:33	77.0
N	19902		21	0010:29	62.0
NA	19915	BTN	22	0105:24	75.8
NA	19927	BTN	23	0005:20	60.8
N	19940		24	0100:16	74.5
NA	19952	BTN	25	0000:12	59.5
N	19965		26	0055:07	73.3
S	19978		27	0150:03	87.0
N	19990		28	0049:59	72.0

Oscar 7 Orbital Information

Orbit		Date (Feb)	Time (GMT)	Longitude of Eq. Crossing °W
10127	B	1	0108:20	69.3
10139	BX	2	0007:40	54.2
10152	B	3	0101:58	67.7
10164	A	4	0001:18	52.6
10177	B	5	0055:35	66.2
10190	A	6	0149:52	79.7
10202	BQ	7	0049:13	64.6
10215	A	8	0143:30	78.2
10227	BL	9	0042:50	63.0
10240	BL	10	0137:08	76.6
10252	BL	11	0036:28	61.4
10265	A	12	0130:45	75.0
10277	B	13	0030:06	59.9
10290	A	14	0124:23	73.4
10302	B	15	0023:43	58.3
10315	BX	16	0118:00	71.9
10327	B	17	0017:21	56.7
10340	A	18	0111:38	70.3
10352	B	19	0010:59	55.1
10366	A	20	0105:16	68.7
10377	BQ	21	0004:36	53.5
10390	A	22	0058:53	67.1
10403	BX	23	0153:10	80.7
10415	A	24	0052:31	65.6
10428	B	25	0146:48	79.1
10440	A	26	0046:09	64.0
10453	B	27	0140:26	77.6
10465	A	28	0039:46	62.4

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.
OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.
Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

The transponders on AMSAT's OSCAR 6 and 7 increase that range to 5000 miles, but only for 20 minutes or so, three or four times a day. The Phase III spacecraft will put a whole hemisphere in range for up to 15 hours a day. This means that round-table QSOs between stations in Europe, the U.S.A. and Japan could become commonplace. This would introduce a whole new era in phone patches, traffic handling, emergency communications, and educational uses.

It is these latter uses that will be instrumental in getting a place aboard the launch vehicle for the spacecraft. It's going to take a lot of planning to ensure that we utilize the Phase III spacecraft in the best way. One way to do it would be to split the passband into modes, similar to the voluntary band plans in effect in IARU Region 1 on all amateur bands. Starting at one end of the passband, there is a CW section, then an SSB section, with an overlap area for mixed mode contacts. The top end of the SSB section and the bottom end of the CW section could be used for traffic and messages where allowed by the licensing authorities. Then follows a segment reserved for SSTV and RTTY. Another segment is reserved for educational uses, including an Emergency Calling Frequency. The last section is a small one reserved for the use of the AMSAT Command Stations as an intercom frequency. It may also be used for announcements, similar to those presently being made on AMSAT's OSCAR 6 and 7. The actual locations of the assignments and the amount of passband allocated to each must be made by us as users, because it is voluntary and can only be enforced if the users agree to do so. The development of any kind of band plan *should be started now*, because it's going to take two years to get everyone to agree.

Your comments are needed. Comment on the type of band plan (if any), the amount of spectrum allocated to each mode, and on anything else.

Repeater Update

The following repeaters have been licensed and have gone on the air since the publication of the last *73 Repeater Atlas*. Other areas of the country will be updated in future issues. Watch for publication of the new *73 Repeater Atlas* soon.

Connecticut

WR1AFR	New Canaan	447.70	
WR1AGC	Avon Mountain	224.78	
WR1AGD	Ansonia	146.985	
WR1AHA	Harwinton	147.27	
WR1AHP	West Haven	147.255	RTTY
WR1AHP	New Haven	147.855	
WR1AMU	Storrs	147.30	

Massachusetts

WR1AAA	Malden	29.52	29.685 IN
WR1ABK	Westwood	149.295	
WR1ABP	Billerica	147.12	
WR1ACO	Malden	449.40	
WR1AEO	Brookline	146.39	146.99 IN
WR1AFO	Belmont	448.10	
WR1AFP	Fitchburg	224.34	
WR1AGK	Yarmouth	147.645	
WR1AHL	Springfield	224.34	
WR1AHR	Chatham	147.375	
WR1AIT	Somerville	224.18	

Maine

WR1AES	Boothbay Harbor	146.79	
WR1AQW	Topsfield	146.67	

New Jersey

WR2ACQ	Atlantic City	146.745	
WR2ADK	Pleasantville	147.21	
WR2AEA	Punnemede	146.76	
WR2AGZ	West Orange	146.415	147.415 IN
WR2AHV	Newton	147.50	
WR2AHY	Frenchtown	146.85	
WR2AIN	Kearney	146.475	147.475 IN
WR2AIO	Middletown	146.50	147.50 IN
WR2AJC	Princeton	146.46	147.46 IN
WR2AJY	Willingboro	146.925	
WR2AKE	Manahawkin	146.835	
WR2AKJ	Cape May	146.61	
WR2ALW	Robbinsville	147.21	
WR2	Willingboro	224.86	
WR2	Atlantic City	147.00	

New York

WR2AAB	Yonkers	146.46	147.46 IN
WR2ACB	Stony Brook	448.825	
WR2AFV	Rochester	146.70	
WR2AHV	Newton	147.30	
WR2	Cooperstown	146.64	
WR2	Delmar	146.64	
WR2	Cuba	146.94	
WR2	Niagara Falls	147.36	
WR2	Syracuse	147.18	
WR2	Warren Cty Raceway	146.73	
WR2	Buffalo	53.05	52.05 IN (T 1407)

FCC

BEFORE THE
FEDERAL COMMUNICATIONS
COMMISSION
WASHINGTON, D.C. 20554

In the Matter of

Waiver of Section 97.28(b)(1)
of the Commission's Rules

ORDER
ADOPTED: NOVEMBER 23, 1976;
RELEASED: NOVEMBER 24, 1976

1. The Chief, Safety and Special Radio Services Bureau, acting under delegated authority, has under consideration the waiver of Section 97.28(b)(1) of the Commission's Rules in order to establish a procedure for processing requests for multiple Novice Class written examinations. Under the present rules, an applicant for a Novice Class license in the Amateur Radio Service must first pass a test in the use of Morse Code before making an application that a written test be sent to the applicant's volunteer examiner for administration. In situations where one examiner has been tutoring many applicants, problems have arisen in the time delay experienced in receiving the exams by mail and then administering them after the regularly scheduled sessions of instruction have ended. It is anticipated that large groups of students will be concluding their Novice courses in the next few months and that a method for expediting applications will be necessary.

2. A waiver of Section 97.28(b)(1) will allow an examiner with several applicants to apply for the written examinations prior to successful completion of the Code test. To implement this new procedure, the Commission will require the following:

(a) Examiners must administer the tests to at least five applicants.

(b) Requests for exams must be received no later than thirty days prior to the date of examination.

(c) Examiners must continue to meet the eligibility requirements of Section 97.28(b): They must be twenty-one years of age or older, holders of a General Class license or higher, and unrelated to any of the applicants.

(d) Requests must include the number of tests needed, the date the examinations are to be given, the name and address of the examiner and a photocopy of the examiner's license.

3. Examiners are reminded that they will be held accountable for returning all used and unopened examinations, and that they are expected to establish a method of control to insure the integrity of each examination. All requests for examinations should be mailed to: Federal Communications Commission, P.O. Box 1020, Gettysburg PA 17325.

4. Accordingly, the Commission, by the Chief, Safety and Special Radio Services Bureau, under authority delegated pursuant to Section 0.331 of the Commission's Rules, ORDERS that Section 97.28(b)(1) of the Rules is hereby WAIVED for the period beginning November 24, 1976 and ending June 30, 1977.

FEDERAL COMMUNICATIONS
COMMISSION
Charles A. Higginbotham
Chief, Safety and Special
Radio Services Bureau

Ham Help

Under date of September 11, 1976, I wrote your magazine to the effect that I was an over-aged citizen disenchanted with CB, wondering how I could get into amateur radio, how I could accumulate in a hurry the knowledge that licensed hams already have, and requesting information on the sources of used ham gear. For your convenience I enclosed a stamped return envelope.

You did not personally answer my letter. You *did* publish my letter in the Ham Help column of the very next issue of *73 Magazine* which went to press!

That is when all hell broke loose!

Within a two week span following publication, I received more than two dozen letters, one from as far away as Sioux Falls, South Dakota, providing genuine assistance of one form or another. During this same period, I received at least a dozen phone calls, one of which was from as far as fifty miles away, again offering the kind of assistance I had hoped for in my letter to you!

In all of my previous experience, I had never encountered such willingness to be of help, and all of it offered without any expectation of monetary return!

As a consequence of your publication of my plea, I did enroll in a Novice class course at UMPG (although it had already run too many sessions for me to catch up), found a volunteer of assistance toward Novice within 10 miles of my home, located

Continued on page 135

Special Report

from page 15

channel spacing (e.g., 8 or 9 kHz) has also been addressed by the SWG. While Regions 1 and 3 have adopted plans to reduce channel separation as a means of increasing the number of channels, this scheme affects adjacent channel interference, the development of AM stereo, and poses serious conversion problems for the US which has developed its AM service largely around the use of directional antennas designed for use only on specific frequencies. Comments on this issue and the extension of the broadcast band to 1805 kHz are requested.

The International Broadcasting SWG indicated that additional spectrum was required, particularly at 3900-4000 kHz. We have not proposed any change to the band 3900-4000 kHz, which permits broadcasting in certain regions under specified conditions. Although the recent LF/MF conference rejects the use of single side band, we feel this technique should be examined and commented upon.

The *International Broadcasting* (SWG) requested retention of their present allocations of a total of 2150 kHz and additional worldwide allocations of more than 2000 kHz; this amount would double the current allocation and include approximately 20% of the spectrum available between 4 and 27.5 MHz.

The Commission currently licenses ten transmitters for operation in the high frequency bands allocated to broadcasting, approximately 5% of the total US broadcasting; the other 95% of US HF Broadcasting is conducted by the US Government through USIA and the Board for International Broadcasting. Presently, throughout the world, there are approximately 1500 transmitters on the air carrying about 22,000 daily frequency hours. Two or three international shortwave broadcasters operating on one frequency is a common occurrence. The US requirements for additional spectrum in the HF band are under consideration.

Citizens Radio

The Citizens Radio SWG requested an additional allocation of 1 MHz in the 26-28 MHz band, a 5 MHz allocation in the band 216-300 MHz with 220-225 MHz preferred, and a 10 MHz allocation between 470 and 947 MHz, preferably between 890 and 947 MHz. These are needed to meet the explosive growth of CB and to provide additional services such as channels for repeater operations, municipal service tie-ins, and weather information.

The SWG further requested that this service be redesignated as the "General Radio Service," and that this new service be recognized internationally by the inclusion of it and its associated spectrum in the ITU table of frequency allocations. The utilization of Citizens Band frequencies in the US is extensive by any standard, with the uses extending into nearly every area of personal and business communications. However, we are unable to endorse the principle of advancing an international allocation for a specific service, such as the "General Radio Service," particularly when the need for such a service has not been advanced on a large scale.

There is already a provision for the Mobile service between 27.5 and 28 MHz in the International Table, so no change is required, recognizing, however, that in the US the band 27.54-28 MHz is subject to exclusive government use. We are proposing that the band 220-225 MHz be allocated for shared use by the Mobile Service with the Amateur, Amateur Satellite and Radiolocation Services. Part of this band could be allocated domestically to the Citizens Radio Service, if it is eventually decided that this allocation would be in the public interest. As our table shows, we also propose to meet the requirements of the Mobile services by providing access to the band 890-947 MHz; use of these frequencies by the Citizens Radio Service could result from domestic rule-making.

Further, an effort to establish CB as the "General Radio Service" could well work against the expansion of spectrum desired by the Citizens Band SWG since future domestic allocation actions may well provide for expanded spectrum. Thus, we are proposing to continue the present international allocation at 26100-27500 kHz for Fixed and Mobile (except Aeronautical Mobile), which is used domestically in part by the Citizens Radio Service. While the actual desires of the SWG have not been fulfilled, we feel that our proposal will prove to be the most beneficial one for the needs of the service in the long range future.

Conclusion

As we have previously indicated in this proceeding, all participants should keep in mind the importance of the 1979 WARC results. Based upon past experience, decisions reached at this conference can be expected to provide the basis for international radio regulation policy for most of the remainder of this century. It is of the utmost importance to develop US proposals which effectively promote that combination of telecommunication uses which offers the maximum social and economic contribution to the national welfare and which also contain the flexibility necessary to accommodate important new applications of this dynamic technology as well as the unique requirements of our international partners in the ITU.

LETTERS

from page 126

wrote to Washington DC to Advertising, Credit, and Fraud, Margery Smith, Acting Director, Bureau of Consumer Protection, Federal Trade Commission, Washington DC 20850. Yesterday the mailman had a letter from Trigger — yes, just a *check. But Margery Smith did it.* Now I am going to *"burn"* a Blue Electronics Book for good. Took a FCC radio test yesterday and now I can move forward again after 2 years of waiting for parts.

My 73 to the publisher and thanks.

Frank J. Jelinek, Jr.
Linwood NE

BALONEY!

The card is because I must take immediate issue with the Holiday issue, page 8, second letter, as follows: Baloney, Wayne, it IS that good and gettin' always better!

That's not my ego — I began writing for you because *73* IS the best. If I qualify for you, I stand well judged, and then I strive to do better each time, too.

Feel free to put this in "Letters." You have earned the praise — in spades — and in spite of IRS, big (phoney) business, and the stigma of CQ past. Hi!

Dave Brown W9CGI
Noblesville IN

I/O DOWN UNDER

I saw you needed articles for the I/O section of *73*, so I'm enclosing one. I could not think of anything more useful to a microprocessor than interrupts (boy . . . am I getting sick of typing that). I hope it will be of some use. If you want an article on programs (not programming, you seem to have enough of them), it's coming up next. Around here a small group of us are getting micros built; we have access to a resident cross-assembler to the Burroughs Computer for the M6800 with Mikbug — very useful. We also have a number of minis at university (at present I am a student at Auckland University doing computer studies and electronics) with interactive BASIC.

I am now working on an ALGOL interpreter for an M6800 (ALGOL is a high level scientific and general purpose language; it stands for ALGOrithmic Language, and has lots of nice features not found in FORTRAN). I'll let you know about that later. Probably some time in 1978-9, the way things move around here.

I enjoy reading your I/O section; keep up the good work.

Robert Leyland ZL1TRM
Auckland, New Zealand

HEURISTICS

The article "What Computers Can And Can't Do" in your Holiday issue was an interesting one, and has moved me to make two comments. The first is an answer to the question of unfair competition raised at the end of the article. The simple answer to this is that any station which receives any assistance during the contest automatically falls into the multi-operator category. Your readers must ask themselves if their stations, computerized or not, can compete with the likes of W3AU or W7RM. The second is a slightly more philosophical one, and open to debate. Since there is no well defined technique or algorithm for contest operating, the computer program must involve heuristics and, as a result, the personality and prejudices of the programmer will be built into the program. In short, the computerized contest station, although faster than its human owner/programmer, will probably not be a much better contest operator.

Robert A. Hyman K3OCN
Silver Spring MD

SCHULTZ COLLAPSES

Even though I may be considered one of your Associate Editors, I am going to sue you!! The bookshelf I had hung on the wall collapsed after I placed the 11/76 issue of *73* on it.

John Schultz W4FA
FPO New York

QUICK SERVICE

As the editor of *73*, I feel that you must be informed of the extremely fast service I received from one of your advertisers. The company I am referring to is Kemit Electronics, Sunnyvale CA.

They had advertised the G.I. chip AY38500 TV game chip for $29.95, so I sent them a check one week ago today. Lo and behold, today in my mail was a package from them.

I feel that such service should not go by without your knowing about it. I feel that these people should be put on your list of good advertisers.

Raymond J. Keefe
Montclair NJ

Briefs

from page 118

"Citizens Amateur Radio Service"; RM-2770, to legalize the use of any emission mode on any amateur frequency; RM-2771, to permit the use of ASCII on the ham bands; RM-2774, which would set up temporary licensing; RM-2775, to expand the operating privileges of Novices and Technicians; RM-2776, to create a new Special Radio Service on 11 meters; and RM-2780, aimed at revamping logging requirements for repeaters.

AMSAT is looking for money and volunteers in order to continue the amateur satellite program. A spokesman at their Washington office told *73* that the ten dollar annual dues of the approximately 3000 members is not nearly enough to keep the program going.

Two satellites are currently awaiting funds to finish their construction. The AOD satellite, which will probably become OSCAR 8, will feature 2 meter to 432 MHz and 10 meter transponders, as well as microprocessor control. The 144-432 transponder was built by the Japanese AMSAT group and the structure by a group of California members. Only the 2 to 10 meter transponder needs to be finished. It's being built at AMSAT Washington, with a projected launch date of September, 1977. An AMSAT spokesman said that if OSCAR 6 is still in operation at the time of the launch of OSCAR 8, OSCAR 6 will be put on "furlough" and will probably be used for educational purposes only. OSCAR 6 had an expected life of one year when it was launched in 1972 and is still going strong.

The AMSAT Phase III satellite has a projected launch date sometime in 1979. Its higher orbit would make contacts possible over a 15 thousand mile range, rather than the current 5000 mile limit.

Because of the new equipment in both satellites, higher power solar cells will be needed. AMSAT is suggesting that contributors send ten dollars to buy a single cell (or more if possible). Although how to acknowledge the contribution has not been decided, it's expected the contributor would receive a certificate of some kind.

AMSAT is also attempting to put together a group of volunteers to approach foundations and corporations for larger contributions, since they doubt individual contributions will be enough to keep the program going.

Volunteers, ideas, and contributions are needed to keep the amateur satellite program operational over the next few years. Contact AMSAT, Box 27, Washington DC. The phone number is 202-488-8649.

Harrisburg hams have four repeaters on the air. Central Pennsylvania Repeater Association has just added a 220 MHz machine to a 450 MHz machine, a two meter teletype machine, and the well-known 16/76 repeater. The teletype machine is on 147.975/.375 MHz. Services worth hearing from the RTTY repeater at Harrisburg include ARRL bulletins every day, detailed radio propagation reports from NBS and ARRL, National Weather Service condition reports and forecasts for the East Coast and the world daily, plus the Yellow Sheet. (Yellow Sheet is a daily listing of all amateur gear for sale to amateurs in their area.) *Newsletter* of the Nittany Amateur Radio Club, State College PA.

The FCC has shut down its Canadaigua Monitoring Station, replacing it with a Limited Enforcement Office (LEO). HF monitoring and related direction finding will be terminated, with inspections, investigations, and VHF/UHF monitoring throughout NY and CT taking their place under a much reduced staff arrangement. *RaRa Rag*, Bulletin of the Rochester Amateur Radio Association, NY.

An Indianapolis IN federal court has convicted a CBer on six of nine obscenity counts. He was charged with use of profane and indecent language on CB. The *Indianapolis Star* called the case a landmark decision, after a two week trial. Thanks to *The Radiop's Log*, Bulletin of the Westpark Radiops, Cleveland OH.

Using an FCC computer, Texas amateurs recently caught a pair of bootleggers. FCC officials caught up with them within two hours, and federal charges followed.

It's called "Amigos de las Americas" . . . a social service organization devoted to helping the people of South America. The Amigos have conducted immunization, dental, and ophthalmological programs for some twelve years, using amateur radio for communications with their stateside headquarters. If you're looking for something to do this summer, and can pay your own transportation (about $700 round trip) and expenses, contact the Amigos representatives in Houston TX at 713-481-2502 or 713-526-2771. Those who apply should hold Technician class or better, and be prepared to keep daily schedules with Houston plus inter-

staff communications, using either Amigos equipment or their own. The hams will be free to work DX or sightsee during off-hours. Stateside monitors are also needed 24 hours daily on 15, 20, and 40 meters. Countries participating during summer '77 include: Guatemala, Honduras, Nicaragua, Costa Rica, Ecuador, Bolivia, Paraguay, and Dominican Republic.

W1AW should have an improved signal soon. Construction is due to start on a 120' tower with stacked 4 element yagis for twenty and a 3 element yagi for forty. They look for a 10 dB improvement on forty and a bit less on twenty. *West Coast DX Bulletin.*

73 Publisher Wayne Green W2NSD is appearing weeknights on Boston's WGBH-TV. Wayne is a regular on Club 44, a show about leisure time activities. Subjects Wayne will cover range from ham radio (of course) to horseback riding and sports car rallying, along with microprocessors, CB, and more. That's Monday through Friday on channel 44 in Boston at 7:30 pm local time.

Edgecomb, Inc. of Torrance CA says it will produce the first microprocessor controlled 2m synthesized radio by spring. Company spokesman Ed Jay K6LOM (Signal 1-Multi 5000) says the rig will measure 2½ x 5½ inches, with 25 Watts output, programmable PL, scanner for priority channels, LEDs for frequency readout and decoding of repeater IDs, all for an expected list price of less than $500. According to Jay, the Edgecomb uses a 2901 chip (four bit slice) and will be available sometime this spring.

73 Advertising Director Bill Edwards WB6BED is expected back in his Peterborough office early in the new year, after suffering a mild heart attack. Bill recuperated at home, working part time out of his newly built ham shack. WB6BED can be expected to pack quite a signal from his Hillsborough diggings, especially on 40 and 20 meters.

Universal Subaudible Access Tone concept gains acceptance as the Chicago FM Club endorses the principle. This was first suggested on a broad scale by the Ohio Area Repeater Council, it seems, when the former president (Bill Mengel WA8PIA) of OARC placed the proposal before that body while in session at Delaware OH a couple of years ago. Subsequently, it was the subject of discussion at an FM forum during the Dayton Hamvention and has since been receiving attention in many areas. Briefly, the proposal advocates that guarded repeaters using subaudible tone for access (that are still "open" repeaters) provide a second tone access of 100.0 Hertz for use by transients running mobile and/or hand-held units. For example, Cincinnati repeaters using tone guard of 123.0 Hz would also install a decoder on 100.0 for travelers going through to access the system. It will, of course, require cooperation from those few systems now using 100.0 Hertz tone access to adopt a different tone as primary. Like all new concepts, it will be subjected to considerable discussion, but with the almost uncontrolled growth of repeaters, tone access is becoming an issue of major concern to repeater operators in populous areas. So, as tone access grows, the desire for a universal tone access for transients gains proponents. Lake Erie ARA *Newsletter*, Lakewood OH.

The FCC has made official a long held, but practically secret, policy on Novice license exam procedures. Under an order in later November '76, volunteer examiners can request up to five tests without first sending proof of an applicant's code proficiency. The FCC is apparently experimenting with the new procedure in the face of rapidly increasing Novice applications, because the rule will expire June 30, 1977. Address your requests for exams to FCC, PO Box 1020, Gettysburg PA 17325. FCC officials had informed *73* of the procedure, but requested we not publish news of it, fearing mass confusion would result in Gettysburg. The official notice arrived a week later.

New Products

from page 20

condition in a matter of a few seconds. I just pop the magnetic mounts in the trunk.

One unique antenna in the line merits mention. The PO-150 is a 144-174 MHz 5/8 wave that is designed for use *without* a ground plane. It fits a standard PL-259 socket and works wonders on an HT as a replacement for the rubber duckie. These are useful for non-metallic vehicles such as boats, recreation vehicles, and Corvettes. A conversion kit can be ordered to adapt it to base use by the addition of radials.

The 50 and 144 MHz models handle 200 Watts of power, while the 440 MHz model handles 150 Watts. Base coils are coated with epoxy for full weatherproofing. These antennas are made for full-time use and should last longer than the car. All are covered by an unconditional six month guarantee.

Larsen says that you can hear the difference with their antennas. I tend to agree. Their high quality products are unique and dependable. The Larsen should be the last mobile antenna you'll ever have to buy.

Depending upon the mount and whip, Larsen antennas sell over a large range of prices. For example, a quarter wave permanent mount sells for $8.50, while a 5/8 wave with a magnetic mount retails for $38.55. *Larsen Electronics Inc., 11611 NE 50th Ave., PO Box 1686, Vancouver WA 98663.*

Stan Miastkowski WA1UMV
Associate Editor

TURNER HL6 MICROPHONE

Iowa-Turner Division of Conrac Corporation announces the availability of the Amateur HL6 microphone. This microphone has been designed specifically for the radio amateur who wants superior performance from a cardioid microphone, especially when vox is employed.

The Amateur HL6 has the capability of high or low impedance by selection on a slide switch inside the microphone. This fact, plus universal six wire switching, allows the Amateur HL6 to be easily installed with virtually all models of transceivers.

The Amateur HL6 has a flat frequency response from 50 to 13,000 Hz, which allows maximum speech intelligibility with a reduction of local noise interference. *Turner Division, Conrac Corporation, 716 Oakland Road NE, Cedar Rapids IA 52402.*

EICO IC SWEEP/FUNCTION GENERATOR

EICO, long a pioneer in the field of electronic test equipment, has introduced its new Model 390 Sweep/Function Generator.

In announcing the Model 390, Harry R. Ashley, President of EICO, stated, "It has long been EICO's policy to provide the professional technician and the home hobbyist with reliable test equipment at a moderate cost. By using the latest IC technology, we were able to develop a new breed of instrument which will rapidly overtake in popularity the traditional audio signal generator. This new .2 Hz to 200 kHz instrument is the practical answer to many of the signal source needs of design labs, schools, audio repair shops and hobbyists."

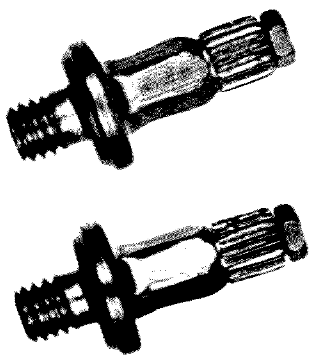
The Model 390 generates discrete sine, square, and triangle waveforms over the very broad frequency range of .2 Hz to 200 kHz, more than enough for the most exacting work. And, what's more, at the flick of a switch, you can have a choice of either linear or logarithmic sweep with a choice of slow, medium, or fast rates.

With its 50 Ohm output impedance and complete attenuation controls, the Model 390 can handle everything from checking the response of an audio amplifier to driving digital circuits, and with its low frequency triangle output, even driving servo systems! *EICO Electronic Instrument Incorporated, 283 Malta Street, Brooklyn NY 11207.*

GOLD LINE TERMINAL STUD KIT

A new Terminal Stud Kit for two way communications has been introduced by Gold Line Connector.

A Gold Line spokesman says the new kit (the #1105) was designed for batteries with side mounted terminals and that it provides the necessary connecting hardware for those direct-to-battery applications where standard battery studs do not. The 1105 lets you hook up communications equipment, tape players or automobile tune-up instruments easily. *Gold Line Connector, PO Box 893, East Norwalk CT 06855.*



SWITCHCRAFT ACQUIRED BY RAYTHEON

Plans for the acquisition of Switchcraft, Inc. by the Raytheon Company, Lexington MA, have been completed, according to a recent announcement by the two companies.

Upon completion of the acquisition early in 1977, Switchcraft will become a wholly owned subsidiary of Raytheon. Wilfred L. Larson, president of Switchcraft, who founded the company with Fred and William Dumke in 1946, will continue as president.

Larson said that "Switchcraft will maintain its program of marketing its products to electronic distributors and manufacturers through the independent sales representatives who have contributed to our company's success over the years.

"The new association with Raytheon is a big step forward for Switchcraft. It brings us the opportunity and means to expand our manufacturing facilities, which has become necessary to meet growing customer demands for our products. Also, we foresee the introduction of a number of new products to fulfill new customer needs." *Switchcraft, 5555 North Elston Ave., Chicago IL 60630.*

I/O EDITORIAL

from page 68

came out to an average of $2032 per . . . about what your shopping list will indicate. If that seems like a lot of money to you, then it is probably time for you to think seriously in terms of making your hobby pay off . . . perhaps by writing articles for one of the ham magazines. Ahem.

By way of throwing some further rocks in your path, I think you probably should not know that most of the fellows with going computer systems are planning to spend a bit more on them this coming year. Hold tight . . . the estimate of planned spending is also right around $2000. I suspect that those with running systems are now convinced that they really want to have a floppy disk to go with their machine . . . or perhaps a dual floppy. If you do decide to go the floppy route, be sure to check on the programs available . . . the disk and disk controller are the easy part; you still need a good disk operating system (DOS) and without it you are again up aforesaid creek. I know where you can buy a multimegabyte disk system, complete with an Altair compatible controller, for a few hundred dollars. All you have to do is write your own DOS . . . I forget how many man years IBM spent on a DOS recently.

We'll be having more and more ham oriented operating systems in *73*. If you've worked up any, please send them in for all of us to enjoy. You'll have to read *KB* for most of the non-ham programs . . . and we'll have a lot of them.

While the above probably has not galvanized you into anything but inaction, I did think I should level with you as to the honest state of the field of microcomputers. On the positive side, I'm in touch with thousands of computer hobbyists and they are having the time of their lives. A surprising percentage of them are hams and you can bet they will be doing a lot of ham stuff via microprocessor. Sit tight if you want, but you are missing out on fun. These are days that will never come again and those who are there will never regret it.

Corrections

A correction for my article "Superprobe," in the Holiday issue, on page 92 and 93. Resistor R9 is shown incorrectly installed from pin 3 of IC2 to ground, and should be moved to the other side of the capacitor C3, or from pin 5 of IC2 to ground. If wired as shown, the symptom will be that the pulse LED will remain lit at all times.

C. W. Andreasen WA6JMM
Van Nuys CA

In "Mobile Smokey Detector" (Holiday *73*, page 32), it was stated that since power levels are below 100 mW, it might not be necessary to have a ham license to operate in the 10.5 GHz band. This was incorrect. The band requires a license for any power.

The CT7001 IC described in December's "CT7001 Clockbuster" is no longer available from Cal-Tex Semiconductor. Fairchild Semiconductor is manufacturing the IC under the designation FCM7001. They are available from *James Electronics, 1021 Howard Avenue, San Carlos CA 94070* for $7.00.

Our apologies for failing to mention that the author of "A 60 Foot Antenna on a 20 Foot Lot" (Holiday issue, 1976, p. 138) was Norman Rossignol WB6DPR. The editors extend their apologies for the error. The article first appeared in *World Radio News*, January, 1976.

Please be kind enough to publish the following correction and addition to my February, 1976, article "Put Your SB-10 on 160m."

Because of the inexactness of the method of extrapolation I used, the value of the phase shift capacitors that I stated to be 1240 pF should be corrected to 1744 pF. Since 50 Ohm phase shift resistors are used to produce 45 + 45 = 90 degrees shift the following formulas may be used to calculate the phase shift capacitors:

$$X_c = 50 \text{ Ohms} = \frac{1}{2\pi FC} = \frac{1}{(6.28)(1.825)(10^6)C}$$

$$C_{pF} = C_F(10^{12}) = \frac{(1)(10^{12})}{(6.28)(1.825)(10^6)(50)} = 1744 \text{ pF}$$

The use of 1744 pF capacitors will result in maximum SB suppression in the SB-10. In addition, one should add a 50 pF capacitor is parallel with the output connector on the unit to resonate the SB-10 output as a pi network. As Leeds Radio Co. no longer supplies these capacitors, they may now be obtained from Cap Electronics, 134 Duane St., New York NY 10013.

Arthur Eckman WA2ECI
New York NY

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	7A	14	14
ARGENTINA	14	7	7B	7	7	7	14	14	14	14	14A	14
AUSTRALIA	14	7B	7B	7B	7B	7	3A	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7A	14	14	21	14	14
ENGLAND	7	3A	3	3B	3B	7	7A	14	14	14	7A	7
HAWAII	14	7B	7	7	7	7	3A	3A	7B	14	14A	14
INDIA	7	7	7	3B	3B	3B	7A	14	7A	7B	7	7
JAPAN	14	7B	7B	3B	3B	3	3	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14	14A	14	14
PHILIPPINES	14	7B	7B	7B	7B	3B	7	7	7	7B	7B	7A
PUERTO RICO	7	7	7	7	3A	3A	14	14	14	14	14	14
SOUTH AFRICA	7A	7	7	7	7B	7B	14	14	21	14A	14	14
U. S. S. R.	7	7	3	3	7	7	7B	14	14	7B	7B	7
WEST COAST	14	7	7	7	7	7	7	7A	14	14	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	7A	7B	7	7	7	7	14	14	14	14A	14
AUSTRALIA	14A	14	7B	7B	7	7	7	7	7A	7A	14	14
CANAL ZONE	14	7A	7	7	7	7	7	14	14	21	14A	14
ENGLAND	7	3A	3	3B	3B	3B	7	7A	14	14	7B	7
HAWAII	14A	14	7	7	7	7	7	3A	7	14	14	14A
INDIA	7	7	7B	3B	3B	3B	3B	7A	7A	7	7	7B
JAPAN	14	7A	7B	3B	3	3	3	3	7	7	7B	14
MEXICO	14	7	7	3	3A	3	3	7	14	14	14	14
PHILIPPINES	14	14	7B	7B	3B	3B	3	7	7	7	7B	7A
PUERTO RICO	14	7	7	7	7	7	7	14	14	14A	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	14	14A	14	14
U. S. S. R.	7	3	3	3	7	7	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	7A	14	14
ARGENTINA	14	14	7B	7	7	7	7B	7B	14	14	14	14A
AUSTRALIA	21	14A	14	7B	7	7	7	3B	7	7A	14	14
CANAL ZONE	14	14	7	7	7	7	7	7A	14	21	14A	14
ENGLAND	7	3	3	3B	3B	3B	3	7	14	14	7B	7B
HAWAII	21	14A	14	7	7	7	7	3A	7	14	14	14A
INDIA	7B	14	7B	3B	3B	3B	3B	3A	7	7	7	7B
JAPAN	14	14	7B	7B	3	3	3	3	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7	14	14	14A	14
PHILIPPINES	14	14	7A	7	3B	7B	7B	3	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14A	14A	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7B	14	14A	14	14
U. S. S. R.	7	3	3	3	3	7	7	7A	7A	7	7B	7B
EAST COAST	14	7	7	7	7	7	7	7A	14	14	7A	14

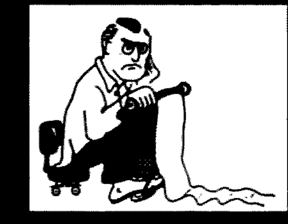
A = Next higher frequency also may be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

FEBRUARY

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1 F	2 P	3 P	4 F	5 G
6 G	7 F	8 F	9 P	10 G	11 G	12 G
13 F	14 G	15 G	16 G	17 G	18 G	19 G
20 G	21 G	22 G	23 F	24 P	25 F	26 F
27 G	28 G					

73 AMATEUR RADIO

MARCH 1977
$2.00



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

Since one of the basic reasons for the amateur "service" is the pioneering and inventing we do (97.1b), the FCC is going against its own rules when it prevents amateur experimenting and pioneering. Why doesn't some national club haul the FCC into court and force them to obey their own rules?

The FCC has a long history of making it somewhere between difficult and impossible for amateurs to live up to 97.1b. Their recent refusal to permit experimenting with ASCII on the low bands, using as an excuse the bandwidth docket which is under consideration, is a typical example. Here we have a docket which the FCC admits can take several years to conclude and it is used as a reason for preventing the development of amateur techniques. Many FCC rulemaking procedures take from three to five years to complete, and amateur radio just cannot afford to move at such a snail's pace.

This is no worse than the excuses used in the past to prevent amateur experimenting . . . for years the FCC refused to allow amateurs to use any mode of emission which their monitoring stations were not set up to copy. Amateurs were held back for years in RTTY developments as a result of this restriction.

If the FCC has no real intention of permitting amateurs to live up to the rules as written, then they should at least be honest about it and delete 97.1b from the regulations . . . and they should explain to us why they have deleted this.

When you consider what amateurs have been able to do, despite the efforts of the FCC to smother the ham creative urge, it is a miracle. I wonder what might have developed if we hadn't had to fight the FCC every inch of the way?

I'm exaggerating, you say? Take a look at the way repeaters developed before the FCC got into the act. We had things really moving along . . . with a repeater network up and working on a daily basis where a chap could talk from San Diego to Phoenix to San Francisco. I stood on a street corner in Las Vegas a few years ago and talked with a chap in San Diego, one in Los Angeles, and one in Phoenix in a round table. The FCC outlawed this, as they did crossband . . . for instance, we added ten meters and the repeater users were able to talk from an HT via two meters with amateurs all around South America. I set up another repeater for 2m-20m work and worked DX while walking anywhere around town with an HT.

More and more repeater groups were expanding the services of their systems . . . some to six meters, some to 220 MHz, some to 450 MHz. All this got stopped when the repeater regulations were made into law . . . and the result has been a serious drop in the activity on both 6m and 220 MHz. How can we get the FCC to leave us alone so we can try different systems . . . invent new modes . . . and pioneer new ideas?

For a while, after the January, 1974, hearing before the Commissioners, it looked as if the Commission was going to try to turn over a new leaf and ease up on the restrictive amateur regulations. They have, to some degree, followed through with this, but they've hardly made the amateur service an example of deregulation.

The FCC might work on the basis of permitting experimentation during discussions of rule changes rather than prohibiting it. If they eventually prohibit a certain mode, then we would have to stop using it. This would be better than waiting three to five years to even start experimenting.

Speaking of the bandwidth docket, perhaps we would do better if we convinced the FCC to do their deregulation bit by bit instead of in big lumps. One of the major problems with this docket was the tying in of killing amplitude modulation with a lot of desirable changes. Amateurs don't like AM much on the low bands, but they are not completely convinced that it should be killed off by fiat. This could prevent experimentation with double sideband techniques, and these hold great promise for better band densities with less interference than anything in view for single sideband. If we can get five times as many stations in a band with less interference than we're suffering with SSB, why should we prohibit experimentation? Synchronous detection may turn out to be one of the great undeveloped fields of amateur radio. Or it may not . . . but should one for me. The next time you see your ARRL director or write him, ask that he get the League to work in the same direction . . . and make sure he lets you know what is happening.

BASIS AND PURPOSE: THWARTED?

While rereading the FCC regulations for the umpteenth time — it was during some work in cooperation with the FCC on a project to update the ham exams — I got to thinking about the meaning of the first paragraph, 97.1 Basis and Purpose. The language is so muddled and exact interpretation is impossible — a strategem used by government bureaus which permits their continued growth, while providing good flank protection.

The proposed Novice exam material seemed to be a bit scant as far as the basis and purpose of amateur radio was concerned. It had boiled the five parts of 97.1 down to three, so I looked at the rules to see what had been omitted. Two parts had been left out. One turned out to be 97.1e, the enhancement of international goodwill. I was sort of sorry to see that on the way out — perhaps it was an oversight — or maybe it didn't seem all that important anymore to the FCC.

The other omitted part of 97.1 was a legitimate deletion. The actual intent of 97.1 is to define the basis and purposes of the *rules*, not of the amateur service, but since four of the five parts of the paragraph apply to both, 97.1 itself has come to be thought of as being a statement of the basis and purpose of amateur radio. This part is most significant in the light of recent rule changes and proposals for rule changes. 97.1c states that the purpose of the regulations is for the "encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both communication and technical phases of the art."

That seems simple on the face of it. Yet, as the ONLY rule applying solely to the purpose of the rules themselves, it would seem that it should have a binding effect on the Amateur Division of the Commission when they are preparing new regulations for enactment.

The rules then should encourage

recent major rules changes from this viewpoint.

The "incentive licensing" rules: In what way did they contribute to the advancement of communications or technical pioneering? The taking away of band segments to force amateurs to go back for a new license exam would not seem to be even remotely relevant to either. The Commission apparently got carried away with doing the bidding of the ARRL, even though it was inconsistent with the basic mandate laid down by its own rules.

The repeater docket was most restrictive to those interested in pioneering and technical experimentation. We've been promised that the most severely restrictive aspects of the docket will be modified, but still we had a good example of the Commission going directly against its most basic basis and purpose, as stated in 97.1c.

How about recent dockets? How much of the change proposed in the rules can be justified as being consistent with the mandate of 97.1c? What changes will encourage the development of communications skills? Will any parts of it encourage technical developments or the pioneering of new techniques? Let's really look closely at the dockets with these basic guidelines in mind and include this in our comments we file with the Commission – with 14 copies.

Is the taking away of RTTY and other such privileges from the General class and Tech licensees consistent with 97.1c? Will the goal of having them be relicensed as Advanced or Experimenter class licensees in any way be consistent with 97.1c? It is possible that the Amateur Division of the Commission has gotten its sights askew and is aiming us at some goal not specified by 97.1, and it is difficult to see how forcing us to pass more and more advanced FCC exams for higher classes of license is consistent with any of the parts of 97.1, though it is easy to see how it is quite *inconsistent* with 97.1c.

One of the reasons for proposed rule changes has to do with getting more amateurs. This is a good goal, undoubtedly, but it is in no way consistent with 97.1 – there is nothing whatever in there about getting more amateurs. Another purpose has been to get away from the problems of faked mail order licenses. This, too, is probably a good goal, but difficult to justify under 97.1 . . . particularly since there has been no real evidence that the problems involved are serious enough to warrant an enormous upheaval.

Since 97.1c says the rules should provide for enhancing communications skills, we must ask how putting restrictions on the use of a license work in this direction. The more restrictions there are, the less communications skills are going to be enhanced . . . right?

COMMUNICATIONS SKILLS

What amateur activities are best for developing communications skills? Just about any on-the-air activity, possibly with the exception of plain

old rag chewing, might be considered beneficial in skill developing.

Sending and receiving CW is a skill. Rapid typing on RTTY is a skill. Finding Oscar and making contacts takes skill. Sorting out the pileups to get a rare one on either phone or CW takes a good deal of skill. Contests sort out the unskilled in short order.

What in our recent rule changes has been added which would tend to encourage the development of skills? Do we do better to require someone to take an exam and prove he knows the theory of SSTV before we let him get on the air and operate with it? This is part of what we're doing with Docket 20282, and it seems like nonsense to me.

If we want people to develop skills in working with SSTV, we want to first of all remove as many obstacles as possible that are preventing them from developing these skills. We want to get them on the air with SSTV as quickly as possible, then they'll have the incentive to learn and be in touch with the people who can teach them. I didn't know beans about SSTV when I went on the first time.

I knew even less about RTTY the first time I got on the air on that mode, but my interest was stirred and I soon learned all I could. RTTY was so much fun that I had to know more, to build equipment and to get on more bands. We were stuck up on 2m and 11m in those days and FSK was illegal on the low bands. I got on 80m just sending mark signals and had a ball. We put an RTTY repeater on 2m in 1948.

Communications skills will best be developed, I think, if we keep the restrictions to a minimum and encourage new modes, new ideas, and the fun of it all. One thing is for sure, and I doubt if I will get any disagreement on this: The one single aspect of amateur radio that is just about the *least* fun is taking an FCC exam.

TECHNICAL SKILLS

The more the FCC can do to encourage amateurs to experiment and develop new ideas, the more value the amateur service will have — and this is consistent with 97.1c. Just look at recent technical developments: Amateur pioneers are hard at work with incredible circuits for SSTV, digital timers for Oscar alerts, Morse code to RTTY converters and vice versa, synthesizers for everything, computer applications for amateurs, sophisticated repeater controls — the list is almost endless . . . just look over the articles in *73*.

Instead of making these developments more difficult and hamstringing us (pardon), the FCC should be fanning the flames of interest and enthusiasm. They should be coming out with rules which would continue to remove more and more of the restrictions so we can work with pulse technology — with telemetry — and all the other far out ideas which might prove valuable if pioneered.

We have plenty of band room for new ideas. Why have we been prevented from having repeaters on ten meters when the band is virtually dead? Why are we so restricted on six meters when that band is a wasteland? Look at the restrictions they put on 220 MHz . . . and for what? No sooner did amateur repeater groups agree on standards for repeaters than the FCC shot them down with subband allocations. Insane! Has the FCC *ever* had any success in trying to read its crystal ball? And yet, this is what was going on . . . they divided up a totally unused band on the basis of what might someday happen, provided there were no unforeseen technical developments . . . and that is one thing you can depend on . . . amateurs will come up with unforeseen technical developments.

Just take a look at the 146-148 MHz band . . . in the early 60's that was and had been virtually deserted for almost 20 years. Loud voices were asking that it be turned over to CB. Then came repeaters, and within a few years this unused band had more amateurs using it than any other ham band. Use expanded very rapidly until the FCC got into the act and passed rules which stopped its growth for a while . . . then, after the biggest battle in the history of the hobby, the FCC (Walker) backed down and FM began to grow again.

Let's try and keep the FCC from putting through more and more restrictions which interfere with amateur pioneering and the development of communications skills. Remind them of 97.1c every time they start to make life difficult for us.

CAN HAMS REALLY BE TRUSTED?

Though I know of nothing in the FCC regulations which specifies that amateurs be self-policing, the fact is that we have done a rather good job of this and we accept it as a responsibility . . . some more than others, unfortunately. I would like to see more amateurs be serious about this.

The major growth of FM repeaters on two meters was almost totally without FCC interference. The first reaction of amateurs to mutual repeater interference was one of frustration . . . then repeater wars . . . and finally the development of repeater coordinators and repeater councils. To me this whole thing was an excellent example of the true amateur spirit. Even the hottest of heads eventually were calmed down and brought around to a reasonable and cooperative solution to the problems.

It was this example that was laid before the FCC at the hearing before the Commission in January, 1974 . . . a hearing demanded by the amateurs and ignored by the ARRL. On the strength of this proof of amateur responsibility, the ball was put in motion to deregulate us. This has resulted in a reduction of about 25% of the rules so far, and a lot more deregulation is under consideration. These things are monuments to the trust and foresight of FCC Chairman John Wiley, Charlie Higginbotham and Johnny Johnston.

The repeater problem wasn't the first instance of good amateur cooperation by any means. Whenever emergencies come along, amateurs drop their differences (which are many . . . like any other mixed group) and cooperate. And older timers will remember the "gentleman's agreement" as far as sideband was concerned on twenty meters. With very few exceptions, amateurs turned out to be gentlemen and virtually all sidebanders kept to the high end of the band, with the AM on the lower end of the band . . . and this despite the fact that there was little DX to be worked from the high end . . . it was all on the low end.

It is my impression that amateurs are perfectly capable of making gentlemen's agreements . . . and keeping them. Some of our self-proclaimed policemen aren't as subtle as we might like, but I'd rather have a nerd rattle the chain than no one at all. When you hear things going wrong, for heaven's sake speak up and see if you can pour some oil on troubled waters. It may be a guy with his mike up too high . . . a chap who got his switches backwards and is calling in the DX band and listening in the U.S. band . . . or someone stretching the bounds of decency on any band.

The fact that many amateurs have the feeling that they only have to watch out for FCC monitoring stations does not help matters. The FCC would do us a big favor if they were to announce that they would no longer issue citations for infractions of the rules, for this would forcibly make all amateurs aware that it is the responsibility of every amateur to uphold the honor and reputation of the group. I think we would very quickly be rid of the unspeakable garbage a few 75m AMers are putting out . . . and the disgusting behavior on a few Los Angeles repeaters. Even CBers wouldn't put up with rot like that!

The frequency coordinators for repeaters have been particularly protective of non-repeater interests, oddly enough. Most of them bend over backwards to make sure that repeater groups stay out of the way of all the other users of the VHF bands . . . AM, SSB, RTTY, Oscar, Moonbounce, DXing, meteor scatter, ATV, etc. We seem to be in much better hands when we are governing ourselves than when we are depending on the FCC . . . and the action sure is a lot faster. Many FCC actions are sped along from proposal to rule making in *only* four or five years, while some drag on for eight or ten. This is a real drag for amateur radio, since most of our significant developments sweep in and are accepted by us way before the FCC can get organized to cope with it rulewise.

The FCC reaction to repeaters was a good example of their fast work . . . by the time they got around to screwing up the works (royally), repeaters were too big a deal to get killed off. Obviously the FCC does not read its own rules . . . as I have written earlier . . . where they are supposed to encourage amateurs to pioneer and invent. Even in 97.3a they define the amateur radio service as "a radio communication service of self-training, intercommunication, and technical investigation carried on by amateur radio operators." Note that technical investigation part and ask any old-timer how many times the FCC has done just about everything in its power to stall same.

Amateurs, left to their own ends, might come up with even more fantastic developments than they have already . . . and, in case you've forgotten, chalk up FM, NBFM, SSB, and SSTV (so what else is there?) all to amateur inventing and pioneering. For years the FCC prohibited any amateur transmissions which could not be copied by all FCC monitoring stations . . . how about that for locking the door on developments? If we were permitted to be our own bosses, and I don't mean via ARRL, I think we could set up our own system for coping with the needs of progress . . . and on a speed which would be more geared to reality.

Why did I single out ARRL there? Their record on repeaters is typical . . . and a model of what service we get from them. They tried to ignore FM and repeaters for years . . . then, when it could no longer be ignored, they tried to step in and take control. Their recent ARRL band plan for the repeaters has battles going on all around the country because it is so out of touch with reality. ARRL is great for what it is designed for: radio relays. Their traffic system is fine and a service of which to be proud. Their record in other areas is execrable.

If we can't get quick action from the FCC on our needs . . . and we can't depend on the ARRL, what can we do? To whom can we turn for help?

How about starting with our repeater councils . . . we have them spread all around the country and they are already responsive to the will of the grass roots via representatives from the repeaters they serve. We might set up a yearly meeting (or every other year) where each council would field two representatives to decide upon the "gentlemen's agreements" for the next year or two. This would give us speed and responsiveness. It would keep the cost down, too, since there might be only about forty or so repeater councils involved.

On the other hand we might do better with a week-long national convention where the delegates were sent by interested clubs. This activity could become a major activity of most ham clubs . . . in which case we could have a couple thousand delegates getting into the act . . . probably every two years. That would be a truly democratic system.

When you stop to think about it, a structure starting with the local clubs expressing their views to a council of clubs makes a lot of sense. And a group of 80 delegates might get a lot more work done in a shorter time than 2000. The ITU system of breaking problems into separate committees for discussion gets things done quickly . . . then the committees bring their recommendations to the whole group for ratification.

In order for the actions of a conference such as this to have any validity, we would need a mandate

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BE MY GUEST

visiting views from around the globe

C'mone Texas Salt Rat...

The scene is a Washington cocktail party at the home of an influential congressman. Guests from government and business are milling about, socializing and discussing the issues of the day or whatever. Suddenly the low volume of a local dinner music FM station is shattered by the deafening roar of undemodulated single sideband: "Come on Texas Salt Rat . . . this is the Maryland Grease Monkey . . . you got a copy?" Two blocks from the congressman's home, a CBer, operating illegally out of band with a broadband linear amplifier, strains his ears against the static, then starts to call again: "C'mone TEXAS. Ya got this here MARYLAND state . . . MARYLAND . . . MARYLAND . . . MARYLAND, C'MONE?"

The cocktail party, by this point, has shifted gears from the issues of the day or whatever to "those damn CBers," or worse, "those damn hams." The congressman, highly irritated, is on the phone by the time our CB friend cranks up the power for call number three, calling an aide to FCC Chairman Richard Wiley. "The folks back home have been writing me about this damn interference," he tells the aide, "and it's high time you guys got over here and did something about it!"

Needless to say, the congressman and a large number of his Capitol Hill colleagues have begun to put the wood to the FCC. When congressmen talk, the FCC listens. And what the FCC has been hearing a great deal of lately are interference complaints. In fact, last April the FCC stopped counting them after passing the 100 thousand mark. The axe is about to fall, and amateurs everywhere better be sure they're not in the way, because it is much later than most of us think.

Meeting room #6 at the Hotel Sahara's Convention Space Center in Las Vegas: Thirty ham radio equipment manufacturers, worried over press reports of an impending linear ban and type certification of ham gear, meet with FCC representative Dick Everett. They learn a proposed rule making is on Chairman Wiley's desk — in general, it would ban the manufacture and sale of linears capable of 24 to 35 MHz operation and force type acceptance. It is the eleventh hour, and ham radio has no lobby in Washington (ARRL can't lobby due to its non-profit status). The organizers of the SAROC meeting (Dentron's Dennis Had and Bob Levine) suggest formation of a manufacturers association, and the group is founded. It's called ARMA, the Amateur Radio Manufacturers Association.

ARMA was formed to encourage high standards and ethics in the ham radio industry, to promote the general growth and welfare of amateur radio, to work toward favorable rule making and legislation for the benefit of amateur radio, to function as liaison between the manufacturers and the FCC, to encourage public relations functions for the industry, and to collect and disseminate market information to the members. Two classes of membership were set up: full membership for domestic manufacturers and importers, and associate membership for publishing organizations, dealers, and other interested parties. The list of organizers reads like a "who's who" of the ham radio business.

The week after Las Vegas, ARMA sent a four man committee to Washington. They were able to see several FCC Commissioners, Senator Barry Goldwater, FCC Chief Engineer Ray Spence, and Enforcement Chief Richard Smith. One of the committee members, Marv Druskoff (VHF Engineering), described their greeting at FCC headquarters this way: "They wanted to know where we'd been, where we were when they needed us." The committee learned that the linear ban proposal had been written by two FCC staffers, without the benefit of outside ham help. Few specifics could be learned about the proposal because it had gone so far along in the FCC hopper, rushed through, in fact, in face of increasing complaints from Capitol Hill and pressure from the all-powerful broadcasting lobby. The broadcasters, ARMA learned, were worried about lost revenue as TV viewers switched to channels not affected by the CB interference. The TV lobby, Senator Barry Goldwater K7UGA told the committee, is so strong that it has twice managed rejection of his bills aimed at forcing built-in high pass filters and better shielding of TV receivers. Senator Goldwater assured the ARMA committee he'd try again, and support them in every way possible.

Back at the FCC, the committee members were hard at work trying to win delay of the linear amplifier ban, in hopes of suggesting engineering solutions. "We're working on the idea of pre-filtering with an 8 pole filter to eliminate 27 MHz," says Dentron's Dennis Had. "If disconnected it would have to totally disable the amplifier, because the FCC won't stand for any more easily clipped jumper wires." At deadline, engineers in Ohio, Pennsylvania, and California were working on such a system, along with several other ideas, but the question of a delay rested with the full FCC, which was scheduled to meet on the subject January 26th.

In Had's words, "We told them they'd waited two years, so why not put it off another 45 days?" ARMA was also working on point of sale control to prevent non-licensed people from buying equipment. Had says such controls would have to have regulatory backing to avoid problems with the Federal Trade Commission. (The manufacturers, by refusing to sell gear to offending dealers, could open themselves to legal action without federal backing.) Had told *73* he was optimistic, but realistic, on delaying the linear ban. As he put it, "It may have gone too far before we got there."

At best then, the notice of proposed rule making on the linear ban may turn out to be more general then it would have been if ARMA didn't get to the FCC when it did. The rub is that the manufacturers are afraid the FCC will bow to the Capitol Hill and broadcasting industry pressure . . . and make a move designed to be expedient, a move that could really hurt ham radio in the future. That, by every measure we could find in preparing this report, is not the FCC's intention. As one member of the ARMA committee put it, "They've got a problem and they need a solution . . . and they don't want to cripple the hams in solving it."

At the root of the interference problem is the FCC's placement of CB on the 11m band. It made it all too easy for amateur equipment to be used on CB, and the amazing growth of outlaw activity and the TVI-RFI problem is the result. ARMA members were told by high-placed FCC officials that the mistake would never happen again. Manufacturers have played their part as well. The smell of easy money has impaired the judgment of more than one company. The FCC, *73* has learned, has a list of the "pirate" manufacturers, but cannot stop them from making broadband amplifiers of questionable quality under the guise of 80 through 10 meter coverage. The "catch 22" is a loophole in the FCC's ban on broadband amps to allow for amateur coverage of 10 meters. Of course the quick buck manufacturers got around it by including bandswitching for 80 through 10 meters, switching that in most cases only cut power output down on all bands but 27 MHz! FCC tests have shown some pretty questionable engineering on the broadband amps, like tricks to build up forward power on built-in swr bridges (in one case pure ac was coupled into the circuit!). Another FCC amplifier test reportedly found power output in excess of 300 Watts, but when a 27 MHz filter was put across the output, the rf at 27 MHz was down to about 40 Watts! (It's not hard to understand where all those TVI complaints are coming from, is it?) The thing that really hurts on the FCC end is the placement of advertising (in *other* ham magazines) for these bootleg linears. In the absence of a viable ham radio lobby (like ARMA), the FCC really didn't have much choice but to plug the loophole, to ban linear amplifiers capable of 11 meters.

By the time this issue reaches you, a rule making proposal will probably be public. It could mean legitimate amateur amplifiers will stop at 15m, or traps will be built in to prevent operation on 11m. It will *not* stop hams from home brewing their own 10 meter amplifiers, and it won't outlaw existing equipment. It *will* require type certification of commercial amateur equipment, a burden the manufacturers have assumed for some time was on the way.

Okay, you're saying, a ban on newly manufactured linears covering 11m won't clear up the TVI mess . . . and you're right. But it will, argue FCC staffers, stunt the growth of out of band activity and power amps on the regular CB channels. The second step is education, using the same approach that's worked with ham radio — peer pressure and self-regulation. It may not be long before TV commercials and magazine ads begin pushing *legal* CB operation. Maybe a "Smokey the Bear" character warning CBers that the guys running amplifiers are only hurting everybody else since they mop up several channels at a time.

Another thing: A lot of the out of banders (and regular CBers as well) think of themselves as hams. They use a peculiar mix of ham and CB jargon in a format typical of our beloved (and often boring) QSO. When blindfolded, most of us would swear we were listening to 75m if it wasn't for an occasional "mercy sakes" or "come

on back." Listen for yourself both above and below the 11m band ... the typical SSB QSO covers the weather, equipment, antennas ... and sometimes several thousand miles. We still don't know if it was a joke or what, but the Post Office recently delivered a *Swiss* CB QSL addressed to a Peterborough CBer! (We still haven't found the CBer ...)

Fact is, it's those guys, with stations rivaling many amateur installations, who are the prime candidates for ham radio. Reaching them is the problem. The best way to do it is on the local level — include a welcome to CBers at your next auction or hamfest. Be sure all PR mentions a *local* address or phone number to find out more about ham radio. And don't forget the shopping centers — a good exhibit and a few friendly club members can go a long way. Another idea is to hand out back issues of your favorite ham magazine (and copies of the other ones, too). A lot of hams are doing it already, but I haven't heard of any clubs distributing magazines — if there are any interested, drop me a line.

So, in the midst of proposed bans on linear amplifiers above 24 MHz, type acceptance of ham gear, strong growth in the amateur ranks, and 40 channel CB, what's the future of ham radio? It *has* to be positive.

For one thing, there are the FCC assurances that CB allocations and ham bands will never be placed near enough together to cause the kind of problems we've seen on 11 meters. That's led to several sighs of relief regarding 220 MHz and Class E. (As reported last month, ARRL hopes to swap the 900 MHz WARC allocation for CB allocations at 220 MHz.) We've also heard of tests going on to determine how useful 900 MHz would be for CB, with interesting results. There is, of course, no skip, and coverage seems comparable to 27 MHz. It's only logical to see 900 MHz CB repeaters, complete with autopatch, in the future.

But what about 10 meters? Indications are that the loss of newly manufactured commercial amplifiers for 10m will not slow the band's growth. 28 MHz, according to sources both in industry and government, would have been opened to a new class of licensees months ago, if it wasn't for the tremendous volume of CB and ham applications coming into the Gettysburg computer facility. It all begins to fit together: multiple choice code exams, expansion of Technician and Novice class privileges, the dropping of "N" prefixes for Novices ... the Communicator class is just around the corner, and it looks like 10m will be added to the previously discussed 220 MHz allocation for Communicators. (In the same vein, the FCC would probably consider granting Technicians equal status on 10m.)

The implications of all this for ham radio are unclear. For one thing, there are too many variables to be sure Communicator class licenses will become a reality in the near future. For another, we don't know whether the 220 MHz for 900 MHz swap with the CB interests will work (that largely depends on those 900 MHz tests we mentioned). There is also the question of WARC, and the international situation (see *73* Special Report, February, 1977). The best assessment is probably Dennis Had's: "I'm optimistic but realistic." That's a good attitude for all of us.

Warren Elly WA1GUD
Associate Editor

RFI/TVI - An Analysis

Radio frequency and electromagnetic interference from a phenomenally growing number of sources, such as CB sets, consumer electronic devices, video games, computers, switching power supplies, ignition systems, and industrial, scientific, and medical equipment, has reached proportions beyond the effective control of the understaffed Federal Communications Commission.

The majority of complaints (87%) of interference to home electronic entertainment equipment involve CB transceivers. CB units have interfered with nearly every mobile and fixed communication service, including business, industrial, law enforcement, utilities, aircraft, and other public safety devices.

However, CB is not the only culprit, as garage-door-opener transmitters, industrial rf heating, medical diathermy equipment, community antenna television systems, super power FM stations, and auto ignition systems contribute their share of RFI. Compounding the RFI/EMI problem for the FCC is the appearance of millions of potential sources of interference from consumer devices such as video games, computers, switching power supplies, etc.

To combat this problem, the FCC has taken two steps, the first being the adoption of stricter regulations for RFI emitters like CB equipment. Also, the FCC has proposed revisions which will strengthen two crucial sections of its regulations, Parts 18 and 15. The former regulates industrial, scientific, and medical equipment, while the latter covers devices with low power intentional radiation, such as wireless intercoms, and devices with unintentional radiation, such as electronic games.

Historically, the FCC has considered the emitters of interfering radiation the villain, but with emitters growing by the millions, it is now considering imposition of regulations requiring the manufacturers of consumer entertainment electronic equipment to make their products RFI/EMI proof. At present, the FCC has no legal authority to do this, but an amendment to Section 302 of the Communications Act would rectify this.

At present the harmonic suppression requirement for CB transmitters is -60 dB below the carrier. The CB manufacturers claim that this amount of suppression in a legally operated transmitter will not cause RFI to TV sets, and when it does happen, it is the fault of the wide-open front end of the TV set. However, Joseph DeMarinis, director of engineering for GTE Sylvania, disagrees. He states: "The filtering and shielding of a TV set is an order of magnitude, or more, better than the state of the art of CB transmitters."

Less known is the fact that the radiation from oscillators of CB receivers has been creating interference problems for three public services: the Power Radio Service used by electric, gas, water and steam utilities in the 37 MHz band; the aircraft services band, 100 to 135 MHz; and the Forestry Conservation Service operating on 151.205 and 151.400 MHz.

Interference to Power Radio Services stems from the heterodyne type of frequency synthesis used by many 23-channel CB transceivers. To minimize the number of crystals, the 23 oscillator frequencies are obtained by heterodyning the outputs of two oscillators. One uses crystals at 37.6, 37.65, 37.7, 37.75, 37.8, and 37.85 MHz. The other has crystals at 10.180, 10.170, 10.160, and 10.140 MHz for a combined total of 23 channels.

The 37.6, 37.7, and 37.8 MHz frequencies happen to be those used by the Power Radio Service. To alleviate interference of all three services, the FCC amended Part 15C by adding a new Section 15.59 that requires the certification of CB receivers to new low limits of oscillator radiation. The manufacture of CB receivers not certified to meet the new requirements must cease no later than Aug. 1, 1977.

Illegal or bootleg rf amplifiers increase the CB transmitter many times its legal 4 Watt limit. These amplifiers are made available to CBers by a few irresponsible CB suppliers who manufacture amplifiers, ostensibly for amateur use, but which can be driven by only 3 or 4 Watts. As most amateurs have exciters with about 100 Watt capability, the subterfuge is quite obvious.

To help combat bootleg activities and other sources of CB interference, the FCC's Field Operations Bureau is investigating a random selection of TV interference complaints. It is engaged in the following activities:

1. Monitoring a CB station unannounced to determine if a linear amplifier or other illegal accessory, such as a VFO or power mike, is used.

2. Inspecting CB station equipment for spurious emissions through the use of spectrum analyzers.

3. Inspecting a complainant's TV receiver for received signals and antenna quality.

4. Installing high pass filters on the TV receiver and low pass filters on the offending CB set.

5. Making a neighborhood survey to determine the impact of interference on the local area around a CB set.

Most of the FCC regulations governing consumer electronics devices and equipment appear in Parts 15 and 18 of the Commission's rules, but Part 15 has not been amended since 1948, and the basic technical specs of Part 18 have remained the same since 1946.

Since then, however, vast technological advances have occurred. Semiconductors, integrated circuits, and digital systems have appeared. Many new devices operating at frequencies substantially higher than in the late 40's present new interference problems.

Consequently, the FCC has proposed overdue changes to Parts 15 and 18. One proposed change in Part 15 is the certification of restricted-radiation devices such as electronic (coin operated) games that use rf energy, rf switching supplies operating above 10 MHz, wireless intercoms, etc. Other devices will be added to the list as the need arises.

A real headache for the FCC is the TV game that can be connected to the antenna terminals of the owner's set. "These games are potentially as popular as CB sets," says Milton Mobley, chief engineer in charge of the FCC's testing laboratory in Maryland. "We've had more applications for TV game type approval in the second quarter of '76 than we had in the past four years ..."

A number of interference sources producing random broadband electrical noise can be just as disruptive to communications as the narrow band emitters, such as CB sets. As yet, these devices are unregulated by the Commission. However, complaints from these products have increased.

Reprinted from Squelch Tales, *San Diego Radio Club bulletin, Dec., 1976. Also appeared in* Electronic Design.

Continued

A New Repeater Era?

Can you imagine walking around town with an HT and talking to the world on 20 meters? Or talking to Japan when propagation conditions are mediocre? All that and *much* more may be possible if Docket 21033 goes into effect. The notice of inquiry and proposed rule making would profoundly shake up the existing system of repeater licensing and operation.

That bombshell was released early in January by the FCC. As the Commission puts it, "Our experience has demonstrated that amateur radio operators are fully capable of developing and operating complex systems of stations with a minimum of regulation by the Commission. We are aware of no compelling reason why amateurs wishing to operate repeater, auxiliary, control, or remotely controlled stations should continue to be required to obtain Commission permission before beginning such operation."

The FCC then goes on to propose that all repeater licenses be eliminated altogether. *Any* amateur would be allowed to set up a repeater *without* the need for FCC permission.

But that is not all. The docket proposes that deregulation of repeater stations continue with deletion of the requirement that all open repeaters be monitored by control stations in real time or be recorded. Logging requirements would be changed so that rather than authorized control points, the names and addresses of control operators would be listed in the log.

So what? That might create a bit more confusion on 2 meters. The biggest shock comes in paragraph 12 of 21033. Again, quoting the FCC, "It appears that many amateur operators seek greater flexibility in the choice of frequencies for repeater operation. We are therefore proposing to permit repeater operation on *all* frequencies allocated to the Amateur Radio Service, except 435 to 438 MHz." Completely unexpected, that part of 21033 seems to be the biggest surprise out of Washington in quite a while. The implications, should the docket be adopted, are enormous.

73 contacted several frequency coordinators and other amateurs and asked for their initial reactions to the proposal. The majority of answers were negative, ranging from mild dislike to utter consternation. In general, the feeling seems prevalent that near utter chaos will result from complete repeater deregulation. Those involved with frequency coordination were the most vehemently opposed, saying frequency coordination is difficult enough at the present time.

It's evident that with the ever-increasing headache of CB and the attendant enforcement and paperwork problems that are being created, the FCC is anxious to ease their workload in amateur areas. The paragraph about amateurs being able to operate with a minimum of regulation is one that all hams can be proud of. Coming from a government bureaucracy, it becomes even more amazing.

The problem is, with the number of hams increasing, how long can we continue our self-regulation? With increasing numbers come increasing problems. Witness "Repeater Appreciation Week" on the West Coast and the "Ohio RTTY War" (see *Briefs*). Suddenly, operators who feel they have a "right" to a frequency and increasing congestion on repeaters are creating bad feelings and hardening attitudes.

It seems that the FCC's proposal would create, if not chaos, a good bit of confusion and disorder on the ham bands. The FCC says that part 97.63 would be revised to "emphasize the two principles which have made possible the efficient operation of many amateur radio stations in relatively small spectrum space, namely, that a station using a frequency has first priority in such use over other stations and that all frequencies allocated to the Amateur Service are shared on a non-exclusive basis. It is presently the responsibility of amateur licensees to strike an appropriate balance between these principles to ensure the fair and efficient use of available spectrum." The existing rules say that if a repeater channel is being used for simplex operation, the control operator is not supposed to allow the repeater to be turned on. How often is this the case? The Commission further recognizes that increased congestion might result, and goes on to say that at the present time, they have no specific recommendations to make regarding coordination. They do, however, solicit comments in that area.

The appeal of a 2 meter to 15 meter repeater or any of the numerous possibilities is too great to dismiss. Perhaps a mandatory system of frequency coordination will have to be instituted. *73* is currently surveying the comparative success and failure of coordination. Look for a special report on the subject in next month's issue.

April 1 is the deadline for comments on Docket 21033. They may be sent to Federal Communications Commission, 1919 M St., NW, Washington DC 20554.

Stan Miastkowski WA1UMV
Associate Editor

CB and the ARRL

A scenario has become clear regarding ham radio, CB, and the ARRL. Some clues from* X-MITTER, *Journal of the Penn Wireless Association, Bristol PA:

We are grateful for having had Chod Harris WB2CHO as our speaker at our twelfth annual awards banquet on the 13th November. Chod is an excellent speaker, and presented an important message.

Chod is running the newest ARRL department: Clubs and Training. His most important responsibility right now is assisting as best possible the recruitment and training of new amateurs — these times being the best ever for the expansion of amateur radio. He, presumably in concert with others of the HQ staff and the Directorate, obviously has studied at length the varied avenues possible, and is directing the League's major effort to presenting our story to those who have tried casual and hobby-type operating on the Citizens Service and have found it unsuitable for such use (as FCC intended).

His presentation to Penn Wireless touched only briefly on the training aspect, however. His message was that of top level cooperation between the two services, lumping them (correctly) as "personal communications" wherein one group has tremendous numbers and practically no expertise, and the other, with comparatively low numbers, has technical abilities fully in line with the state of the art. Personal communication in general having need of overpowering numbers and the ultimate in technical abilities, the combination should be irresistible while individually both could founder.

What are the situations to which this might apply? Many exist — they can be left to the imagination. Several were discussed at the banquet both in Chod's formal presentation and in the open discussions following. Local level legislation, for one. Tower ordinances are literally flying around the country; many are very poorly drawn. There is even some attempt to legislate RFI! RFI is an extreme problem. Our BCI and TVI problems of 10 and 20 years ago seemed bad at the time, but those of today are orders of greater magnitude. Emergency communications practices — they're always needed. Competition with other services, both domestic and international, is a continual problem, coming to a periodic head with the 1979 WARC.

All of these problem areas and more can be handled best with numbers (which CB can provide) and the ultimate in technical abilities (which we have). Thus, the times demand that we seek out the CB users to offer our complete cooperation. Why not the other way around? Because there is not (and likely will never be) any centralized CB organization in any way comparable to our ARRL and IARU. The service simply is not adaptable to any such centralization any more than there could be a central organization of telephone users. An ATT and an FCC, perhaps, but of users?

What is evolving is the stabilization of the two services. Those who would have radio for learning about electronics and radio will ultimately be licensed amateurs; those who need radio — for whom the wired telephone is insufficient — will be CB equipped. And probably this latter group will include most of the mobile portion of our population, for business communications are really desirable for most of us. The enforcement problem will never disappear, but it's conceivable that as the hobbyists leave the Citizens Service for amateur radio, the CB enforcement will become practical.

This is the goal which ARRL is aiming for. The tiny group in Newington can't do it alone. They can only help coordinate a flexible program and rely on us as scattered clubs and individual responsible amateurs to implement it. But the way Chod put it to us, it is not only mandatory to the long term welfare of amateur radio, but it's already started. The future of amateur radio looks good. Our 1976 facilities exceed anything imagined in 1956. It's predicted we won't need another 20 years to see equal advancement and expansion.

Updating WARC

Opposition to FCC WARC proposals for 15m and the lack of additional ham bands at 10, 18, and 24 MHz are prime ARRL reactions to docket 20271 (see Special Report, 73, February, 1977). Following is part of a letter to affiliated clubs and League Directors issued the week after FCC publication of the proposed US WARC position.

"We urge you to study this carefully and to file comments with FCC. This is one of the most important documents on amateur radio that you will see in this decade, and it is imperative that the Amateur Radio Service make its voice known in these proceedings.

"There are three broad areas where we believe comment will be beneficial. First, where we agree with the position taken by the Commission, we should comment favorably and reinforce their action. This is necessary because undoubtedly other services will be unhappy with some of the gains registered by the amateur service and will seek to have those positions modified. Thus, we must be sure to support the Commission in those actions they have taken in favor of the amateur service. For example, the FCC has proposed the creation of a new amateur band at 160-190 kHz, it has proposed an exclusive amateur band at 1800-1900 kHz and a shared amateur band from 1750-1800 kHz, it proposes the continuance of the 3500-4000 kHz band making 400 kHz exclusive in place of the present sharing arrangement, it proposes expanded bands at 6950-7300 and 13950-14400 kHz, and our bands at 28 MHz and the VHF/UHF are maintained. These are positive actions to comment on favorably.

"Second, we believe that adverse comment is required concerning the proposed change at 21 MHz. The Commission has shifted that amateur band from 21000-21450 to 20700-21200. Admittedly, this is a gain of 50 kHz, but it would come at the expense of considerable modification and replacement of existing amateur equipment. The Commission stated that the shift in the band was necessitated in order to accommodate certain requirements of the maritime mobile service. However, the League staff believes that with a slight rearrangement of the various allocations in the vicinity of 21 MHz, the martime mobile requirements can be met and the amateur bank 2100-21450 need not be shifted.

"Third, we believe that our original request for new bands at 10, 18 and 24 MHz was entirely justified, and has not been given adequate attention. In particular, a new band at 10 MHz, even a narrow one, would permit improved communication between amateurs in all parts of the world at those times when the maximum usable frequency does not reach 14 MHz. At the present time, such communications must be conducted at 7 MHz, a circumstance which requires the use of greater transmitter power because of increased absorption and interference from the Broadcast Service. New bands at 18 and 24 MHz would serve similar purposes."

At deadline, the word from Washington sources was 15m could be solved, but new ham bands at 10, 18, and 24 MHz seem unlikely. More next month.

Warren Elly WA1GUD
Associate Editor

Breaker, Breaker, Six...

A large volume of our mail continues to focus on theft . . . and here's one of the better ones, courtesy of the Minuteman Repeater Association Bulletin, Lexington MA. Jack W1DXQ and Murry K1GGP tell how an "MMRA Soft Sell," follow-up, and just plain cool help recover a stolen rig.

One afternoon in October, W1DXQ and K1GGP were in QSO during DXQ's "long" ride home from work. During our QSO, we heard a rather odd break station.

"Breaker six."

Our first thought was ignore him and he might go away.

"Breaker six."

Well, guess he won't go away; maybe we can scare him away. We stood by for the break station, and the conversation went like this:

Good Guy: Go ahead, breaker.

Bad Guy: Hey there, good buddy, is this channel six?

Good Guy: No sir, this is not channel six. You are operating on the two meter ham band. This is not the CB band. It appears that you don't know that you have a ham radio there.

Bad Guy: Oh, OK, good buddy, just doing some work on this here radio for a friend of mine. Trying to find out how this mobile telephone works.

Good Guy: Well, first of all, you do have a very good signal. However, you cannot operate unless you have a ham license. If you're working on the radio for a friend, he must be a ham and would do his own. If you or he thinks it's a CB radio, it must be a hot radio, and you must have a second class or better to do service work on CB equipment. By the way, what's your handle?

Bad Guy: Handle here is Rick. I didn't know about the license stuff.

Good Guy: Well, Rick, I would suggest that you cease operation of that equipment because you don't have a proper license. (Now for a big scare:) The Federal Communications Commission and other federal agencies frown on such activities. By the way, Rick, the handle here is Jack. You are giving us such a good signal, I wonder, what's your 10-20?

Bad Guy: OK, Jack, 10-20 here is Hanover.

K1GGP overriding "Bad Guy": Hey — I know of equipment that was stolen at the Hanover Mall.

Bad Guy continues: Well, thanks for the information, Jack. I had better get out of here now.

Good Guy: OK, Rick, it is a good idea that you do that. You will save yourself a lot of grief. The repeater would be shut off anyway if you continued to transmit. I'd like to give you more information on this subject, Rick. Do you have a telephone number that I can reach you at?

Bad Guy: Ya, sure, Jack. You can get me at 826-XXXX; got it?

Good Guy: OK, Fine, Rick. I have it and I'll give you a call later.

Well, the "Bad Guy" went away, and Murry and I carried on for a short time, making few comments on the incident.

After I arrived at home, I thought, what the heck, I'll give the guy a call. I know it's a phony number. He was a dummy, but the odds are that he wouldn't be stupid enough to give me a valid telephone number. I called and sure enough, he now qualified as "dummy of the year."

Good Guy: Hi Rick, this is Jack.

Bad Guy: Hi Jack, glad you called. (Gads, super dummy!)

Well, at least he told the truth about the telephone number . . .

Good Guy: I think you should get rid of that radio, as your friend appears to be the owner of a hot radio. What is your friend's name?

Bad Guy: Well, he is not my friend; he is a friend of a friend. I don't know his name.

Good Guy: Well, Rick, I would suggest that you get his name, or at least his plate number and a good description. When the FCC makes their investigation, they won't accept answers like that. (There — that line of bull should throw the fear of God into him — last we'll ever hear him on two meters.)

Bad Guy: OK, Jack, I'll give it back; he is getting me in trouble.

Good Guy: Well, Rick, you just tell the truth when the investigation comes about and you might not be in such trouble.

After the telephone conversation, I figured that just about all that could be done, had been done. To present such information to a local police department, or even the FCC, would be a waste of everyone's time. No real facts or names. Just a telephone number. During both the radio conversation and telephone conversation, the "Bad Guy" did mention that the radio was a Heathkit. I thought of the many rigs that had been stolen in the area, but I had knowledge of only one "Grief-Kit." I recalled that WA1QPL (Dave) had a Heath stolen several months prior. Murry verified that fact, but the chances of this being Dave's rig was a million to one shot.

With the 07/67 grapevine at work, Dave gave me a call after hearing of the incident. He mentioned his stolen rig taken eight months prior from his car in Milton. Well, as far as I was concerned, a Hanover thief would not go to Milton to steal a radio. Make odds now two million to one. Dave was quite interested in a follow-up to the Hanover police. I attempted to soften the blow. I have been through local police and, in most cases, they are too busy to be bothered, or in some cases, could care less. It appears I was wrong. Dave contacted Hanover and gave them what information he

Continued on page 170

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

SOUTH DAKOTA STATE QSO PARTY

Starts: 0000 GMT March 13
Ends: 2359 GMT March 14

The contest is sponsored by the Prairie Dog Amateur Radio Club. The same station can be worked on different bands, modes, and counties for multipliers.

EXCHANGE:

SD stations give RS(T) and county; others send RS(T) and state, province, or country. No SD to SD contacts!

FREQUENCIES:

Phone — 1.975, 3.920, 7.230, 14.280, 21.380, 28.510.

CW — 70 kHz up from bottom.

Novices — middle of band.

SCORING:

SD stations multiply number of contacts times number of states, provinces, and countries. Others multiply number of contacts (with SDs) times number of counties.

ENTRIES:

Certificates to each section. Send logs by April 1st to: WB0EVQ, Box 493, Springfield SD 57062.

CQ WORLDWIDE WPX SSB CONTEST

Starts: 0000 GMT Saturday, March 26
Ends: 2400 GMT Sunday, March 27

Only 30 hours of the 48 hour contest period permitted for single operator stations. The 18 hours off may be taken in up to 5 periods during the contest, but must be clearly indicated in the log. Multioperator stations may operate the entire 48 hours. All bands, 1.8 to 28 MHz, may be used, but all QSOs must be 2xSSB only.

ENTRY CLASSES:

Single operator, all band or single band; multi-operator (all band only), single or multi-transmitter; multi-operator, multi-transmitter only allowed one signal per band.

EXCHANGE:

RS and 3 digit progressive QSO number starting at 001; use 4 digit number over 1000; multi-transmitter stations use separate numbers for each band.

POINTS:

QSOs with stations on different continent — 3 points on 14 to 28 MHz, 6 points on 7 to 1.8 MHz. Contacts between North American countries (not your own) count 2 points on 14 to 28 MHz, 4 points on 1.8 to 7 MHz. Contacts between stations in the same continent but not in same country count 1 point on 14 to 28 MHz, 2 points on 1.8 to 7 MHz. Contacts between stations in the same country count only for multipliers, not for QSO points.

MULTIPLIER:

The multiplier is the total number of different prefixes worked regardless of band. Each prefix may be counted only once.

SCORING:

Single op, all band and multi-operated stations — total number of QSO points from all bands times the total multiplier. Single op, single band — total number of QSO points from that band times the multiplier. NOTE: A station may be worked once on each band for QSO points, but the prefix multiplier is only counted once.

AWARDS:

Certificates will be awarded in each category in each country, and each call area in US, Canada, and Australia. Other special awards and trophies will be awarded as listed in *CQ Magazine.* To be eligible for awards, single operator stations must work a minimum of 12 hours; multi-operator stations must work a minimum of 24 hours.

LOGS:

Show all times in GMT; use a separate sheet for each band. Prefix multipliers should be entered only the first time they are contacted. Logs should be checked for duplicate QSOs and prefix multipliers. It is recommended that you use a prefix check sheet and include it with your entry. Each entry must be accompanied by a summary sheet listing all scoring information, category, and your name and mailing address in block letters. Also, a signed declaration that all contest rules and regulations for amateur radio in your country have been observed should be included. Official logs and summary sheets are available from *CQ Magazine.* Send a large self-addressed envelope with sufficient return postage or IRCs to: CQ WW WPX SSB Contest Committee, 14 Vandeventer Avenue, Port Washington, LI, NY 11050. All entries should be postmarked no later than May 1 and addressed to the address shown above. The deadlines will be made more flexible in rare isolated areas.

Please check the January issue of CQ Magazine *for complete rules and changes made at the last minute.*

BARTG SPRING RTTY CONTEST

Starts: 0200 GMT Saturday, March 26
Ends: 0200 GMT Monday, March 28

Only 30 hours of the total 48 hour contest period may be operated. The 18 hour rest period can be taken at any time, but off periods may not be less than 3 hours at a time. Times on and off the air must be summarized on the log and score sheets. There will be separate categories for multi-operator and SWLs. Use all amateur bands from 3.5 to 28 MHz. Stations may not be contacted more than once on any one band. In addition to the ARRL country list, each W/K and VE/VO call area will be counted as a separate country.

EXCHANGE:

Time in GMT, must be a full 4 figure group — use of "same" or "same as yours" will not be permitted. RST and message number. Message number must consist of a 3 figure group starting with 001 for the first contact.

POINTS:

All 2-way RTTY contacts with stations within one's own country will count 2 points. All 2-way RTTY contacts with stations outside one's own country will count 10 points. All stations will receive a bonus of 200 points per country worked including their own. NOTE: Any one country may be counted again if worked on another band, but continents are counted only once.

SCORING:

The total score is the sum of (the 2-way exchange points times the number of countries worked) plus (the number of countries worked times the country bonus points times the number of continents).

LOGS & SCORE SHEETS:

Use one log sheet for each band and indicate any rest periods. Logs must contain: date and time in GMT, callsign of station worked, RST report and message number sent, RST report and message number received, and exchange points claimed. The judges' decision will be final. Send contest logs to: Ted Double G8CDW, 89 Linden Gardens, Enfield, Middlesex, England EN1 4DX.

AWARDS:

Certificates will be awarded to the leading stations in each class and to the top stations in each continent and each W/K VE/VO call area. The final positions in the Results Table will be valid for entry in the "World Champion of RTTY" Championship.

If any contestant contacts 25 or more different countries (W/K VE/VO call areas do not count as separate countries for award) on 2-way RTTY during this contest, a claim may be made for the QUARTER CENTURY AWARD issued by the British Amateur Radio Teleprinter Group and for which a charge of $2.00 or 8 IRCs is made. Make your claim at the same time as you send in a contest log. Holders of existing QCA Awards will automatically have any new additional countries added to their records.

If any contestant contacts stations on 2-way RTTY with all six continents and the BARTG Contest Manager receives contest logs from the operators in those six continents, a claim may be made for the WAC Award issued by the RTTY Journal. The necessary information will be sent on to the RTTY Journal who will issue the WAC Award free of charge.

WISCONSIN STATE QSO PARTY

Starts: 0000 GMT Sunday, April 4, 1977
Ends: 0000 GMT Monday April 5, 1977

This annual event is jointly sponsored this year by the Neenah-Menasha Amateur Radio Club and the Yellow Thunder Amateur Radio Club. Phone and CW are considered separate bands. The same station may be worked once each band, county and mode. Wisconsin stations may work other Wisconsin stations for QSO and multiplier credit. No contacts can be counted if made on Wisconsin nets while in session or if made through repeaters except for OSCAR. Multicounty portable/mobile operations can be worked in each county they operate from.

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CALENDAR

Mar 5 - 6*	ARRL DX Contest — Phone
Mar 5 - 6*	YLRL YL-OM Contest — CW
Mar 13	South Dakota QSO Party
Mar 19 - 20*	ARRL DX Contest — CW
Mar 26 - 27	CQ Worldwide WPX SSB Contest
Mar 26 - 28	BARTG Spring RTTY Contest
Apr 2 - 3	Tennessee QSO Party
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest — CW
Apr 16 - 17	CD Party — CW
Apr 23 - 24	CD Party — Phone
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest — Phone
Apr 30 - May 2	Connecticut QSO Party
June 11 - 12	ARRL VHF QSO Party
June 18 - 19	West Virginia QSO Party
June 25 - 26	ARRL Field Day
July 2 - 3	QRP — Summer — Contest
July 4	ARRL Straight Key Night
July 9 - 10	ARRL Bicentennial Celebration Plus One
Aug 20 - 21	New Jersey QSO Party
Sept 10 - 11	VHF QSO Party

*Described in last issue

LETTERS

CAN SOMETHING BE DONE?

Gentlemen:

I am writing this letter to inform you and fellow amateurs of my recent experiences with and the apparent "fraud" of Trigger Electronics of 7361 North Avenue, River Forest, Illinois 60305.

Enclosed you will find a copy of the letter I have sent to the Illinois Attorney General's Office concerning Mr. Treger's so-called business. I hope you will make this information available for those who read your publication. Hopefully, this will stop many people from making the mistake of placing an order with Trigger Electronics, as I have done.

Anyone interested in information about Trigger Electronics or the appearance of the store itself in River Forest, please feel free to contact me.

David B. Hasenick WD8BNS
8369 Ferris Road
Springport MI 49284
Phone: (517) 857-2385

On October 8, 1976, I ordered from Trigger Electronics, River Forest, Illinois, merchandise amounting to $177.93 by a mail order. I sent a postal money order in like amount to pay in full the amount of my order, copy attached of postal money order #21602081193.

After much time had gone by and I had not even received an acknowledgement of my order, I made several telephone calls to Trigger to see what had happened to my order. Some of the phone calls were by date and amount as follows: October 27, $1.60; November 3, $1.02; November 9, $1.31; November 17, $1.42; November 27, $1.08. At those times I was told that the order was still being processed, but that they had no record of any orders being sent until 30 days after the order was received there. This didn't exactly make sense, but it was their reply.

During this time, a small amount of merchandise from my order was received by me in the amount of $20.41, leaving the balance of $157.52 for a large antenna.

After many of these fruitless telephone calls, we drove to Chicago on December 8, 1976, to Trigger Electronics. The woman that met us in the front office gave the same story as we had received over the phone – that there was no shipping department there, that it was elsewhere and she did not know the location or telephone number of such a department, etc. In looking over in back of the office area, it looked like what shipping was done was one package with dust on it that looked like a "front" and had been lying there for ages waiting to be "shipped." There were stacks of orders lying around with envelopes open and papers still in envelopes. She then told us that no one else was there, but we saw others in the back and asked about this. We were told that everyone was indeed out to lunch and might not be back all afternoon when we pressed her. We then told her we would wait until they arrived. When we persisted, Mrs. Treger came running out from in back screaming that she would call the police if we didn't leave the premises right away. She made this phone call (or what was supposed to be a phone call) to the police, but we waited and no one showed up from this "call." We told her that we were there to settle this account and that we did not drive 200 miles one way for nothing. Finally one of us left to call the police ourselves while the other stayed. Then Mr. Treger showed up from hiding in back and said he was going to beat me up if I didn't leave. He was screaming with fists clenched and would not begin to talk any business, just told me to get out or else he would get me out with a shotgun. When I did not leave, then he did come out with a gun. I did depart and went to the River Forest police station. We went over the entire situation with Sgt. George Straugh, who said his hands were tied unless Treger actually assaulted or shot us. They were as helpful as they could be and suggested we write your office with complete details on this experience.

Now how can any business be left to operate when they only pocket the money and do not ship ordered and paid merchandise? Where are the laws that protect the individual from losses like this? How many people must they cheat and steal from before something can be done?

David Hasenick WD8BNS

BOYCOTT TRIGGER

Let me introduce you to one of the most efficient employees I have yet to encounter. This hard-working and dedicated person is – the TRIGGER TELEPHONE LADY!

As I had ordered an antenna from Trigger Electronics in July and was still awaiting its arrival in November, I called to ask why. That is when I first met the Trigger Telephone Lady! I could almost see her smile sweetly as she promised immediate action.

During that and four subsequent phone calls (so far), the Trigger Telephone Lady has compiled the following exemplary record:

She has succeeded in forgetting all previous calls, even when two were made the same day.

She has managed to place me on hold an average of twice per call (at long distance rates this is a rather convincing argument).

She has apparently lost every message she took as I have never been contacted by Trigger on the missing antenna.

Through all of this faithful service, she preferred no public recognition for her excellent work and consistently refused to give her name, job title, or employee number.

She has remained utterly faithful to her employer throughout, effectively insulating Trigger Electronics from all complaints so that they might continue to perform their dastardly deeds unhampered by the outraged squawks and protests of their victims. All Hail to the Trigger Telephone Lady!

Gary S. Breschini WB6NCK
Salinas CA

P.S. How about including "Boycott Trigger Electronics" on all QSL cards being sent to Novices, that they too may join in the praise of these turkeys?

FISHY

Just a short note to you regarding the letter in your column about IL *vs* Trigger. I have sent the Attorney General's office my incident with Trigger, that Trigger must have my check in their hands, cleared by the bank, before I could come in the store to pick up any merchandise, if they had it in stock. Sounds fishy, huh?

Thank you for your kind attention.

Art Surges
Evergreen Park IL

P.S. I took my business elsewhere.

IRKED

As a subscriber to your mag, I thought that I would write you about one of your 1975 articles.

This is in reference to the Levy Associates ad, this company formerly of Temple City CA, now of 1037 E. Lemon Ave., Monrovia CA 91016. For approximately $110, I purchased a ÷10 and ÷100 prescaler. This did not work with my MICRO Z FM 36 counter; however, I assumed that the counter's sensitivity was low. So then I purchased a Hewlett-Packard 5381A counter and a Davis (Tonawanda NY) scaler. This combination works perfectly.

I then sent my prescaler back to Stanley Levy WB6SQU on 4 Oct., 76, at their request. Early this year I received the scaler and he said they had a hard time getting the ÷100 IC; it is a Plessey. Believe this is an English make; he also said they have discontinued manufacturing this scaler due to trouble getting this part.

Well, at any rate, not sure if they ever did replace the IC. It doesn't work anyway, so have resigned myself to *never* ordering any gear from a small manufacturer, though I will say I am happy with the way the Davis divider operates.

Always liked to patronize small companies – but never again.

Have about $10,000 of gear here, so can afford the loss, but it sure irks me.

Larry Briggs W3MSN
Oxon Hill MD

Don't prejudge all small companies – that's where the big ones come from. – Ed.

HIGHLY RECOMMENDED

During this day and time when there seems to be so much emphasis on the negative, it is nice to get service from one of your advertisers, Communications Specialists in Brea, Calif., like I did. I ordered their ME-3 on Monday and I had it the next Monday. This is real VIP treatment. No waiting for my check to clear the banks and they sent my ME-3 UPS Blue Label Express, all prepaid. You can bet that I will highly recommend them to my friends. And the unit works A-1.

Dr. William W. Fulcher, Jr.
K4RTA/W4AST
Madison TN

ARRL ON TOP

In Dec., 1976, *QST*, page 38, recent equipment (HAL's FYO keyer paddle) is described. When I attempted to order one, I discovered that HAL is no longer making them – ARRL is really on top of things. I became angry and decided to see if I could make one myself. It proved much easier than I had imagined, and was made entirely from the junk box. It required only simple hand tools such as a hacksaw and a small round file. Mounted on a walnut base, it is also good-looking.

Every CW op to whom I have mentioned the project has been interested, and several have sent an SASE for a sketch. And so I ask if you might be interested in an article, "The Poor Man's FYO," with photos and sketches, etc.

Fred Maas WA5YTX
Santa Fe NM

Do it. – Ed.

THE GENTEEL HALF

I'm sure you'll find this one interesting from the "genteel" half of amateur radio.

Christine Boniakowski WA2KOU
Neptune NJ

Editor – *QST*
American Radio Relay League
225 Main Street
Newington CT 06111

Dear Sir:

I have been an amateur radio operator for approximately four years and absolutely love being a part of a

"man's world." I enjoy taking part in contests and am quite surprised by the different reactions I get from various operators when I am on the air.

However, it has come to my attention in the last few contests that there must be some guidelines established regarding the use of the national calling frequency of 146.52 MHz. The contests I am specifically referring to are the recent June, 1976, and January, 1977, VHF Sweepstakes.

In my opinion, it's not very fair for people to monopolize the national calling frequency for solely high power contest use since VHF Sweepstakes are intended to test both equipment and operating skill. However, it is quite obvious that there are many of us who are fortunate enough to have top-of-the-line equipment, including big arrays and kilowatts. These are fine at the low end of the band but not on 146.52.

In addition, since when have the FCC regulations been changed to allow a reverb on the air? I did not know that hams were in the radio broadcasting business.

I would like to suggest that 146.52 and all FM frequencies above 146 MHz remain contest-free and that the ARRL contest advisory committee look into the matter of suggesting alternate FM simplex frequencies for use during contests. Why should the FM bands be monopolized by a few who are inconsiderate and cannot leave the simplex bands alone for the purpose they were intended for — low power, mobile intra-community communications and public service.

I have been informed that the ARRL has refrained from publishing letters that tend to question its activities, of which the VHF Sweepstakes are a part, but it will be interesting to see how much attention a female rocking a male boat will receive.

Thank you for your consideration in this matter. I hope that there will be changes made in the near future to safeguard the FM bands from being hoarded by the "big guns."

Christine Boniakowski WA2KOU
Neptune NJ

She said it. — Ed.

RETROSTEP

San Antonio, which was among the earliest proponents of the Texas Band Plan for VHF/UHF FM (which was later adopted almost en toto by ARRL as a National Plan), joins the Bicentennial Celebration by virtue of a retrostep which sets orderly spectrum utilization back 20 years, if not the full 200.

South Texas first provided the English language with the word "maverick" during the mid-1800's when rancher Samuel A. Maverick allowed his unbranded cattle to roam the open range.

To top Sam Maverick's independence required considerable effort, but alas, it has been done. San Antonio now has a maverick to top all mavericks: WR5AFF/5 (no challengers please). This ill-conceived maverick repeater, licensed to Robert J. Sarvis WB5CIT, has its input on 146.39 MHz and output at 147.51 MHz (a designated simplex channel). With a rather unique spacing of 1120 kHz, this anachronistic machine conforms to accepted practice only in that it operates with low in/high out, and uses a 30 kHz channel for its output. Whether or not this was due to some oversight, or confusion caused by the choice of 146.39 MHz, which isn't even a half channel, could not be determined.

Please consider the creation of a Maverick of the Year Award to properly honor the contemptuous disregard for established order which characterizes such operations as this. The efforts of thousands of dedicated amateurs to voluntarily regulate themselves and promote orderly growth and spectrum usage appear wasted on our barbaric brethren.

Robert G. Wheaton W5PKK
San Antonio TX

GET OFF OUR BUTTS

After three unsuccessful tries of obtaining publication in QST (you remember, that's the organization "devoted entirely to amateur radio" — I understand that slogan will be mounted on the new $800,000 wing of ARRL Headquarters, Hi Hi), I thought after recently subscribing to *73 Magazine* and liking what I saw, I would appeal to you.

My message to our wonderful ham fraternity is this: Let's get off our butts and devote the same amount of energy towards publicizing and promoting amateur radio as we do denouncing the CBers and their band. Recently coming up from the ranks myself and passing my General theory, I do not believe the majority of amateurs are aware of what's going on in today's advanced CB market. In particular, I am talking about the so-called SSB HFers who operate between channel 23 and the ten meter Novice band. This group of bootleggers numbers over 70,000 with their own published callbooks and specialized illegal callsigns. Sure, a lot of these interested shortwave radio enthusiasts are running amateur equipment. It is easily available and the distributors and manufacturers of this equipment see the money in this market and of course are not going to establish any rules or regulations to prohibit sales. All we need to do is grab the "cream of the crop" from these ranks and talk about, demonstrate, and third party these fellows right into ham radio. The old tightwad image of the average ham radio operator is changing. These fellows already have been practicing Morse code, know about propagation, and have erected everything from tribanders to inverted vees. Still a nonbeliever?

Take a look at the gear confiscated in recent raids in the Baltimore area (*73*, January, 1977, page 12 — $65,000 worth), and that's just a drop in the bucket compared to other populated areas.

My point is this: For years we have been searching through our local clubs, etc., for people interested in getting into amateur radio, people who have no idea at the beginning what shortwave radio is all about and become easily turned off at the expense of getting into many areas of ham radio. We are looking in the wrong places. Get out of those department store and shopping center exhibitions and try going to some of the CB coffee and breakfast breaks on Sunday mornings. In my area, the hams meet at one end of the restaurant and the CBers in the other. Ridiculous, isn't it? Let's get together.

Mike Stone WB0QCD
Durant IA

MORE Z-80

I'd like to add my thoughts to yours concerning the Z-80 CPU chip in I/O Editorial in the December, '76 issue of *73 Magazine*.

Those of us who already own a 8080 based microcomputer can hardly be expected to junk a perfectly good CPU card and run right out and buy a Z-80 CPU! Remember that for many of us it was all we could do to get that 8080 based machine into the house — past all of the cold stares of our spouses, our friends, and our creditors.

Obviously, the Z-80 chip is intended for the "unlucky" souls that have yet to buy their first computer (that includes me). I am enthused about the Z-80 chip — precisely because it is advertised to execute 8080 programs without reprogramming! Furthermore, there are numerous new instructions that would appear to be valuable for a general purpose computer to have. Thus this Z-80 chip appears to give me the best of both worlds! Easier implementation electronically only sweetens the deal.

In my year of studying all of the uP oriented articles in *73* (and *Byte* and anything else I could get), I had largely ignored the 6800, 6501, F8, SC/MP, and all the rest, because I sensed that right or wrong, the largest number of active and unselfish programmers were probably on the 8080 bandwagon. Had the Z-80 chip not come along, I would have bought an 8080 chip based machine. Now that the Z-80 is here, that is what I'll buy, on the basis that it is "upward compatible" with the 8080 chip.

I expect to use those fancy new Z-80 instructions only when writing programs for new applications, for which satisfactory 8080 programs were not available.

Concisely, when I write programs for the *Kilobaud Software Library*, I expect that they will be in Z-80 code, but I expect that I will also submit an 8080 version (to fatten my royalty checks?) that will be virtually the same program except that each of the Z-80 only instructions would be replaced by a CALL to a subroutine that effectively emulates the replaced Z-80 instruction in 8080 code.

Kenyon F. Karl
Waterville ME

A REAL STATION

Along with my sub extension, I thought I would send along a minor gripe. It is about all those pictures of shacks and operating benches, desks, etc. I don't know how those people can even get on the air with those setups! Don't they know that clip leads, wires, and cables are essential to normal operation? Also, where else can you hang schematics, girlie pictures, calendars, logbook — to mention only a few. I am enclosing a photo of a *real* station. As you can readily see, everything is within easy reach — no hunting around for stuff. Band changes are a snap — merely move clip lead(s) from here to there. I didn't include a photo of the repair and building bench, as it is a mess.

But seriously, you have a fine magazine. It is the only one (of four originally) to which I still subscribe. The others seemed to aim their articles toward the more (than me at least) affluent amateurs.

Keep up the good work.

Ed Black W9YYD
Tallula IL

Continued

W9YYD's operating desk.

Steve Welsh WB9MLM serving as net control for March of Dimes Bike-a-thon from his hospital bed.

NEVER SAY DIE!

Here's a picture that the XYL took, and I think it's a good demonstration of the fact that hams are crazy enough to operate anywhere! Members of the Twin Ports Two Meter Club of Duluth, Minnesota, and Superior, Wisconsin, recently ran checkpoint communications for the March of Dimes Bike-a-thon. I had planned to help, but was hospitalized with an acute asthma attack. But between sessions on the respirator, I served as net control station, operating through WRØAIM, Duluth's 34/94 repeater. I was able to access it easily with my HR2A and a ¼ wave. Never say die!

Steve Welsh WB9MLM
Superior WI

LLOYD AND IRIS

We have just finished another successful DXpedition at VP2EEQ, Anguilla. Some 8,000 QSOs were made with amateurs in 123 countries. Operation was on 28 through 3.5 MHz, with very heavy concentration on 3.5 MHz.

Anguilla was different from our other Caribbean stops for two main reasons. There is no town or city in Anguilla, at least not in the normal sense. There are some stores, banks, etc., but they are widely separated and not in one downtown area. The other difference is that there is no central electric power system. Most people, including ourselves, have to obtain their electric power from individual electric generators. Our generator broke down just before we left and our stay in Anguilla was, therefore, cut short by a few days.

The people of Anguilla are very friendly and helpful. A radio amateur license is obtainable immediately, upon payment of $25 US. The country is relatively flat, which is a welcome change from most of the nearby countries which are mountainous, making it difficult to find a good radio site.

We ended 1976 with more than 70,000 QSOs operating from nine different DX countries.

KV4AA, a YASME Director and former President of the YASME Foundation (QSLs via YASME after 1 January 1977), finished the year with over 35,000 QSOs, all from AJ3AA.

It is most likely that every serious DXer in the world made at least one QSO with a YASME station in 1976. We hope that 1977 will be as good.

Lloyd Colvin W6KG
Iris Colvin W6QL
Anguilla

NEED VE6?

I got a hold of a couple issues of *73* and have already sent my subscription for 3 yrs. This VE6 thinks you have a great mag. Your editorials are great. I would like to see some beginner's basics on microprocessors.

Also, any W/K stations looking for VE6, I am on most afternoons on 14.300 or 21.300 and would be glad to contact.

Keep up the good work, Wayne. See you at Orlando Hamfest.

Arnie N. Brown VE6ARD
Calgary, Alberta Canada

ATTICA

At present I'm doing a stretch here in Attica Prison and the only way I can keep up with what's going on in the ham world is through reading. Seeing that I can't pop over to the local radio emporium for my monthly copy of *73* anymore, I finally have to subscribe. In a few days you'll be getting my money order for $9.00 a one year subscription. If the price has gone up, please let me know and I'll send the balance pronto. In the meantime please start with the Jan. 77 issue.

I'd subscribe for longer but I'm hoping to win my appeal. But if I should lose what's your rate for 15 years?

Two questions maybe you can help me with. Know anybody who would like to buy a used Drake TR-22C in good shape, except for the antenna which was broken while being chased by the cops? Plenty of crystals and cheap. Also my trusty ole Galaxy III, ac power supply, VOX, etc. Will sell all my gear cheap because I need money for my lawyer. And do you know any ham who would like to write a ex-ham in prison? A YL would be great! But I won't be fussy.

Looking forward to reading *73* again.

Peter Neenos
Box 149-75C275
Attica Correctional Facility
Attica NY 14011

NEED BY?

You can say "I told you so!" So far I have run into brick walls on operating privileges. Most people don't know what I'm talking about, or act like it. One guy around my age (43) said his buddy was one "before liberation" (1949) up in Tiensen, about 60 km north of here. In the larger cities, I have been told, they let middle school age (12-15) children build and operate short-range radio transmitters and receivers (short-range = 100 feet).

I have a S/W receiver and can get CW on it but the only ham band it covers is 80m. So far I have not heard any K or W stations. Out of 13 Americans here, one is K5KNL, Fred from Texas. He lives on the top (3rd) floor and has an "outdoor" antenna on the roof. He can get 20 and 15 occasionally. We are straight west and a little south of Pyong Yang, N. Korea, inland of the Pohai (Wide Sea) on North China's east coast.

I haven't given up, but the chain of command to do anything around here staggers the imagination. Tsang Chou, with a population of 170,000 (and they each have a bicycle!!) is classed a "rural town" and doesn't rate much attention. I wrote Peking about a license, but so far no answer.

Anyway . . . much success in the coming year. If anything interesting develops I'll let you know.

Don McCoy WAØHKC
China

HARD KNOCKS

I am writing this letter in the hope that I may be able to save someone else a lot of pain and suffering.

I learned my lesson the hard way!

Whenever climbing a tower to do any work, BE SURE TO USE A PROPER SAFETY BELT, or *don't* go up!

On 7 June 75, I was standing on top of the top section of a 3 section crank-up tower which we thought was completely lowered. Because of some confusion, the safety belt I was planning to use didn't show up that day. I figured I would be able to stand on top and wrap my left arm around the six foot mast extending above the top while with my right hand install a two meter antenna on top of the mast. Just as I was about to install the antenna, the tower section I was standing on dropped two feet suddenly. I lost my grip and fell off, about twenty feet down to the ground. Luckily, I landed rather erect with my knees bent slightly, which helped to break the fall, and I went down hard right on my rear and rolled back onto my back in excruciating pain. An ambulance was called and arrived about three minutes later, although it seemed like an eternity due to the intense pain I was in.

After the ambulance ride to the hospital, which was very painful because every little bump in the road sent shots of pain through my body, I was treated in Emergency and X-rayed to find out the extent of injury.

I suffered a hairline fracture of the lumbar number one vertebra, or in other words, a broken back.

I have now been in bed for 22 days and shortly will be getting a plaster body cast which will run from just below my waist to my armpits, which I will have to wear for 8 to 10 weeks. Not very pleasant during the summer; however, as temperatures in Vancouver rarely exceed 80°C, it might not be too bad.

I figure I was quite lucky in that there was no lateral shift in the fracture and no spinal cord damage, so I will suffer no paralysis.

I am still fairly young (29) and was in good physical shape when the accident happened; otherwise, I might have been permanently crippled.

I expect to be released from hospital in about a week.

In a few months I will be able to climb towers again, but NEVER WITHOUT A PROPER SAFETY BELT, as anything can happen.

I hope you print this so that others can learn from my error and misfortune and avoid injury.

Matthew T. Lewis VE7CHI
Vancouver, B.C., Canada

DON'T PUT CBers DOWN!

This is in reference to the letter published in your Holiday 76 edition of *73* by Carol G. Sakowski about CBs and CBers. Granted, Citizens Band is not the finest radio service in the world, but I was quite disturbed by Ms.(?) Sakowski's statement, "Anything that 6 and 10 year old kids can do, you can do, right?" True. But then take a quick look at ham. Anyone, regardless of age, can obtain a ham ticket through a simple multiple choice and Morse code test. There are children on your frequencies too.

I feel it is time that people stop putting down CBers! Face it – where would ham be without CB? There goes a good deal of electronic components, and, by the way, where do all the Novices come from? *CB*! Another thing – Ms. Sakowski does not seem to have any call letters. All of that from a non-ham?

I have been into CB for exactly one year. I am an avid SWL, and am one wpm from my Novice. However, even after I become well into amateur radio, I am not going to forget my many friends on 11 meters. CB may be crowded, ridden with illegalities, and not very efficient, but there are plenty of would-be hams on 27 MHz who are trying to clean up the channels of flakes. We are not *all* the typical "10-4 Good Buddy" media CBers.

I am proud of my CB call letters!! Do not put CBers down if you want some new hams!

Jim Cullen WAE2NR
Succasunna NJ

SOMEDAY . . .

This letter comes not from a ham, but from a long-time would-be ham. I just wanted to let you know that if I ever make it, you'll get a large share of the credit (or blame). For something like 15 years I've wanted to get into amateur radio. For 14 years, I was convinced that I could never learn the code. Now I've got your tapes and everything seems possible. Not easy — just possible.

I've also got the license guide books you publish and find them straightforward and logical. That's more than I can say for some of the things put out by the ARRL. Right now I'm trying to learn some of the basics through the Heathkit Continuing Education series. While I'm speaking from a position of ignorance, you might want to consider telling your readers about this series. Heathkit seems to have put together a winner.

You are to be congratulated for your efforts to bring CB people into the ranks of ham radio. While there are some crazies on that band (I tune up there and listen from time to time), there are also some very interested and dedicated people. These are the ones who would be tremendous as amateurs. I figure the crazies wouldn't have the patience to learn what they have to know to pass the tests, so, even if you get their attention, they probably still pose no threat.

Congrats, again, for getting into the home computer field. It is my feeling that within the next 5 years or so there will be a home computer system with adequate software to appeal to the average homebuyer. The fact that the hobby electronics magazines have nearly all added computer sections recently shows just how far ahead of the pack *73* really is.

So, thank you, Wayne, for keeping me on the track. Between the rigors of starting a new business and the time required by continuing to go to college, I still find some time to study radio theory. Someday . . .

William F. Blinn
Worthington OH

TOYS OF THE PEOPLE?

I want to send this note for what it is worth.

I am a ham who was a CB nut at one time before they became the toys of people who seem to need something to convey their silly talk over.

I have always wanted to work with radio but never had the chance . . . CB radio got me interested. I believe there are a lot of CB men like me who are in earnest about radio and doing it right. I do not believe, however, we should try so hard to get them. If they are in earnest, they will seek it out.

Above all, we should not let down the rules to let them in. I have had one heck of a time passing the tests, and for all those who told me "there's nothing to it," I can only say "speak for yourselves." But I will also say that now that I have my ticket, it was worth every bit of it. And it means something to me to have done the work.

I, too, thought CW was nuts before I learned it, because I didn't want to spend the time learning it. Now I can see its value and fun.

The best drawing power the ham has is his dedicated interest and knowledge of radio and communications. Most of my old CB friends have no idea what I have learned getting my ticket, but I have found they all hold a special respect in the fact that I am a ham. And frankly, I tell them if they want to get serious about radio, this is the route to take. But until they are serious, they're not ready for us and we're not ready for them.

I cannot help but believe that the FCC and others in power in this matter hold a respect for what the ham world has become and contributed all these past years.

I for one am very proud to be a ham and thank all those who have gone before me in making it what it is today.

Thank you for your time . . . just must speak out.

Clinton J. Reser
New Strawn KS

SEARS AND 2M

It was with great distress that I observed a two meter transceiver on page 967 of the Spring/Summer 1977 Sears catalog. I hope you and *73 Magazine* will take an immediate stand and make a strong statement to both Sears and the FCC. I strongly feel that the open availability of CB equipment through mail order catalogs such as this with no requirement or proof of licensure has added to the number of unlicensed operators on CB today.

I sincerely hope that rapid action will be taken to eliminate the unlicensed non-ham from acquiring a two meter rig, complete with crystals, antenna, and instructions on ham procedures. We have been very lucky in the past to prevent violation of the ham bands and I hope we will be able to nip this in the bud before two meters becomes another eleven meters.

George H. Stokes, Jr. WA4MZL
Mobile AL

We're on the case! Check out the Montgomery Ward story in Briefs. — Ed.

THE LUNATIC FRINGE

The following is going to be difficult to believe unless you have been on the Bicentennial Net for the past several months. Many derogatory comments are made about CBers, but what difference is there when licensed amateurs cause deliberate interference in the following ways: jamming with carriers of up to 30 minutes and more, profanity, obscenities and indecent language (by definition), amateurs with high powered linears that move as close to the net as possible and refuse to move when tactfully asked to do so, whistling, blowing, tapping, and groaning into the microphone, playing a radio and transmitting a phone patch signal deliberately on net frequency. Tuning up on net frequency was always done without any regard or consideration for fellow amateurs — this appears to be entirely acceptable for many amateurs at any time. CBers discourteous???

All of the above did not dampen our spirits; however, there was one thing that was learned very quickly and that was not to acknowledge this type of interference. It is like the obscene phone call — leave them alone and they will go away.

The fellows acting as net control certainly deserve a lot of praise for their patience in keeping the net operational. One bright spot to all of this was the amateur who checked into the net from Kentucky and said he would accept a collect call from any part of the country to get on the air at any time for his state. That is *truly* the Spirit of '76.

Lloyd Krob WAØEFW
Eagan MN

The lunatic fringe lives. — Ed.

OPPOSING VIEWPOINTS

Thought you'd be interested in the enclosed clipping from *Computerworld*, regarding a radio program for ham-computer buffs.

In your January "Letters" column, you published a letter from AA7NEV, who didn't know what kind of time "PMEDT" stood for. Tell him it means afternoon or evening, Eastern Daylight Savings Time!

Your magazines, particularly the editorials, are always stimulating, generally thoughtful, and frequently controversial! Although your readers naturally don't agree with your points of view all the time, we gotta admit one thing: You offer, in the columns of your magazine, an opportunity for opposing viewpoints to be presented — a real rarity these days.

I only wish that all your reader-writers would use a little more courtesy in some of their comments, since the opportunity to present our views is a privilege *73* is granting to us, and not a right which we should demand and abuse.

Hang in there, Wayne!

Bill Houghtaling
Raleigh NC

You're kidding! If it's courtesy you want, read the letters in QST. Don't bother looking here. — Ed.

Hobbyists in Boston Getting Radio Show

CAMBRIDGE, Mass. — Computer hobbyists will take to the airwaves with their very own radio show beginning Jan. 22.

Believed to be the first radio series of its kind, "The Computer Program" will be broadcast on WBUR-FM, a noncommercial radio station with a 100-mile radius in the Boston area.

The format of the show will feature a guest who will speak on a topic of his choice and answer questions from listeners, according to Richard Gardner, host and originator of the show.

The program will also include news items of interest to the home computer hobbyist and a weekly announcement of resources related to the speaker's topic.

The program will be available to other stations and parts of each program can be broadcast as separate programs.

Further information can be obtained from Gardner at Box 134, Harvard Sq., Cambridge, Mass. 02138.

THE FEES DEBATE

I used to sit back comfortably secure in the thought that the people who run our country and agencies such as the FCC were so much brighter than myself, but now I really am worried. I just heard today that they (FCC) are going to eliminate all license fees from CBers and hams. I sure don't understand this. From one side of the FCC's mouth comes word that they don't have enough money to police the wild antics of the CBers, and from the other side they say we have so much money, let's forget the license fees.

The wild rush to the CB bands had already started one quarter of the way when the FCC decided to lower the rate to $4.00 from $9.00. It definitely wasn't lowering the rates that increased the CBers. Maybe the FCC didn't know how to handle the tremendous amount of money that would have come in if they left it alone. My calculator does not go that far, so I can't tell you how much money would have come in.

Does the FCC think that by dumping the $9.00 it will increase the ham ranks? When a prospective ham is ready to spend from $700 to thousands for ham equipment, what difference would $9.00 make? I would sure be interested in knowing how much money the FCC throws away by dropping the fee from $9.00 to $4.00. I wonder how many men could have been hired by the FCC in each state for police action by the money that was thrown away.

Harry Torossian WB8SWD
Dearborn Heights MI

FREEDOM OF INFORMATION

Thomas Houser, Director
Office of Telecommunications Policy
Washington, D.C.

Dear Mr. Houser:

Your recent letter to FCC Chairman Richard Wiley claims that "the federal agencies that compromise the OTP-chaired Interdepartment Radio Advisory Committee have studied all of the frequency bands currently under government control to determine whether any additional spectrum might be made available for Citizens

Continued on page 60

Briefs

Compiled by Warren Elly WA1GUD and Stan Miastkowski WA1UMV

How many times have you spent the day getting to the nearest FCC office, struggled through an exam, passed, and dragged yourself home . . . only to wait two or even three months for your new license? It's frustrating, and soon to be a thing of the past. Field Offices, starting sometime in March, will issue temporary authority for amateurs to use their new privileges before receiving the Gettysburg paperwork. The temporary permit will be good for 90 days and will require special identification while operating under temporary status. FCC's Greg Jones told *73* the March target date wasn't definite, but instead a goal.

The Long Island Mobile Amateur Radio Club (LIMARC) ATV repeater became operational on a regular basis at the end of January. The 439.25 in, 427.25 out machine is located in Plainview NY on a 320 foot antenna. It has an ERP of 200 Watts and is omnidirectional, allowing amateurs within a 20 mile radius to use its facilities.

Ed Pillar W2KPQ, Chairman of the LIMARC ATV Committee, and 30 members built the machine in their spare time from converted components. Most of the equipment and parts were donated by local industry and salvaged from various commercial sources. The club estimated the total cost in the vicinity of $2000, and will be running an experimental educational program on amateur radio and basic electronics in three schools within the Syosset NY school system.

The club is also planning to move its weekly technical net to the ATV repeater, with the visual medium giving an added punch to technical discussions.

The one year grant for the use of the 420 to 450 MHz band for experimental ATV repeater operation was issued on February 27, 1976. LIMARC has asked the ARRL board of directors to petition the FCC for a *five* year extension of the grant, citing the fact that last March the FCC granted offshore radio location (HIRAN) an extension for that period of time.

Ed Piller W2KPQ, Chairman LIMARC ATV Committee, with ATV repeater.

The FCC's proposal to deregulate (and decontrol) repeaters (see Guest Editorials and FCC) has drawn mixed reviews from the Ohio Area Repeater Council. Meeting January 8th, two days after the FCC proposal was released, the council voted 55 to 6 *against* elimination of repeater sub-bands, repeater licenses, and repeater callsigns . . . as Docket 21033 calls for. Instead, the council's officers were instructed to file comments with the Commission, "asking for continuation of repeater sub-bands, licenses, and callsigns, and for establishment of procedures by which the FCC will secure the comments of frequency coordinating groups such as the Ohio Council before acting on an application for a repeater license." The Ohio group did like the FCC's plan to simplify logging requirements and restrictions on remote bases and auxiliary links. Thanks W8GRG.

The Amateur and Citizens Division name change wasn't supposed to take effect until January 20th . . . but receptionists were answering the phone with the division's new name ("Personal Radio Division") the week before. There are no changes in the division's operation as of now, but the future could incorporate other radio services like private aircraft and marine.

Even if you try to pay the FCC for your new license or renewal, the Commission will still refuse. As reported last month, all fees were suspended by court order, effective January 1st. If you do send a check, the FCC will destroy it, and advise by mail. Cash or money orders will be refunded by government check. FCC officials, at press time, were still investigating retroactive refunds dating back to the court decision's effective date.

Topics expected to come up at the January 20th ARRL Directors meeting included a hike in League dues and a formal vote on the League's reply to the FCC docket on WARC. Some sources said they expected dues to go up $12 in the US, with the cover price of *QST* up to $2. (We'll have an update in Briefs next month.) On WARC, a letter to ARRL directors shortly after the FCC released its WARC proposal indicated the League would continue to push for new allocations at 10 MHz. See comments of Dave Sumner K1ZZ in last month's WARC report.

The case against Irael Treger W9IVJ continues in Chicago. Illinois Assistant Attorney General John McPhee says things are proceeding slowly, with the latest developments only promising further delay. McPhee is trying to get a court injunction barring Treger's company (Trigger Electronics) from advertising or carrying out business by mail. Over 350 people have complained that they mailed orders to Trigger, received their cancelled checks, but never got what they ordered. According to McPhee, about a third of the complaints have now been settled, "either to the total satisfaction, or partial satisfaction, of those concerned." However, with Treger hospitalized after suffering a stroke in early January, the chances of most victims recovering their money begin to fade. As McPhee put it, "The Judge may well tell us to leave Mr. Treger alone, concluding he has suffered enough already." In other words, after months of stonewalling the AG's demands for financial statements and depositions, Irael Treger continues to send out his catalogs and collect money from unsuspecting customers . . . and it seems like the courts may let him get away with it. Justice, anyone?

The role of amateur radio as a valuable public service was once again demonstrated after an earthquake in northern Italy last May. Details of amateur radio's part in the disaster have just become available. Repeater stations survived the shock and passed the word of the quake to the outside world. Next day 200 members of the Italian emergency corps established an emergency network to assist authorities in rescue efforts. The activity continued for nearly two weeks and was acknowledged with thanks by government authorities.

The on-again, off-again "Big Noise," the broadbanded buzzsaw interference that has been disrupting worldwide communications, was off at press time. A high-placed FCC source said that the Washington offices had received no complaints since the first of the year.

The noise had tapered off toward the end of 1976, and the FCC added that there seemed to have been a concerted effort to keep the noise out of the maritime and aeronautical safety services.

As reported in *73* last month, the Soviet Union admitted that the noise was coming from their country and was an "experimental use of the radio spectrum."

World mass media picked up the story toward the end of 1976 and speculated about the nature of the noise. Although many experts consider the noise a propagation study, some journalists have theorized that it was an experiment in the disruption of worldwide communications which could be used to create havoc with an army's communication during a war. Yet another farther out theory considers the possibility of the development of a "death-ray."

Whatever the nature of the noise, it seems to be gradually disappearing. FCC spokesmen did add that any further reports would be appreciated, including the time, frequency, and type of interference.

Just before press time, the "DX Jukebox" program of Radio Nederland in Hilversum reported that the Reuters News Service had quoted the Norwegian Defense Minister as saying US intelligence sources had indicated the radio interference was from a very powerful Soviet over-the-horizon radar, which could track aircraft anywhere in the world. Due to the extremely long range of the radar, it had to operate in the HF band rather than the UHF or VHF spectrum. It was further stated that the interference was coming from four transmitters, two located near the city of Kiev and two near the city of Nikolaev, both in the Ukraine.

The largest radio telescope in the world for ultra-short wavelength study has just been completed near the Amherst campus of the University of

Massachusetts in the western part of the state. Dr. Richard Huguenin, Director of Radioastronomy, in a *73* interview said the 45 foot dish has been under construction for nearly three years. It's fully steerable and enclosed in a geodesic dome.

Radiowaves in the one millimeter region (300 GHz) will be studied in an effort to understand interstellar molecules and their role in the birth of stars.

The installation was funded by the National Science Foundation and the Commonwealth of Massachusetts. It will be used by scientists from around the world.

Lowdown is a new monthly newsletter designed for the interest of LF band enthusiasts 540 kHz and down. A one year subscription is free to anyone who sends 12 SASEs to H. John Clements, 9010 Tobias #258, Panorama City CA 91402.

Persons involved on both sides of the RTTY/repeater controversy on 146.70 MHz in the Ohio area continued to take hard lines at press time. As reported in the January issue of *73*, Robert Scott W8FSK organized RTTY enthusiasts to protest a new 10/70 repeater on the frequency, which had been used for RTTY nets.

A great deal of correspondence between RTTY operators and the Ohio Area Repeater Council was generated, and the Council took up the issue at its January meeting. According to the minutes of the meeting, "It was agreed that if the individuals concerned had requested approval of 10/70 for a RTTY repeater before the voice repeater group asked for the pair, the RTTY request would have been approved. However, as there has been no such request, and in view of the use of other repeater pairs for teletype elsewhere in Ohio, the membership confirmed its earlier approval of 10/70 voice repeaters, and reaffirmed its decision not to reserve any repeater frequencies for direct use on either RTTY or voice."

Scott vowed to continue the fight against the use of 146.70 for voice. With the situation deadlocked, bad feelings abound and both sides seem to be drifting farther apart.

Opinions vary on the success of "Repeater Appreciation Week" in California the first week of January. Twelve major systems and virtually all of the minors shut down for a five day period from January 1st through 5th. The shutdown was caused by increasing abuse and bad language on many repeaters in the state. WR6ABE was shut down for two months last fall because of the severity of the situation on that machine.

During the "appreciation" period, control operators monitored the input frequencies for emergency traffic. No major problems were reported, although some of those alleged to have caused the trouble appeared briefly on some of the machines left on.

By shutting off machines, owners and control operators hoped to motivate users to self-police the offenders. Many systems came back under rigid control of operators and were immediately shut off again at the first sign of jamming or bad behavior.

Although first reports after the resumption of normal repeater activity showed a noticeable decrease in bad behavior, the next few months will tell the story about the future need for more appreciation periods.

St. Nick put out a lot of HO HO HQs on 2 meter FM.

Looking for Smokey? Owners of Drake series R-4 receivers can now tune in to CB channel 19 by doing the following: Set the band selector to 28.5 MHz and the "xtal" switch to 160 meters. Rotate the preselector to 15 meters and the dial to read 535. 10-4 and thanks again good buddy to the Santa Barbara CA Amateur Radio Club.

As reported in the February Briefs, the Bicentennial Relay project had become bogged down in red tape. Congratulatory messages from 45 governors and the Mayor of the District of Columbia to President Jimmy Carter were held up for nearly two months, while Bill Miller K4MM pressed for an appointment. In Chicago, where the idea got started with the local Quarter Century Wireless Association Chapter and Eric Shalkhauser W9CI (a participant in the first Presidential Relay held back in 1916), Lee Knirko W9MOL tried to interest the media with little success. A Chicago press conference drew only one reporter, and in Washington it was much the same story. The messages were delivered January 12th to Mr. Carter's appointments secretary, Fran Voorde. An appointment with the President prior to his inauguration proved impossible for two reasons: Mr. Carter's busy schedule and the Secret Service's reservations. The SS reportedly worried that if the hams got a chance to present the new President with the messages, "every group in the country would try to do the same thing." *That*, in the security conscious minds of the SS, would be a major no-no. (Incidentally, W9CI's fine history of ham radio begins with this issue of *73*.)

An unemployed engineer, complaining that waves emanating from a car's citizens band radio caused him pain, hurled a cinder block through the car's windshield yesterday, police said. Two Nassau County police detectives riding to work in the car immediately arrested the engineer.

Police charged James O. Nelson, 32, of 2 Norway Pine Drive, Medford, with third-degree criminal mischief, a felony, and second-degree reckless endangerment, a misdemeanor, and District Court Judge Warren Doolittle ordered him held in lieu of $1,500 bail. The detectives, George and John Staudt, were not hurt. The two are brothers.

Nelson, a former employee of the Grumman Corporation, allegedly stepped from the curb at Farmers and Stewart Avenues in Bethpage at about 8 am. Police said he threw a nine inch by 12 inch cinder block through the windshield of George Staudt's car and walked away. The detectives went after Nelson and arrested him. The car had been stopped at the intersection for a stop sign, according to police, who said the Staudts were on their way to work in the Eighth Precinct. *Reprinted from* Newsday, *Garden City, LI, NY.*

Members of the St. Jude Hospital Amateur Radio Club and the Southern California ATV Club staged an ATV "first" on December 22. They made it possible for patients at the Fullerton hospital to talk with Santa Claus while viewing him on 432 MHz color ATV.

The project was set up by Joe Moell WA6JFP and XYL April WA6OPS, Director of Occupational Therapy at St. Jude's. The TV signal source was the hospital's color TV camera, with 432 MHz equipment provided by Ernie Williams WB6BAP and John Verna WA6CAS of the SCATV Club.

Santa visited each room in the pediatrics and long term rehabilitation units of the hospital by means of a battery-operated color TV set and ATV converter, wheeled from room to room. Patients talked back to Santa on 2 meter FM simplex. A realistic "set" for St. Nick was made by hospital therapists, and background sound effects of reindeer and workshop elves came from an endless tape loop. In order that there be no doubt of Santa's authenticity, he was thoroughly briefed beforehand of each patient's name and background.

Newsfilm of Santa's ATV visit was shown to all of Southern California Christmas Eve on a Los Angeles television station. Thanks to WA6JFP for story and photos.

The antenna zoning case of Walter Weber WA9FXG has not yet been settled. In January, *73* reported that Weber has been ordered to remove his 72 foot tower and antennas. The fight against the Des Plaines IL city council has so far cost Weber nearly $2000 out of his own pocket. At press time, it appeared that the city council was dragging out the case through numerous legal loopholes in an effort to drain Weber financially.

In court late in December, the Des Plaines city attorney filed a motion to have Weber's suit against the city council dismissed. Because no reason was given, the motion was denied. The city then filed a point by point denial

Ed Webb W9IPO, President of the Chicago Area Chapter, Quarter Century Wireless Association, sponsors of the Amateur Radio Bicentennial Relay, Prof. Eric (Shaw) Shalkhauser W9CI, Honorary Chairman, receiving award in Chicago of message from President Gerald Ford, with Lee Knirko W9MOL, Relay Chairman. (Photo by John Bayalis W9CSA)

of Weber's suit.

Most antenna zoning cases have been quietly settled out of court in the past due to vague zoning laws. This case appears to be the first in Illinois and one of the first in the country to actually reach the courtroom. A negative decision could make it difficult for amateurs to erect antennas anywhere in the country.

A fund has been started in an attempt to help pay for the legal costs of the tower battle. Contributions can be sent to WA9FXG Tower Fund, c/o Hajek & Hajek, Law Centre, Mannheim & Roosevelt, Westchester IL 60153.

73 West Coast Associate Bill Pasternak reports that although the 1977 SAROC in Las Vegas seemed well attended, complaints abounded from both amateurs and exhibitors. Early arrivals found that the hotel reservations had been almost totally fouled up and some were forced to return home before the proceedings began. Many remarked that the speaker programs were "bad." Amateur manufacturers and distributors who exhibited were bothered by the lack of interest from the crowds. Most of the advance sales had gone to microprocessor enthusiasts, despite the fact that only two micro manufacturers were represented in the exhibit hall.

Many exhibitors who had been at SAROC in the past were absent this year. One said he would not be back, adding that SAROC is a "dud, and getting worse every year."

A number of new products were shown at the show. Among them was the long-awaited Dentron MLA-2500 linear, as well as a new Drake transceiver, the TR-4CW featuring a switchable CW filter. Amateurs got a first look at the previously announced Atlas 350-XL, with digital readout and 350 Watts out. More HF equipment made its debut with two new rigs from Ten-Tec, the Triton IV, yet another digital readout unit, and the Century 21, a 70 Watt allband rig.

With the large part that VHF is playing in amateur radio these days, the majority of new equipment was for that part of the spectrum. VHF Engineering introduced a new line of 2 meter amplifiers. The record for mobile 2 meter amps will now go to TPL, who introduced a *250* Watt unit. Kenwood was showing the TS-600, an all mode transceiver for 6 meters that should be available soon. KLM introduced the VFO-711 for their 2 meter rigs.

Accessories were well represented with new crank-up towers from Tristo and Wilson, as well as Wilson's super heavy duty rotator, capable of turning half a ton.

One unique product was the Astro 200 transceiver from CIR. It has digital tuning that is done automatically in 100 kHz steps. You push a button up or down for tuning in the corresponding directions.

Dale Hoppe K6UA of Fallbrook CA is the proud holder of the second WAZ certificate for 75 meter phone, and the first for the northern hemisphere. An avid DXer since being licensed in 1941, Hoppe started working toward the certificate in January of 1973 and received it late in 1976.

When asked about the toughest zones, Hoppe said that the last, zone 23, was the most difficult. A confirmed QSO there with UA9NH/JT-1 in Mongolia put him over the top. Adding to the difficulties, zones 15, 16, 17, and 18 required long path propagation.

The first WAZ for 75 meter phone belongs to Dr. Juan Fernando EA8CR in the Canary Islands.

Hoppe uses a Kenwood driving a Henry 2K. His antenna system is a directive curtain using four delta loops, two driven and two parasitic, giving a 10 dB gain.

He is active on all bands, including 2 meter FM and SSB, and holds a WAZ on 15, 20, and 40, as well as a WAC for 160 meters.

After nearly a year of operation, an amateur radio club formed to promote the use of SSB on 2 meters is expanding at a rapid rate. The "Side Winders On Two" headquartered in Fort Worth TX has over 300 members located all over the country. Nets have been formed on 145.10 MHz to demonstrate the potential of the 2 meter band and the SSB mode for rag chewing and DX.

Requirements for membership are working two members on 2 meter SSB. A list of members and further information on membership can be obtained from George Bretz, Treasurer, Side Winders On Two, 3520 Livingston, Fort Worth TX 76110.

It appears that the USSR is on the verge of launching an amateur radio satellite. Persistent rumors coming from Soviet amateurs put the launch date at sometime in the spring.

Nearly a year ago, several Soviet hams told AMSAT in Washington that the satellite was built and was undergoing final tests. It was not launched due to an unexplained delay.

Details were sketchy at press time. An issue of a Soviet amateur radio magazine showed a picture of a 2 to 10 meter transceiving installation and hinted at its use for a new satellite.

Both OSCAR 6 and OSCAR 7 continue to have battery problems. At press time, AMSAT president Perry Kline told *73* that telemetry data was still being gathered, but it appeared that one of the 18 cells in OSCAR 6 had failed. Instructions were given to command stations to change the voltage rating at which the satellite was shut down.

AMSAT was considering two theories in an attempt to rejuvenate the cell. One was to charge it vigorously for a period of time. The other was to continue to discharge the battery and then recharge it. Each of the 18 cells supplies 1.8 volts at full charge.

OSCAR 7 developed a problem with one of the solar panels, causing a voltage reduction aboard that spacecraft. Kline said that it was expected that OSCAR 7 Mode B orbits would be switched to Mode C until at least the end of February (Mode C is Mode B at half power).

Plans are continuing for a concerted fund-raising effort for AMSAT. As reported last month, funding for OSCAR 8 and the Phase III satellites is a problem. AMSAT officials are considering several avenues for seeking contributions and still seek new members and volunteers. AMSAT is located at Box 27 in Washington DC.

The famous sound of Morse code's dah-dit may be phasing out for the maritime industry. This is because two communications satellites are in synchronous orbit over the Atlantic and Pacific oceans. These maritime satellites, built by Hughes, are owned and operated by a consortium of carriers headed by COMSAT General Corporation. Called Marisat, the satellites are currently relaying high-quality voice, telex, facsimile, and data over both oceans for the international maritime industry. Marisat also serves the US Navy for fleet communications.

A third satellite, for Navy use and commercial backup, was placed in synchronous orbit over the Indian Ocean last October. Four-foot-diameter ship antennas allow ships to make instant contact with home port or to be reached instantly by ship telephone. Ships can also reach other ships via the system's ground station for telex messages.

Reprinted from IEEE Spectrum, *The Institute of Electrical and Electronics Engineers, Inc., New York NY.*

Collins Commercial Telecommunications Division of Rockwell International has received a $25.5 million contract from the Corporation for Public Broadcasting (CPB) to build an earth station system.

Collins will provide an earth station system comprised of 150 to 165 stations for the new nationwide satellite-based television system that will serve the Public Broadcasting Service (PBS). It will be the first large scale application of small earth terminals for television distribution by satellite in the United States.

Collins will provide a turnkey station which will include receive-only ground terminals, interconnect links, and services such as frequency coordination and site selection, prototype and qualification testing, site preparation, construction, installation, and long term maintenance support.

With the new satellite system, PBS will be able to broadcast multiple programs to public television stations simultaneously, enabling each station to decide which program to air and which one to tape for later showing. The new system will also enable PBS to provide additional channels to enlarge programming options for various groupings of its stations.

The new system is designed to provide flexibility and access to public television stations not previously financially possible, and expansion of the PBS interconnection using its new satellite system will be less complex and costly than at present. Under present conditions, linking up of a new public television station often takes two to three years. With the new system, PBS can have a new ground terminal installed as quickly as the equipment can be erected and frequency coordination requirements met. Also, the costs of interconnecting new stations in the satellite mode are substantially less than such costs in the present terrestrial mode.

Signal quality will be improved with the new satellite system, because a single signal will be picked up at approximately equal strength by each receive-only ground terminal. Distance has little significance, of course, and signal deterioration will not occur as it does in terrestrial systems.

The new public broadcasting satellite system will utilize three transponders of Western Union's WESTAR satellite to beam signals across the continental US, and to Alaska, Hawaii, Puerto Rico, and the US Virgin Islands.

The basic television receive-only earth station system will include 10 meter "nominal" antennas, low-noise amplifiers ranging in temperature from 50° Kelvin to 300° Kelvin, and the new Collins 55U3-1SC frequency agile video receiver.

The single shelf receiver can be tuned locally or remotely to any of 500 channels in the 3.7 GHz to 4.2 GHz band. It also features a maintenance logic unit that can diagnose faults to the replaceable module level and an ac/dc dual-voltage power input capability for redundancy of primary power, if desired.

The terminals will be designed for a video signal-to-noise of 53 dB assuming a video peak deviation of 13.5 MHz and a carrier-to-noise of 14 dB minimum.

The PBS satellite system is expected to be operational by the fall of 1978.

Collins has been involved in satellite communications since the early 1960's, when Collins engineers transmitted video, voice, and data signals from Iowa to Texas by bouncing them off the orbiting Echo balloon.

A growing trend on repeaters is the running of simulated emergency nets on an unscheduled basis. The nets give emergency coordinators an indication of the areas covered by the machines used and the availability of volunteers, as well as being a valuable training exercise. How about trying the idea on your repeater?

The Santa Barbara CA Amateur Radio Club reports that you can't beat CW when it comes to a tough communications path. Recently, a pleasure boat in the Santa Barbara Channel asked for assistance on the CB REACT network. Because of radio problems, the boat could not be understood. Dave McCollum WA6RGJ was on duty. He determined that the boat owner was familiar with CW, had

him switch the radio to SSB, and key the mike in CW. The message was then passed successfully.

It may be that 2 meter rigs will be as common as CB radios on the shelves of the nation's large retailers. The two largest mass merchandisers in the country, Sears Roebuck and Montgomery Ward, are both in the process of testing the water in the selling of ham gear.

The spring-summer edition of the 1977 Sears catalog has a 2 meter rig sitting beside the CB listings. The 22 channel rig is accompanied by a full explanation of ham radio and a caution that a license is needed for operation of the unit.

A spokesman at Yaesu Electronics in California admitted to *73* that the Sears unit is manufactured by Yaesu in Japan, but is not offered under the Yaesu name in the United States.

Meanwhile, the Montgomery Ward store in Plattsburgh NY is the site of a test marketing program for amateur radio gear. Michael Hanrihan, communications products manager for the store, told *73* that he was in the process of contacting major amateur product manufacturers in an effort to build a complete choice of product lines. At press time, Hanrihan admitted that he was getting little support from the companies that he had contacted. Of three major manufacturers contacted, one insisted that the entire line be purchased, one promised to call back but never did, and one gave Montgomery Ward an outright negative answer, saying that they did not want to jeopardize their existing dealer structure.

Another roadblock put in front of Montgomery Ward was a requirement that they take care of all warranty work. Although the amateur department may not be as full as first envisioned, the store was successful in obtaining the Midland line of 2 meter rigs.

Top officials at both Sears and Montgomery Ward were reluctant to comment on their future plans regarding the amateur market. A Montgomery Ward official said that the success or failure of amateur products at the Plattsburgh store would be studied over a one year period. If the pilot program is successful, the company may consider adding an amateur department to all of its retail stores, as well as the catalog.

The reluctance of major amateur products manufacturers to consider mass merchandisers draws an interesting parallel to a situation which existed in the photographic industry nearly ten years ago. At that time, manufacturers of advanced amateur cameras and accessories were reluctant to sell to mass merchandisers, fearing a complete loss of business in photo specialty stores. When one company broke down and decided to enter the market, others soon followed, and a number of discounters suddenly were equipped with fully stocked photo departments. Instead of taking business from specialty retailers, the increased availability of the products created a whole new market which all shared. A vastly larger distribution network for amateur products could possibly create enough demand to give amateur radio thousands of new devotees.

Trio-Kenwood digs in hard to officially break ground at the site of their new offices in Compton, California. The 23,000 square foot structure is being built to TKC's specifications by Nova Construction Company and is scheduled for completion in April, 1977.

The problem of CB radio theft has finally come to the attention of the federal government. Several congressmen, including Senator Thomas Eagleton of Missouri, have introduced legislation into Congress that would make CB radio theft a federal offense. Two bills were introduced last session, H.R. 13222 and 13223, that would make such theft punishable by a possible $5,000 fine and one year imprisonment. The bills specify that a transceiver missing for over 24 hours would be considered to have crossed state lines, thus allowing federal law to take effect. All mobile transceivers would be covered under the proposed laws, thus including amateur two meter gear which is also highly susceptible to rip-off. However, in a conversation with Senator Eagleton's office, *73* was informed that the two bills had "died" when the last session of Congress ended. It is hoped that they will be reintroduced when the change of administration is complete.

The London Ontario Amateur Radio Club reports that a number of Canadian amateurs are having problems passing through customs with amateur units when returning from trips into the United States. The depressed market for 23 channel rigs in the U.S. has made them attractive to a number of Canadians. Since border personnel may not be aware of the difference between amateur and CB rigs, Canadian amateurs are urged to carry a photocopy of their license and the bill of sale for the radio. When entering the U.S., they should have Canadian customs officials fill out form Y38, which will record the unit as having left Canada and should facilitate easy reentry.

Tired of waiting for QSL cards from slow DX stations? Have patience. Two years ago, scientists at Jet Propulsion Laboratories in Pasadena CA sent a message to a star system that they believe has a high probability of having habitable planets. If an answer is sent back as soon as the message is received, it should be arriving here on earth in 48,000 years. Is a new WAG (worked all galaxies) certificate far behind?

The US State Department has announced success in its negotiations with The Republic of the Philippines. A reciprocal operating treaty was the result, effective October 25th.
From ARRL Bulletin.

We've been getting some letters from MARS members of late, complaining about changes in their calls. Marc Leavey WA3AJR wrote of his belief that the FCC had purposely shuffled MARS calls to grant special bicentennial calls to the general amateur population.

"A little more than two years ago, the three MARS programs operated just as they had for decades. Upon entering MARS, an amateur would assume a callsign based on his FCC issued identification. The scheme was, where "n" represents the FCC Call District, thus:

Prefix	Army	Navy	Air-Force
Wn	An	N0	AFAn
Kn	AAn	N0	AFBn
WAn	ADn	N0	AFCn
. . . etc.			

"This was all well and good until about two years ago, when we were informed of a change.

"It turned out that the FCC had determined that the calls we were using on the MARS frequencies were illegal. The prefix 'AD3', as in AD3AJR, for example, was not a USA call at all, but rather one assigned to the tiny nation of Lower Ugorgi, or some such. Thus, to comply with international treaty regarding amateur callsigns, a change was in order.

"This declaration was of note for several reasons. First, it has been established in many other cases that the MARS program does *not* fall under the jurisdiction of the FCC, but of the Inter-Agency Board (IAB), a faceless group which looks over military and government radio use. Further, there is no reason for MARS callsigns to follow amateur regulations as operation is not under the Amateur Radio Service rules, nor is it on amateur frequencies. Certainly the 'Command' stations, WAR, AIR, NAV, and NPG, have calls which do not follow amateur convention.

"Nonetheless, without a whimper, we complied. Our reward was:

Prefix	Army	Navy
Wn	AAMn	NNN0
Kn	ABMn	NNN0
WAn	ACMn	NNN0

"Air Force was unchanged, Army got jawbreaker calls, and Navy people started stuttering!

"Then came the Bicentennial and the famed bicentennial callsigns. Looking suspiciously like the 'illegal' Army MARS calls, which were never heard on amateur frequencies, use of these 'special' prefixes was encouraged on all ham bands, especially in international contacts. Remember:

W = AC
K = AD
WA = AA
WB = AB

"Do you think, maybe, the *real* reason for changing the MARS calls was to provide the block for Bicentennial use?

"Well, now it's 1977, a new year. The celebration is over, the calls are gone. Of course, the FCC is now issuing the old Navy calls to amateurs (NnXX), having finished with the Army/Bicentennial calls. Is there any hope for us to get our old calls back?"

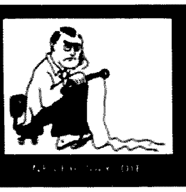
Marc I. Leavey, M.D.
WA3AJR-ACM3AJR
(ex-AD3AJR)
Randallstown MD

We're checking. Meanwhile, what about the scuffle for 1 x 2 callsigns? It's gotten to the point where you don't know whether you're talking to a seasoned veteran or an 18 year old kid. (More on the FCC's callsign shuffle next month.)

There *is* a place where Technican class licensees can operate SSB on HF, and where Novices can operate voice on 2 meter FM. It's the Military Affiliate Radio System (MARS) which is always looking for dedicated traffic handlers. Besides the extra privileges, MARS licensees are issued distinctive callsigns and are given access to surplus equipment. MARS units in many areas of the country are currently running membership drives. For further information, write: Commander U.S.A.A.C., Attn CC OPS OM, Fort Huachuca AZ 85613.

LIMARC, The Long Island Mobile

Continued on page 196



. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 7.

from the FCC. We are still far too restricted by the FCC to be able to set up much in the way of gentlemen's agreements on the use of our bands. If the FCC were to throw out the bandwidth proposals now under consideration (Docket 20777) and remove all restrictions on modes of communications, we would then have a situation where we could start governing ourselves.

Since the repeater councils presently represent about half of the active amateurs, we have a good start. Most repeater clubs have expanded to be regular ham clubs, with many non-FM members. Those which haven't opened up to non-FMers should get their act together . . . how can you run Novice classes when Novices can't use FM? And what red-blooded ham club doesn't have a Novice class going these days?

Think about a structure for amateur radio founded on the radio clubs. Representatives of the clubs would meet with area councils to pass along the wishes of the clubs . . . and bring back the ideas from other clubs. Council representatives would meet to agree on changes in our agreements on subbands, modes, etc. This would permit amateurs to keep up with technical developments, and should encourage the pioneering of new ideas. This would take only a national meeting of councils to be put into effect . . . everything else is already in motion and working reasonably well.

Such a system would need a mode of communications . . . a forum where ideas for changes in agreements could be discussed . . . the pros and cons developed. It goes without saying that *73 Magazine* is available for this . . . it always has been. Clubs can't be sure of getting all the information they need to make intelligent decisions unless there is a relatively free press . . . and this comes down to *73*. *QST* is not known for allowing more than the ARRL side of things. *HR* seems to panic at any suggestion of offending *QST*, upon whom they are overdependent. I'll print just about anything in *73*, and whether I agree with it or not is irrelevant.

So there's an idea. You can let me know what you think.

MA BELL WISES UP

When Bell decided to use on-line signaling for long distance calls, a number of engineers advised against it. They pointed out that this would encourage the development of ways to defeat the billing for the calls. The engineers tried hard to convince higher-ups that they should use separate wires for signaling and thus avoid any problems with customers using signals of their own. The deaf ear turned to these engineers was not one of the brighter decisions made by phone company officials.

It was this decision to use the same wires for operating the dialing equipment as for the phone conversations which brought about the development of the red box, the black box, and eventually the blue box . . . devices for getting around some of the on-line signaling. The engineers raised a chorus of "I told you so" as blue box use escalated. I suspect that the phone company reacted by firing the wise guys.

At any rate, Bell has recently announced that they are at long last setting up separate lines for handling dialing. With some of the newer high speed systems, one set of signaling lines will be able to handle hundreds of customer lines, since few signals will take more than a second or two to transmit. Bell is trying out the new system in Wisconsin and expects it to be all over the country in a few years. This will greatly speed up connections on long distance calls and will make it possible to make collect calls without the help of an operator. It will also thwart any blue box fans who are still not in jail.

MAIL ORDER RIGHTS

Since a good number of the ads in *73* are mail order ads, it may be helpful to both prospective customers and mail order firms if I go over the new mail order laws.

The Federal Trade Commission has some rules which go a long way toward protecting the mail order buyer. It really doesn't pay to fool around with these chaps, so read on and see what they've done.

A customer has the right to know when to expect merchandise to be shipped. If no date is set by the seller, you have the right to have your merchandise shipped within 30 days. If the seller does not ship within 30 days, you have the right to cancel your order and get all of your money back. The seller must notify you of the delay and give you a free means (postage paid reply). If the delay is 30 days or less, you have the right to cancel your order and get your money back, the right to agree to a new shipping date, or the right not to answer . . . in which case the seller assumes that you agree to the shipping delay. If the shipping delay is more than 30 days, you must give your express consent to the delay, otherwise the seller must return your money at the end of the first 30 days of the delay.

If you cancel, you have the right to get all of your money back, and it must be mailed to you within seven working days after you cancel. On credit sales, the seller has one billing cycle to adjust your account.

If you have a problem, write to the dealer directly. If you don't get results, outline the facts, with a copy of the ad and a short letter, and send it to: Director, Bureau of Consumer Protection, Federal Trade Commission, Washington DC 20580 . . . and please send a copy to Wayne Green, *73 Magazine*, Peterborough NH 03458, so I'll know when a firm is lousing up.

A CALL FOR PAPERS

It wasn't very long ago, historically, that one of our ham magazines was calling for those unused frequencies between 146-148 MHz to be made into a new citizens band. It probably wasn't so much cooler heads prevailing as the glacier-like movement of the FCC which saved our present repeater band.

Today we hear that familiar cry of "use it or lose it" ringing out plaintively, echoing up and down our many virtually unused ham bands. One or two furtive teenagers calling CQ every night do not constitute much of a foothold on an empty ham band. And since there is probably no way in this world to get that old-timer's tuning knob unfrozen from 3999 kHz, where he's been for over twenty years, we have a desperate need for newcomers.

Many clubs are doing a great job of attracting new blood to hamming. The big source of beginners in amateur radio has been CB, now that amateurs have discovered there are some nice people on CB, much to their surprise. Where in 1973 only about 50 ham clubs had license study classes, now almost 3000 clubs are offering these, and the result is a ham increase during 1976 of 22,497 (according to the Callbook) . . . that's about an 8% increase . . . showing that while we haven't grabbed the brass ring, we definitely are back on the merry-go-round . . . to coin a phrase.

Prior to ARRL's "incentive licensing" fiasco, the ham growth had been about 11% per year for quite a few years. We certainly should get back on that schedule, at the least. I think we can do it . . . heck, I *know* we can do it. We had to live with zero growth for over ten hard years, so we're pretty rugged.

I see the key to growth lying in the expanding interest in CB. With millions of people becoming familiar with two-way radio, I think we can spark a hamming interest in this tinder.

To spark this interest, we need to tell the world about the fun of hamming. Oddly enough, hardly anything has been written by amateurs telling about the various hobbies that go to make up what we call amateur radio. I'd like to see papers submitted to *73 Magazine* on every facet of hamming. These could be published in *73* . . . put into booklets to go to CB clubs . . . booklets in radio stores . . . etc.

A paper should explain about one particular phase of amateur radio in terms a beginner can understand . . . it should be well illustrated with photographs and any drawings or maps which will help explain. The deadline for papers for this competition is May 15, 1977. Winning papers will be published and the authors will receive a certificate of merit for their contribution to the growth of amateur radio . . . plus a check for $250.

Papers which get honorable mention may also be published and will be paid for at regular rates . . . the fact is that any well done paper will probably be used in this drive to convince CBers (and everyone else) that they should get their ham tickets.

Major facets of hamming:

- DXing
- Contests
- Certificate Hunting
- SSTV
- RTTY
- ATV
- FM/Repeaters
- Public Service
- MARS
- Nets
- Traffic Handling
- Oscar/Amsat
- Club Work
- Home Building
- Antenna Experimentation
- Novice Classes
- Microcomputers
- QRP
- Mobile
- Moonbounce
- 160m DXing
- DXpeditions
- High Speed CW
- VHF SSB

Here is a way to have a lot of fun . . . to give a big boost to your own special interest . . . to help amateur radio in general . . . and to get some recognition. There's nothing like being published in the magazine to make you an "expert."

Since the main purpose of these papers is to attract newcomers to amateur radio, be sure to start out with something dramatic if you can. Emphasize the fun . . . be honest about the cost, but try not to scare off the beginner. Try to have the best pictures you can . . . black and white. You might plan for one color picture later if the paper is a winner . . . something that might be used on the magazine cover. This takes a very good camera and experience.

You might think of this as a way to help pay back amateur radio for the enjoyment it has given you.

WRITING FOR 73

What does an author expect from a publisher . . . in addition to being paid well and promptly? Well, there is a bit of vanity in all of us and we want to know that our ideas will get the best possible distribution. We want to reach those who will be receptive to our ideas.

Since *73* has done most of the pioneering in the ham field, most of the top name authors have tended to write for *73* . . . it is the best way for them to reach the people who count. There is no discounting the impact of *73* . . . for instance, it was *73* which brought FM and repeaters to general use . . . and it was the *73* push to get clubs to start hamming classes and get

Continued on page 34

New Products

HY-GAIN 3750 SSB/CW TRANSCEIVER

Every so often a truly unique radio appears on the scene, and after a few years it disappears almost as quickly as it arrived. The cutting edge is usually price. Signal Ones and HRO-500 receivers could only be afforded by a minority of amateurs, despite claims that hams are a wealthy, exclusive lot who can afford $2000 pieces of equipment. Figures I've seen recently project that hams will spend an average of $400 in the next 12 months on additional gear, and that doesn't seem to allow for many 2 kilobuck transceivers. The market then for radios like the Hy-Gain 3750 may be small, but it undoubtedly exists.

Hy-Gain has had its problems (*73* Briefs, February, 1977), but reorganization has divided the company's CB and ham divisions, and autonomy is bound to bolster the amateur side. A new 2m HT is now available (watch for a *73* New Product Review), and Hy-Gain's long-established line of antennas continues to sell well. The 3750 transceiver is the centerpiece in Hy-Gain's amateur plans for the future, and it represents state-of-the-art design.

Marketed by Hy-Gain here in the US, the 3750 is manufactured in Japan by National (no connection to the American company). Not many 3750s had reached the US at deadline, but by the time this issue gets to you, availability will be up. Most people we worked with the 3750 had never heard one before, and the radio caused quite a commotion as soon as stations realized what they were listening to. Several pileups were caused by the curious, but we couldn't find anybody who criticized the signal or the audio characteristics. The Hy-Gain has a distinctive sound, and many fellows were stumped trying to figure out what it was. Inevitably their reaction was, "Wow, that's that $2000 transceiver?" Yes, it is.

Okay, you're saying to yourself, "Why so expensive? What makes the Hy-Gain worth $2000?" Well, how about a phase locked loop circuit that locks the first local oscillator and VFO, resulting in direct injection into the 9 MHz first i-f, a total lack of spurs and images, dual-gate MOSFETs throughout the rf amplifier and mixer stages, a 20 dB pad . . . all in front of a narrow band SSB crystal filter? The CW filter is very sharp, but signals remain strong. A 50 kHz T-notch filter and 9 MHz crystal filter are designed to put the 3750 in a class of its own in notching unwanted signals. Then there's a gated noise blanker that functions like a squelch circuit in cutting pulse noise without reducing the receiver's ability to handle cross modulation. You really have to hear the 3750's receiver to believe it! After a few hours of using the Hy-Gain, it began to really show its stuff, sort of like learning to play an instrument. It's the best I've ever heard.

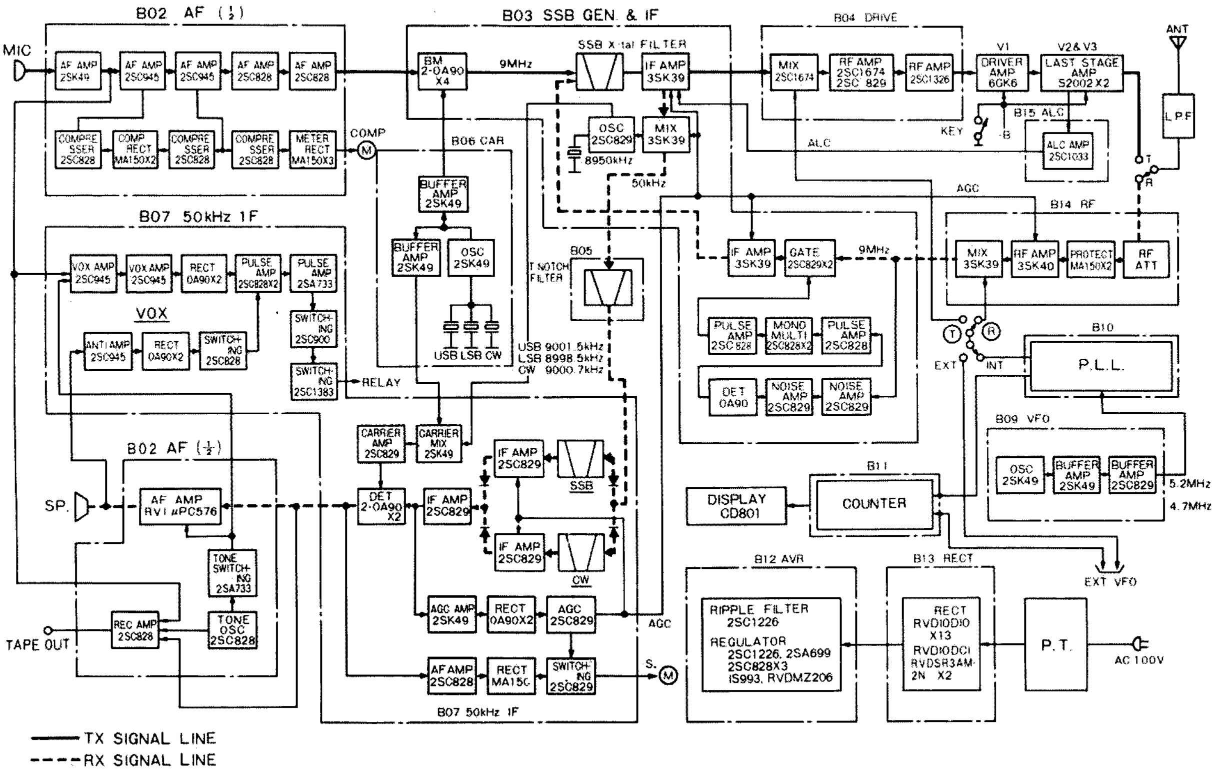
Our proving ground was 40m SSB, where broadcast interference and weak signals combine to produce enough noise to drive away all but the most dedicated DXers. It is uncanny how the 3750 sweeps the noise aside, through the use of notch filter, 20 dB pad, and noise blanker. As one *73* editor put it, "Using that rig on 40m was like talking on the telephone." He's right. Especially good is Hy-Gain's audio quality on receive, even on the built-in speaker. The speaker is mounted on the bottom chassis, but it never protested the wide variations in audio produced by tweaking the notch and noise blanker.

Dialing up a frequency is a simple matter of selecting a band, mode, and tuning the VFO until the digital readout displays the desired spot. If you go out of band, a series of LEDs flash on across the readout. The VFO's tracking is quick, so quick that you have to tune slowly . . . otherwise the counter will zip right by. RIT is included, of course, and when used in conjunction with the notch and blanker, it makes for easy copy in round tables and nets. The RIT actually registers on the LED readout, a feature unique to the 3750. Hy-Gain uses a bit different slant on memory readout than other transceivers employing digital readout. In the 3750, the memory LEDs are separate and allow off-channel tuning without the loss of the main tuning LEDs . . . other systems have only one set of LEDs that are switched between direct readout and memory readout.

The Hy-Gain 3750 is no mini transceiver. It weighs in at 44 pounds, and measures 16" wide by 7" high by 13" deep. Construction is solid, with a well laid out front panel. Band switching, final tuning, and RIT controls are to the right of the VFO. Receive controls are on the left with dual concentric pots for af-rf gain and mike level-audio compression. A row of toggle switches takes care of power (receiver only), heater (final and driver tubes), remote VFO selection, AGC range, compressor, and rf attenuation. A row of push-buttons covers modes and the tune position. Front panel jacks are provided for mike, headphones, key, and recorder output, with two rows of miniature pots for easy VOX adjustment, CW sidetone level, frequency counter calibration, and output meter sensitivity. The front panel is rounded out by a large well-calibrated multimeter which covers everything from plate current to compression level.

Band coverage goes a bit beyond complete. The Hy-Gain is set up for 160 through 10 meters, but more than enough extra coverage is included for MARS activity without the need for a remote VFO. A remote unit is available (model 3855) which allows selection of 7 crystal controlled channels. Interfacing between the transceiver and remote VFO is good, with the operator able to switch transceive functions between both VFOs, or separate receive and transmit.

Hy-Gain uses S-2002s (a pair) for finals, and a 6GK6 in the driver. Otherwise it's solid state all the way, with (counting the receiver as well) 98 transistors, 43 ICs, and 120 diodes. Construction is modular, with 21 boards (or modules) interconnected through computer type connectors,



Block diagram of Hy-Gain's 3750.

The Hy-Gain 3750 transceiver.

making for easy access to the boards. Hy-Gain provides an in-depth instruction manual of over 50 pages, covering everything from operating the radio to circuit theory. The manual is illustrated with many close-up photographs of the modules and scores of block diagrams and schematics.

The transmitter's main selling point is the audio system. ALC and audio compression are combined to keep average output up, and it works . . . using a monitorscope we were unable to make the 3750 flat top or distort. On-air reports showed a preference for the *compressor*, a point that underscores the effectiveness of the Hy-Gain's audio system. Use of a panadapter by stations 50 and 1500 miles away showed no evidence of splatter, even with mike gain and compression levels turned all the way up. Output was measured at 190 Watts on all bands except 10m, where the Bird meter indicated about 110 Watts out.

The basic Hy-Gain 3750 (completely self-contained with power supply and speaker) retails at $1895. By the time you add a remote VFO and remote speaker, you're well over $2000 ($2460 to be exact). The Hy-Gain, make no mistake, is an impressive radio. A solid month of operation by three *73* editors produced no problems, and lots of great QSOs. The 3750 is built like a battleship, and refused to bother even the most ancient and TVI-prone TV we could find. After removing the top and bottom covers (a job that takes patience and time due to the tremendous number of screws), still more shielding had to be removed. The design reminded us of broadcast equipment. And we were left with the strong belief that the 3750, like most high quality broadcast gear, would last forever. *Hy-Gain Electronics Corporation, 8601 Northeast Highway Six, Lincoln NE 68505.* Test unit supplied by *C & S Marketing Associates, Algood TN 38501.*

Warren Elly WA1GUD
Associate Editor

OPERATING IMPRESSIONS OF THE HY-GAIN 3750

I was especially impressed with the receiver. In a crowded 40 meter band one Saturday night, I was able to take a signal, which was down in the mud, and enhance it until it was of the quality only produced by locals.

Signal reports from throughout the country while using only a dipole antenna confirmed the fantastic output from the rig. Many comments were made concerning the fine audio, and I was told by many that I had one of the strongest signals on the band.

The built-in speech compressor seems to be of excellent design. After many on-the-air tests with distant stations, it appears that the compressor does its job to get the signal through without any noticeable decline in audio quality.

Tuning the rig is one of the easiest procedures I have seen; it is virtually foolproof.

Rich Force WB1ASL
Associate Editor

For every hobby there is an "ultimate" unit. For the sports car enthusiast it's the Ferrari. For the amateur photographer, it's the Hasselblad. For the amateur radio operator, it's the Hy-Gain 3750 transceiver.

The 3750, besides being the most expensive amateur transceiver on the market, is also the best. It's state of the art, utilizing phase locked loop circuitry with dual gate MOSFETs in the rf amplifier and mixer stages.

The real beauty of the rig is the digital readout. In the 3750, you have not one but two. By flipping the little switch called "Memory," there displayed in front of you is the last frequency that you were on. No need to write it down. If you want to return to it, there it is. The second set of readouts also function with the external VFO, telling you where it's set. Talk about the arrival of digital electronics and convenience to ham radio – this is it.

Stan Miastkowski WA1UMV
Associate Editor

73 TESTS THE TUNERS

At the risk of provoking more controversy over swr and antenna tuners, 73 proposes to test every antenna tuner we can get our hands on. We're not going to do them all at once, because more often than not those kind of articles end up a meaningless buyer's guide to manufacturers' specifications. Instead, we're running them one or two a month after operating the units over a period of time long enough to judge actual performance. Frankly, we're beating the heck out of them, trying to decide, among other things, whether those specifications we mentioned earlier are in fact realistic.

And about all that controversy on antenna tuners – matching networks will not turn your 200 Watt transceiver and 35' high dipole combination into one of the "big guns."[1] *That takes a good antenna. But if you lack the 10 acres you'd like for an antenna farm, and can't handle a behemoth antenna for each band, read on . . . one or two good antennas and a tuner could solve your problem.*

Take trap beams, verticals, and dipoles. Most are closest to "match" over a narrow portion of each band (often you have to choose phone or CW). Or fan dipoles, where the same elements are used on two or more bands, like 40 and 15 meters. In both cases there is a need for a tuner. Limited space is another reason. I'm living in an apartment, in a low signal TV area, with a 100' by 50' lot. The location's only claim to fame is three good size trees at the front and rear, with only enough room for two or, at most, three antennas (a tower could develop this spring, but only one tower, so I'll probably be forced to go the multi-band route there, too). Because of all this, an antenna tuner has become essential.

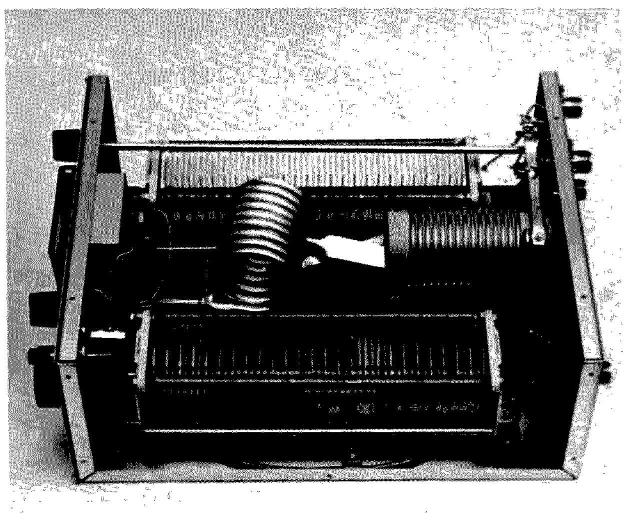
One more argument – the real impact of tuners is greater efficiency. Nearly everyone, on both sides of the swr controversy, can agree that transmitters run more efficiently when properly matched to a load. So far so good? It follows then that an antenna tuner can increase power output and prolong the life of your finals.

The debate continues over tube versus solid state transmitters, and even amplifiers are being caught up in it, as broadband output circuits catch on. Output really suffers when faced with mismatches that tube equipment finds relatively tolerable, so it may not be long before antenna tuners are as standard in ham shacks as swr bridges.[2]

1 Rayer, F. G., "Exploding the SWR Myth," *73*, Dec., 1976, p. 122; Woods, Hubert, "Exploding the Power Myth," *73*, Dec., 1976, p. 120.

2 *73 Magazine* Staff, "The Super Transmatch," *73*, July, 1976, p. 150.

The Drake MN-2000 2 kW matching network. Note antenna switching left, power meter swr controls right.



The MN-2000 with two layers of shielding removed. Silver-plated coils and swr-power meter PC board are clearly visible.

THE DRAKE MN-2000

Now that we've convinced you you need an antenna tuner, consider the Drake MN-2000. This is a high power matching network, capable of handling well in excess of the legal limit. The silver-plated switch contacts and tank coil are the first clue, along with the spacing of the MN-2000's nearly foot long tuning capacitors.

Drake's tuners (both the 2000 and 200 Watt models) are double shielded, with the typical Drake copper-colored chassis and black cabinet. SO-239 coax connectors are used throughout, with a ground post the only other rear panel connection.

The MN-2000 has been around for years, and the original design has held up well. Coverage is 80 through 10 meters with an insertion loss of less than half a dB. The Drake took everything an SB-200, Henry 2K, and Alpha 374 could offer . . . willingly. Even faced with extremely bad mismatches, the MN-2000 tuned easily and without the confusing series of dips usually associated with transmatches.

The Drake is really several station accessories in one — aside from being an antenna tuner, the MN-2000 serves as a wattmeter (comparing most favorably accuracy-wise with a Bird unit), swr bridge, and antenna switch. A large well-calibrated multimeter dominates the front panel, with wattmeter and swr controls right, and antenna switching for three antennas left.

A unique feature on the Drake is its ability to completely take the tuner out of the line, while maintaining wattmeter and swr functions. Two antennas can be switched in this way, with the third antenna switching position wired straight through (excellent for a dummy load).

The MN-2000 is a component of the Drake system and, like the rest of the Drake line, its layout is classic. (Those of you who didn't go through junior high dreaming about girls and Drake lines really don't know what you missed!)

The matching network is larger than the companion R4C and T4XC transmitter and receiver series, but not big enough to present a problem in most shacks. The controls are well laid out with a solid feel (the bandswitch leaves no doubt when it's engaged), and the tuning controls are large and operate smoothly.

Although designed for coax cable, the MN-2000 can handle open wire feeders with the use of a balun, and it worked fine with random wire antennas as well. The network is fairly broadbanded once tuned, allowing you to go as much as 100 kHz without touch-up. Tune-up can be a really quick procedure — if you take the time to tune each band and antenna, and draw up a chart plotting proper adjustment of the resistive and reactive tuning controls. The MN-2000's swr bridge uses a minimum of switching, with a spring-loaded sensitivity control doubling as a switch for forward calibration. The wattmeter is broken down into two ranges (200 and 2000 Watts) on the 3" by 2½" meter scale.

Some other features of the MN-2000 include its ability to put 2nd harmonics down 25 to 35 dB (thus helping to reduce TVI problems). I checked Drake's claim on harmonic attenuation by tuning for the 2nd harmonic on my station receiver (a Drake R4B), and sure enough, the S-meter indicated Drake's specs were accurate. Another nice feature is the fact that using the MN-2000, there is no need to retune the exciter when driving a linear amplifier, since the tuner shows a pure 50 Ohm load.

The best thing about the MN-2000 is probably its price. At a suggested retail of $220, Drake is well within competitive limits with other full legal power antenna tuners, in an attractive easy to operate package. *R. L. Drake Company, 540 Richard St., Miamisburg OH 45342.*

Warren Elly WA1GUD
Associate Editor

DENTRON 80-10 ANTENNA TUNER

Back in what are affectionately known as the "good old days," being an amateur was much simpler than it is today. That's especially true when it comes to putting up antennas. Large lots, pastures, and the wide open spaces were the rule. If you wanted a 70 foot tower — no problem. A 160 meter dipole? Just string it up.

For most of us, the situation has changed drastically. Apartments, condominiums, and small suburban lots have made things quite a bit more difficult. Our mobile population and increasing numbers of people have created space problems. Besides, why go to all the trouble of putting up a permanent installation if you're going to be moving in a few months or a year?

Fear not! There is an answer to the antenna problem. It's called the random wire. Having been around at the time of Marconi, it certainly can't be called a new concept. But with the space and time limitations of our society, it's a very logical solution to getting on the air.

So you've strung a wire out the window to the neighbor's apple tree. Now what? You need a tuner. A random wire tuner. The new Dentron 80-10 Skymatcher will fill the bill perfectly. This compact unit handles 500 Watts PEP, more than enough for any barefoot transceiver on the market. (If you're planning on running a full gallon, best bet is an orthodox antenna . . . any type.)

Although the home QTH in the hills of western Massachusetts has more than ample room for a large antenna farm, I tried out the random wire concept by spooling off somewhere around fifty feet of antenna wire and attaching it to a nearby barn. The Skymatcher has no swr meter, but my Ten-Tec Triton IV does, so I was able to get a quick indication of the match. What started out as a horrendous mismatch was soon brought down to 1.1:1 by the use of the antenna matching and inductance controls on the unit. The same was true on other bands. No problem at all.

For $59.50, the Dentron 80-10 is a solidly built little unit. After exposing the guts, heavy duty construction was evident throughout. The inductance control is a ceramic 12 position rotary switch. An SO-239 is provided for the feed from the transmitter, and the wire itself is attached to a ceramic feedthrough. A huge bolt is provided for attachment of the ground wire, a *very* important part of any random wire system.

Besides apartment or home use, the 80-10 is great for operating portable. String a wire between a couple of trees and you're ready to go. The continuous tuning from 3.2 to 30 MHz makes it easy. And don't forget that it can also match a standard antenna system. *Dentron Radio Company, Incorporated, 2100 Enterprise Parkway, Twinsburg OH 44087.*

Stan Miastkowski WA1UMV
Associate Editor

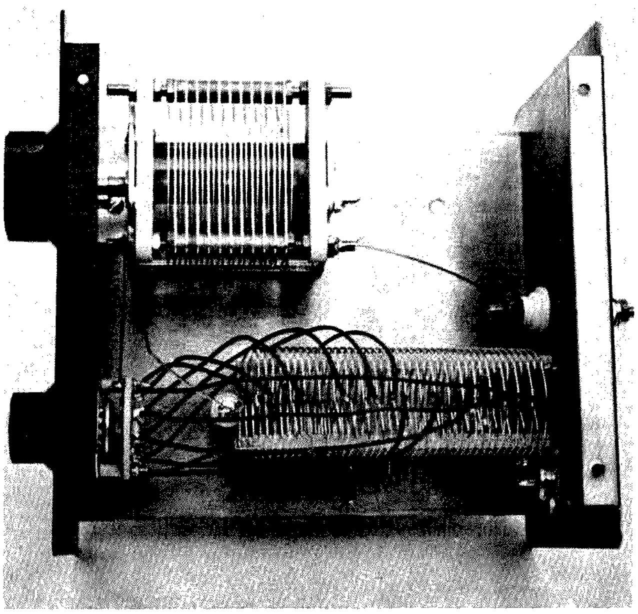
THE KENWOOD TR-7400A 2m TRANSCEIVER

The recent growth of amateur radio has not gone unnoticed in the sales departments of major manufacturers. Conventions are being broken as companies devoted to VHF equipment move into the HF market, and vice versa. The relative price of equipment is being forced down where the competition is especially tough, and the prime battleground is 2m FM.

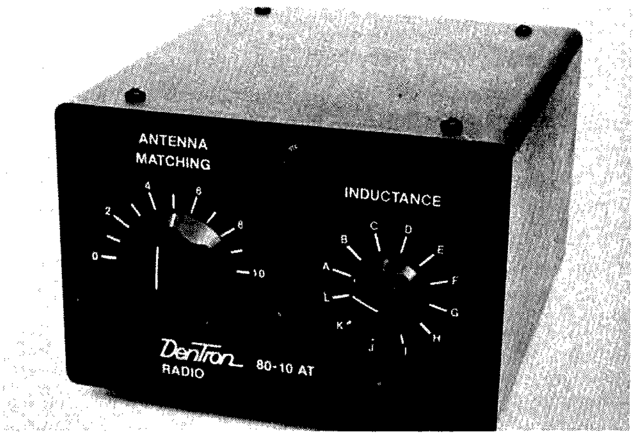
Surveys have shown that more than half the licensed amateurs here in the US are on 2m FM. Repeater frequencies are as valuable as gold in the big cities, and the situation is getting worse even in rural areas. More than 3000 repeaters are listed in the new 1977 *73 Repeater Atlas* (available now from Radio Bookstore, Peterborough NH 03458), and with recent FCC proposals to deregulate repeaters under consideration, the situation is bound to burst wide open.

Whatever the results, it's logical to predict that the new generation in repeater operation will grow out of 2 meters, with increased emphasis on crossbanding. Amateurs will probably be left with the decisions on what goes where, and it seems likely

Continued on page 84



Guts view of Dentron 80-10 AT. Note 3000 V capacitor spacing.



Dentron 80-10 AT random wire tuner. Size is compact: 7" wide, 5" high, and 8" deep.

James E. Seidel WA6FEI
1066 N. Westside St.
Porterville CA 93257

Pitcairn Island

-- an inside look at VR6TC

All photos courtesy VR6TC and W6HS

Tom Christian VR6TC, Pitcairn Island, is one of the most sought after contacts in amateur radio. Tom is also a very celebrated person in his own right: He is a direct descendant of Fletcher Christian of *HMS Bounty* fame.

Mutiny aboard His Majesty's transport ship *Bounty* occurred just before dawn on the morning of April 28, 1789. Some eight and one half months later, on the 15th day of January, 1790, Fletcher Christian, who was the leader of that mutiny, eight of his fellow mutineers, six Tahitian men, twelve Tahitian women, and one infant child went ashore on Pitcairn, one of the world's most remote islands.

It was there on tiny Pitcairn Island that those twenty-eight people began a new life and a new breed of society to be known around the world as the Pitcairners, descendants of mutiny.

Thomas Coleman Christian, born on Pitcairn November 1, 1935, is the great-great-great grandson of the most famous mutineer in the world. And from what was a British naval disaster came the greatest sea adventure story in Western history. Many books have been written about this historical event and two movies, "Mutiny on the *Bounty*," were made. The latest movie had Fletcher Christian being portrayed by that famous actor, Marlon Brando.

When VR6TC comes on the air, it is no surprise that Tom will be a man in demand: The ham at this end not only gets to log a new country, but will have a momentary trip via amateur radio to a very historical place.

Tom's voice, Polynesian and British in accent, will be recognized almost the first time it is heard. It has a certain distinctive flavor all its own.

If you want something bad enough, and determination is a prevailing factor, you will succeed in your endeavor. In my case, it was a contact with Tom Christian VR6TC, Pitcairn Island.

The QRM, if you have never been in one of Tom's pileups, is absolutely unbelievable. I know, because from the first time I heard Tom until VR6TC was logged, almost a full year had elapsed. Since that day of success, I have talked to Tom on many different occasions. We have had a few schedules and during our many conversations I've learned a great deal about Pitcairn and VR6TC. I spent many more hours just reading the mail while Tom was talking to other friends he has schedules with. He is a very interesting person, even if you're only listening.

Pitcairn is a small rugged island of formidable cliffs of reddish-brown and black volcanic rock. It looms up from the sea in the middle of nowhere to a maximum height of 1100 feet. The island is only two miles long, and about one mile wide. It's about midway between the Canal Zone and New Zealand and some 3300 miles east-northeast of her nearest shipping point, Auckland, New Zealand.

To the south of Pitcairn there is nothing but open sea until you reach the icecaps of Antarctica. Her South Pacific location is latitude 25 04 south and longitude 130 06 west.

As you approach Pitcairn from the northern side, there will be a small indentation in the sheer inhospitable cliffs that surround the island. This will be the famous Bounty Bay, the only landing point for the island.

Bounty Bay is so named for it is only one hundred yards east of the landing slip where the ship *Bounty* was stripped of all usable cargo and material, and under orders from Fletcher Christian himself, set afire and sunk on January 23, 1790, only eight days after the mutineers landed.

Adamstown, the smallest British colony, and the original home of the mutineers, is situated on one of the few relatively flat areas of land on the whole island. It is here, some four hundred feet above sea level and about three hundred feet west of the bay, where all sixty-two inhabitants live, most of whom are also descendants of one of the nine mutineers who landed in 1790.

Shady Nook, a little area on the outer rim of the village, is where Tom, his wife Betty (also born on Pitcairn), and their three little girls call home. This is also the very same piece of real estate where Fletcher Christian and Mi'Mitti (Fletcher's Polynesian mate) made their first home some 187 years ago.

At one end of the Christian home in a small room is where the radio equipment is located for VR6TC. Most of the gear is from America, some of which was donated by the manufacturers several years ago.

Just outside of Tom's home is a 7 kW, 230 volt, single phase, 50 cycle diesel generator. This is Tom's and is used to supply electricity not only for the ham gear, but also the numerous appliances in the home when the community generator isn't in use.

The island had a 70 kVA, 230 volt, three phase, 50 cycle diesel generator, but something of an unknown nature happened and in June of '76, it went up in smoke

and thirty foot flames. A total loss. It has since been replaced with a smaller unit.

The community generator is only operated from sundown to 11 pm, and this leaves a big gap where no electricity is available. This is why Tom has his own generator and so helps keep VR6TC supplied with electricity.

I asked Tom one time what it costs for diesel fuel to run the generator. His answer sure made me appreciate fuel prices in the United States.

"We purchase diesel fuel in forty-four imperial gallon drums at a cost of $100 per barrel, plus $30 per barrel for shipping and $17 per barrel as a deposit. Fuel is expensive to obtain."

At $2.67 for each gallon of diesel (U.S. measurement), I wholeheartedly agree that electricity gets very expensive to produce on an island as remote as Pitcairn.

Tom's generator has been unreliable for quite some time and has had many problems. It isn't a complete unit but it is made up of parts from here and there. Belt-driven from a separate motor, the performance could stand much improvement.

Tom Christian VR6TC at his amateur radio station on Pitcairn Island, South Pacific. From here, in the past twenty years, Tom has made contact with nearly every country in the world. He is very well-known and one of the most popular operators on the airways; he is also one of the most friendly. The equipment is Hallicrafters: to the lower right is the driver and to the left is a linear. On top is the receiver. The two small units on top of the driver are a rotor indicator sitting on an electronic keyer. Tom very seldom uses the keyer. He says, "I like my straight key a lot better." VR6TC has three schedules each week with other operators in the States. "Calling up a fellow ham in the United States is almost as easy," Tom says, "as dialing a telephone."

Dr. Charles "Mert" Moser W6HS, a very close friend of Tom's, felt that the generator couldn't be relied upon to ensure VR6TC stayed on the air. With so many amateur radio operators around the world and Tom being the only operator on the island, something should be done to guarantee electricity to keep amateur radio alive on Pitcairn.

W6HS, through contributions, collected $2,500 and purchased a new generator for Tom. It is on the island now and has been installed. Contributions were sent in from all over the U.S. and some foreign countries, most of which were other amateur radio operators, but not all. Would you believe that amateur radio transmissions are monitored by the FCC? Well they are, and an FCC monitoring station sent a contribution for this generator fund. On behalf of VR6TC and all of amateur radio, we thank you.

A wind generator was sent to Pitcairn in 1975 to help charge a storage battery power supply that Tom purchased from Australia. The batteries supply electricity of 110 volts for electric lights and a few appliances that will operate from a dc source. The battery supply can't be used for the ham gear because all the equipment is wired for ac use only.

Tom told me one time that he has a 110 volt dc to 230 volt ac converter, but it isn't a reliable unit. He said that he will use it only in case of an emergency.

If something breaks down, and it does occasionally, you don't call a repairman. You fix it yourself. After all, the nearest repair service is over three thousand miles away, by sea. Tom has become very efficient, which is understandable, in the repair of both mechanical and electrical problems.

One morning VR6TC was almost thirty minutes late for a schedule. "My receiver was completely dead this morning," Tom said, "and it took a few minutes to locate and repair the problem."

Many of the homes on Pitcairn are connected by a telephone system so someone can be contacted if the need arises. This system was installed by the islanders as are all other equipment and services on the island.

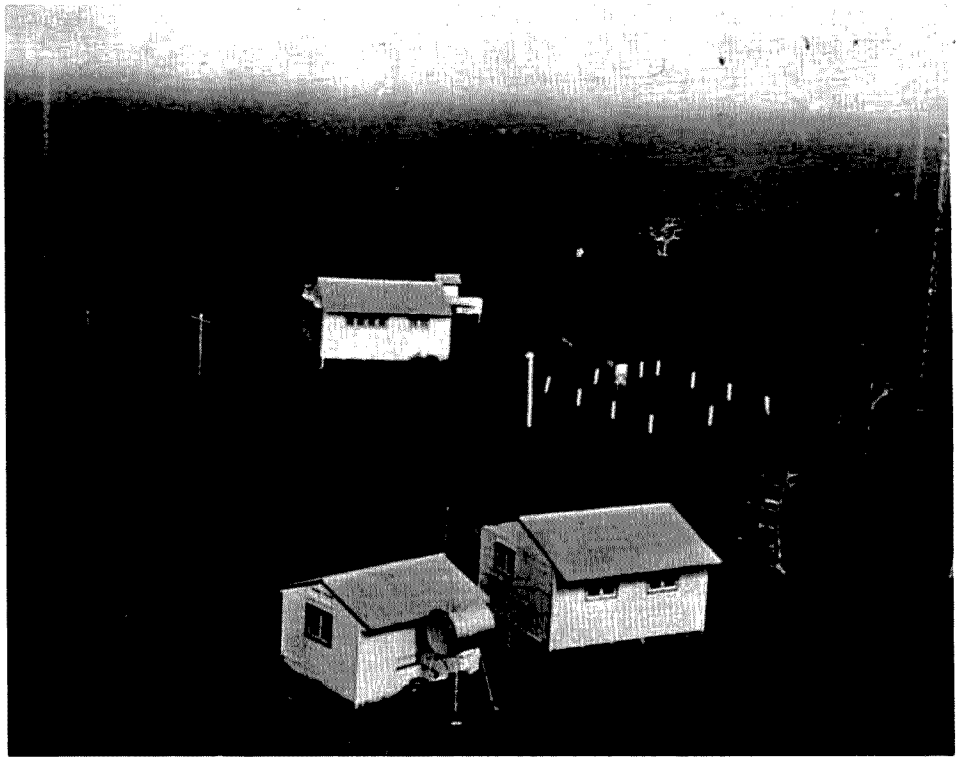
During a QSO one day, Tom received a phone call and was informed that the generator for the dispensary wouldn't start up. He left the air for less than an hour and then returned. All was OK; generator repaired.

If you happen to be listening to VR6TC and he suddenly goes off the air, grab a cup of coffee and QRX; he will be right back.

One time his sister Thelma, who lives next door, started up her washing machine and the circuit breaker kicked out on the generator. Tom was back on the air in short time. I guess amateur radio, at least this time, had priority.

Tom's VR6TC station is Hallicrafters equipment – a receiver, driver, and linear. Maximum output is 1 kW. Although the station is capable of more power, Tom said that he normally runs a maximum of five hundred Watts.

At one corner of Tom's home stands a forty foot wooden pole which has been cemented into the ground for support. Three feet above the



Pitcairn's radio station "ZBP" is situated at Taro Ground, 870 feet above sea level. Three of the seven steel 60 foot towers for the rhombic antenna system can be seen. The building in the foreground left houses the diesel generator which supplies electricity for the station. The building to the right is a storage shed. The one in the background is the station itself. The white markers to the right are the posts of the wire enclosure where the meteorological instruments are kept. The station is commercial and is operated six days each week by either Tom Christian or a staff member.

pole is a three element tri-band antenna. The system was put up about ten years ago. "The pole," Tom said, "has deteriorated so badly from the weather that it is unsafe to climb."

The antenna rotor indicator quit working and Tom has to stick his head out the window to see what direction the antenna is pointing. At night, he uses a flashlight.

Tri-Ex Tower Corporation heard about Tom's problem with the wooden pole and how unsafe it was, and they have very generously donated a new THD-354K, fifty-four foot crank-up tower to him. It should be arriving on Pitcairn any day.

Arrangements have also been made to ship a new rotor unit and tri-band antenna along with the tower unit. This will certainly ensure that VR6TC will remain on the air.

On March 23, 1955, Tom received his first amateur radio license in Wellington in the form of a New Zealand certificate. In 1957, exact date unknown by Tom, he received the VR6TC call for Pitcairn Island. Before Tom received even that first amateur radio license, he spent some time off the island.

For three years, Tom went to school in New Zealand, where he studied meteorology and radio communications technology. These studies enabled Tom to fulfill the requirements for the job he had held for the last twenty years: Pitcairn's Radio Officer. That schooling also earned Tom a 1st class radio telegraph operator's license for both coast and marine operation.

That 1st class license landed Tom a job with the Union Steamship Company for about a year. He worked as a radio officer aboard a passenger ship. While he was telling me this, he said, "While aboard one time during a run, the ship ran aground with about 450 passengers. Although no one was injured, it was quite an exciting moment."

I never did ask Tom how that accident happened, but I'm sure it was just one of those things that fate played a part in.

Upon return to Pitcairn, Tom was now qualified for setting up and maintaining the commercial radio station on the island.

Taro Ground, the location of "ZBP," Pitcairn's radio station, is a mile and a half from Adamstown by steep dirt road at an elevation of 870 feet. The equipment is British with a power output of around five hundred Watts. The large antenna system is of rhombic design situated on seven sixty foot steel towers. Tom maintains all equipment, which he also installed.

The radio station is under British authority with the administrative headquarters located in Auckland, New Zealand. Cablegrams, on an international basis, are received and transmitted on an average of one hundred per month. All traffic from "ZBP" is by CW mode.

Weather reports are transmitted twice daily. Ships at sea are contacted by radiotelephone from the marine radio equipment, also at the station. Any distress signals at sea can also be received here at this location.

"ZBP" is in contact with headquarters in Auckland each day. If a ship is scheduled to depart a certain country, which will later head for Pitcairn, Tom will be notified. In this way, the island people will know the approximate date of its arrival and can prepare to meet it. Sometimes, up to two months advance notice has been received.

Meteorological readings are taken on a regular schedule each day from a special area just outside the station building. The following are the results:

Annual rainfall is from 60 to 70 inches. Maximum summer temperature is around 86 degrees, with an average of 75. Minimum winter temperature is around 52, with an average of 64 degrees Fahrenheit.

That is typical South Pacific weather with ideal temperatures. The wind is generally mild, from 11 to 15 mph. Hurricanes are extremely rare, but have been experienced. I heard Tom recall a very windy day where a home had the roof blown completely off.

The radio station is maintained each day except Saturday (which is the Sabbath) by either Tom or one of his personally trained staff members. Since all traffic from the station is by CW, I was curious as to the code

speed requirement for the staff. Tom's reply was not only interesting, but informative as well:

"Most of the CW traffic by other operators is on an average of twenty words per minute. I require any person on the island who wishes to apply for a staff position to take a code test. The test will be for ten minutes at a speed of twenty-two words per minute. Only two mistakes are allowed during that ten minutes."

Six months ago, six British engineers arrived on the island for a special project in Bounty Bay. Their job was to extend the jetty in the bay out at least another thirty-three feet. This was done in an effort to make the entrance safer. The surf is treacherous and breaks relentlessly against the cliffs. Rocks were blasted out of the bay and large steel pilings were driven down in place. Rocks were then piled around them.

By the time you read this, the project will be done and Tom will have more time for amateur radio. His working on the bay project with the other men on the island has left very little time for ham contacts.

I know that a large number of operators have heard Tom, but never had a chance to make contact; some have never had the chance to even hear him. I asked Tom if a special day could be set up for publication and he agreed. VR6TC will be on the air for this special time as well as other times.

VR6TC is on every Tuesday at 2230 to 0100 GMT at 21.350 MHz. The *special* date is Sunday, April 10, 1977, at 1630 GMT at 14.300 MHz. It's possible that he may be on the following Sunday as well, but those mentioned are confirmed. Good luck.

The road from the village to Taro Ground and the radio station is long, steep, and a very tiring walk. Tom, in 1966, purchased and introduced the very first motorbike on Pitcairn. Now the trip is made with greater ease and speed on those twice daily schedules. Betty also has a motorbike. In fact, there are almost forty of them putting around on the island, as well as two Mini Moke cars. Why walk when you can ride, even on an island as small as Pitcairn.

Tom and Betty, a few years ago, took off on the motorbikes to go fishing. It was a nice clear day, but before they could get back, a rainstorm began. The dirt roads turned to gooey red mud and on the way back an accident occurred.

People on Pitcairn are no different than you or I and sometimes go barefoot. On this day, Tom was barefoot and the bike slipped in the mud and his toe got caught in the spinning chain. The rest you can visualize: Tom is now missing half of one big toe.

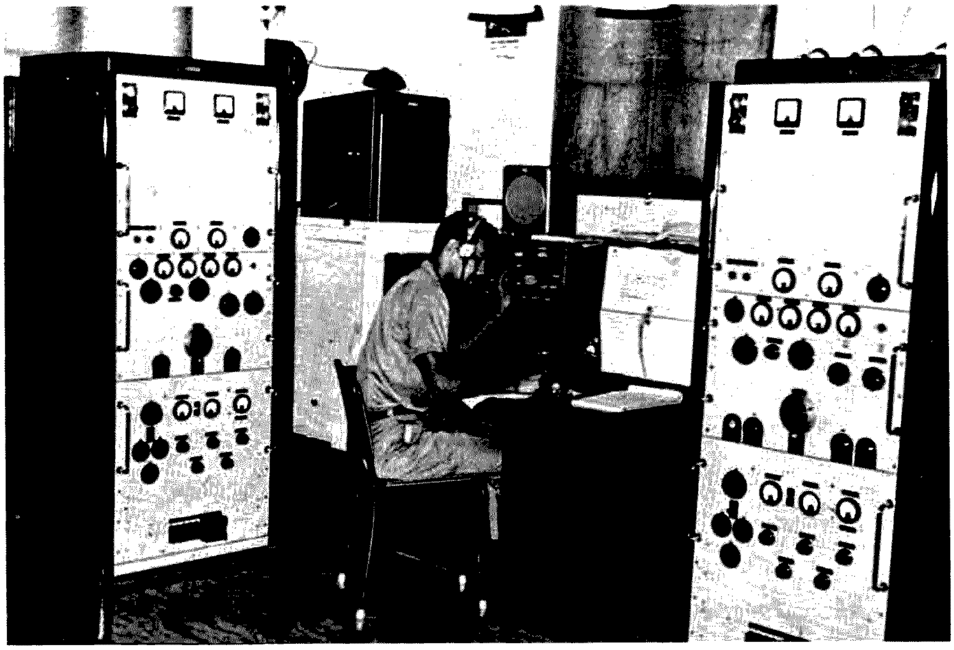
Probably the most feared ailment anyone on the island could encounter is appendicitis. While Tom was in New Zealand, one of his two sisters had an attack of appendicitis and a ship at sea was contacted by radio. Before the ship could get her to New Zealand, she died. "It was quite a shock when word reached me." Tom told me about this not too long ago. What he didn't tell me was that he too had been stricken. I found out during my research for this article.

One day on the island several years ago, Tom too had that terrible pain in his side and he knew exactly what it was. Every household turned its refrigerators up to the maximum setting and made as much ice as possible. Tom was packed in the ice and a ship was contacted from the radio station. The ship arrived, but had no doctor. Tom was taken aboard and kept in ice for the eight day trip to New Zealand. He was one of the few who were fortunate enough to survive. The world of communications again had been needed and proved to be an appreciated treasure.

In the year 1967, one year after Tom and Betty were married, they both came to the United States, where, for about eight months, they were residents of California.

Tom had come here to further his training in radio communications at the Voice of Prophecy, international radio broadcast center of the Seventh-day Adventist Church, located in Glendale CA.

Here he met Eddie Pullen WA6ECC, chief engineer for the VOP and operator of the ARC station K6DTT. VR6TC and K6DTT are in contact each week via amateur radio and these two friends exchange events of here and there. Eddie Pullen also helps Tom and the people of Pitcairn when certain items are needed on the island. With no department store on the island, it takes a long time to get much needed items. Amateur radio reduces that waiting time to half.



Tom Christian on duty operating Pitcairn's radio station "ZBP." The equipment is British with a power output of about five hundred Watts. Tom operates, maintains, and installed the station. Two daily overseas schedules are kept with Auckland, New Zealand. Cablegrams on an international basis are received and transmitted on an average of one hundred per month. The marine radio, also at the station, is used to contact ships at sea, some of which stop at Pitcairn. All traffic from "ZBP" is by CW mode. Tom and Betty both have a code speed of twenty-five words per minute.

Tom also met Dr. Moser W6HS, who so generously set up the fund for the previously mentioned generator. Dr. Moser, called "Mert" by everyone, is a PhD professor at the University of Southern California. Tom and Betty were house guests of Dr. and Mrs. Moser for several weeks. VR6TC and W6HS also have a weekly schedule via amateur radio, now that Tom is back on the island. Dr. Moser on many occasions had made medical *housecalls* for Pitcairn via amateur radio. One of them will be mentioned a little later.

While Tom was in the States, he did a personal appearance tour with the MGM movie, "Mutiny on the *Bounty*." He also appeared on the TV show "To Tell the Truth." Not one of the four panelists guessed that he was the real Tom Christian, descendant of Fletcher Christian of *HMS Bounty* fame.

Tom has relatives in New Zealand, Australia, Norfolk Island, the state of Washington and, of all unlikely places, my home QTH.

For more than two weeks, Tom and Betty stayed at Tom's cousin's home in Porterville CA. Three-quarters of a million amateur radio operators around the world would jump at the chance for a face to face QSO with Tom and here he was, only six blocks away from me, and I didn't even know it. You can't win 'em all.

I had a schedule with VR6TC about two weeks after I found out about the above. During the schedule, Tom's cousin, Beverly Lowe, and her husband Harry had a ten year reunion with Tom and Betty Christian, thanks to amateur radio. It really is a small world when amateur radio gets involved.

Although VR6TC is the only license issued to a member of the Christian family, there were others who operated from Pitcairn before Tom. Floyd McCoy VR6AC and Andrew Young VR6AY both operated from Pitcairn over thirty years ago. Some of you old-timers may have a QSL card from one of these hams, both of whom are also descendants of the *Bounty* mutineers.

More than 20,000 QSL cards have been mailed from Pitcairn with VR6TC imprinted on them destined for every corner of the world. If you made contact with VR6TC, sent a card but never received an exchange, there could be a definite reason.

Pilferage of mail has been known to occur with letters and packages sent to and from Pitcairn. Certain items which Tom knows were sent never reached their destination. Where they went astray is anyone's guess. For any QSL card that Tom received – if he has it confirmed – a VR6TC card will be or has been sent in exchange.

Remember, Pitcairn is a distant and very isolated island and the shipping to and from there is on a one to two month basis, sometimes longer. The mail will pass through several hands before its final destination is reached.

If the weather is bad, ships have been known to bypass the island, even when they carried much needed supplies for the island, including mail. This means that it could take several more months before that mail is finally delivered and the mail on the island is picked up. Several years ago, an incident occurred which was responsible for the loss of many QSL cards leaving the island for their worldwide distribution.

The only entrance and exit for Pitcairn is from Bounty Bay in one of the island's 38 foot long, 9 foot wide diesel-powered whaler type longboats which are built on the island. They are capable of carrying up to 5 tons of cargo and are the only method the people have of getting out to the ships for transfer of cargo and mail.

On June 23, 1972, one of the longboats attempted to take a supply of mail out to a waiting ship and pick up cargo for the island. The seas were violent and the longboat was caught by a large wave and capsized, spilling all the men overboard, and also the mail. Half of those men were injured. The most serious was Tom; the boat had landed on top of him.

"I almost lost my life but managed to make it to the rocks. From there," Tom said, "I crawled toward the landing. My right leg had been broken and the left one was severely bruised."

Tom clung to those rocks for a half hour before anyone could get to him for rescue. He was taken to the island dispensary and the leg was set. A few months later, when the leg didn't heal properly, he went to New Zealand and into a hospital; the leg had to be broken again and reset.

The cargo of mail which spilled overboard when the accident happened contained a large number of QSL cards; they sank to the bottom of the bay.

If by chance you had sent Tom a QSL card prior to that date and never received one in return, yours may have been one lost at sea. Send another one; I'm sure Tom will be very happy to reciprocate, again.

"QSL information is Tom Christian, Box 1, Pitcairn Island, South Pacific." Tom has given that VR6TC contact information a thousand times over. When he gives it to you, a few tips will get a QSL card back a little faster. The envelope will also have a very rare Pitcairn stamp on it.

The U.S. Postal Service now charges 42 cents for a single IRC. One of them is worth only 10 cents on Pitcairn. It costs Tom 35 cents to mail your card back to you. That means you would have to spend $1.68 for IRCs to help Tom pay some of the postage. Save some money and slip a single dollar bill into an envelope with your QSL card and a self-addressed return envelope. That little extra change will help Tom to defray some of those expensive fuel costs to produce electricity for amateur radio's VR6TC. I'm sure he would appreciate the kindness and you will save, also.

When you mail everything, be sure to use a dark colored envelope so the contents can't be seen. Send it *air mail*. This way it will be flown to either the Canal Zone or New Zealand, the only pick-up points for mail going to Pitcairn. If sent by surface, it will wait in some port for the next ship going to one of those two locations. That could cause an additional delay of several months.

The engineers on the bay project took a special survey at the request of an unknown company in Tahiti. It was to determine the possibility of constructing an airstrip of about 900 meters (2,952 feet) on the island. As Tom put it, "It would require the moving of mountains." He did say that it was possible for a 600 meter runway, but no further information was available. Someday it might just be a few weeks before an exchange of QSL cards is possible instead of the current time of up to six months.

Tom and Betty Christian have three girls: Jacqueline Beth, born January 8, 1971, Raelene Kari, born January 28, 1974, and Sherileen Teresa, born December 1, 1975; all are on Pitcairn.

Tom has been asked several times when he will come to the U.S. again. His answer is almost always, "With Betty and the small children, it would be very difficult to get away."

Tom is under contract to operate station "ZBP," but has been heard several times to say that he isn't sure he wants to sign another 3 year contract. Just before Christmas I asked him what the possibility was of him coming here again. This was his answer: "A new contract would compel me to stay here on the island, but I'm

Tom and Betty Christian amongst the numerous tropical fruits which grow in abundance on Pitcairn Island. Tom is holding a breadfruit, the plant which in turn brought about the existence of the descendants of mutiny and the people of Pitcairn Island.

not sure if I want to be tied down. If possible, I may go on a trip of about 6 months starting in June of '77. Very much thought is on visiting the States again, soon."

I would be wrong if I attempted to say that Tom *will* come to the States. Only time and Tom himself can do that.

"Amateur radio is a break from the normal life and a chance to sit down, relax, and talk to friends in other parts of the world." Those are Tom's words and feelings in conversation one day. Public service also gets involved, especially on an island as small and isolated as Pitcairn.

We take for granted the medical services available to us, since we live in a country where a hospital and doctor are always close at hand. On Pitcairn, there is no hospital or doctor, only a small medical dispensary.

It is a requirement that the wife of the Seventh-Day Adventist pastor (who serves a two year tour of duty on the island) be a registered nurse. She is the medical officer for the island. Her qualifications are excellent, but sometimes an illness can reach into the field of an M.D.

On Thursday this past August 12th on 14.225 MHz, I was waiting for VR6TC to come on frequency for his regular schedule with W6HS. It was almost 15 minutes before Tom was due at 1600 GMT when I heard VR6TC call for W6HS; no answer. Another station answered and I heard Tom state that he was calling early because of a possible emergency on the island. Pastor Newman was very sick with a temperature of 104 degrees and had been this way for several days.

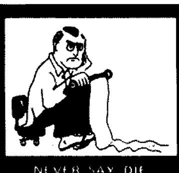
Since W6HS was still not on frequency, I gave him a long distance phone call and told him of the above. He got on the air immediately.

After a short discussion between Tom and Dr. Moser, a colleague of Dr. Moser's was contacted who specializes in respiratory diseases. A phone patch connection was provided by John Stagnard W6MAB for Dr. Dickson Young, Beverly Hills CA. The results were a 4,500 mile housecall via amateur radio.

Dr. Young talked to Tom and the nurse on the island for several minutes. They explained Pastor Newman's symptoms and what medication had been administered.

Diagnosis: viral pneumonia. Recommendations were made for additional medication from what was available in the island dispensary. The following week I heard Tom say that Pastor Newman was very much improved and could now get out of bed for extended periods of time. Today, Pastor Newman is in New Zealand and is very healthy.

Pitcairn Island is a unit unto itself, isolated by a stretch of empty sea. Amateur radio is a vital link to the outside world and plays an important part in the lives of every person on the island. Without amateur radio . . . ■



NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 22

CBers into the hobby which reversed the ten year license downward trend.

Few authors like to have their articles rewritten by magazine staffers, particularly when major changes are made. Other than correcting grammar and spelling errors, *73* publishes just about all articles as they come from the authors . . . and in this respect *73* seems to be unique in the field.

Few of us are wealthy enough so we can afford to flat give away the enormous amount of time and work (not to mention the expense of photographs) that it takes to prepare an article for publication . . . plus later proofreading of galleys and then answering of reader questions. While most articles pay only about $100 to $300, this still takes a lot of the sting out. And it is the amateur who benefits from adequate author pay in the long run, for paid authors tend to keep writing, and unpaid ones tend to find better things to do.

Right now microprocessors are of high interest to *73* readers, but what will be next? *73* called the turn on SSB, on RTTY, on SSTV, on transistors and ICs, so keep watching: Whatever it is, it will be in *73* first.

As an author, then, you are interested in placing your article where it will get the best readership, where you'll get the most money for it, and where it won't get mangled by some "editor" who doesn't really understand what you've written. How do the four ham magazines shape up in these respects?

On the payment end of things, we seem to have *73* on one end, paying the highest dollar for articles . . . and paying upon acceptance (which means right away). The other magazines range from somewhat less pay, to very little and wait a year or so, down to no pay whatever.

Readership? You probably have this figured out . . . one magazine is aimed mostly at contesters . . . another at engineers . . . and one seems to be largely going to libraries these days. *73* has been reaching both the active old-timers and the newcomers . . . it's where the action is.

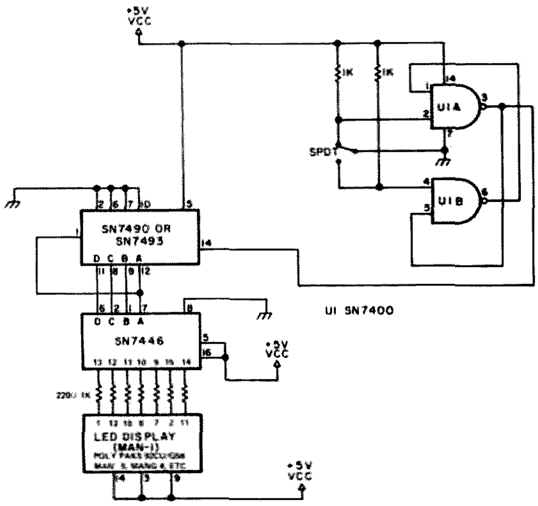


Fig. 1. Basic counting test circuit.

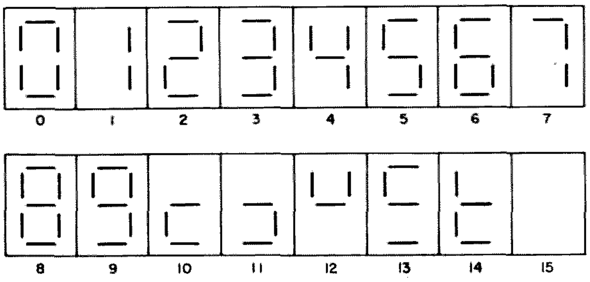


Fig. 2.

How Do You Use ICs?

-- part VI

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Before leaving the wonderful world of counter displays, there are several other ICs which you should know about. Not that they are especially useful, but they sound as if they were, and you might be able to use them.

Specifically, there is the SN7492 divide-by-twelve counter and the SN7493 4-bit binary counter. They don't really sound promising, but they must have been built for something.

The first looks the most promising, as if it remotely had something to do with time, and the other is just there. However, for a reason which will become obvious, we will start with the second.

Before plunging in, review Fig. 1. This is the schematic of one counting digit using the SN7490 decade counter. This test circuit will count from one to ten (zero).

In particular, notice the A, B, C, and D outputs and how they connect to the SN7446 decoder/driver. The pin connections for the SN7493 are exactly the same as for the SN7490 (except there is no nine reset circuit), so you can just substitute one for the other with no changes. Now you see why it comes first.

But what does it do? With this hookup it counts to 16. This will take a bit of explaining. The first thing you want to know is how to count up to 16 with just one digit. It can be done. It's weird, but it can be done.

The key to understanding actually lies in the decoder/driver and the readout IC. In most applications, the decoder/driver is only called upon to count up to ten, but the circuitry is built in to decode up to 16 pulses. The next problem is how do you display a count of 16 on a seven-segment readout designed for zero through nine count?

There is a very simple answer. You cheat. If you look at Fig. 2 you will see how it is done. They simply chose arbitrary combinations of segments for the additional figures. One of the combinations blanks out the readout on that count. You have to be watching for it or you will miss it.

There does not appear to be any normal type of device that uses this feature in amateur use. It appears to be used for some data instrumentation purpose rather than a specific counting purpose.

The SN7492 divide-by-twelve counter sounds like it might be related to a 12 hour type of thinking. It is, but not directly.

Notice in Fig. 3 that the pin connections for the 7492 are not the same as for the other two ICs. The B, C, and D outputs are not the same pin numbers. Apart from these changes, the circuit is the same for the rest of the test circuit.

When in place, the inclination would be to assume that it would count from 1 to 12 in the same manner as the 7493 counted from 1 to 16. Not so.

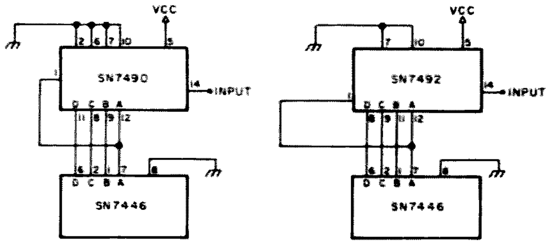


Fig. 3. Note A, B, C, and D pin connection differences.

To understand this, refer to the logic tables in Fig. 4. This is the table of the coded output for each number of pulses that gets fed to the decoder/driver.

Notice that they are all the same from zero to five, but after that they are not the same. If you try to go past five in the count sequence with the 7492, you will not get six. So much for its ability to count.

The reason lies in the truth tables. Notice that the output codes for the 7490 and the 7493 are in binary code, the same as they would be written out. They are both binary counters.

The 7492 is not. Its output follows the binary code up to five and ceases to be binary after that. If you look at the table, you will see that six has the binary code of eight, seven has the code of nine, and so forth.

After nine, it goes into the arbitrary segment selections for the higher numbers. This still follows the binary coding, but with the break in the middle, the continuity is lost.

So what can you do with it? Getting back to time, there is an obvious answer. To count seconds, you go from one to ten (zero), but when you get to tens, it goes 57, 58, 59 seconds, one minute. In other words, from zero to five. This is six counts.

The 7492 is also a divide-by-six counter. The trick is to make it reset to zero after the fifth count. This is easy once you know how.

Look at the truth table again. Notice that the output at six is exactly the same as for zero except for the D output. Also notice that the D output does not appear in any of the sequences from zero to five. Therefore, we can do without the D output.

To do this, we lift the D output from the 7492 counter and leave it floating. Then ground the D input pin of the decoder/driver. Now the circuit will count from zero to five.

One obvious application would be to cascade units to get a seconds and minutes readout for an elapsed time counter circuit. This gets you into reset circuits a little more deeply.

Resetting is usually done with logic levels, but in a simple circuit like this one, it's done by grounding (0 or low logic) or ungrounding (1 or high logic) the correct pins.

With the 7492, both reset pins must be high (1) to reset to zero. At least one of the reset pins must be at low (0 or grounded) to count.

With the 7490, there are two sets of reset pins. To reset to zero, both zero reset pins must be at logic 1 (high), and at least one of the nine reset pins must be at logic 0 (grounded)). For proper counting, at least one of each set's reset pins must be at logic 0 (low or grounded). The 7493 is the same except there are no nine reset pins.

This is mostly done for you on the published schematics, but when you roll your own, you may forget to see that those pins are accounted for.

One of the first things to look for when you don't get proper counting action is an error in the basic hookup or the incorrect use of the reset pins.

These gadgets are designed to be compatible, so there is no real problem when cascading them to get a timing readout. Two digits are shown in Fig. 5. Except for the obvious changes in wiring for the two different counter ICs, the circuit is the same as for the regular readout.

The external circuitry would be very similar to what a counter would use. In a simple setup like this, there would be a timing chain derived from the ac line frequency, a gating circuit to start and stop the count, and a reset circuit.

External to the unit would be some method of keying the elapsed time counter mechanically or electronically. Something must tell it when to start and when to stop. There are a wide variety of switching methods depending upon the application.

Still, this is similar to the frequency counter application, and may in fact be somewhat simpler. However, neither of these counter ICs has found wide application in amateur counting circuits. They are, however, familiar in frequency dividing circuits.

Just as the 7490, the 7492 and the 7493 have both been used to get different frequency divisions. This usage was covered in a previous article.

If you have a few of these ICs on hand for frequency dividing, you might try them in this test circuit so that you will know how they behave. Then when you run across them in an application you want, they will not be unfamiliar to you. ■

	7493 DCBA	**7490 DCBA**	**7492 DCBA**
0	0000	0000	0000
1	0001	0001	0001
2	0010	0010	0010
3	0011	0011	0011
4	0100	0100	0100
5	0101	0101	0101
6	0110	0110	1000
7	0111	0111	1001
8	1000	1000	1010
9	1001	1001	1011
10	1010		1100
11	1011		1101
12	1100		
13	1101		
14	1110		
15	1111		
	Binary Code	**Binary Code**	**Non-Binary after five**

Fig. 4. Logic table.

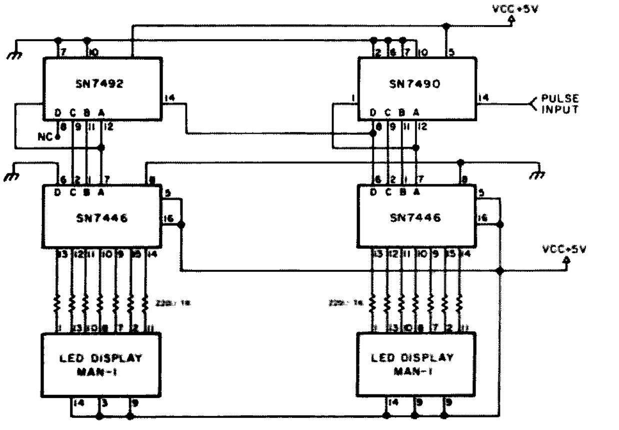
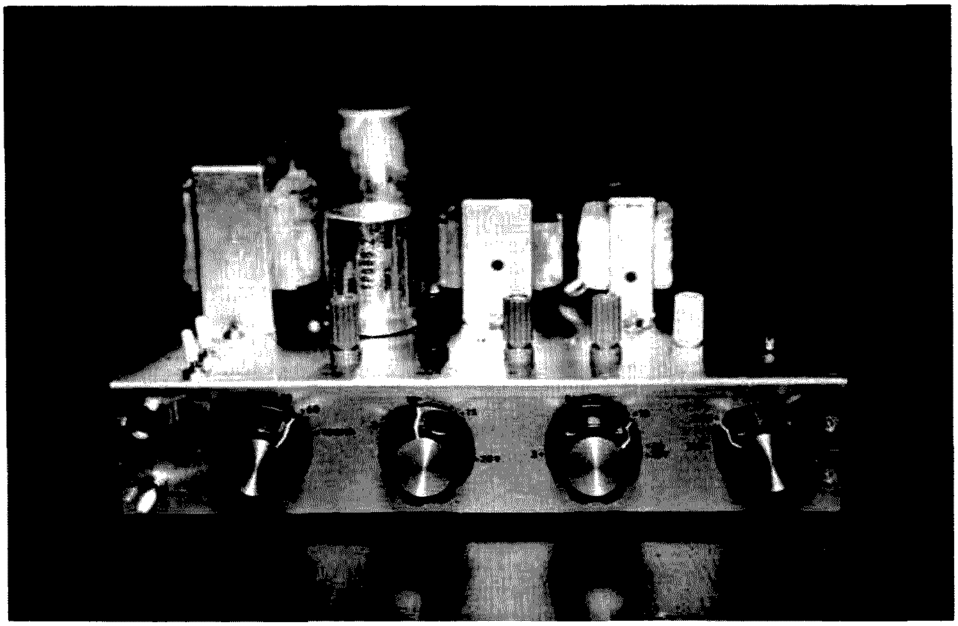


Fig. 5. Sixty event counter (0-59).



Super Low Voltage Power Supply

- - with overcurrent protection

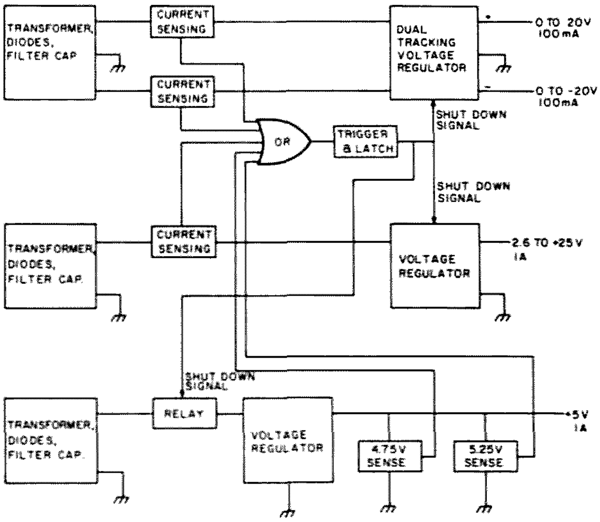


Fig. 1. Basic layout.

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The following article was prompted by the many disasters I have had while experimenting with unfamiliar ICs and untested circuit designs. This past year I have destroyed two TRV2000 voltage regulators, one XR205 function generator, two 741 op amps, two 709 op amps, one optical isolator, and so on. Sometimes it happens when the meter probe slips and sometimes it happens because of incorrect design of the circuit. In nearly all cases, however, things burn out because of excessive current drawn for too long a time. The remedy is a power supply that abruptly removes the voltage from the circuit once a preset current is exceeded. I felt this would be superior to the usual type of current limiting in which the power supply delivers a constant current to the load and less voltage once the current limit is reached; the objection to the latter is that the user may not be aware that the current limit has been reached and that the voltage is no longer regulated, especially if it happens for only a very brief interval. A circuit may not operate correctly with the unregulated voltage during this interval and the user would be hard pressed to discover the reason for the malfunction.

Basic Layout

Three power supplies were constructed as shown in Fig. 1. The first is a dual tracking supply with variable output voltage 0 to ±20 volts and current to 100 mA on each output (200 mA total current capacity). Also available is a +12, -6 volt option. Current sensing is done in both the positive and negative legs, and when the current exceeds a preset level, a signal is developed to shut down the output from the voltage regulator. This signal latches so that output voltage can only be restored by pressing a reset switch.

The second supply has variable output from 2.6 to 25 volts and current to 1 Ampere. Up to 34 volts is available at reduced current. This supply also has adjustable current sensing and, like the first supply, the output voltage shuts down when the current exceeds a preset level. Voltage is restored by pressing the reset switch.

The third supply provides a fixed 5 volt output at currents to 1 Ampere for operat-

ing TTL circuits. This supply has output voltage sensing and will shut down if the voltage moves outside a preset range from 4.75 to 5.25 volts.

The first supply provides the power for the sensing circuits used in all three supplies. Also, if any one supply shuts down, the other two will shut down also.

All three supplies use voltage regulators that are short circuitproof, an added safety bonus in the event that the current sensing circuits are manually disabled or in the event of the failure of some component in the current sensing networks.

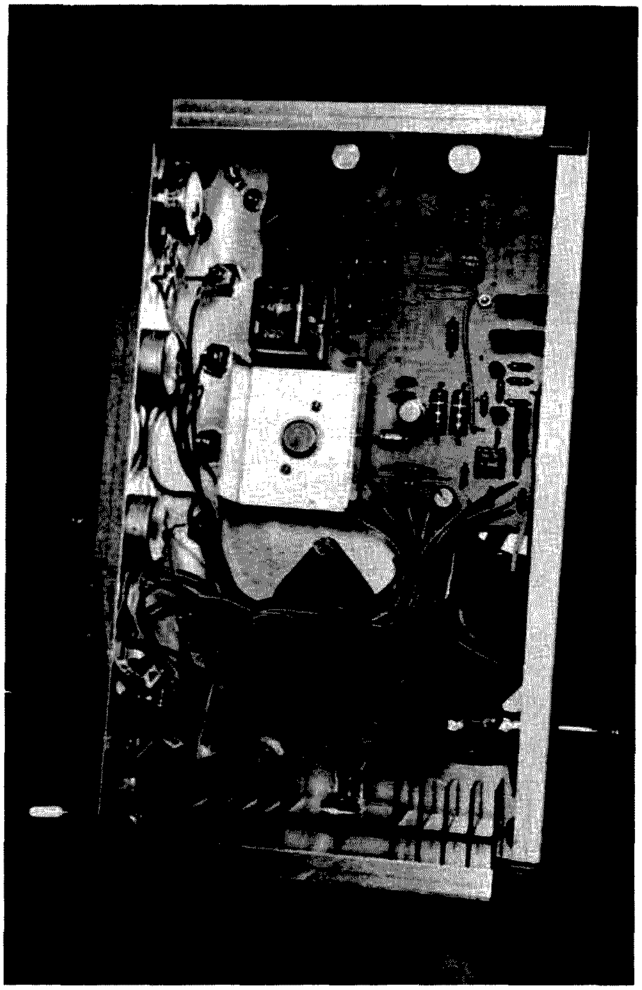
Current Sensing

The current sensing network in Fig. 2 operates as follows: Assume that initially no current is drawn from the supply. With R2 set to 500Ω, R2 + R3 = 21k and R4 + R5 = 21k. With the wiper of R4 set closest to R3, the voltage at pin 11 of voltage comparator IC1A will be 14 volts, exactly half the voltage across C1. Assuming for the moment that no current flows in R1, the voltage across R6 and R7 will be 28 volts and the voltage at pin 10 of IC1A will be 14 volts also. When current is drawn from the positive leg of the supply, a voltage drop develops across R1 and the voltage at pin 10 of IC1A drops below 14 volts. This drives pin 13 of IC1A positive and the resulting current in R21 charges C3. Q1 fires, sending a pulse through C4 to SCR1. SCR1 turns on, operating relay K1 and forcing Q2 to switch on. Q2 shorts out R27, thus reducing the output of IC3 to nearly zero volts. K1 interrupts the current to IC6 in Fig. 3. Q1 also sends a pulse to C14 in Fig. 3. This pulse turns on SCR2, forcing Q4 to switch on; this action reduces the output of IC5 to zero volts.

When the load is removed from the output of IC3, the power can be restored by opening S2A and S2B (normally closed switches). By moving the wiper of R4 closer to R5, the voltage at pin 11 of IC1A is lowered. It then requires a greater voltage drop across R1 (more current in the load at output of IC3) to lower the voltage at pin 10 of IC1A so that pin 13 will go positive. Thus the setting of the wiper of R4 determines what current will drive pin 13 of IC1A high.

An identical network consisting of R8 to R14 and IC2 senses the current in the negative leg of the supply. The output of IC2 switches between 0 volts and -26 volts approximately. Since IC1B will not operate normally with any input below -0.3 volts, the voltage from pin 6 of IC2 is divided down by R15 and R17 so that the voltage across R17 switches between 0 volts and -0.25 volts. R16 and R18 form another voltage divider which provides -0.15 volts to pin 8 of IC1B. Thus IC1B switches like IC1A in response to an overcurrent in R14. D5 and D6 form an OR gate, hence isolating the outputs of IC1A and IC1B from one another.

In Fig. 3, current sensing is done in the same manner as described for the positive leg of Fig. 2. Since the maximum current for this supply is 10 times greater than for the first supply, resistance values have been adjusted according-



Bottom view of power supply.

In all diagrams, all resistors are ¼ W, except as otherwise noted. All capacitors are in uF.

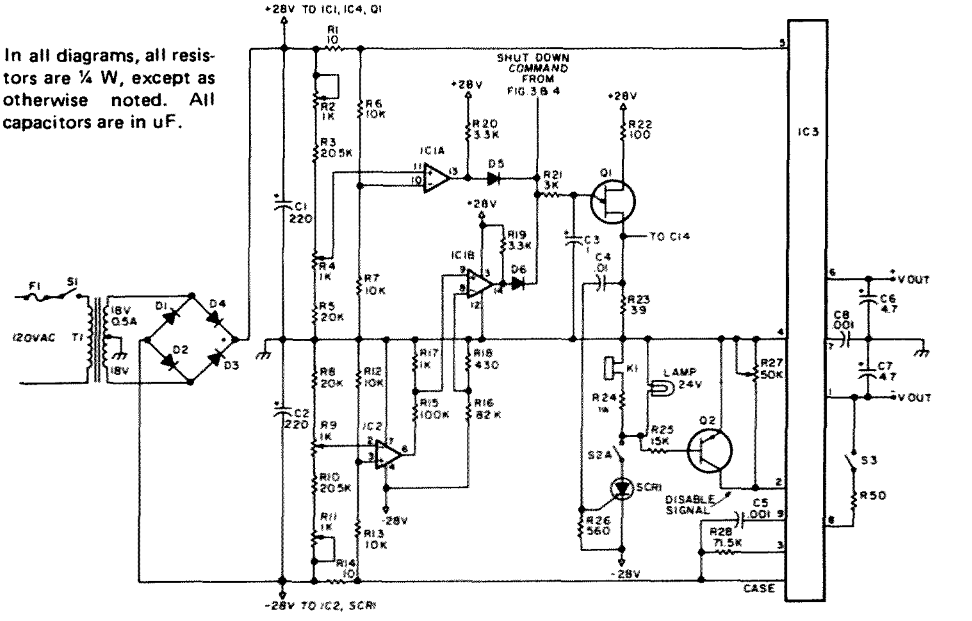


Fig. 2. Dual tracking regulated supply.

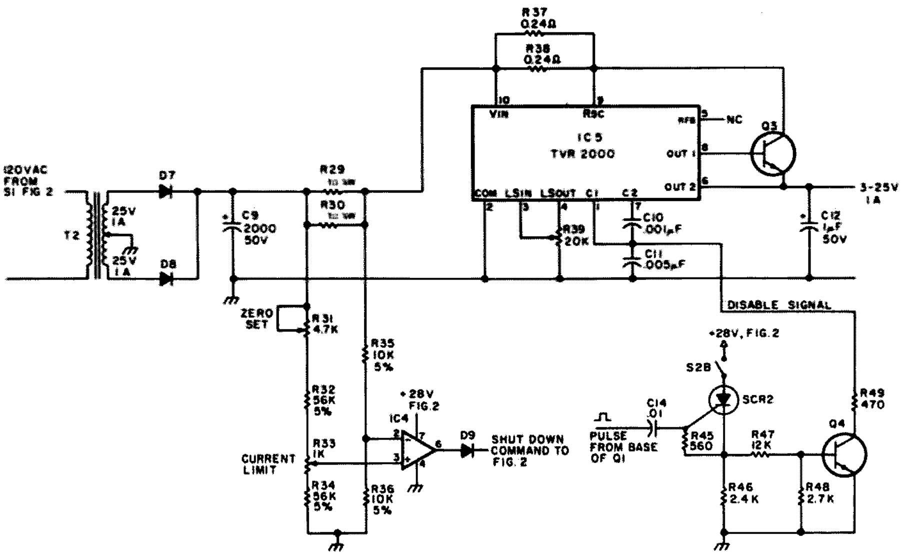


Fig. 3. Variable voltage power supply.

ly. D9 forms another part of the OR gate that feeds R21.

Voltage Sensing

For the 5 volt supply in Fig. 4, it is more desirable to have output voltage sensing than current sensing. This is because there are wide variations in the current demanded by TTL circuits when they are switching from state to state. The current limit point would always have to be set rather high, and consequently only gross overcurrents could be sensed. On the other hand, a circuit that senses when the voltage falls below 4.75 volts, the lower operating limit for 7400 series TTL, is quite useful. Suppose, for example, that you are operating near the 1 Ampere limit of IC6; a brief current pulse could exceed this limit and the internal circuit of IC6 would then allow the output voltage to drop. Without voltage sensing this could easily go unnoticed and your circuit would malfunction.

In Fig. 4, D14 provides a reference voltage. R41 acts as a voltage divider and is set to 5.25 volts. R42 is another voltage divider and is set to 4.75 volts. IC1C and IC1D compare the output of IC6 to these voltages and, if the output moves outside the window from 4.75 to 5.25 volts, pin 1 or pin 2 will go high. This signal goes to R21 of Fig. 2 and eventually shuts down all the supplies.

Response Time

R21 and C3 determine the response time of the circuit. With R21 = 3k and C3 = 1 uF, the circuit responds to an overcurrent, overvoltage or undervoltage that lasts 3 milliseconds or more. K1 adds an additional 7.5 ms to the time required for the 5 volt supply to shut down. By reducing C3 to 0.1 uF, response time can be made as low as 0.3 ms. R21 can be increased to as much as 10 megohms if desired to lengthen the response time, but should not be reduced below 3k.

The Voltage Regulators

The 4194TK regulator is available through advertisers in this magazine. It is internally current limited at about 350 mA when the positive output is shorted to ground. It also has internal thermal limiting that will reduce the output when it gets too hot. A small heat sink is required when the operating current is 100 mA in each leg of the output. In Fig. 2, S3 is normally open. When S3 is closed, R27 can be adjusted to give +12, -6 volts output for the operation of certain types of voltage comparators.

The 309K also has current limiting and thermal limiting. It will provide a little over 1 Ampere when mounted on a heat sink with the circuit shown.

The TVR2000 has been available from Poly Paks for a number of years and is quite inexpensive. It is surprising that in spite of its outstanding performance and low cost I have never once seen it used in a magazine article. Perhaps it is because the information on how to use it is hard to find; the specification sheets that come with it do not give enough information on how to use it. A very complete article on its use in a wide variety of applications can be found in the periodical called *EEE* (Electronic Equipment Engineering), Volume 17, No. 6, June, 1969, pages 82 to 90, available at large libraries. The name of the article is "Voltage-Regulator ICs with Foldback Current Limiting," by D.R. Sullivan and H.W. Mamie.

In Fig. 3, the foldback current limiting option is not used. Instead, simple short circuit sensing is used. R37

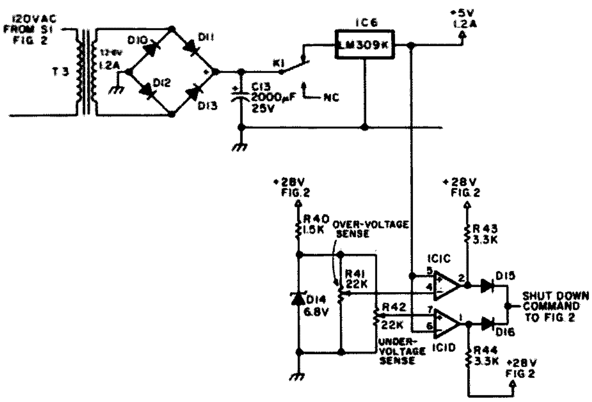


Fig. 4. 5 volt power supply.

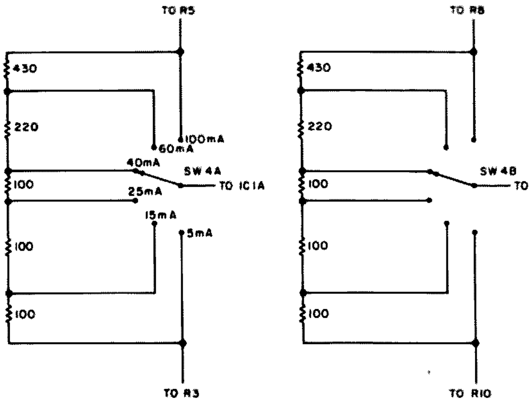


Fig. 5. Switch selected resistors replace R4 and R9.

and R38 set the short circuit current to a value of about 1.2 Amperes. The relationship here is $R_{SC} \cdot I_{out} \approx 0.1$ volt, where R37 and R38 in parallel make up R_{SC}. R39 sets the output voltage. Q3 acts as a current booster and is mounted on a heat sink. C10 stabilizes the current limiting circuitry and C11 stabilizes the regulator section of IC5. Different values from those shown may be required to drive high capacitance loads.

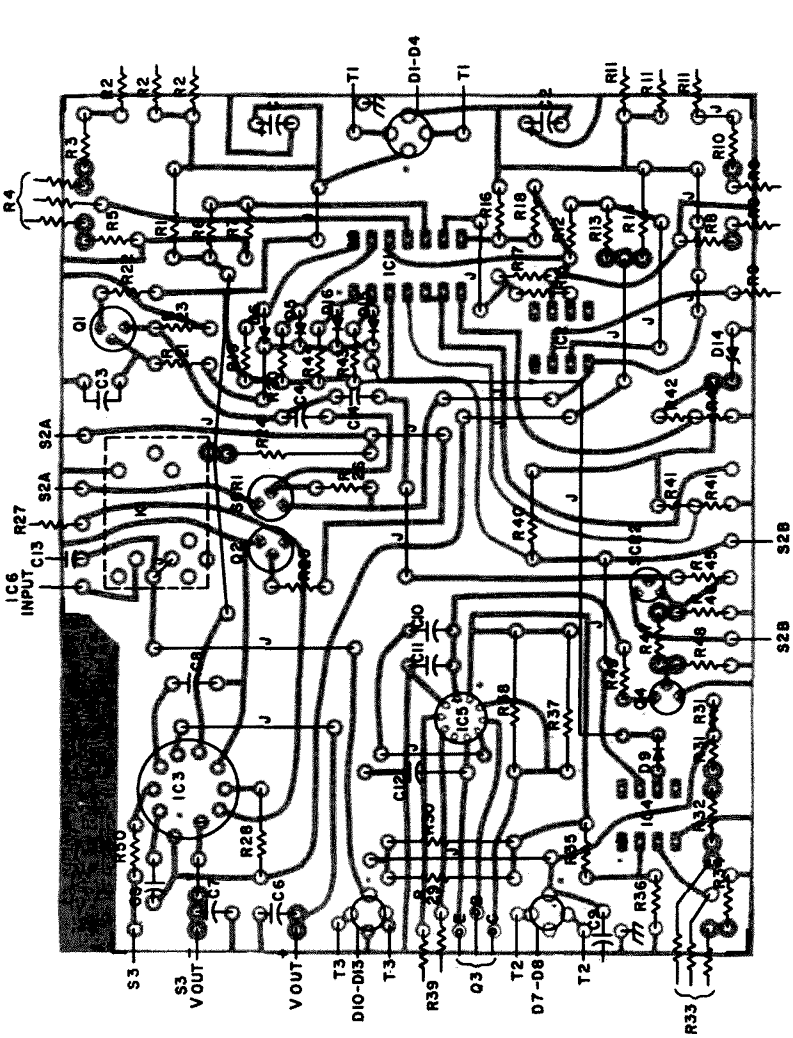


Fig. 6. Parts layout.

Selecting Resistors

Resistors of 1% tolerance are best for R1, R3, R5 to R8, R10, and R12 to R14. This will make the final adjustments simpler and will keep tracking errors in R4 and R9 to a minimum. In Fig. 3, 5% resistors will suffice for R32, R34, R35, and R36, providing you choose them such that R32 ≤ R34 and R36 ≥ R25.

Regarding the tracking of R4 and R9: Since they form a tandem control, it is important that they both exhibit approximately the same resistance between their wipers and their ends for all rotations of the shaft. Failure to do so will mean that the positive and negative legs of the supply will trip at different currents. Several dual controls I bought did not track very well. If you want very good tracking, replace both R4 and R9 with a series of 5% resistors and use a two pole rotary switch to select the current limit you want as shown in Fig. 5.

Construction

All three supplies were constructed on a single 4" x 5" printed circuit board as shown in Figs. 6 and 7. IC3 does not plug directly into the board; the holes in the board have been spaced out to assure clean etching. Solder a short wire to the outside of each pin of IC3; insert the wires into the PC board and solder. A piece of aluminum was bolted to IC3 as a heat sink. There are so many connections to the PC board from the external switches, controls, transformers, etc., that it was not possible to arrange for an edge connector on a board of this size; instead there are about 35 wires soldered at various points around the edge of the board and all are routed to one end of the board so that the board can be hinged outward from the chassis if parts on it need to be replaced in the future.

All components fit nicely on a chassis 10" x 6" x 2" as shown in the photograph.

Final Adjustments

Switch S2 to reset. Leave S3 open. This disables the shutdown mechanism. Connect a high impedance voltmeter between pin 7 of IC1D and ground. Adjust R42 for a reading of 4.75 volts. Connect the voltmeter between pin 4 of IC1C and ground. Adjust R41 for a reading of 5.25 volts.

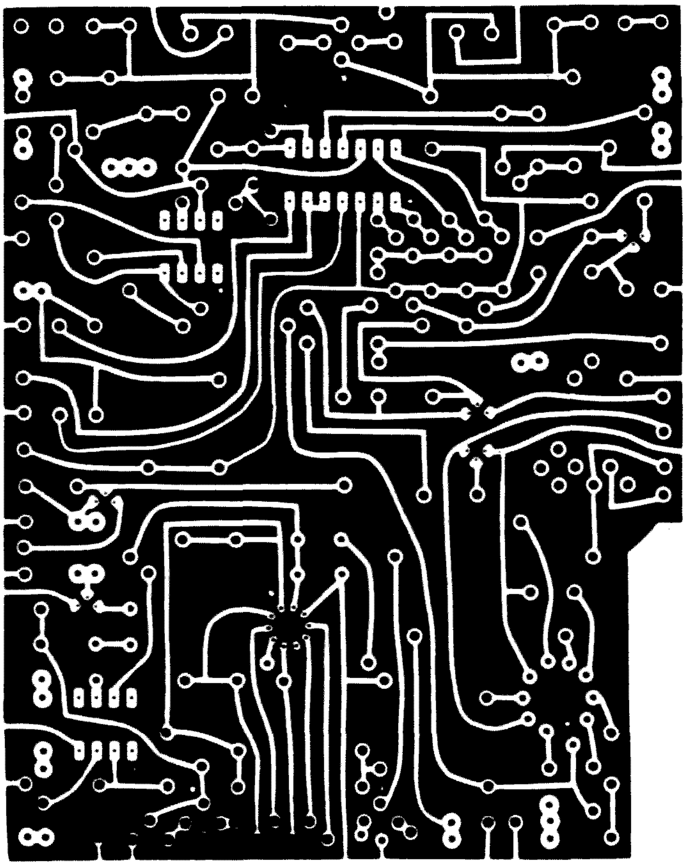
Set the wiper of R33 to the end closest to R32. Connect a voltmeter between pin 6 of IC4 and ground. Adjust R31 so that the reading just goes to zero.

If you are using a dual potentiometer for R4 and R9, proceed as follows: Set the wiper of R4 to the end closest to R3; the wiper of

Partial Parts List

IC1	339
IC2, IC4	741
IC3	4194TK
IC5	TVR2000 (available at Poly Paks)
IC6	309K
D1-D4, D10-D13	2 A 100 piv bridge rectifier
D7-D8	half of 2 A 100 piv bridge rectifier
D5,6,9,15,16	1N4148
D14	1N957B 6.8 V, 0.4 W zener diode
Q1	2N2646
Q2	2N4249
Q3	MJE3055
Q4	2N5550
K1	ITT type 24A02C18A
R4,R9	dual section control; see text
SCR1,SCR2	C103B

Fig. 7. PC board.



R9 should then be at the end closest to R10. Connect a voltmeter between pin 13 of IC1A and ground. Adjust R2 until the reading just drops to zero. If you run out of adjustment with R2, interchange R6 and R7 and try again.

Connect the voltmeter between pin 14 of IC1B and ground. Adjust R11 until the reading just drops to zero.

If you elect to use the switched resistors in Fig. 4, proceed as follows: Set the switch in Fig. 4 to the 5 mA position. Connect a load between the positive and negative output terminals of the supply and adjust the output voltage so that the load draws 5 mA. With a voltmeter from pin 13 of IC1A to ground, adjust R2 until the voltage just drops to zero. If you run out of adjustment with R2, interchange R6 and R7 and try again. Connect the voltmeter between pin 14 of IC1B and ground. Adjust R11 until the reading just drops to zero. ■

CONTESTS

from page 12

FREQUENCIES:

1810, 3550, 3735, 3900, 7050, 7135, 7235, 14050, 14280, 21050, 21135, 21300, 28050, 28600, 50-50.5, 144-148.

EXCHANGE:

RS(T) and QTH – Wisconsin stations will send their county for QTH; others send ARRL section or country.

SCORING:

U.S. and VE contacts count one point, while DX contacts count 3 points for Wisconsin stations. All others score 1 point per Wisconsin contact. Wisconsin stations are to multiply the total QSO points by the number of ARRL sections and Wisconsin counties contacted (146 max.). KP4, KH6, KL7 and KZ5 count both as 3 point QSOs and as section multipliers. All non-Wisconsin stations should multiply the number of Wisconsin QSOs by the number of Wisconsin counties worked (72 max.). Multi-county portable/mobile operations will keep a single log for the entire operation and will multiply the contact points by the total number of different sections and counties worked.

AWARDS:

Certificates will be awarded to the high scoring fixed, portable, mobile, Novice and VHF stations, in Wisconsin as well as each ARRL section and each DX country. The Neenah-Menasha Club is sponsoring a magnificent traveling trophy to be awarded to the high scoring Wisconsin entry of a club each year. This trophy will be awarded to the club submitting the highest total combined score of its members.

ENTRIES:

A summary sheet and station log are requested. Indicate each multiplier the first time worked. Logs must be received no later than May 6, 1977 (DX logs by May 20). Wisconsin clubs should forward a letter stating the calls of their members whose score counts for their club's total. Club members should be sure to identify their club on the first page of the log submitted. All entries should be addressed to: Kenneth A. Ebneter K9GSC, 822 Wauona Trail, Portage WI 53901. Enclose a business size SASE for notification of results.

1977 MASSACHUSETTS QSO PARTY

Starts: 1200 UTC, May 14
Ends: 2200 UTC, May 15

The contest is sponsored by the South Shore Repeater Assoc., Weymouth MA. No time limit. A station may be worked once per band, CW and phone considered separate bands. No crossband or repeater QSOs permitted. Mass. stations may work each other.

EXCHANGE:

RS(T) and county (for Mass.) and ARRL section (or country) for others.

SCORING:

Count two points for each completed exchange. Outside stations multiply total QSO points by different Mass. counties worked (total: 14). Mass. stations multiply total QSO points by different Mass. counties plus ARRL sections and DXCC countries worked. (Do not include E. Mass. or W. Mass. as sections.)

FREQUENCIES:

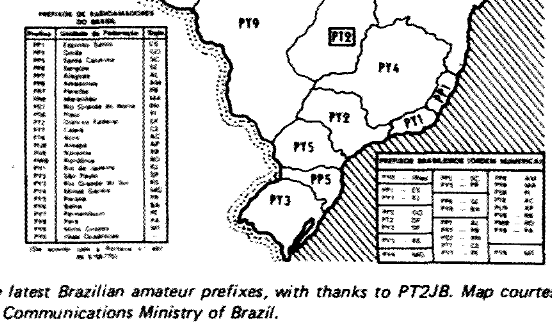
CW – 1810, 3560, 7060, 14060, 21060, 28060.

Phone – 1820, 3960, 7260, 14290, 21390, 28590, 50.110, 146.52.

Novices – 3720, 7120, 21120, 28120.

AWARDS:

Suitable awards. Mailing deadline, June 30. SASE for results and awards, c/o R. J. Doherty W1GDB, RFD #1, 14 Pine St., Sandwich MA 02563.



The latest Brazilian amateur prefixes, with thanks to PT2JB. Map courtesy of the Communications Ministry of Brazil.

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QLF? Not with the Great Lakes Sideswiper!

-- almost perfect CW

With no apologies due the electronic keyers and the modern keyboard or "CW" typewriters, a telegrapher's "fist" is as individual as handwriting. We observe this, of course, by listening to the other guy.

It can be a pleasure to listen to some hand keying, or it may be almost impossible. For instance, how often do we hear persons sending things like, "My nag is Bobbob"? The Lone Ranger's nag is "Silver." We should remember this the next time we send letters in words that need accurate spacing. This used to be called QSC, meaning "your spacing is bad." The OBCQS, or Official Board for Changing Q Signals, replaced this with QSD for some obscure reason. Still, QSD is one of the rarest and littlest used of all the Q signals.

While on the subject of the OBCQS, someone of course had to take over eventually! Think of conditions that used to exist. When you heard the signal QRL immediately followed by twenty of the abbreviations for "I understand," it was reasonable to assume that the station sending all that was busy. They simply removed the 20 "I understands."[1] See how logical the work of this secret board turned out to be? Now we have just QRL, meaning "I am busy," though inferred is the added information, "Please QRT or QSY or turn your receiver on before clobbering my QSO." I hope the OBCQS has been disbanded for malfeasance, as it loused up a number of things (like "QSB"), so nowadays you have to spell it out to find if your spark is bad.

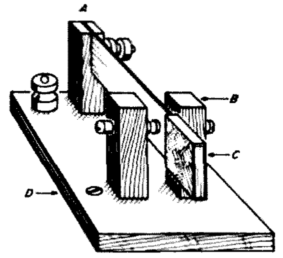


Fig. 1. A: Support for the blade and paddle. B: Posts (parallel connected, or for electronic bug, a terminal for each post). Distance from A to contacts on blade and posts is 2½" (6.3 cm). C: Paddle, to overhang front edge of base D about ½" (1.25 cm). Distance from front end of C to contacts is approximately 2" (5 cm). Dimensions of C, approximately ¼" x 1" x 1¼" (0.6 cm x 2.5 cm x 3.2 cm). Center of paddle to deck, 1½" (3.7 cm). D. Base, 3/8" x 3" x 6" (0.95 cm x 7.5 cm x 15 cm). Front of D to center of B or contacts is 1¾" (4.4 cm). Anti-skid hole in D, same as above.

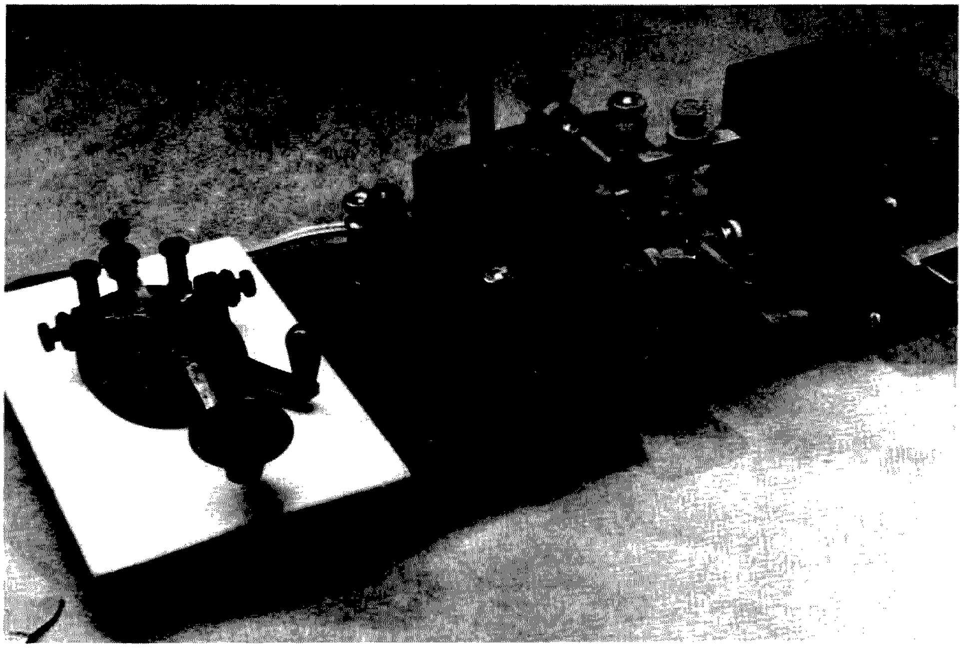
Now to get back to QSD. Recently I read an article by J. K. Bach entitled "Glass Arm."[2] I would like to confirm his interesting, factual observations regarding this affliction. Many newcomers are so devastated when they realize their spacing is terrible that they go out and purchase a microphone. This usually happens after their friends ask, "QLF?" (This is the unofficial, impolite way of saying "QSD," or "are you sending with your left foot?") The result of going on phone at this point is that when some rude person comes on code with SOS, our phone man answers, "This frequency is in use, you lid!" He cannot read his own call any longer. CW is smoke signals to him.

When glass arm set in about two days after I got a ticket to operate, I had to find a reasonable cure. I had a Ford coil going, and no way to get on phone. Some of my peers had built sideswipers (sometimes called cootie keys). They were sailing along at 20 wpm. They had found that running ten Amps through a telegraph key, or most bugs, would cause the contacts to weld closed. So many small silver coins became 20 Amp contacts. Bugs and big fast relays were hard to come by, too. So build a cootie. You never have to worry about glass arm again once you get used to a Great Lakes Sideswiper. But glass arm does last. After reading Bach's article, I loosened the bearings on the straight key and tried his remedy. I could go about 15 wpm fairly well. Above this, QSD. Some good operators can do about 30 wpm on a pump. Not I, alas.

The reason for going into the "fist" aspect of telegraphy is that, as Bach points out, you have to have the right amount of "feedback" (no pun intended). Loosening the bearings on a straight key seems to increase this.

Let's look at the meaning of feedback for a moment. "Once you get the feel of it" is an expression one often hears when trying to get used

to some new experience. Your own built-in servo system has to become accustomed to take the necessary cues from your vision, or hearing, or other senses. The pilot of a boat or plane will readily admit that the autopilot can surpass his ability in the long run. The experienced race driver is in a life or death situation during competition, hanging on the end of a thread which can snap. The ones with the good circulatory ducts and range finding vision live longest. Feedback controls your speech and handwriting and temper and keying – in fact, everything you do while awake or asleep. An interesting experiment in balance is to close your eyes and try to stand steadily on one foot for a moment or two. Sooner or later, if one does not peek, one starts searching for that lost horizon by hopping – to remain upright. Norbert Weiner demonstrated feedback with an automated toy which could move about on the stage avoiding obstacles put in its path. Real magic. Now we have the "sleeping torpedo" lying on the ocean floor waiting for its victims above. We hope it retains its faculties!



The three keys on the left in the illustration are self-explanatory. But that black box on the right is another version of the cootie. It was built to key screen voltage and is shockproof. It may be used as a pump in the position shown. To the left of the home brew bug is my 1921 air-cooled Sideswiper with the 20 Amp contacts. It has been around the world twice with me and still will key a large spark set if you can find one. With it, when a ship rolls to port it will not send a dash of its own as a bug will. This type key is the traditional favorite in rough seas or mobile on rough roads. The tag "Great Lakes" comes from operators there trying to send with one foot on the bulkhead in a storm. You can usually tell who is using one by the spacing it induces in one's fist. The dots are usually longer than the spaces in between them, and the dashes may be a little uneven. This depends on that "fist."

To send with precision is to learn to turn up the feedback, turn on the code practice oscillator, and listen carefully. If you get used to it, make a tape recording of what you think passes for OK stuff. Now play this back. Horrors, you say? So what's the big technique for improvement?

1. Ungrit your teeth and take a warm bath. Then with the thumb and the next two fingers, lightly grasp the paddle in the space position. Breathe normally. Start at 15 wpm with a few Vs.
2. Start every letter by moving the paddle to the left side.
3. In between letters for the spaces, let go of your light grasp without removing your hand.
4. To send every letter or number, go from left to right to left until the letter or number is completed.

Letter A would be left, – RIGHT.
B: L – r – l – r.
C: L – r – L – r.
D: L – r – l, and so on.
Figure number one: l – R – L – R – L.

Take a few runs at the alphabet and some numbers while recording yourself and try the playback again. Better now?

Stick to the procedure. Very important is #3, the loosening of the grasp between letters. This gives you dash length spaces. Try not to rush through the dot sequences (such as in the letters S and H). When you begin to make errors, *stop*. Weiner's machine got psycho and ran into walls when it was tired out. He had to put it to bed and turn off the lights!

When signals are weak and covered with pulses of QRN or M, any sloppy sending is very difficult to copy. Good spacing will permit much better copy by your victim. This of course goes for all keying and for any speed. This also goes for handwriting or skywriting.

The Sideswiper is no toy. It has been manufactured in the past by Bunnell & Co. of sounder and relay fame. Lately a Scandinavian outlet has been advertising one. You may wish to build your own. The outline drawing gives the dimensions. You can use pieces of Mechano, pieces of hacksaw blades, and angle brackets, plus your imagination.

The fixed contacts may be made adjustable for gap width. A gap on each side of about 50 thousandths of an inch with plus or minus 30 thousandths adjustment (1.0 mm ± 0.5 mm) is best. A wide space is recommended for best inter-dot spacing time. If, after practice, you find the spaces are still too short, a relay adjusted to give a few milliseconds delay may be placed between the key and the transmitter. This remedy is a move of desperation and only complicates things. Practice some more.

The Sideswiper will never replace the bug types as a speed key, but it is a cut above a straight key. You will hear it in use by both amateur and commercial stations throughout the world. With care, a speed of 30 words per minute is feasible. You probably will have a fist that your friends will recognize. If you send poorly, and you have a KX prefix, some guy will turn his beam toward YU land and give you a call. It happens with other keyers, too, however. Whatever key you use, try for good spacing or your NAG will be MUD. ■

References

[1] *Robinson's Manual*, U.S. Naval Inst., 1918, p. 222.
[2] *73*, May, 1976, p. 38.

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of

Deregulation of Part 97 of the Commission's Rules to simplify the licensing and operation of complex systems of Amateur Radio stations and modification of repeater subbands.

Docket No. 21033

RM-2664
RM-2780

NOTICE OF INQUIRY AND NOTICE OF PROPOSED RULE MAKING

Adopted: December 22, 1976
Released: January 6, 1977

By the Commission: Commissioner Quello absent.

1. The Commission has before it the two above-captioned Petitions for Rule Making, submitted in accordance with the Administration Procedure Act, 5 U.S.C. 553(e), and the Commission's Rules, 47 C.F.R. §1.401. Each of these Petitions for Rule Making seeks revision of Part 97 of the Commission's Rules, 47 C.F.R. §97.1, *et seq.*, concerning the licensing or operation of stations in the Amateur Radio Service.

2. The petitioners in RM-2664, Mr. Gordon Schlesinger and Mr. William F. Kelsey, request explicit recognition in the Rules of so-called "remotely controlled base stations." They state that considerable confusion exists concerning the definition and operation of remotely controlled base stations, and that there is a need for specific rules to regulate the operation of such stations. Petitioners have proposed specific rules which, if adopted, would both add to the rules several provisions concerning remotely controlled base stations and substantially relax the requirements for the operation of such stations. We have also received several comments from interested parties supporting the basic proposals of RM-2664.

3. The Middle Atlantic FM and Repeater Council (T-MARC), petitioner in RM-2780, seeks simplification of the Amateur Radio Service logging requirements, particularly the rules requiring the notation of all third party traffic sent and received, the retention of station logs for one year, and the recording of transmissions from "open access" automatically controlled repeater stations. T-MARC states that much of the logging required by the Rules is of little benefit to either Amateur operators or the Commission and requests that logging requirements be relaxed accordingly.

4. We believe some of the proposals in the petitions we have received merit serious discussion, and we are herein proposing revisions of Part 97 of the Rules which, if adopted, would result in a substantial simplification of the licensing and operation of stations in the Amateur Radio Service presently licensed as repeater stations, control stations, auxiliary link stations, and all other remotely controlled stations, such as remotely controlled base stations. The revisions we are considering, which are discussed at greater length below, would both accommodate many of petitioners' wishes and would be a significant step in the Commission's program of deregulation of the Amateur Radio Service.

5. Since adopting rules governing the operation and licensing of repeater and associated stations in 1972 in Docket 18803, 37 FCC 2d 225 (1972), the Commission has steadily reduced the burden placed on applicants for and licensees of complex systems of amateur radio stations and has afforded such licensees increasingly greater flexibility in the operation of such stations. For example, in Orders adopted January 10, 1974, and November 17, 1975, we deleted the requirements that certain technical showings be submitted with license applications for repeater and remotely controlled stations. In Reports and Orders in Dockets 20073, 20112, and 20113, adopted May 28, 1976, June 11, 1975, and October 29, 1976, respectively, the Commission revised its Rules to permit the linking, automatic control, and cross-band operation of amateur repeater stations.

6. Our experience since adoption of the rules regulating the licensing and operation of repeater and associated stations in Docket 18803 has demonstrated that amateur radio operators are fully capable of developing and operating complex systems of stations with a minimum of regulation by the Commission. We are aware of no compelling reason why amateurs wishing to operate repeater, auxiliary, control, or remotely controlled stations should continue to be required to obtain Commission permission before beginning such operation, as they have in the past. For this reason, we propose to delete those provisions of Sections 97.40, 97.41, and 97.43 of the Rules requiring that licensees obtain prior approval of the Commission to operate a remotely controlled station and requiring that repeater stations, control stations, and auxiliary link stations be separately licensed. We would discontinue the issuance of station licenses with "combined" station privileges: all amateur station licenses would convey authority to operate as repeater, control, auxiliary link, and remotely controlled stations now operate. Functions now conducted by repeater stations would be conducted under a form of station operation known as "repeater operation." Functions now conducted by control stations and auxiliary link stations would be combined in a single form of station operation known as "auxiliary operation." Auxiliary operation would serve to meet the need for point to point links within a system of stations, including the transmission of control and communication signals to other stations within a system, and the need for the automatic relaying of signals received at one location in a system of stations to stations at other locations within the system. Section 97.3 of the Rules would be revised to include new definitions of repeater and auxiliary operation.

7. Similarly, we believe that operators of other remotely controlled stations, such as remotely controlled base stations, have demonstrated the capability of adequately controlling the emissions of such stations, and that the prohibition against the operation of such stations from control points in portable or mobile operation, presently contained in Section 97.110(b) of the Rules, may be unduly restrictive. Accordingly, we propose to revise the Rules to permit the portable and mobile operation of all primary, secondary, and club stations when such stations are in repeater or auxiliary operation.

8. Because no new station licenses would be issued to repeater stations, as such, we propose to discontinue our policy of assigning call signs prefixed with the letters "WR". Stations presently assigned such call signs would be permitted to retain them indefinitely. A licensee wishing to engage in repeater operation and wishing to obtain a "WR" call sign would be required to request that prefix. Stations with "WR" call signs would be restricted to repeater operation, however.

9. Because stations in repeater or auxiliary operation would be taking advantage of specialized modes of operation, we believe the transmissions of such stations should be distinctively identified. We propose to require that auxiliary or repeater operations conducted by stations with "traditional" call signs (that is, call signs not prefixed with the letters "WR") be identified by the addition of a distinctive suffix to the station call sign. Stations in repeater operation would be identified by the addition of the suffix "R", "RPT", or the word "repeater" to the regular call sign. Stations in auxiliary operation would be identified by the addition of the suffix "A", "AUX", or the word "auxiliary" to the regular call sign. We also propose to revise the station identification requirement for stations in repeater operation or stations in auxiliary operation automatically relaying the signals of other stations in a system to require identification of intervals of at least ten, rather than five, minutes.

10. Petitioner in RM-2780 seeks relaxation of certain logging requirements, and we are considering deletion of the requirement found in Section 97.111(g)(2) of the Rules that communications from open access stations in repeater operation under automatic control be either monitored in real time by the duty or control operator or recorded and the recordings retained for a period of thirty days. This requirement, which was originally intended to ensure that licensees have the capability of determining whether their stations were being used properly during periods when no control operator was on duty, has proven to be of little benefit to the Commission and may unduly burden licensees operating "open" repeater stations under automatic control. Of course, the licensee of a station would continue to be responsible for its proper operation, and we wish to receive comments addressing the issue of the continued usefulness to the Amateur Service of the recording requirement in ensuring the proper operation of "open" automatically controlled repeater stations.

11. We are proposing to revise the present rule that all remotely controlled stations have entered in their logs a list of all authorized control points and copies of all control and auxiliary link station licenses to require the entering of the names, addresses, and primary call signs of all authorized control operators. Such a revision would be based on the proposition that the responsibility for the proper operation of a remotely controlled station should be traceable to specific control operators rather than specific land locations. We also propose to require the posting of a list of authorized control operators at the remotely controlled transmitter site. We are not proposing to delete the requirements that the logs of stations in repeater or auxiliary operation contain certain specialized technical information, however.

12. Additionally, it appears that many Amateur operators seek greater flexibility in the choice of frequencies for repeater and auxiliary operation. Operators of remotely controlled base stations, for example, are not restricted to the repeater frequency subbands listed in Section 97.61 of the Rules, although remotely controlled base stations closely resemble repeater stations, and it may be that such stations should be treated identically. We are therefore proposing to permit both repeater and auxiliary operation on all frequencies allocated to the Amateur Radio Service, except 435 to 438 MHz, and to delete the requirement that frequencies below 225 MHz used for auxiliary operation be monitored by the control operator before and during periods of operation. We would revise Section 97.63 of the Rules, however, to emphasize the two principles which have made possible the efficient operation of many amateur radio stations in relatively small spectrum space, namely, that a station using a frequency has first priority in such use over other stations, and that all frequencies allocated to the Amateur Service are shared on a non-exclusive basis. It is presently the responsibility of amateur licensees to strike an appropriate balance between these principles to ensure the fair and efficient use of available spectrum.

13. The Commission is aware that adoption of the rules proposed herein could result in a significant increase in the number of repeater, remotely controlled station, and associated activities pursued by amateur licensees. We are also aware that severe frequency congestion is presently being experienced in some parts of the country, and that the possibility exists that increased interference might result from adoption of these revisions. Many amateurs have voluntarily established techniques for managing available spectrum, and we commend such efforts. We are not prepared to make specific recommendations in this area at the present time, but we are nonetheless interested in receiving comments concerning present and future anticipated interference patterns, whether present techniques used by amateur operators to limit interference are adequate or could be improved, and whether present levels of voluntary cooperation are sufficient to justify continuation of the existing cooperative system. In this regard, we wish to receive comments concerning the utility of the limitations on the effective radiated power of stations in repeater operation contained in Section 97.67 of the Rules. Should such limitations be eliminated in their entirety, modified, or retained without change? What limitations, if any, should be placed on the effective radiated power of stations in repeater operation operating on frequencies not currently listed in Section 97.67 of the Rules?

14. The specific rule revisions we are proposing are set forth in the attached Appendix. Authority for these proposals is contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended. We invite interested parties to submit comments concerning our proposals on or before April 1, 1977 and reply comments on or before April 15, 1977. An original and five copies of all comments submitted shall be furnished the Commission, pursuant to Section 1.419 of the Rules. Respondents wishing each Commissioner to have a personal copy of the comments may submit an additional six copies. Members of the public wishing to express interest in our proposals may participate informally by submitting one copy of their comments, without regard to form, provided the correct Docket number is specified in the heading of the comments.

15. Individuals wishing to inspect the comments and reply comments filed in this proceeding may do so during regular business hours, 8:00 A.M. to 4:30 P.M., in the Commission's Public Reference Room, 1919 "M" Street, N.W., Washington, D.C. 20554.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins
Secretary

APPENDIX

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is proposed to be amended, as follows:

1. In §97.3, paragraphs (l), (m) and (n) are revised, as follows:

§97.3 *Definitions.*

(l) *Additional station.* An amateur radio station, other than a primary station, including the following:

Secondary station. An amateur radio station licensed for a land location other than the primary station location. A station assigned a call sign prefixed with the letters "WR" is also considered to be a secondary station.

Special event station. An amateur radio station licensed for a specific land location for operation designed to bring public notice to the Amateur Radio Service and related to the celebration of an event, past or present, which is unique and of general interest to either the public at large or amateur radio operators.

(m) *Amateur radio operation.* Amateur radio communication conducted by amateur radio operators from amateur radio stations, including the following:

Mobile operation. Radiocommunication

conducted while in motion or during halts at unspecified locations.
Repeater operation. Radiocommunication, other than auxiliary operation, for retransmitting automatically the radio signals of other amateur radio stations.
Auxiliary operation. Radiocommunication for remotely controlling other amateur radio stations, for automatically relaying the radio signals of other amateur radio stations in a system of stations, or for intercommunicating with other amateur radio stations in a system of stations.
(n) *Control.* Techniques used to operate an amateur radio station. Must be one or more of the following:
Automatic control. The use of devices and procedures for control so that a control operator does not have to be present at the control point at all times. (Only rules for automatic control of repeater operation have been adopted. Automatic control of all other types of amateur radio operation must be approved by the Commission in advance on a case by case basis.)
2. In §97.40, paragraphs (d) and (e) are deleted, and paragraph (c) is revised as follows:
§97.40 *Station license required.*
(c) An amateur radio operator may be issued one or more additional station licenses. A secondary station license shall not be issued to an amateur radio operator for a land location where a primary station license has been issued to the same amateur radio operator. This section does not apply to stations assigned call signs prefixed by the letters "WR".
3. In §97.41, paragraph (c) is deleted, paragraphs (d), (e), (f), and (g) are redesignated paragraphs (c), (d), (e), and (f), respectively, and paragraph (b) is revised, as follows:
§97.41 *Application for station license.*
(b) Except for applications for club stations and military recreation stations, each application must state whether the proposed station is a primary or additional station. If the proposed station is an additional station, the application must state the type of additional station.
4. §97.43 is revised, as follows:
§97.43 *Location of station.*
Every amateur radio station must have one land location, the address of which appears on the station license, and at least one control point.
5. In §97.53, paragraph (j) is redesignated paragraph (k), and a new paragraph (j) is added, as follows:
§97.53 *Policies and procedures applicable to assignment of call signs.*
(j) A station only engaging in repeater operation may be assigned a call sign prefixed by the letters "WR".
6. In §97.61, paragraphs (a) and (c) are revised and a new paragraph (d) is added, as follows:
§97.61 *Authorized frequencies and emissions.*
(a) The following frequency bands and associated emissions are available to amateur radio stations for amateur radio operation, other than repeater and auxiliary operation, subject to the limitations listed in paragraph (b) of this section and §97.65:
(c) All frequency bands and the associated emissions authorized by paragraph (a) of this section, except 435 to 438 MHz, are available for repeater operation, including input (receiving) and output (transmitting).
(d) All amateur frequency bands, except 435 to 438 MHz, are available for auxiliary operation.
7. In §97.63, the headnote is revised and the text amended, as follows:
§97.63 *Selection and use of frequencies.*
(a) Although an amateur station occupying a frequency listed in §97.61 has first priority in the use of that frequency over other amateur stations, such frequencies shall not be assigned for the exclusive use of any amateur licensee or licensees and must be shared.
(b) All Amateur Radio Service licensees shall cooperate in the selection and use of authorized frequencies and shall take such other steps as may be necessary to minimize interference to other amateur radio stations. Licensees making prolonged use of a particular frequency or frequencies shall cooperate with other licensees in the use of such frequency or frequencies.
(c) Sideband frequencies resulting from keying or modulating a carrier wave shall be confined within the authorized amateur band.
(d) The frequencies available for use by control operators of amateur stations are dependent on the operator license classification of the control operator and are listed in §97.7.
8. In §97.67, paragraph (c) is revised, as follows:
§97.67 *Maximum authorized power.*
(c) Within the limitations of paragraphs (a) and (b) of this section, the effective radiated power of an amateur radio station in repeater operation shall not exceed that specified for the antenna height above average terrain in the following table:
9. §97.83 is redesignated §97.82 as follows:
§97.82 *Availability of operator license.*
10. §97.85 is redesignated §97.82, as follows:
§97.83 *Availability of station license.*
11. §97.87 is redesignated §97.84, and paragraphs (c), (d), and (e) are revised, as follows:
§97.84 *Station identification.*
(c) Amateur radio stations in repeater operation or stations in auxiliary operation used to relay automatically the signals of other stations in a system, shall be identified by radiotelephony or radiotelegraphy at intervals not to exceed ten minutes.
(d) When an amateur radio station is in repeater or auxiliary operation, the following additional information shall be transmitted:
(1) When identifying by radiotelephony, a station in repeater operation shall transmit the word "repeater" at the end of the station call sign. When identifying by radio telegraphy, a station in repeater operation shall transmit the fraction bar $\overline{DN}$ followed by the letters "R" or "RPT" at the end of the station call sign. (The requirements of paragraph (d)(1) of this section do not apply to stations having all call signs prefixed by the letters "WR".)
(2) When identifying by radiotelephony, a station in auxiliary operation shall transmit the word "auxiliary" at the end of the station call sign. When identifying by radiotelegraphy, a station in auxiliary operation shall transmit the fraction bar $\overline{DN}$ followed by the letters "A" or "AUX" at the end of the station call sign.
(e) A station in auxiliary operation may be identified by the call sign of its associated station.
12. A new §97.85 is added, as follows:
§97.85 *Repeater operation.*
(a) Emissions from a station in repeater operation shall be discontinued within five seconds after cessation of radiocommunications by the user station. Provisions to limit automatically the access to a station in repeater operation may be incorporated but are not mandatory.
(b) Except for automatic control operations, as provided in paragraph (e) of this section, the transmitting and receiving frequencies used by a station in repeater operation shall be continuously monitored by the control operator immediately before and during periods of operation.
(c) A station in repeater operation may concurrently receive and retransmit amateur radio signals on one or more frequency bands authorized for repeater operation. A station in repeater operation, operating in conjunction with one or more stations in auxiliary operation relaying radio signals received at other locations to stations in repeater operation, may use input frequencies not available for repeater operation, provided the input frequencies to the stations in auxiliary operation are in frequency bands authorized for repeater operation.
(d) A station in repeater operation shall be operated in a manner ensuring that the station is not used for one-way communications, except as provided in §97.91.
(e) A station in repeater operation, either locally controlled or remotely controlled, may also be operated by automatic control when devices have been installed and procedures have been implemented to ensure compliance with the rules when the duty control operator is not present at the control point of the station. Upon notification by the Commission of improper operation of a station under automatic control, such operation shall be immediately discontinued until all deficiencies have been corrected.
(f) A station assigned a call sign prefixed by the letters "WR" shall engage only in repeater operation.
13. A new §97.86 is added, as follows:
§97.86 *Auxiliary operation.*
A station in auxiliary operation, either locally controlled or remotely controlled, may also be operated by automatic control when it is operated as a part of a system of stations in repeater operation operated under automatic control.
14. §97.88 is retitled and revised, as follows:
§97.88 *Operation of stations by remote control.*
An amateur radio station may be remotely controlled when there is compliance with the following:
(a) A photocopy of the remotely controlled station license and a list of authorized control operators, their names, addresses, and primary call signs, must be posted in a conspicuous place at the remotely controlled operator, or shall be carried in the possession of any control operator controlling the remotely controlled station from a station in auxiliary operation being operated portable or mobile. The transmitting antenna, transmission line, or mast, as appropriate, associated with the remotely controlled transmitter must bear a durable tag marked with the station call sign, the names of the station licensee and all authorized control operators and such other information as may be necessary to enable the Commission to quickly contact the control operators.
(c) Except for operation under automatic control, a control operator designated by the licensee must be on duty when the station is being remotely controlled. Immediately before and during the periods the remotely controlled station is in operation, the frequencies used for emission by the remotely controlled station must be monitored by the control operator. The control operator shall terminate all transmissions upon any deviation from the rules.
(e) A station in repeater operation shall be operated by radio remote control only when the control link uses frequencies other than the station's receiving frequencies.
15. §97.89 (Amended).
In §97.89, paragraphs (c) and (d) are deleted.
16. In §97.103, paragraph (c)(5) is deleted, and paragraphs (c), (d), and (e) are revised, as follows:
§97.103 *Station log requirements.*
(c) The log of a remotely controlled station shall have entered the names, addresses, and primary call signs of all authorized control operators and a functional block diagram of a technical explanation sufficient describe the operation of the control link. Additionally, the following information shall be entered:
(1) A description of the measures taken for protection against access to the remotely controlled station by unauthorized persons;
(2) A description of the measures taken for protection against unauthorized station operation, either through activation of the control link, or otherwise;
(3) A description of the provisions for shutting down the station in case of control link malfunction; and
(4) A description of the means for monitoring the transmitting frequencies.
(d) When a station has one or more associated stations, that is, stations in repeater or auxiliary operation, a system network diagram shall be entered in the station log.
(e) The log of a station in repeater operation shall have the following information entered for each frequency band in use:
(1) The location of the station transmitting antenna, marked upon a topographic map having a scale of 1:250,000 and contour intervals;
(2) The antenna transmitting height above average terrain;
(3) The effective radiated power in the horizontal plane for the main lobe of the antenna pattern, calculated for maximum transmitter output power;
(4) The transmitter output power;
(5) The loss in the transmission line between the transmitter and the antenna, expressed in decibels;
(6) The relative gain in the horizontal plane of the transmitting antenna; and
(7) The horizontal and vertical radiation patterns of the transmitting antenna, with reference to true north (for horizontal pattern only), expressed as relative field strength (voltage) or in decibels, drawn upon polar coordinate graph paper, and the method used in determining these patterns.
(f) The log of a station in auxiliary operation shall have the following information entered:
(1) A system network diagram for each system with which the station is associated;
(2) The station transmitting band(s);
(3) The transmitter power input; and
(4) If operated by remote control, the information required by paragraph (c) of this section.
(g) Notwithstanding the provisions of §97.105, the log entries required by paragraphs (c), (d), (e), and (f) of this section shall be retained in the station log as long as the information contained in those entries is accurate.
17. §97.109 (Deleted).
§97.109 is deleted.
18. §97.110 (Deleted).
§97.110 is deleted.
19. §97.111 (Deleted).
§97.111 is deleted.
20. §97.126 is revised, as follows:
§97.126 *Retransmitting radio signals.*
No amateur radio station, except a station in repeater or auxiliary operation or a radio remotely controlled station, may automatically retransmit the radio signals of other amateur radio stations. A remotely controlled station, other than a remotely controlled station in repeater or auxiliary operation, shall retransmit only the radio signals of stations in auxiliary operation shown on the station's system network diagram.
21. §97.181 is revised, as follows:
§97.181 *Availability of RACES station license and operator licenses.*
(b) In addition to the operator license availability requirements of §97.82, a photocopy of the control operator's amateur radio operator license shall be posted at a conspicuous place at the control point of the RACES station.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Editorial amendments of Parts 0, 1, and 97 of the Commission's Rules to change the name of the Amateur and Citizens Division to the Personal Radio Division.

ORDER

Adopted: January 5, 1977;
Released: January 6, 1977

1. This Order is being issued to change the organization statement of the Safety and Special Radio Services Bureau. The Amateur and Citizens Division has recently undergone reorganization, and the name of the Division is herewith changed to the Personal Radio Division.
2. This amendment relates to internal Commission organization, and hence, the

prior notice, procedure, and effective date provisions of the Administrative Procedures Act (5 USC 553) are not applicable. Authority for the promulgation of this amendment is contained in Sections 4(i), 5(b), 5(d), and 303 of the Communications Act of 1934, as amended and Section 0.231(d) of the Commission's Rules.

3. Accordingly, IT IS ORDERED, effective January 20, 1977, that Parts 0, 1, and 97 of the Rules and Regulations are amended as set forth in the Appendix attached hereto.

FEDERAL COMMUNICATIONS COMMISION
Richard D. Lichtwardt
Executive Director

NOTE: Rules changes herein will be covered by T.S.I(74)-7.

APPENDIX

Parts 0, 1, and 97 of Chapter 1 of Title 47 of the Code of Federal Regulations are amended, as follows:

In Sections 0.132(e), 1.951(a), 97.25(d), and 97.41(d), the words "Amateur and Citizens Division" are deleted, and the words "Personal Radio Division" are substituted in each instance therefore.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20654

In the matter of

Revision of Parts 0, 1, and 97 of the Commission's Rules to institute a system of Interim Amateur Permits in the Amateur Radio Service

ORDER

Adopted: January 5, 1977
Released: January 13, 1977

By the Commission: Commissioner Lee absent.

1. Under the existing Amateur Radio Service licensing system, Amateur Radio Service licensees successfully completing examinations for higher class licenses than the licenses they hold must wait while their new license applications are processed at the Commission's Gettysburg, Pennsylvania, facility before they may take advantage of the added privileges afforded them by their new operator licenses. A delay of several weeks may be involved, although both the licensee and the Commission are aware of the results of the examination and know a new license will be issued.

2. By this Order, we are revising Parts 0, 1, and 97 of the Commission's Rules to permit the issuance of Interim Amateur Permits by the Engineers in Charge of the various Commission field offices. Interim Amateur Permits (FCC Form 660-B) will be issued to applicants already holding amateur operator licenses as soon as possible after successful completion of higher class license examinations and will authorize immediate utilization of all additional operating privileges acquired. Licensees operating under the authority of Interim Amateur Permits will be required to add distinctive suffixes to their station call signs denoting the Commission district office at which their higher class licenses were obtained. Interim Amateur Permits will be valid for a period of 90 days or until issuance of the permanent station and operator licenses, whichever is less. A record of the issuance of an Interim Amateur Permit will be retained at the office of issuance, and requests for confirmation of an operator's status must be directed to that office.

3. Authority for these amendments appears in Sections 4(i), 5(d), 303, 307, 308, and 309 of the Communications Act of 1934, as amended. Some of the amendments adopted herein are editorial and procedural in nature, and the prior notice and public procedure provisions of the Administrative Procedure Act, 5 U.S.C. 553, are not applicable. Further, because of the enormous number of Amateur and Citizens Radio Service license applications we receive each month, rapid implementation of the interim permit system is essential, and we are, for good cause, dispensing with the prior notice and public procedure provisions of the Administrative Procedure Act as impracticable.

4. Accordingly, in view of the foregoing, the public interest being served thereby, IT IS ORDERED that Parts 0, 1, and 97 of the Commission's Rules ARE AMENDED as set forth in the attached Appendix effective March 1, 1977.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins
Secretary

NOTE: Rules changes herein will be covered by T.S.I(74)-7.

APPENDIX

Parts 0, 1, and 97 of Chapter 1 of Title 47 of the Code of Federal Regulations are amended, as follows:

1. In §0.314, a new paragraph, (v), is added, as follows:

§0.314 *Additional authority delegated.*

(v) To issue Interim Amateur Permits to Amateur Radio Service licensees, pursuant to Part 97 of this Chapter.

2. In §1.922, a new FCC Form and Title are added, as follows:

§1.922 *Forms to be used.*

FCC Form	*Title*
660-B	Interim Amateur Permit

3. In §1.925, the headnote is amended, and a new paragraph, (e), is added, as follows:

§1.925 *Application for special temporary authorization, temporary permit, or interim amateur permit.*

(e) Upon successful completion of a Commission supervised Amateur Radio Service operator examination, an applicant already licensed in the Amateur Radio Service may operate his amateur radio station pending issuance of his permanent amateur station and operator licenses by the Commission for a period of 90 days or until issuance of the permanent operator and station licenses, whichever comes first, under the authority of a properly executed Interim Amateur Permit (FCC Form 660-B). An Interim Amateur Permit conveys all operating privileges of the licensee's new license, but may be set aside by the Commission within the 90 day term if it appears that the permanent operator and station licenses cannot be granted routinely.

4. §1.934 is revised, as follows:

§1.934 *Procedure with respect to amateur radio operator license.*

After an application for an amateur radio operator license is accepted and an examination conducted by the Commission in accordance with Part 97 of this Chapter, the examination is graded by the office supervising the examination. If the applicant is successful, and if the applicant already holds a license in the Amateur Radio Service, the supervising office issues the applicant an Interim Amateur Permit conveying all operating privileges of the applicant's new operator license. The results of the examination are forwarded to the Commission's Gettysburg, Pennsylvania facility for issuance of a license.

5. In §1.1115, paragraph (c)(6) is revised, as follows:

§1.1115 *Schedule of fees for the Safety and Special Radio Services.*

(c)

(6) Applications for Interim Amateur Permits or Novice Class licenses in the Amateur Radio Service, applications for amateur stations under military auspices, and applications in the Radio Amateur Civil Emergency Service (RACES).

6. In Section 97.3(d), the definition for "operator license" is amended and a new definition, "Interim Amateur Permit," is added, as follows:

§97.3 *Definitions.*

(d)

Operator license. The instrument of authorization including the class of operator privileges.

Interim Amateur Permit. A temporary operator and station authorization issued to licensees successfully completing Commission supervised examinations for higher class operator licenses.

Station license. The instrument of authorization for a radio station in the Amateur Radio Service.

7. A new §97.32 is added, as follows:

§97.32 *Interim Amateur Permits.*

(a) Upon successful completion of a Commission supervised Amateur Radio Service operator examination, an applicant already licensed in the Amateur Radio Service may operate his amateur radio station pending issuance of his permanent amateur operator and station licenses under the terms and conditions of an Interim Amateur Permit, evidenced by a properly executed FCC Form 660-B.

(b) An Interim Amateur Permit conveys all operating privileges of the applicant's new operator license classification.

(c) The transmissions of amateur radio stations operated under the authority of Interim Amateur Permits shall be identified in the manner specified in §97.87.

(d) The original Interim Amateur Permit of an amateur radio operator shall be kept in the personal possession of or posted in a conspicuous place ih the room occupied by such operator when operating an amateur radio station under the authority of an Interim Amateur Permit.

(e) Interim Amateur Permits are valid for a period of 90 days from the date of issuance or until issuance of the permanent station and operator licenses, whichever comes first, but may be set aside by the Commission within the 90 day term if it appears that the permanent operator and station licenses cannot be granted routinely.

(f) Interim Amateur Permits shall not be renewed.

8. In Section 97.87, paragraph (f) as amended, is redesignated paragraph (g) and a new paragraph (f) is added, as follows:

§97.87 *Station identification.*

(f) When operating under the authority of an Interim Amateur Permit with privileges authorized by the Permit, but which exceed the privileges of the licensee's permanent operator license, the station must be identified in the following manner:

(1) On radiotelephony, by the transmission of the station call sign, followed by the word "interim," followed by the special identifier shown on the interim permit;

(2) On radiotelegraphy, by the transmission of the station call sign, followed by the fraction bar $\overline{DN}$, followed by the special identifier shown on the interim permit.

(g) The identification required by this section shall be given on each frequency being utilized for transmission and shall be transmitted either by telegraphy using the international Morse code, or by telephony, using the English language. If the identification required by this section is made by an automatic device used only for identification by telegraphy, the code speed shall not exceed 20 words per minute. The Commission encourages the use of a nationally or internationally recognized standard phonetic alphabet as an aid for correct telephone identification.

Tracking the Hamburglar

LOOTED: Regency HR-2A with extra osc. deck for xmit section, s/n 04-06931. Has following crystals (xmit) 146.37, 52, 34, 07, 19, 16, 94 (rcvr) 146.97, 52, 76, 67, 79, 94 marked with Dymo tape on front. Has special telephone female jack hanging from back for touchtones. Also Regency AR-2 two meter amplifier, s/n 115-0388. These were stolen between December 18 and 22, 1976 from under dash of two-tone green pickup truck in my driveway at 11318 Gravenhurst Drive, Cincinnati, Ohio. A 50 dollar reward is offered leading to convictions of suspects involved. Notify Herbert L. Drake W8QIL, 11318 Gravenhurst Drive, Cincinnati, Ohio 45231, or your local police department. Items have been entered into (NCIC) FBI computer, by Police Dept., Colerain Twp (Hamilton County) Ohio OH0314200.

LOOTED: Icom 22S, s/n 2265. Channeled for: 94/94, 22/82, 28/88, 52/52, 16/76, and 90/30. Home brew 1800 cycles osc. built into AM radio was stolen with rig. Stolen from: Ed Weiss WØSSJ, 4501 West Kentucky #56, Denver CO 80219.

ABDUCTED: Regency HR-2MS, s/n 11-01554. Channeled for: 34/94, 22/82, 16/76, 143.99/148.01, 94/94 and 82/82. Stolen in Topeka, Kansas from: C. E. Widsteen 303-687-3142, Box 937, Woodland Park CO 80863.

RUSTLED: Motorola Metrum II, #C064 with 94, 76, 88, 82, 67, 75, 85, 34, 70, 52, 91, 79. 18 PL. Motorola HT220 H23FFN #TP1174C with separate 12 freq t&r sw, 1BPL, TT on back, "custom WB9BVT" on rear. Robert Scott WB9BVT, 200 W. Chicago Ave., Oak Park IL 60302.

VANDALIZED: Swan 350, s/n 0-84887 from my van. Bill Zimmerman K8BEB, 18071 Floral, Livonia, Michigan 48152.

Corrections

My article "IC Audio Frequency Meter," Holiday issue, has an error on the schematic. Pin 4 of the 555 should connect to pin 8 instead of pin 2. Thanks to Hubert Minchow for finding this error.

Gene Hinkle WA5KPG
Austin TX

Walt Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

The Capacitor Comparator

-- super simple test equipment

If your junk box is like mine, tucked way back in the corner is a spot where you throw all those unmarked, unidentified capacitors that you just KNOW will come in handy some day. Round ones, square ones, flat ones, fat ones, piston and bypass ones, and those a guy could have a great time screw-drivering if he just knew where to use 'em.

The simple circuit here is an easy one-evening project that when completed will provide an audio tone comparison of a built-in reference capacitor to an unknown capacitor connected to the test clips. Bearing in mind that the larger the capacitor the lower the tone, it is a simple matter to establish the value of unmarked units. The circuit, as described, will identify caps between .5 pF and .001 uF by providing tones between 8 kHz and 100 Hz. The heart of the tester is a 555 timing IC and may be operated from any dc voltage source between 8 and 14 volts.

An LED indicator is provided for testing values larger than .001 uF which do not produce a tone but merely turn the LED off and on. A .1 uF unit will trigger the indicator at approximately 5 Hz.

Piston, compression, and rotary trimmers may be identified by first making a comparison fully closed and then fully opened. Small gimmick caps made from twisted leads are also easily sized.

The LED is, of course, optional, as well as the number of reference capacitors. Any NPN switching or audio transistor may be used in place of the MPS6512. If the LED is not needed, the transistor may be eliminated and the speaker with its 1 uF coupling capacitor is connected directly to pin 3 of the IC. Why not try a Poly Paks unmarked assortment — 100 caps $1.98?? Happy sorting. ■

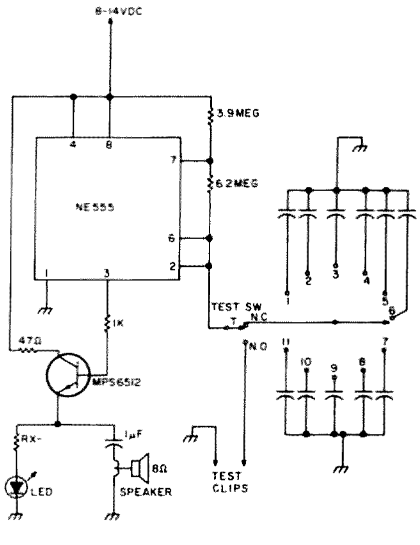
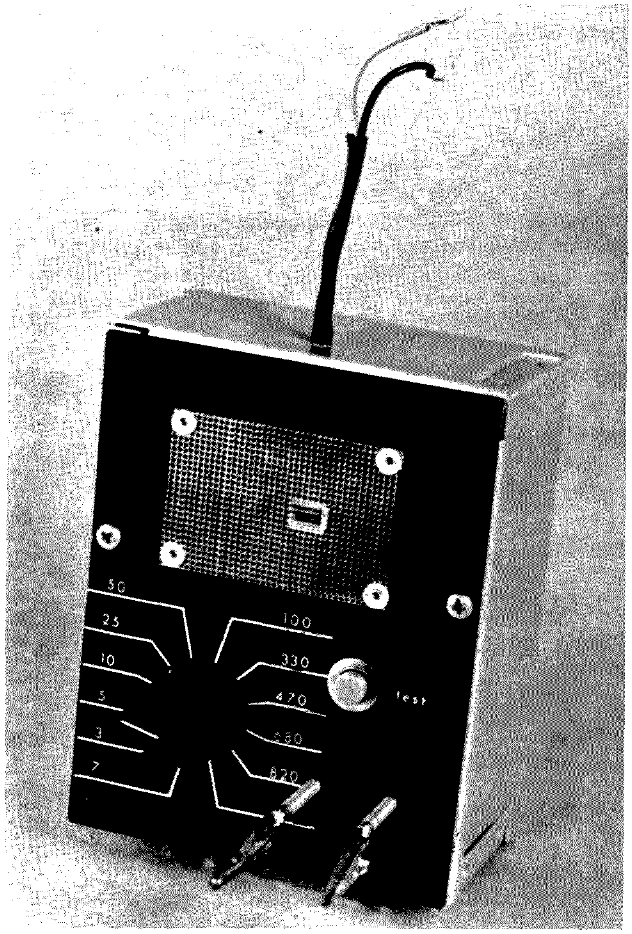


Fig. 1. LED indicator and RX — see LED specs. Capacitor bank: 1 = .7 pF; 2 = 3 pF; 3 = 5 pF; 4 = 10 pF; 5 = 25 pF; 6 = 50 pF; 7 = 100 pF; 8 = 330 pF; 9 = 470 pF; 10 = 680 pF; 11 = 820 pF. Test switch — SPDT push-button.



The LED indicator is located behind the jewel on the speaker grill. The test clips are mounted on small bronze springs for easy attachment to various caps.

Logical Storage for Logic

-- not recommended for CMOS

My first method of storing integrated circuits left me with the vague feeling that perhaps I hadn't arrived at a perfect solution to my problem.

D. E. Stanfield
3408 Catalina Dr.
Atlanta GA 30341

To be honest, I really don't care if you paid less for your chips than I did for mine. Nor am I interested in the psychological motivations that caused you to buy them. What really counts is that we both know that integrated circuits in a jumbled pile do not facilitate rapid retrieval of specific chips.

By way of illustration, assume that today's mail brought several plastic bags of assorted chips. Their price in the magazine had been so low that you rushed off a check and now you have them in your hands. If you are like most of us, you will take your bags and find a place to examine their contents.

Those who have hunted for buried treasure or used metal detectors know the special emotions you will feel as you sort through your chips. A 7400. Nice but ordinary. A 7425. What is it? A 74196. Maybe it's not gold but it sells for more than this whole bag cost. And so on. You recognize many numbers and remember several projects involving their use.

Eventually, you've seen them all and, hopefully, are pretty pleased with your assortment. At this point, what do you do? You can do what I used to do and dump them into boxes for storage. You can throw them out or immediately build a super, self-clocking digital do-it-all.

If you choose the first option, let me point some things out. First, you probably won't remember every type of chip in those boxes for more than two minutes. Second, even if you do remember a specific chip being in a certain box, odds are that it won't be among the first twenty-seven you check. Finally, the pins on integrated circuits do not possess amazing mechanical strength. Once in a pile, these pins have the irritating habit of so interlocking themselves with the pins of neighboring

chips that severe bending leading to breakage can result from trying to separate them.

One solution to all of these problems would be to mount integrated circuit sockets on perf or circuit board and plug in all your chips. However, a couple of moments spent checking the prices of such sockets will probably convince you that there must be a better way. If they don't, please send me all the money you can spare as I need it more than you.

When I faced this problem, I sought a solution that would allow me to plug in my chips, but I didn't want to spend a lot of time or money. I evolved two simple solutions that quite adequately met these requirements. My first method was to punch small holes in a piece of cardboard and insert the chips into those holes. The primary advantages of this technique are extremely low cost, readily available materials, and the fact that the stacking of several boards results in a compact, high-density storage system. The principal disadvantage is that it does take a little time to punch the holes.

My other answer to these problems was to stick the chips into a sheet of styrofoam and go enjoy some liquid refreshment. This method takes less time but I had a lot trouble finding the styrofoam I wanted and the sheets run about a dollar each.

Either method works very well and, for various reasons, I use them both. However, I tend to use the cardboard for chips I don't need right away and the styrofoam for those I've targeted toward specific projects. Using both methods is a logical choice for me, but you can certainly use either one by itself.

There are two other points that may assist you in selecting which method to use: It is possible to use both sides of the styrofoam (which cuts costs in half), and the punched holes in the cardboard act like sockets (which allows you to reinsert other chips into a vacated position). This is handy if you are trying to arrange the chips by type.

If you decide to use cardboard, your first step should be to gather your materials together. These include corrugated cardboard, graph paper ruled ten spaces to the inch, a suitable punch, a knife, a ruler, some masking tape, and a pen or pencil. The cardboard should be larger than the overall dimensions you desire so that it can be trimmed to size. I cut mine eight by ten inches but you can adjust these figures to fit your requirements.

I found the graph paper ruled off at ten spaces to the inch at an office supply firm. While I had to buy an entire pad, this particular size of graph paper lends itself perfectly to laying out boards using integrated circuits.

The punch can be anything from a small nail fitted with a handle to a sharpened test probe. I used a little gadget called a Seam Ripper, used in sewing to open buttonholes and pick threads.

Once you've gathered these materials, you can begin fabrication of the board by using the knife to trim the cardboard to the size you want. I used eight by ten inches, but another size may suit your purposes better. A metal ruler or yardstick makes cutting a straight line very easy. If you anticipate needing more than one board, now is the ideal time to cut them.

After the cardboard is cut, you may lay it aside and prepare a sheet of graph paper which will be used as a guide when punching the holes. My paper measured eight and one-half by eleven inches, so my first step was to draw off a block the size of my boards (eight by ten inches). If your board will be larger than your graph paper, you can glue or tape several pieces together to form a larger sheet. Again, draw off a

Use a metal ruler or yardstick and a knife to cut a piece of cardboard to the desired size.

A sheet of graph paper ruled off with ten spaces to the inch is prepared as a guide to be used when punching holes in the cardboard.

After the graph paper is properly ruled, it is cut to the same size as the cardboard and attached to it with masking tape. Then, each of the seven intersections on the segments of the horizontal lines measuring six spaces in length are punched. The tool shown in use is called a Seam Ripper, normally used in sewing.

block on your paper corresponding to the size of your board.

The next objective is to draw off a grid marking where the chips will be placed. The most common chips have fourteen pins arranged seven on a side. The pins are spaced 1/10 of an inch apart and the spacing between the two sides is 3/10 of an inch. As the chips protrude a bit beyond the pins, each chip will require a minimum space measuring 3/10 by 7/10 of an inch.

Some of the more complex integrated circuits having more than fourteen pins use a spacing of one-half inch between rows of pins. If you are using these types, you will need to make allowance for this fact and develop your own layout.

Whether you wish to devise your own spacing arrangement for ordinary fourteen pin chips or the larger variety, let me suggest that you leave a good bit of room around each chip. This will make inserting and removing chips much easier since your fingers will have enough space to get a good grip on the chip.

If you wish to duplicate my spacing, begin by ruling off a rectangle measuring eight by ten inches. Then, arrange your graph paper so that one of the eight inch sides is at the top. Place a mark in the upper left-hand corner at a point six spaces from the top and seven spaces from the left of the eight by ten inch rectangle. Similarly, in the upper right-hand corner, place a mark six spaces from the top and seven spaces from the right side of the rectangle.

In the lower left and right corners, place marks at points seven spaces from the bottom and seven spaces from the sides. Join the four marks to form a smaller rectangle within the eight by ten inch borders.

Then, starting at the top of this new rectangle, count down three spaces and draw a horizontal line from edge to edge of the smaller rectange. Next, count down four spaces from the previous line and draw another horizontal line. Continue by alternating the spacing between horizontal lines three and four spaces until you reach the bottom line of the small rectangle.

When you finish the horizontal lines, begin in the upper left corner and count six spaces to the right. Draw a vertical line from top to bottom of the inside rectangle. Then count four spaces to the right of the previous line and draw another vertical line. Continue by alternating six and four spaces until you reach the right side of the inside rectangle.

At this point, cut the graph paper along the lines of the eight by ten inch rectangle. Use masking tape and fasten this eight by ten inch graph paper to the top of the eight by ten inch cardboard previously prepared. Be sure to align the edges of the graph paper and cardboard correctly.

After all the holes have been punched, the graph paper is removed from the cardboard and the chips are inserted.

With the graph paper side up, lay this cardboard on a piece of wood and begin punching. Punch a hole at each intersection along the horizontal lines that are six spaces in length. Punching both ends and all points between them will give you seven holes in a row. This corresponds with one side of a chip.

As you are punching, penetrate the graph paper and the cardboard until you feel your punch against the wood. It is not necessary to go through the bottom layer of the cardboard, just be sure that you touch it.

After you have punched all the six space segments on each horizontal line, you should remove the graph paper from the cardboard. This graph paper can be used as a punching guide for many other pieces of cardboard, so don't throw it away.

All that is left is to insert your chips. Remember to check for bent pins and to push each chip into place firmly.

For those of you who feel that the previous method would take up more of your time than you can spare, let me strongly recommend that you give the following system of chip storage a try. The reason styrofoam lends itself so well to holding chips is that you can easily push the pins into the styrofoam without having to drill or punch holes to hold them.

While there are two ways (neat and not so neat) to use the styrofoam, both require at least one sheet of styrofoam. I thought that this would be easy to find, but some quick looking around proved me wrong. Not only did I look in all the wrong places, I finally ran out of wrong places to look. My search eventually led me to one of those craft shops where they sell string and weeds.

After I had finally located my styrofoam, someone mentioned that friendly florists are a great source. I haven't checked this out yet. I feel that it is my duty to warn you that as you search you can expect a lot of busy clerks to direct your path to their supply of styrofoam ice chests.

Once you have your styrofoam, you must decide how neat you want your finished stock of chips to look. If you really don't care, simply start pushing one chip at a time into any area of the styrofoam that looks inviting. When you run out of room or chips, you can stop.

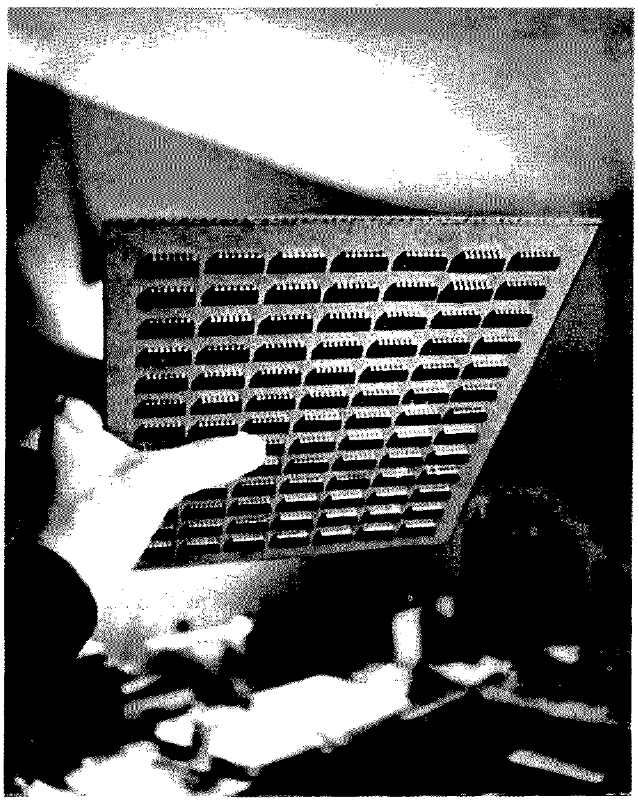
If you would prefer to have the results of your efforts look more professional, allow me to suggest a simple way to do so. In essence, you will make a ruler with appropriate marks to show the proper location of each chip. This ruler should be about 3/8 of an inch thick so that when placed on edge, this thickness will serve as an easy to use guide for setting the spacing between rows of chips.

To make this ruler, choose a length of wood (such as molding) roughly 1/2 by 3/8 inches high and wide. One of these dimensions should equal the spacing you want between rows of chips. The length of this wood should be an inch or two greater than the width of your styrofoam sheet.

Next, lay this piece of wood across the width of your styrofoam so that the side whose thickness you want as the distance between horizontal rows of chips is on the bottom. In other words, imagine that there are already two rows of chips correctly spaced on the board and place the wooden strip so that it would exactly fit into the space between the rows.

Using a pen, draw a mark on the wood at each edge of the styrofoam. Try to equalize the lengths of the wood extending beyond each edge of the styrofoam before making the marks.

Now you will have to determine the spacing



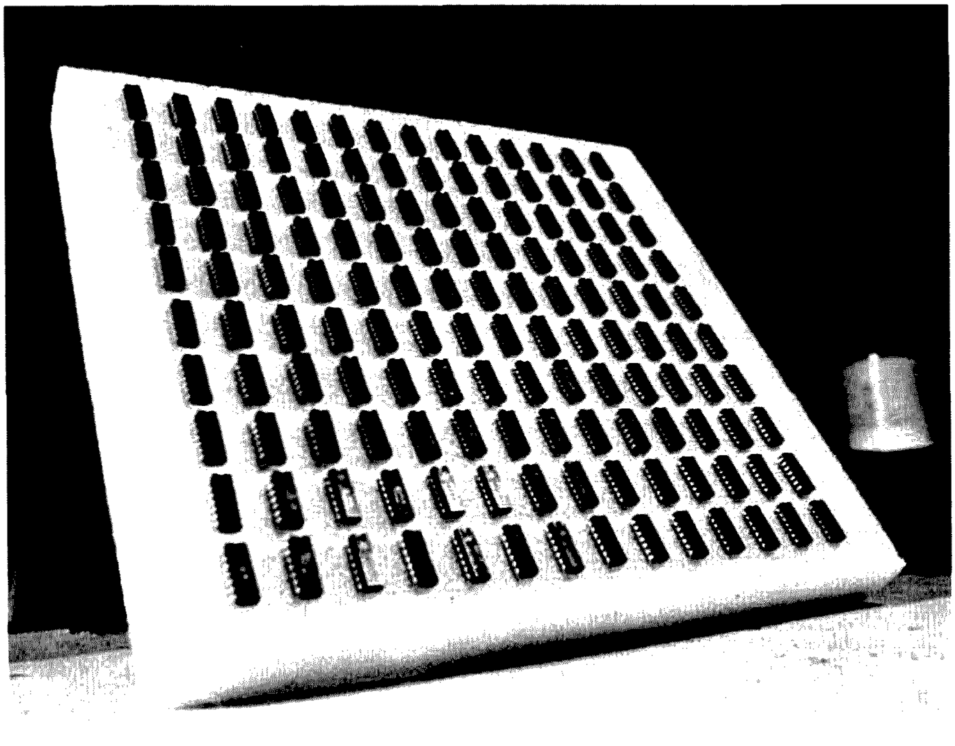
This fully populated board is being held upside down to show that the cardboard will hold the chips quite securely.

This photo demonstrates how the homemade ruler serves as a spacing guide to set the distance between horizontal rows of chips.

Marks on the homemade ruler show where to place each chip. Marks near each end of the ruler serve to align the ruler with the edges of the styrofoam.

between the individual chips on the horizontal rows. An easy way to figure out the spacing is to set out a row of chips on a sheet of graph paper and working with the width of your board setting the outside limits of the row, line up the chips at different spacings until you have them like you want.

Once you are satisfied with the spacing, bring your ruler next to this row of chips and mark the locations of the edges of each chip on the ruler. Do not forget that the two marks you previously placed on the strip of wood located the edges of the styrofoam. Therefore these two marks should be lined up so that they are spaced equal distances beyond their respective chips.



Once all the chips have been inserted, you will have a neat and very practical storage system.

To use this ruler, set it across the styrofoam so that the marks for the edges line up with the edges of the styrofoam. Place it near the top edge of the styrofoam so that all chip and edge locating marks are visible to you and the correct side is on the bottom. Adjust its location until the edge nearest you corresponds to the place where you want the top edge of your first row of chips. Then, while holding the ruler firmly in place with one hand, use the other to plug in the chips.

An easy way to do this is to line up the ends of the chip with the chip location marks and then align the pins so they are flush with the edge of the ruler. Once these conditions are met, push the chip straight into the styrofoam. When seated correctly, the pins on the side of the ruler will be touching it.

Once you complete the first row, shift the ruler down and reposition it so that its top edge is touching the bottom edge of first row of chips. Again, line up the edge locating marks with the edges of the styrofoam and insert chips at the marked locations.

Follow this procedure with all succeeding rows and you will finish with a neat set of stored chips. While things may sound a bit involved, you will find that once you get started, things proceed quite rapidly.

For those of you who like systems thinking, it is not difficult to keep a record of the location of every chip. Assign each board a number, each horizontal row a letter, and each position on the horizontal rows another number. Then an entry such as 07-F-05/7410 would tell you fifth chip on the sixth row of the seventh board was a 7410. ■

CB Can Do Some Things Better

-- are you missing some fun?

David F. Norman
622 W. Sunset Blvd.
Fort Walton Beach FL 32548

Much has been written about "stepping up" to amateur radio from CB. As amateur ranks begin to swell with newcomers from Citizens Band, we can expect to see many more articles on the subject. However, transition between services should not be – and isn't – a one way process. A great many amateurs have realized that CB does things that no phase of amateur radio – including 2 meters – can do. Let's take a look at some of the reasons why the "compleat ham shack" should include a CB transceiver.

Travel Aid

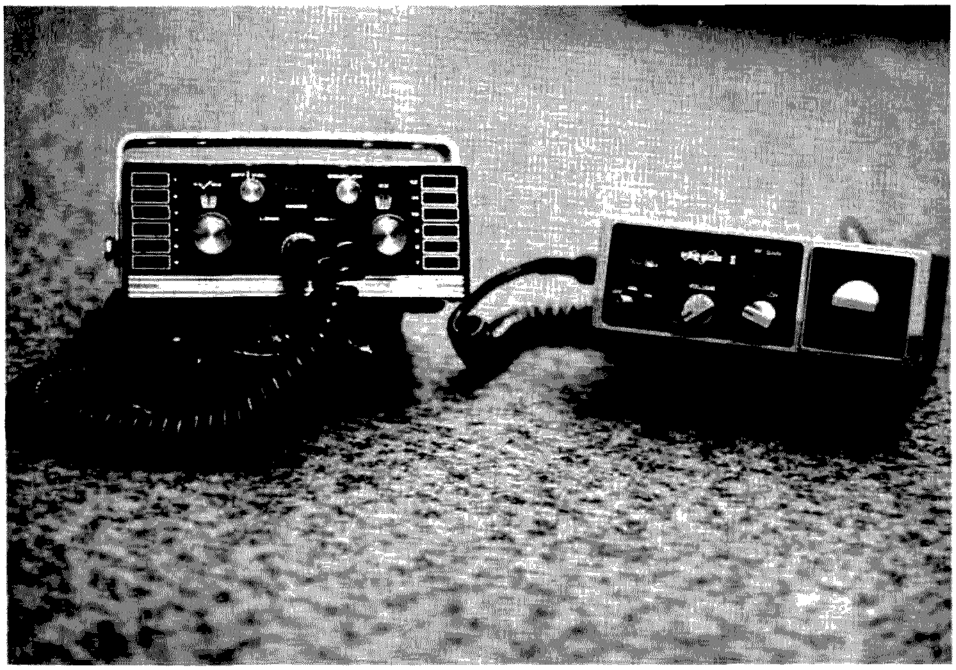
Use of CB by amateurs is seldom limited to the shack. Nowadays, you can see quite a few mobile operators with both 2 and 11 meter antennas and rigs installed in the family car. And why not?

Amateurs on the highway have the same problems to cope with as other motorists. Perhaps in your area you can always hit the nearest repeater; you would find many other locations in sparsely populated areas where you could not reasonably expect to reach anyone, anywhere, with a 2 meter mobile. Even if you are equipped with high frequency gear, your contacts are more likely to be entertaining than helpful as far as your circumstances on the highway are concerned.

Let's assume that you *are* well within range of a local repeater. What is the chance of receiving timely information regarding road conditions and traffic jams on 2 meters? Pretty slim, right?

Okay. At present there is no better system than CB for finding out what is happening a few miles ahead. There is no more reliable way – on the average – of requesting help when faced with car trouble or the discovery of a serious accident. Despite the short range and interference of CB, it has proven its worth time and time again to the traveling public.

Perhaps you don't care for his operating procedure, but if you have a bad back and your wife is faced with changing a tire on the camper in one hundred degree



More and more amateurs are finding CB a useful addition to their mobiles and shacks – with good reason.

weather, are you going to refuse help from the "Trottin' Turkey?" Not unless you are a damn fool.

If the XYL has never been quite able to grasp the necessary theory and code — or didn't care to — you may have wished that there were some legal way for you to keep in touch when she is out in the car. This is the beauty of CB. All that is necessary to operate a CB unit is a simple application. Under one license, your entire family is covered. But you knew that already.

One of the large CB manufacturers used to run ads to the effect that no woman should drive alone without one. An awful lot of CBers agree.

Of course, no amateur would be guilty of speeding, so under most conditions "Smokey reports" would not be of value to him. However, no one likes to be surprised when he is a long way from home.

One thing more about traveling with a CB: You don't have to worry about CBers holding against you the fact that you hold an amateur ticket. Most of them are pretty tolerant.

Introduction to Radio

It is not at all uncommon for someone to be exposed to amateur radio and then vow to get his own ticket. Unfortunately, a great many aspiring amateurs get discouraged by how much code and theory they have to learn before they can do any phone work. Perhaps even your XYL would get on the ball, if she only knew how much fun radioing really is.

A little taste of honey often makes someone want more. With the encouragement that you can give and the fun and experience that CB can offer, your XYL (or YM or YL) has a good chance of making the grade. Even if you have been licensed for several years, there is a good chance that your XYL has never talked to *you* over a radio. With CB, you can put her on the air in a couple of hours.

Overcoming Mike Fright

You might not believe it, but every CBer that you hear on the air had a first time — just like you. The same trembling, proud, sweaty feeling that grabbed at you grabbed him. At one time the 10-signals that he now uses so glibly and the CB slang that assaults your ears were as awkward to him as Q-signals and amateur pleasantries were to you. I know that this statement will probably prompt a lot of argument, but the fact is that most

Fig. 1. Tom Goldsmith WB4EQU is only one of the active amateurs who have added CB. Tom's highly modified 2 meter rig with its T/T pad still has the place of honor on the hump, but the CB comes in handy, too.

Fig. 2. One of the major pluses in CB's favor is the "family style" license. This means that wives — such as the author's XYL — may have the advantages of two-way communication, even if they are not electronically inclined.

QRL	10-6
QRG	10-93
QRT	10-3
QSL*	10-4
QSM	10-9
QRV	10-8
QSP	10-5
QSY	10-27
QTR	10-36
QTH	10-20
QRS	10-11
QRRR	10-33

*Roger is usually phone acknowledgement.

Fig. 3. Partial comparison of CB "10-signals" and amateur "Q-signals." Not all of these translate exactly.

CBers are people just like amateurs: They simply like to talk on the radio.

Whether you agree with that or not, you will have to admit that the enthusiasm of CBers is contagious. If you nourish that enthusiasm, and spring for a CB unit – perhaps trade that old receiver for one – for the family car, there is a good chance that within a few weeks there will be more than one amateur in your family.

The CB in the Shack

If you decide to install a CB in the car, you will probably want to install a matching unit at home. Not only would you then be able to call home when you are on the way home from work, but you would also have the peace of mind that comes from knowing that your wife or daughter can call you for help – without having to leave the car.

Even if you are reluctant to install the CB in your domain, the shack, you can find a corner in the kitchen or family room where it can repose in all of its humble glory. Ask the XYL. She is bound to have an opinion.

Public Service

So far we have talked about all of the wonderful things that CB do for you. However, this is another of those two-way streets. Along with the rights and privileges which come with that CB license come certain responsibilities – moral, if not legal.

It goes without saying – almost – that you will operate the CB unit in as legal a manner as you operate that ham rig, but there is more to it than that. When you receive a road report, you obligate yourself to the sender of it. Since you will likely not have a chance to return that favor to him personally, this obligation makes you bound to do the same for others somewhere down the road.

Your obligation to CBers probably already exists, *even if you don't have a CB unit.*

Remember that last disaster that struck your area? It might have been a hurricane, a brush fire, an earthquake, or a tornado. Whatever it was, you can bet your favorite QSL card that there were CBers right in there donating their time and equipment, and even risking their lives, to do their part.

During Hurricane Eloise, I was busy on the CB base in the Civil Defense Center, talking to and encouraging brave, scared CBers who stayed out until the last minute to warn sleeping residents in low-lying areas that the hurricane was going to strike Fort Walton Beach and not pass west as the weather wizards had predicted. Most of these men had families that they would have much rather been with. Few of them were even regular members of the CD. The major qualification that most of them had was the CB unit in the car or truck.

I don't mean to imply that hams weren't there; the job that they did on 2 meters was great. And then the lights went out all over town.

Emergency repeater power is fine. However, when the water is up to your headlights and the wind is blowing at 125 mph, it is damn hard to get to most repeater sites.

Another instance comes to mind.

During the same storm, emergency shelters were opened in the schools. Anticipating power and phone failure, we sent a mobile unit to each school to provide communications back to CD control (we stopped using callsigns early in the storm and used only unit numbers; there was simply too much traffic to handle). After the storm had abated, but before the people were released from the shelters, one of the shelter CB operators wanted to secure. We (I) told him to hang tight for another hour. It is a good thing that I did.

Within a few minutes, he called in asking for an ambulance. A young girl was hemorrhaging badly. All at once, another station broke in. The breaker was another of the CBers. This one was parked beside the ambulance at one of the hospitals – his own idea – and as he reported that the ambulance was on the way, I could hear the siren wailing.

Would anyone like to try to compute the odds of having two units equipped with 2 meter rigs in both of those places at that particular time?

Any amateur who claims to be interested in community service should definitely equip himself with CB. In several emergencies, stretching over the last decade, I have personally seen CB used as both the common denominator providing interface between various radio services and as the main bulwark of communications

Fig. 4. Terry Bishop, owner of this wrecker, is typical of community-minded CBers who volunteer their time and equipment during emergencies and disasters.

when everything else quit.

Then, too, there is simply the matter of numbers. If your small child turned up missing, you could get every amateur in the area to look. If you happen to live in a fair-sized city, the only problem with asking for help on the CB channels would be that you might have more help than you'd know what to do with. Every single car would be CB-equipped and able to maintain contact with all of the other units.

Get With It

If all of the above isn't enough reason for you to trot out and get one of the 23-channel units or a more sophisticated 40-channel model, look at it this way.

Any CBer could tell you that the skip conditions on 10/11 meters are pretty bad – pretty good, depending on how you look at it. If you are wondering whether 10 is hot or not, all that you have to do is turn on the CB and listen for the "Golden Boy" to come booming out of Nova Scotia. Then turn off the CB and fire up the 10 meter rig for a good crack at a little DX.

Or you can always tell yourself that the CB unit hidden in the bottom of your shopping bag and smuggled into the house will be converted to 10 – just as soon as you check it out with a "good buddy" or two. The same goes for that Moonraker beam. All that you have to do is shorten the elements a bit. Of course, you had first better put it together like the manufacturer says.

Whatever words you might have to eat, or rationalization you feel compelled to make, don't let misguided pride stand between you and one of the handiest pieces of gear that you have ever seen. Just think what your knowledge of radio and antennas can accomplish with something that works well for the rankest tyro. ■

LETTERS

from page 17

Band radio service." The following frequencies were offered: 27.54 to 28 MHz and 222 to 224 MHz.

You should be aware that the amateur service use of the 220-225 band is increasing explosively, plus the proposed "Communicator" license with its reduced licensing requirements for citizens will necessitate full use of this band by the amateur service.

We at this time question your committee's judgment in the matter. From the Table of Frequency Allocations, FCC Vol. 2 Rules and Regulations, we look at the following frequencies being held or possibly "hoarded" for total government use: 225-235 MHz, 235-267 MHz, 335.4-399.9 MHz, and 406-420. These are all fixed and mobile frequencies and exclude Space Telemetry and Aeronautical Radionavigation.

Please submit to us the following information:

Names of each agency with its representative and his position with the agency, methods used to determine spectrum availability, and were the following tools used: 1. % of occupancy level based on monitoring to determine actual usage; 2. Accurate user records and forecasting; 3. Careful evaluation of the priorities of the needs of the United States citizens.

Please notify me within 10 days if it will be necessary to invoke the Freedom of Information Act to expedite this request for information.

Merrill See W8BGZ
Kalamazoo MI

The results next month. — Ed.

KENTUCKY — EAT CROW!

"Big Brother" is here and now in the shape of Uncle Charley, and only Uncle Charley has the constitutional authority to regulate the transmission of energy on the airwaves (in the USA).

And not even the FCC yet has the power to tell us what we can *hear.* We are not yet to the degree of regulation held by the Russian government over their citizens.

I believe that if any of those poor Kentuckians who have lost equipment and money in fines were to fight back, they could make the State of Kentucky eat crow. It is highly unlikely that the anti-scanner law is constitutional, and it most likely violates the Federal Statutes that set up the FCC in the first place.

If you will recall, some states attempted to outlaw radar detectors (receivers) but were unable to enforce the laws, and you never hear of anyone having any problems on that score any more.

I would think you could suggest in one of your columns that those poor Kentuckians should get in touch with the American Civil Liberties League, their lawyers, their congressmen, etc., and have the stupid law repealed.

O. D. Whitwell WB5YBO
Austin TX

DOWNHILL

I am a computer repairman for the U.S. Army Hawk missile system. I read your magazine for the computer content. However, you have opened the world of ham radio to me.

Being a CBer 11 years, and watching it go downhill, well, I no longer have a CB. Several months ago I purchased a Hallicrafters S-120. This and your magazine made me decide to try.

I borrowed some Ø5 Charlie (radio operator) tapes from a friend. I am also interested in learning more about how the radio works.

Anyhow, I want to thank you for putting out such a good magazine. It has helped me quite a bit. Keep up the good work.

Michael P. Olbrisch
APO New York

SKIPLAND

I was into CB before I got into amateur radio, and still do both. With all the Novices and Techs now working the Novice bands, I am surprised at the lack of activity on 10 meters. The problem must be no one knows when the band is open. For the hams with CB rigs, better yet SSB CB rigs, if there is any opening at all, you will hear it on channel 16 lower sideband. When I hear skipland on 11 meters, I go to 10 meters and usually make a contact or two. Hope this stirs up a little more activity on 10 meters.

Leon R. Harris WD8BYM
Battle Creek MI

And the Novices shall lead them. — Ed.

TIMES CHANGE

I think I will let *73* go for a year or so. I first subscribed due to an interest aroused by a pile of back issues from the late 60's — the magazine had a different spirit then. There were a lot of articles for beginners, written in a way that encouraged the less knowledgeable hams to become involved in good stuff like construction. Building — sometimes that's *all* there was. While *QST* was laying out all the mathematical formulas for calculation of the celebration of the angle of the disinclined pandemonium, *73* was telling us about the projects we could have on the air by Wednesday night (well, Thursday afternoon, anyway).

The magazine that arrived in response to my subscription didn't remind me much of the old *73*. The thing that struck me as most out of place was the obsession* with computers. They obviously have some application in amateur radio technology, but enough's enough.

That you would finally publish a computer magazine was a foregone conclusion — I'm sure it will set the pace for the hobby computer crowd. I'm wondering what will happen to *73* once you get fully occupied with *Kilobaud.* I'll be glancing at someone else's issue from time to time to find out.

K.W. Farlow WA3DBL
Wilmington DE

*That word wasn't used as an epithet. You, of all people, would probably agree that a moderate amount of obsession is better than some other things one could mention.

Built a circuit with a CK722 yet, Farlow? Times change. — Ed.

BACK TO BASICS

I would like to congratulate you on the type of articles which appeared in each issue of *73* during 1976. For the most part they were superb, and I will readily agree that same was far ahead of *QST* for the same period.

Also, you are absolutely correct in guessing that my interest in computers has grown steadily through the past year, but one thing bugs me. In several issues of *73* during 1976, there were articles on learning the machine or basic language needed to program a computer and at least one article describing how to use a Model 15 teleprinter for a readout device, and one page of the "Holiday" issue lists various publications beneficial for use after you have built a computer or acquired one. BUT, to my knowledge, there has not been a SINGLE article on how a beginner or experimenter can build his first basic fundamental computer. Please correct me if I am wrong.

Popular Electronics in their August, 1976, issue gave what appears to be a very good article on building the "Elf" basic computer and promised future articles dealing with readout devices, but to my knowledge none has appeared.

I have on order Texas Instruments' computer manual for beginners and the advertisement says the manual describes how to build a basic "machine."

Would it be violating house rules to tell me if an article on "computer construction" is forthcoming in an early issue of *73?*

I have E & L Instruments' "Digi-Designer" and also their "Breadbox," which I find to be of tremendous help in building up test circuits such as were in "How Do You Use ICs?" and other similar articles in *73* for 1976.

Again, congratulations for a job very well done in 1976, and I am convinced that the 1977 issues will be of the same breed.

John W. Yochum W9URQ
Princeton IN

Authors, take note! — Ed.

THE AVERAGE HAM

Would like to see fewer articles on computers, etc., which are written at the level of graduate engineers, and more articles of interest to the average ham, especially those who are relatively new to amateur radio. I like your propagation forecasts.

R. C. Mader WN4AGT
Englewood FL

Try Kilobaud, *OM. — Ed.*

ACCELERATED FUROR

I just simply had to write and say that I enjoy *73* so much! Being a student confronted with an ever-increasing financial crisis, I have had to systematically eliminate "unneeded?" items with an accelerated furor. *73* gets passed over every time (I'm sorry to say I can't say the same for other magazines). I have enjoyed reading the various letters from readers for quite some time and now feel a need to make a few comments of my own.

I really can't see the reason why some readers look down upon, or only simply tolerate, the various I/O articles in *73.* As I see it, a ham who enjoys his hobby and takes it and himself seriously can't afford not to be even remotely interested in the truly fascinating area of microprocessors. For example, a ham who is active in any two, three, or four of the various aspects of ham radio such as RTTY, DXing, CW, Contests, OSCAR, and EME could save a bundle in $$ as well as space by integrating most of the peripheral equipment needed for these various modes into one unit. Enter the microprocessor! Load a cassette and you have an FSK converter, generator, and display. Another program and your EME antennas are aimed at the moon and follow it across the sky. Run another program and you have a contest keyer/memory and a good log. How about a digital signal processor for those weak DX signals down at the low end?

Sure, you might have to learn something about the uP, but we all had to learn something about electronics before we got our ham tickets, too! The next time you find yourself down at one of the radio shops, make a physical movement with your arm and pick up one of the books on microcomputers (pay for it, though!). I guarantee it will be the first of many devoured before you have been even

partially satiated. All I can say is that a modern ham station utilizing a microprocessor for control of its various operations results in a very powerful system to be sure, one that many a non-ham computer buff would be envious of.

Thanks for a good magazine.

Scott G. Turner WB2DLE
Princeton NJ

I/O HELP

73 is responsible for getting me interested in microprocessors and I have ordered my SC/MP and 8K of memory from a couple of the advertisers in your magazine. But many basic questions are starting to bother me. For instance, I want to make the busing system compatible with the Altair bus system so I can use boards and peripherals made for these systems. Can I make the bus in such a manner and then wire the connections for the SC/MP to work or is the SC/MP busing totally different? I guess what I want to know is more on microprocessor hardware in general. I know some of my questions will be answered by the National manual with the kit, but I still need more. What does a computer do when it receives a command to AND the accumulator or to Exclusive OR the accumulator? This I do *not know* either. Can you recommend any good reference material on these subjects, hardware and machine programming?

One more question, or two really. I have purchased the keyboard kit from Poly Paks, another advertiser in *73*, and have some questions on it also. The keyboard produces negative logic by using 7404 hex inverters; they are also used to produce TTL compatibility. I am wondering if I can use 7407 hex drivers which would then not invert the logic and give me positive output. The ROM used with the keyboard is an AY 5-2376; the control and shift inputs are not wired and I want to know what input is necessary to cause the ROM to produce a shifted and control output. Can you answer the question or can you give me an address to write where I can get an answer or spec sheet?

John W. Daugherty WB8DEG/ON8II
SSG Radio, TX Site
USA ELM SHAPE
APO NY 09055

Can someone give John a hand here? If you've ever been stuck overseas trying to get information on something like hobby computing, I'm sure you can appreciate what he's going through. I answered most of his questions, but I'm sure he would still appreciate some help. — John.

INSTANT REPLAY

I just got my first issue of *73* after a few months vacation from your subscription lists. I notice that there is some debate concerning the I/O section. Some of those letters sound like an instant replay from a few years ago.

I can remember back in 1969 when I put my Motorola 5-V in the car and got on 2 meter FM for the first time. I was in Des Moines, Iowa then — FM may have been big on the coasts by '69, but in the Midwest there were just scattered pockets of activity around the cities. Everything was on 94. You worked through the repeater on 34/94 when you wanted to play with the new toy (it was in some guy's basement, I think — very primitive and experimental), but if you wanted to understand the other station's audio, you switched to 94 simplex. The signals were usually stronger on simplex anyway!

The point is that we were more or less shooting in the dark back then as far as repeaters were concerned, and about the only place to get information and any ideas at all from repeaters in other parts of the country was *73*. I used to get a chuckle every month reading letters from those "old goats" who kept telling you (and us) that there was no future in FM and that you should get back to printing articles on "real" ham radio.

Now it's microprocessors. I have to admit that I was one of the "old goats" myself this time. I was upset with *73* because all of my precious FM and repeater articles were being shoved aside for computers (or so it seemed). Since you weren't into "real" ham radio anymore, I let my subscription drop.

But now we're talking about computer control for our repeater, and those little uP chips have been showing up in ovens, sewing machines, even cars. Some of the local hams who work for the big electronics outfits here assure us that they'll be in just about everything soon. Maybe your present transceiver works without one, but you can bet a uP will be the heart of your next one! Not to mention a dozen other things in the shack that will be controlled by them.

So I'm back, Wayne, and I can sit and chuckle again about the guys who'll be out in the cold when computers revolutionize our hobby. It's going to be soon.

Mark Johns WAØRGV
Minneapolis MN

THE UNINFORMED

I have been reading the letters from others for the last few months and am tired of hearing the same old thing, that is, that *73 Magazine* is all computers and no radio. Just did a bit of research and came up with some interesting figures on the subject which you might want to pass along to the uninformed.

I also took the data for the entire year of 1976 from the master index printed in the Holiday issue and it bears out the fact that *73 Magazine* is still very much a ham magazine and not a magazine for the microprocessor users as many would like us to believe. There were 493 major articles listed in the index for 1976 of which only 48 were "I/O" or 9.736%. In the areas of receivers, transmitters, FM, VHF, antennas and mobile operation, there were 140 major articles or 28.397%. The 140 articles do not include such things as commercial equipment, construction, theory, new products, Novice, power supplies, RTTY, ATV, SSTV, surplus, test equipment, or touchtone pads, which will increase the total to 343 major articles or 69.57% of the total.

It seems to me that when a person is condemning a magazine, they should take the time to get their facts straight, as it only took me about ten minutes to add up all the numbers, which does not seem to be much to ask.

There, I feel better now. Keep up the good work on the magazine and keep the I/O articles coming as every thing new that comes out is always a help in understanding our hobby. The I/O articles help broaden my knowledge of electronics in general and thus broaden my knowledge of ham radio.

By the way, I am in the process of preparing an article for a later issue covering the field of converting the 23 channel CB rig to ten meter operation. With the shift in sunspot activity, ten meters will be the DX band that it was back in 1948-1952 when I was working the world with 5 Watts.

Bob Wilder W4NVH
Theodore AL

I'm waiting for the article. — Ed.

	Dec. 1976 Issue	Holiday 1976 Issue	Jan. 1977 Issue
I/O Articles	5	7	7
I/O Advertisers	14	14	11
Other Articles	18	48	44
Other Advertisers	85	85	74
Total Articles	23	55	51
Total Advertisers	99	99	85
% I/O Articles	21.74	12.73	13.73
% I/O Advertisers	14.14	14.14	12.94
% Other Articles	78.26	87.27	86.27
% Other Advertisers	85.86	86.86	87.06

KEEPING UP WITH THE TIMES

Perhaps Doug DeMaw W1FB, *QST* Technical Editor, should read *73 Magazine* to keep up with the times. In the December issue of *QST*, his article titled "Measuring Transmitter Power" says the following: "Perhaps it is time for some manufacturer to develop a directional wattmeter which can be used to read both power characteristics — Average and Peak . . ." For Mr. DeMaw's information, such a meter has both been already developed, and is also advertised in *73 Magazine*. It is the Swan WM 3000, which does exactly what the Technical Editor of *QST* wants. And I might add that keeping up to date means that articles published will be up to date, and this is what readers want in the magazines they pay their hard-earned money for. To me, *73* not only keeps up with the times, but stays ahead of them.

My reason for writing this as a letter to the editor is that I am quite fed up with the poor quality of articles in *QST*, their verbosity, and this is a prime example of their own editors not even knowing what's what.

William Vissers K4KI
Cocoa Beach FL

I've been saying that for years. — Ed.

VEAL CURRY

Would you please have a building article in a forthcoming issue of *73* which is for an LED digital clock which presents time in the 24 hour mode? In addition to being powered by an ac power supply, incorporate a secondary supply (battery) in case of power (ac) loss.

Secondly, how can I get the recipe of the veal curry which Wayne Green spoke of in the Editorial?

L. A. Watts WBØWOD
Colorado Springs CO

Veal curry? Sure. Sautee 4 diced onions; when slightly browned and tender, add 2# veal cut into small cubes (about 1") and sear the veal. Salt . . . pepper . . . 2 tablespoons of curry powder . . . add garlic (about two cloves cut up fine) . . . then add a cup of white wine (doesn't have to be all that good wine); cover and simmer for about 50 minutes. Add more wine if the level gets low . . . you want to have plenty of gravy, you know. Mix 2 heaping tablespoons of flour and a half cup of cold water and add slowly to the curry to make the gravy. Simmer a bit longer, stirring to keep it from sticking. Salt to taste. If you like a "hot" curry, add some red pepper.

You'll want some condiments. Small dishes of these are passed around the table and sprinkled over the curry and rice. Oh yes, the rice . . . make some white rice . . . put the curry over it when you serve . . . then everyone can sprinkle the condiments as they please on top of the curry.

Condiments: crushed pineapple (Hawaiian, if at all possible . . . not Taiwan, Philippines, etc.), chopped peanuts, shredded coconut, toasted coconut shreds or chips, raisins which you've simmered a while to plump, Major Grey's Mango Chutney, chopped hard boiled egg, some people like shredded toasted bumalo fish (known also as Bombay Duck), but I hate the stuff, chopped well-done bacon, chopped dill pickles.

That should feed four well . . . and you won't forget it. — Wayne.

Continued on page 104

Jim Trulove WA7ABV
2345 W. Kathleen Rd.
Phoenix AZ 85023

A New Breed of Voltage Regulators

-- throw away your old 309s

Amateurs are probably building more electronic circuits today than ever before. With the multitude of IC circuits that are available these days to do complicated functions, frequently one has little more to do than build up the manufacturer's recommended circuit to complete his project. However, in breadboarding these new circuits, one piece of equipment that is an absolute must for the test bench is a good, well-regulated power supply.

Several manufacturers have offered three-terminal fixed voltage IC regulators for some time. These ICs just about took all of the work out of power supply design, as long as you only wanted one fixed power supply voltage. However, making up a variable supply was a little messy.

Well, designers at Fairchild Semiconductor[1] realized many IC users require voltages other than the ones that they had standardized for their series of fixed voltage regulators. So they recently introduced two new IC circuits that fill in the gaps in their series of fixed voltage regulators. These two circuits are the 78MG positive regulator and the 79MG negative regulator.

This article will introduce basic circuits for using these two ICs at fixed voltage levels, as well as for variable power supplies. As with most IC circuits, it doesn't do to simplify, so we will also show some of the pitfalls to avoid.

[1] Fairchild Semiconductor, 464 Ellis Street, Mountain View CA 90402.

Features

The 78MG and 79MG variable output voltage regulators offer unique features which make the circuits very simple to use, while providing protective features which are hard to obtain in a discrete design.

The most outstanding characteristics of these IC regulators are protection against output short circuits and protection against excessive power dissipation. These features make the regulators difficult if not impossible to destroy through misuse. A third related characteristic limits the ICs' output transistors to safe area operation.

The regulators are designed to supply up to 500 mA of current, with input voltages in the range of +5 to +35 volts for the 78MG, and -2.2 to -30 volts for the 79MG. The maximum input voltage for either is 40 volts.

The devices are packaged in what is called a "mini-batwing four-terminal package." The wings on the package allow the device to be secured to a heat sink to increase power dissipation capabilities. Both devices feature line regulation of 1% when the input voltage is varied from 7 volts to 35 volts, and load regulation of 2% when the load current is varied from 2 mA to 500 mA. The quiescent current is 2.5 mA, and the regulators require a minimum of 2 volts margin between input and output to stay in regulation. The power dissipation is internally limited to 7.5 Watts.

The older three-terminal, 78 series fixed voltage regulators had an internal voltage reference which was sensed through a resistive voltage divider network. The ratio of resistance in the voltage divider network was preset internally when the chip was manufactured. The 78MG and the 79MG regulators use the same concept, except that there is no internal voltage divider network. Instead, this point is brought outside the package by means of a fourth pin. Thus, all you have to do to set the regulator for any

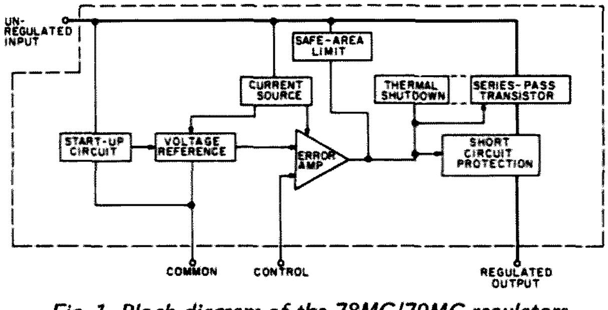


Fig. 1. Block diagram of the 78MG/79MG regulators.

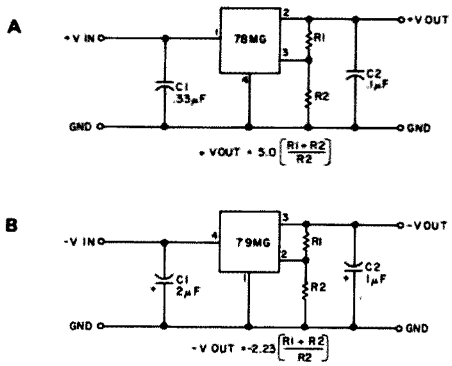


Fig. 2. Basic regulator circuits. (a) Positive regulator; (b) negative regulator.

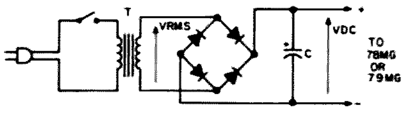


Fig. 3. Unregulated supply.

voltage within its range is supply two resistors of the proper value to supply the feedback voltage to this fourth terminal.

It is the addition of this fourth terminal which meant that the familiar three-terminal, power tab package had to be abandoned in favor of a four-terminal package. The package that was chosen is basically a stretched out four-pin plastic dip package with two "wings" protruding from each side for a heat sink.

The Insides

Fig. 1 shows a block diagram of the 78MG and 79MG regulators. The internal structure, with a few minor refinements, is identical to that of the earlier three-terminal regulators. The major exception is that one input to the error amplifier is brought outside the package so that you can supply any reference voltage you wish.

Let's get a brief idea of internal circuit operation before we get caught up in applications. The start-up circuit contains a zener diode and two transistors which have the purpose of bringing the circuit into initial regulation. After it is in regulation, the start-up circuit is biased off. The error amplifier compares the voltage at the control input to the internal voltage reference and generates an error signal of the proper polarity if the two voltages are not the same. This error signal either increases or decreases the bias current into the series pass transistor, which in turn increases or decreases the regulated output. The safe area limit and thermal shutdown circuits provide protection against normal operating overloads. The short circuit protection reduces the current available to the series pass transistor in the event of an output short circuit.

The regulators also contain a 30 pF MOS capacitor to increase stability and lessen the possibility of oscillation. The regulators achieve thermal stability through careful balancing of positive and negative temperature-coefficient components.

Basic Regulator

Fig. 2 shows the simplest configuration in which the positive and negative regulator can be used. This is really all you need to place in front of an unregulated power source in order to produce a stable well-regulated voltage source. The input capacitor, C1, is necessary to stabilize the regulator under all possible conditions. Although the manufacturer lists this input capacitor as an optional item "needed only if the regulator is located more than a few inches from the unregulated supply filter capacitor," I would very strongly suggest always including it. For the few pennies of extra cost, you may save yourself from destroying a regulator chip. It also allows you a lot more freedom in locating the unregulated source, and in choosing the unregulated supply filter capacitor.

Conversely, C2, the output capacitor, is really not necessary for regulator operation, although it does tend to improve transient response. I would suggest, if you intend to use the regulator to supply power to switching loads, such as TTL circuits, you would be well advised to include an output capacitor of approximately the value shown. One further comment about output capacitance: If there is any chance that you might drive a very large capacitive load (e.g., as large as the unregulated supply filter capacitor), you must provide extra protection for the regulator to prevent possible destruction of the chip. A diode in series with the output, large enough to handle all the output current, will provide quite adequate protection from reverse voltage. In all cases, the application of a reverse voltage between the output and input pins of the 78MG and 79MG regulators must be avoided.

You might notice that the input and output capacitors of the negative regulator are larger values. The larger values are required to maintain the same level of stability as the positive regulator. The formulas for calculating the output voltage are given in the figure. The two constants of +5.0 and -2.23 are the magnitudes of the internal voltage references and represent the lowest obtainable regulated voltage. If a pot is used in place of R1 and R2, an additional fixed resistor should be included in the ground leg of the pot. This linearizes the relationship between the rotor position of the pot and the

Vrms NOMINAL TRANSFORMER SECONDARY VOLTAGE (Vrms)	Vdc AVERAGE DC OUTPUT VOLTAGE (Vdc)	Vout DESIRED REGULATED OUTPUT VOLTAGE (Vdc)	I1 MAX. LOAD CURRENT (Amps)	C1 MIN. CAPACITOR SIZE (Microfarads)
6.3	8.2	2.23* to 5.3	0.5	1200 @ 20 V
		2.23* to 5.3	1.5	3600 @ 20 V
		2.23 to 4.5*	0.5	600 @ 20 V
		2.23 to 4.5*	1.5	1800 @ 20 V
12.6	16.3	2.23* to 12.5	0.5**	600 @ 35 V
		2.23* to 12.5	1.5	2000 @ 35 V
		2.23* to 11	0.5**	300 @ 35 V
		2.23* to 11	1.5	1000 @ 35 V
25.2	32.8	5 to 29.5	0.5**	300 @ 75 V
		5 to 29.5	1.5	1000 @ 75 V
		5 to 26	0.5**	150 @ 75 V
		5 to 26	1.5	500 @ 75 V

*This voltage is obtained only with 79MG.

**If the 78MG/79MG is used without an external pass transistor, full current may not be available for lower output voltages, since the IC will limit power dissipation to 7.5 Watts.

Table 1. Component values for the unregulated supply shown in Fig. 3.

by Wayne Green W2NSD/1

I/O EDITORIAL

Microcomputers are two years old, practically speaking. Though a few experimenters were messing around with the Intel 8008 a little before the Altair 8800 system was announced in January, 1975, there was little available in information or hardware. The Altair, launched with a lot of publicity and advertising, got the whole field going and fired up a new breed of hobbyist.

Now, after two years, perhaps we have enough perspective to get a handle on what we have and where we may be going.

In some ways, there has been a great deal of progress; in others, not much has changed. There are now over twenty different microcomputer systems being made for the hobbyist, and well over 150 different compatible boards for the Altair bus. There are over 50 computer stores around the country helping to sell these systems to hobbyists.

In the "not much change" area is programming. It took about a year for the first computer language to be made available ... BASIC. Some systems still don't even have that much for the user to work with. There are a few games available and a couple books of business and scientific programs, but not a lot else. Magazines such as *Kilobaud* are starting to bring more programs to users, but this aspect of computing has been slow to develop. Higher level languages such as FORTRAN and COBOL are still not generally available for the microcomputers, so the use of these systems is still quite limited.

Many of the early hobbyists started building a computer kit without reading the fine print (so to speak) and they gradually discovered that a CPU does not a computer make. Their $500 CPU looked fine, but it wouldn't do anything until $1000 or so of memory was put in the box. Then they had to hook on a printer or a video terminal, another $250 to $900 out of pocket. Now, with about $2000 invested, and Altair BASIC up and running, they could play hangman or lunar landing games. Star Trek needed another $500 in memory ... sorry about that.

Hobbyists needed some medium to store programs and to record data for the computer to use. The first choice was the cassette recorder, and every manufacturer of microcomputers promptly came out with a different system, making it so no two hobbyists with different systems could swap programs or data. This situation is still up in the air, with no system as yet satisfactory enough for the industry to accept it.

Business had long been using floppy disks, and some eventually were made to work with the hobby systems. They are still rather expensive for the hobbyist, prone to mechanical problems, and not supported with very much in programs to make them do a lot.

The hobby market has not been a large one, so most of the firms involved have been very small. There are a little over 10,000 hobby computer systems up and running so far, according to the best estimates. The readership of the hobby magazines (such as *Kilobaud*) make it plain that there are about 50,000 or so people who would like to get systems, but have been waiting for more information before getting their feet wet. That's a $100 million market, so it's well worthwhile for the small firms to court.

Even bigger, by a couple orders of magnitude, is the coming market for these systems. Hobbyists will be paying the costs of hardware development, which should bring us some relatively inexpensive and dependable computer systems which will be sold by the millions to business. We'll be seeing them in every office, in stores, in schools and in homes, just as we see TV today. It's a market that can't fail to come along when the hardware and software are ready.

We radio amateurs have a tremendous advantage in something like this by virtue of our head start with electronics. Most computer folk are programmers, and they are at a disadvantage because the hardware end of computers is much more difficult to understand than programming. Most hams have already read enough digital articles in the ham magazines to be able to understand the fundamentals of computer systems ... they really aren't all that complicated for us. This is why such a high percentage of the pioneers in hobby computing are hams.

Hams have another major advantage over other computerists ... they have some great things to do with their systems once they get them running. The hobby computerist is stuck with a bunch of games and not a lot more to do that can't be done better with a hand calculator ... and more cheaply. The ham can use the computer to run a repeater, to find Oscar, to operate his RTTY station, to simplify winning contests, keep his log, aim his beam for DXing, copy Morse code ... stuff like that ... combining the fun of doing something practical with knowledge that is of immense value in this exploding field.

One of the major needs today is for information. The manufacturers of computer equipment are way behind on their documentation, so we need to help each other. When we figure out how to interface a BCD keyboard with an ASCII computer, we should write it up. When you write a good ham program for your system, pass it along (via *73*, of course). If you will pass along what you've learned to others, we'll all benefit.

Many of the *73* readers work with microcomputer firms ... or with the manufacturers of peripherals ... please try to overcome the documentation lag by writing articles for *73* on the use of these gadgets. We all want to know. If there are any questions on how to write just send for our poop sheet .. or go ahead and do it without said poop sheet ... as long as you double space your typing.

Okay?

KILOBAUD POSTERS

The reader reaction to the first issue of *Kilobaud* is coming in and it is most gratifying. The most often complimented is the choice of articles ... they are by some of the top people in this new field, so it is no wonder that they are good reading. Expert writers are somehow able to write so beginners can understand.

The type is set pretty much like *73*, so there are a lot of articles in the magazine as compared to the other magazines ... 22 of them in the same space where another magazine gets in 14. More for your money, you might say. A few *73* readers have noticed that articles in *73* are far more compact than those in the other ham magazines.

The hobby computer field seems to have settled down to two main magazines ... *Kilobaud* and *Byte*, with *Byte* aiming at the computer scientist and *Kilobaud* at the beginner. *Microtreck* hasn't been seen since August. *SCCS Interface* and *Interface Age* seem bent on mutual self-destruction, with lawsuits and other time and money wasting jazz. This has left both magazines very scant on material.

The posters? Oh yes ... we've got some posters which we hope will interest more people in reading *Kilobaud* ... and we're hoping you'll dip in an oar to help. We'd sure like to get these posters hung up where they might bring in subscribers ... places like schools with computer science departments. A student is going to be far more valuable to himself and to anyone he works for if he is not only a professional, but also a hobbyist. We've seen that in amateur radio for years.

An employee of a firm making computers, accessories, or even a software firm will be far more valuable if he has the initiative to learn on his own. A subscription to *Kilobaud* could provide this impetus. Thus we'd like to have *Kilobaud* posters in as many firms involved with computing as possible ... the firms will benefit from it ... a lot.

If you have a school or business to spot one of our posters, please drop a note to marketing director Sherry Smythe and we'll get one off to you, complete with a bunch of subscription cards attached.

FREE SUBSCRIPTIONS

Bruce Seals called recently to say that he wants to see what will happen if he offers a free subscription to *73* with every direct sale of an 8K memory board ... either the 500 ns model at $269 (special) or the 250 ns model at $295 (also special). I tried to think of a good reason not to – couldn't. I did suggest that he offer an alternate of our three microcomputer books as an incentive for readers who were life subscribers, and he agreed to that. Either one is a $15 value ... so if you find yourself ordering an 8K memory from Seals you might mention whether you prefer a year of *73* or the three computer books: *Hobby Computers Are Here*, *The New Hobby Computers*, and *Microcomputers Simplified!* Bruce will take it from there.

Don Alexander WA8VNP
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1302 Kinnear Rd.
Columbus OH 43212

High Quality Display

- - with complete cursor and video control

Photos by Mike Barnaby

The video display described in this article is a high quality display with large capacity (2048 characters), extremely high speed (normal memory cycles are used to enter or read data from display memory), and unlimited formatting capability. In writing this article, I have assumed the reader has at least a basic working knowledge of digital logic and is familiar with typical uses of a video display.

The display itself consists of 32 lines each containing 64 characters for a total of 2048 characters. The character set includes both upper and lower case characters and the Greek alphabet, in addition to some special characters. Normal display of a character is white on black, but the video may be inverted on a character by character basis to produce a black character in a field of white.

The display memory is accessed directly by the microprocessor as though it were normal memory. This allows information to be written to or read from any location of the display memory at any time. Scrolling the display then becomes a software process, and as such allows the display to be arbitrarily partitioned into several segments, each being scrolled independently of the others. In fact, programs may be loaded directly into display memory and executed.

The display does not, however, steal cycles from the processor (as many who have seen my display immediately ask). Display memory is normally isolated from the processor bus and is used by the display control circuitry in parallel to normal processing. When the processor performs a read or write cycle utilizing a location within the display memory, control of that memory is automatically switched to the processor. This means that the processor steals cycles from the display when needed.

A Basic Video Display

Before I go into a detailed description of my display, I'd like to go through a simplified description of the fundamental process of creating a raster scan display.

A raster scan CRT (Cathode Ray Tube), an example of which is a normal TV set, produces an image by moving an electron beam horizontally across the screen 262½ times (from left to right) while moving it once from top to bottom. On every other vertical trace of the beam, the start of the horizontal tracing is delayed slightly to produce a field of horizontal lines between the lines drawn by the previous trace. Each of the two fields of lines is called a frame. The process of causing the lines of the second frame to fall between the lines of the first frame is called interlacing.

Movement of the electron beam is synchronized by special pulses which are part of a video signal, the horizontal and vertical sync pulses. For instance, suppose that the beam has just completed a trace across the face of the CRT. The horizontal sync pulse will cause the beam to go back to the left side of the tube (retrace) and begin a new sweep. Likewise, a vertical sync pulse causes the beam to move back to the top of the screen. Another part of the video signal is the blanking. Blanking pulses follow each of the horizontal and vertical sync pulses and serve to blank out the retrace of the beam so that it does not show up as unwanted light on the screen. The final part of a video signal is just the video information itself. This information controls the intensity of the electron beam as it is being swept across the CRT. The sync, blanking, and video information are all combined to produce a single signal which controls the CRT monitor.

Producing a display of characters on a raster scan CRT involves only the synchronization of an appropriate train of pulses with the horizontal and vertical information. I have shown a simplified block diagram to accomplish this in Fig. 1.

The clock and timing information block is responsible for generation of the horizontal and vertical sync and blanking pulses. This information is fed directly to a video combiner and is also used to control the operation of several counters. The row counter and the column counter provide an address to the memory (which contains the characters to be displayed). The data from the memory serves as one input to a read only memory called a character generator. The character generator contains a matrix of dots for each character (see Fig. 2). Since only one row of dots for a character may be produced on a given scan of the electron beam, a scan line counter is needed to tell the character generator which particular row of dots is currently being called for. The output of the character generator is loaded into a shift register and

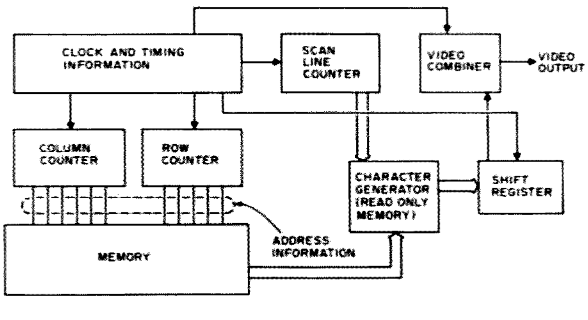


Fig. 1. Video display simplified block diagram.

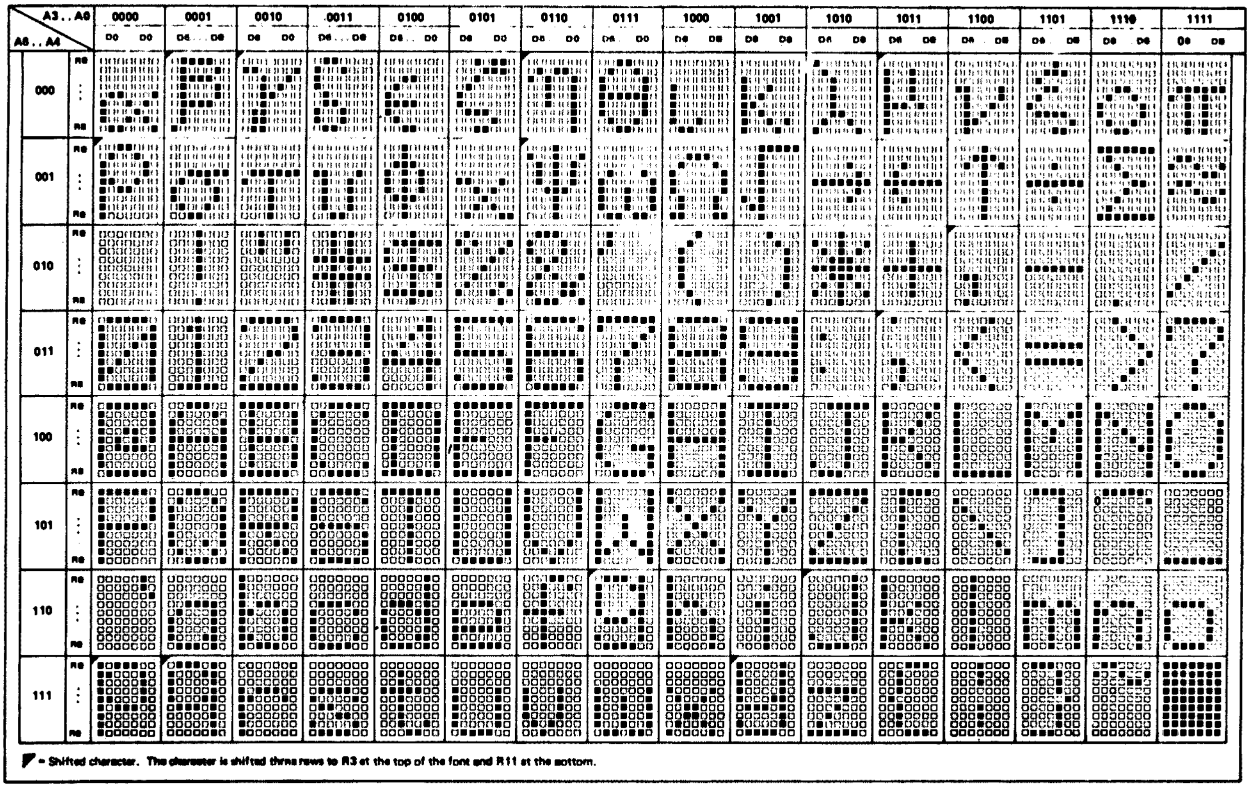


Fig. 2. Character set for the MCM6571A character generator. This read only memory is also available with other character sets.

shifted out to be combined with the horizontal and vertical information to produce white dots on the screen.

My display writes 32 lines of 64 characters per line. I allow 15 scan lines per row of characters. This means that it takes 15 traces of the electron beam to produce one row of characters. A simplified flow of events would be:

1. The system is reset by the vertical sync pulse.
2. Several horizontal sweeps are allowed to happen before anything else to space the characters down from the top of the raster, which is usually distorted.
3. Data from memory is presented to the character generator. At the same time, the scan line counter tells the character generator which row of dots within a character is needed.
4. The output of the character generator is loaded into a shift register and shifted out into the video combiner one bit at a time.
5. The column counter is incremented and the same process takes place over and over until the end of a line.
6. At the end of a horizontal trace, the scan line counter is incremented by the horizontal sync and the same line of characters is presented to the character generator to produce the second row of dots on the screen. This process repeats until the first row of characters has been completed.
7. A few horizontal sweeps are allowed for spacing. Then the row counter is incremented and the above process repeats for the next row of characters (and so on, until all the characters have been completely displayed).

The operation of my display follows this basic outline, except where I have taken advantage of peculiarities within the circuit. I also have had to play tricks because of the interlacing of the two video frames, so that I would have enough scan lines available to produce 32 lines of high quality characters.

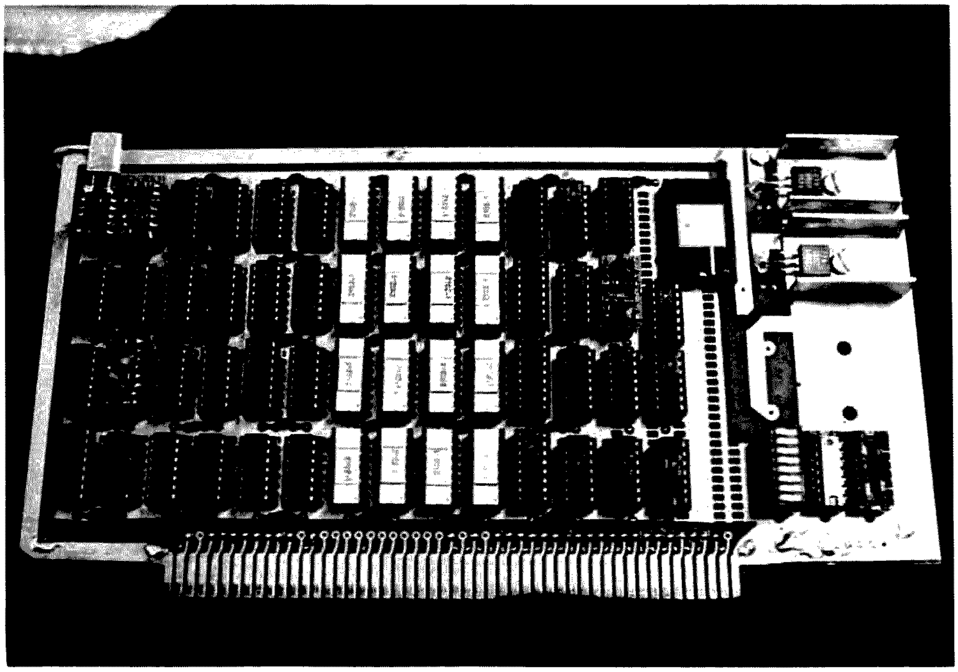
Conventions

For simplicity (at least in the writing of the article, if not in the reading), I have adopted a few conventions in drawing the schematics for publication. First, all crossing lines are *not* connected. Connections are drawn to produce "T" junctions.

A logic gate with an "00" in it is a 7400, one with an "04" in it is a 7404, and so on.

ICs drawn as boxes have their part numbers inside the box.

I have not numbered pin connections on common logic gates; I leave this to the builder, since it is unlikely that his layout will make it convenient to use the same pin numbers. (My display is wire-wrapped. I highly recommend going that way, as a printed circuit layout on this scale would be a great undertaking for the hobbyist.) I have not numbered or shown power connections for any but special ICs. Fig. 3 contains all pin number and power information for the ICs used. Where I have numbered pins on counters, flip-flops, and special ICs, there is little choice (except for the flip-flops which have two gates per package). Numbers in small square boxes refer to Altair bus numbers and are the only off board connections to be made except for the video connection itself. If you are not using an Altair-compatible bus, then you will need to make appropriate corrections to the memory control part of the schematic (note that the only connections to the external world are those appearing on the memory schematic – except for power and the video connection).



Component side of Altair bus video driver board.

The Memory

I'll start my discussion of the actual display circuit by describing the memory schematic shown in Fig. 1, since it is relatively straightforward.

I have used 2102s for memory, since they are cheap and readily available. There is nothing sacred about this choice, and any other memory could be substituted if it were fast enough. I recommend buying memory which is guaranteed to at least 500 nanosecond access time (to insure reliable operation).

The address lines of the memory chips are tied in parallel and connected to the outputs of the 74157 multiplexers, whose function I'll describe soon. Data inputs of the memory are simply connected to the data out bus of the processor. The data outputs of the memory are connected to the character generator (Fig. 5) and to some tri-state bus drivers (74125). The purpose of the tri-state bus drivers is to allow data to be read from the display memory by the processor. If you wish to use another tri-state gate (such as an 8T97), it will make no difference.

The memory control circuit serves to distinguish between valid memory requests and random states of the Altair bus which occasionally look like memory requests if enough care is not taken. The gates in the upper left of the memory schematic decode valid processor requests for the memory by monitoring three status lines and five address lines. If SOUT and $\overline{\text{WO}}$ are both low, then the processor is about to write to memory. If MEMR is high, the processor is about to read from memory. If, at the same time, address lines A11 through A15 are high, then the byte of memory being addressed is within the two kilobytes of display memory. One half of a 7474 flip-flop is used to latch the request status during sync time of the processor, with the Θ_1 clock being used to clock the flip-flop at a time when all address and status signals are stable. While my display memory is located in the high order two kilobytes of the Altair's memory addressing range, it is by no means a sacred choice. You can put your display memory anywhere you wish by appropriate decoding of A11-A15.

When a valid processor request has been decoded and latched, the three 74157 multiplexer chips shift control of the memory address lines from the display's own counters to the computer's address bus. The MWRITE Altair bus signal is gated by the output of the request latch to allow the processor to write data into memory. Similarly, the MEMR signal is gated with the output of the request latch to enable the tri-state bus drivers for a read cycle.

Address bit 2^{10} (from the multiplexers) is used to enable either the high order kilobyte or low order kilobyte of display memory.

When the processor is finished with its request for use of the memory, the multiplexers shift control of the memory back to the display control.

The Character Generator

Before I get into the actual description of the control schematic, I would like to take time to go over the character generator I chose and attempt to explain why I did some of the things I did with the control circuitry.

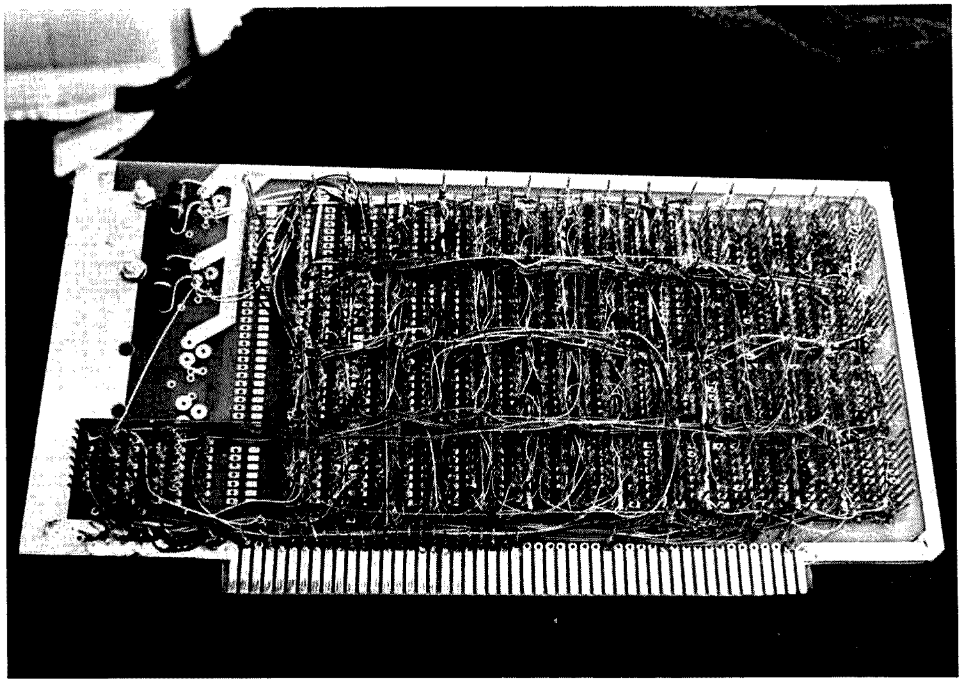
The character generator stores a 7 x 9 matrix of dots for each of its 128 characters. Some of the characters (like j, y, g) should extend beneath the line for best results, so the character generator contains circuitry which shifts the matrix automatically on such characters. What this means is that for a normal character, the dots of the character will appear when lines 0 through 8 of the character generator are addressed. For a shifted character, lines 0 through 2 will come out blank and the 9 lines of the matrix will appear when lines 3 through 11 are addressed. In addition, if lines 11 through 15 are addressed, blanks will result at the output.

What this really means is that from the designer's viewpoint I don't have to know that the information is stored in a 7 x 9 matrix. I can make believe that it is in a 7 x 16 matrix where the last four lines are always blank. Motorola, I love you for the MCM571A!

I use 15 scan lines per row of characters in my display (originally I used 16 but could not achieve 32 lines of characters). Multiply 32 lines of characters by 15 scan lines per character line and you get 480 scan lines (see how nicely the units cancel – high school physics, eat your heart out!).

Now, remember from my earlier discussion that there are only 262½ scan lines per frame. Since I need 480 lines, I must use the fact that alternate frames are interlaced by causing my control circuitry to do every other scan line and alternate between frames. Since I am using 15 scan lines per character line, I must in one frame write the eight even number lines of the first row of characters, then the seven odd numbered lines of the second row of characters, the even of the next, etc., etc.

In the next frame, I must start with the seven odd numbered lines of the first row, the eight even numbered lines of the second, and so on. I



Wire-wrap side of board.

will go low, causing the PAGE ACTIVE flip-flop to be clocked, setting it high.

also have to be sure that I am using the correct frames of the raster to avoid producing some weird characters. It turns out that only about 482 lines of the raster are useful. The rest are contained within the field of the blanking pulses, and attempting to use them results in a rolling display or worse. Otherwise I would have stayed with 16 scan lines per character. I might also mention that the choice of 14 scan lines per character was appealing to me until I tried it and found that the lines began to be uncomfortably close together.

Display Control

Several signals within the control circuitry are important, and discussion of their functions will help to explain the operation of the display control (see Fig. 5). These are PAGE ACTIVE, FIELD INDEX (FI), LINE ADVANCE, END OF PAGE (EOP), END OF LINE (EOL), MASTER CLOCK (MC), VERTICAL DRIVE (VD), HORIZONTAL DRIVE (HD), and COMPOSITE BLANKING (CB). VERTICAL and HORIZONTAL DRIVE are really just vertical and horizontal sync, but the sync generator manufacturer labels them as drive. Any signal shown on the schematic with a bar above it (as $\overline{CB}$ or $\overline{VD}$) is the complement of the signal indicated. The signals VD, HD, CB, and FI originate from the sync generator (Fig. 6). The other signals are generated within the display control.

Sync Signals

I have used a National Semiconductor MM5320N TV camera sync generator to generate timing signals needed to produce a raster. It produces the VERTICAL DRIVE signal, which (along with its complement) is used mainly to reset various counters and flip-flops of the display control. The HORIZONTAL DRIVE output of the sync generator serves the same purpose. The FIELD INDEX output of the sync generator identifies field number 1 of the raster. It is a pulse which occurs for two clock cycles at the leading edge of the vertical blanking for field one. I will discuss the sync generator in more detail when I get to the description of that schematic (Fig. 6), and mention it here only as a prelude to describing the control circuitry.

Page Active

PAGE ACTIVE is a signal which goes high during the writing of a frame of information on the CRT. Thus, it will be low until the electron beam is in position to trace out the top scan line of the first row of characters and it will remain high until the last scan line of the last row of characters has been produced. When it is low, all video output is suppressed and the control circuit is mainly idle.

Here is the sequence of events which results in the clocking of the PAGE ACTIVE flip-flop (which in turn enables the rest of the display):

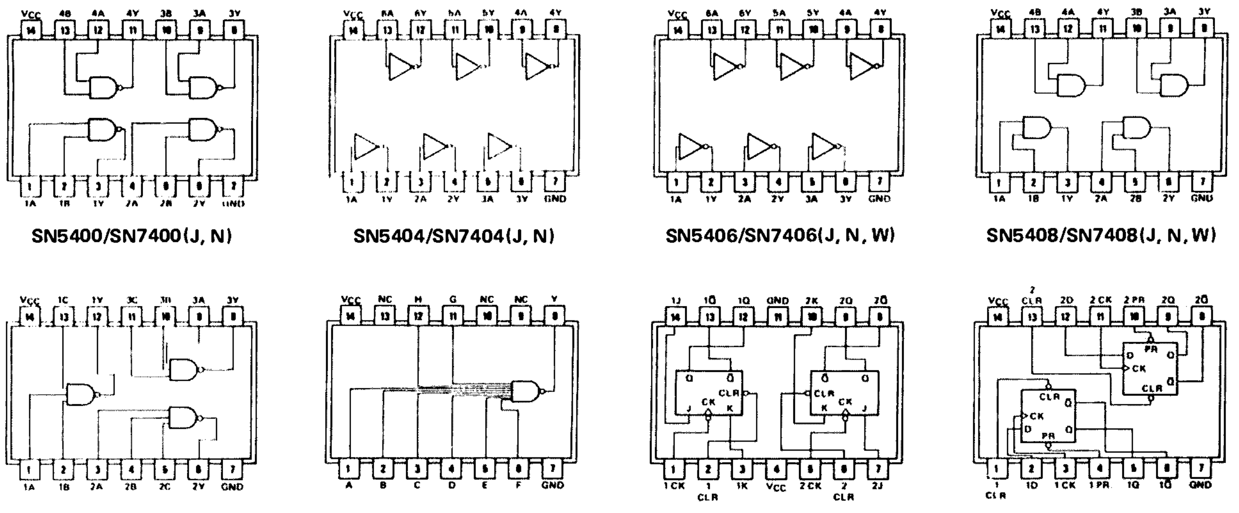
1. $\overline{VD}$ occurs (resetting other things which I will mention later) and causes the scan line counter to be loaded with a five. I will try to explain why I had to do this in a few lines.
2. The CB signal will begin clocking the scan line counter. When this counter reaches seven, the 7410 connected to the A, B, and C outputs of the scan line counter will go low, causing the PAGE ACTIVE flip-flop to be clocked, setting it high.

The reason that I load the scan line counter with a binary five is to cause a fixed number of scan lines to be ignored before clocking the PAGE ACTIVE flip-flop. Remember that I said earlier that only about 482 scan lines were useful? This is because 21 of the 262½ lines per frame occur during the vertical blanking pulse. This leaves only 241½ useful lines per frame. By using the COMPOSITE BLANKING signal to clock the scan line counter, I already ignore the first 21 lines since no clocking of the counter will occur during the vertical blanking pulse. By presetting the scan line counter to five, it will take only a couple of lines to get it to seven where it causes the PAGE ACTIVE flip-flop to come on, thereby wasting as few as possible lines. It turns out that the counter will count the vertical blanking pulse so that I am in fact only wasting about one half of a line at the top of the display. In any case, there are not many lines to waste and this method utilizes the maximum amount of useful raster.

Once the PAGE ACTIVE flip-flop has been set, the row counters and the width counter are enabled (follow the logic on the schematic to convince yourself of this). The PAGE ACTIVE flip-flop is ultimately cleared by the END OF PAGE signal.

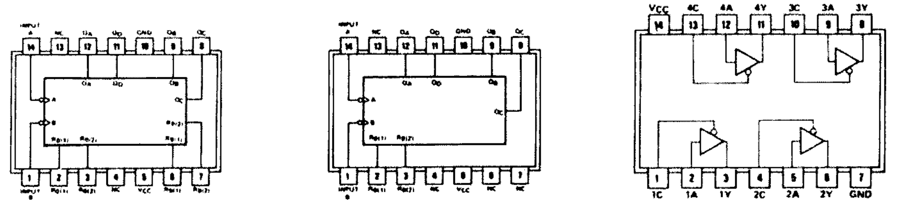
Odd/Even Flip-Flop

The FIELD INDEX is used to keep track of which frame is being written at any given time. Remember that I mentioned earlier the necessity to alternate even and odd scan lines of the characters being displayed. The alternation must occur between rows of characters and also between frames. The FIELD INDEX is used to control the starting point of the odd/even flip-flop within a given frame. This is accomplished by

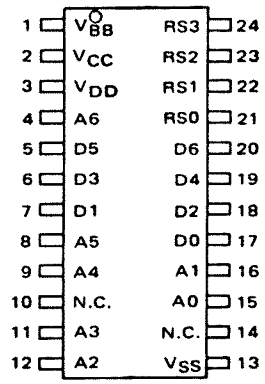


SN5400/SN7400(J, N) SN5404/SN7404(J, N) SN5406/SN7406(J, N, W) SN5408/SN7408(J, N, W)

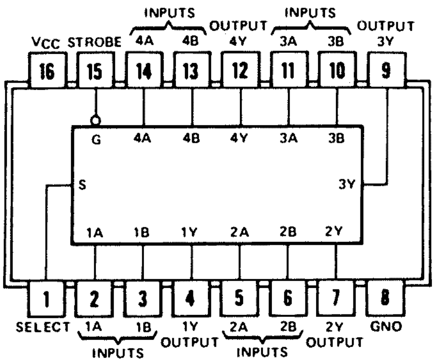
SN5410/SN7410(J, N) SN5430/SN7430(J, N) SN5473/SN7473(J, N, W) SN5474/SN7474(J, N)



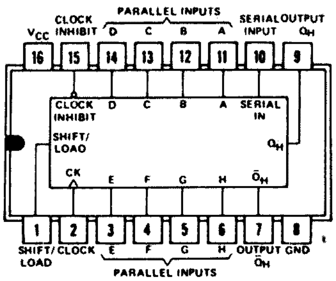
SN5490A, SN7490A SN5493A, SN7493A SN54125/SN74125(J, N, W)



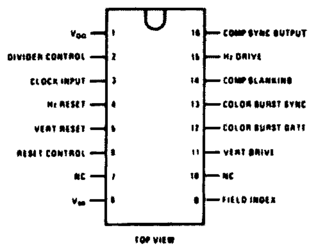
MM5320N



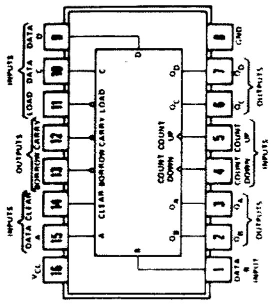
SN54157, SN74157



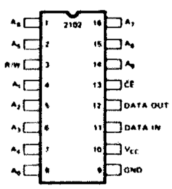
SN54165, SN74165



MCM6571A



SN54192, SN74192



2102

Fig. 3. Pin configurations for the various ICs used in the display.

setting the odd/even flip-flop with the END OF PAGE signal. The EOP flip-flop, however, is cleared by $\overline{VD}$, causing the EOP signal to go away at the beginning of the VD pulse. The FI pulse hangs around for a couple of clock cycles after the beginning of the VD pulse, so that if it (FI) is present it will clear the odd/even flip-flop. Thus the odd/even flip-flop will be set or reset at the beginning of a frame.

The output of the odd/even flip-flop serves as bit zero of the line input to the character generator, causing it to generate the appropriate dot information. The output of the odd/even flip-flop also serves to control the number of scan lines allowed for a row of characters by causing the scan line counter to divide by either seven or eight. This is relatively straightforward and I leave it to the reader to verify that this is so by examining the schematic (I always hated it when textbook writers did that to me ... now it's my turn). Upon completion of two complete scans, there will have been 15 scan lines allotted for each row of characters.

Line Advance

The LINE ADVANCE signal is the same as used to enable the PAGE ACTIVE flip-flop, except that once the PAGE ACTIVE flip-flop is set, the LINE ADVANCE will clock the row counters. I had trouble with a glitch on the LINE ADVANCE, so I had to

put in an 820 (or so) pF capacitor to get rid of it.

Row Counter

The row counter consists of a 7490 decade counter and one half of a 7473 flip-flop. The row counter provides the high order five bits of the memory address to the multiplexers.

End Of Page

The EOP flip-flop is clocked by the row counter after 32 rows of characters have been displayed in a given frame. It is used to clear the PAGE ACTIVE flip-flop (which inhibits the world) and also to set the odd/even flip-flop as described above. EOP is reset by VERTICAL DRIVE.

The Character Generator Again

The character generator accepts a row input from the scan line counter to tell it which row of a matrix to present to its output. The character code is the rest of the input to the character generator and comes directly from the memory. The seven bit output of the character generator represents part of the dot pattern of a character and is presented to the 74165 shift register. Clocking of the shift register to dump the dots out in serial fashion is by the MASTER CLOCK. Loading of the shift register is controlled by circuitry associated with the width counter.

Width Counter

The width counter is a 7490 decade counter which is really dividing by nine because of external gating (shown in the schematic). The width counter is held at zero whenever the PAGE ACTIVE line is low. It is also cleared by the COMPOSITE BLANKING to insure that it begins every line from zero.

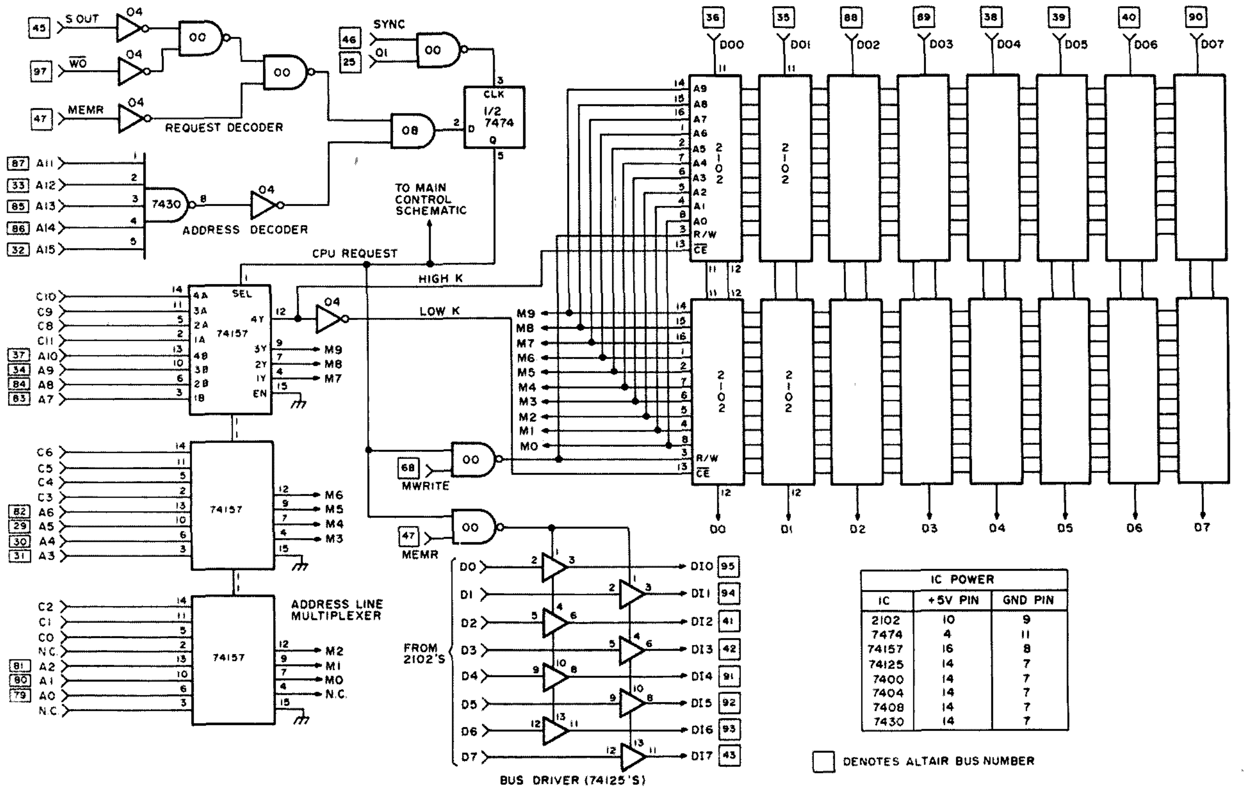
The width counter is clocked by the MASTER CLOCK and is responsible for determining the number of clock pulses allowed for each character in a row. I have allowed nine clock pulses per character. Seven pulses are needed to display the seven dot width of a character, plus one leading and one trailing pulse to allow for spacing between. I have arranged the loading and clocking of the shift register to achieve both leading and trailing blank dots, as opposed to simply allowing two blank dots between characters. This distinction is not too important when displaying normal video, but when the video is inverted on a given character, it assures that the character will be centered in the field of white.

The D output of the width counter is used to provide a load signal to the shift register. The C output is used to clock the column counters, which count the number of characters per row. Note that the column counters are advanced *before* the shift register is loaded. This is to allow sufficient time for the two memories (the main character memory and the character generator) to stabilize. The data loaded into the shift register will be the data from the last character, because of the memory access time.

Column Counters

The column counter, a 7493 and part of a 7490, counts the number of characters within a row and provides the low order six bits of address information to the memory control board. The column counter is reset by the HORIZONTAL DRIVE pulse to insure that it begins counting at zero for each row. The C output of the width counter is used to clock the column counter as discussed above.

One half of the 7490 used in the column counter is a divide-by-four counter, while the other half is used as a flip-flop. To see this, note that the D output of the 7493 is connected to the B clock of the 7490 (the B clock is the input to the divide-by-five stage of a 7490). The C output of the 7490 is used to clock the A input, which will cause the A output to go high after the fourth time the B input is clocked. The A output is connected in turn to the J input of the END OF LINE flip-flop. The END OF LINE



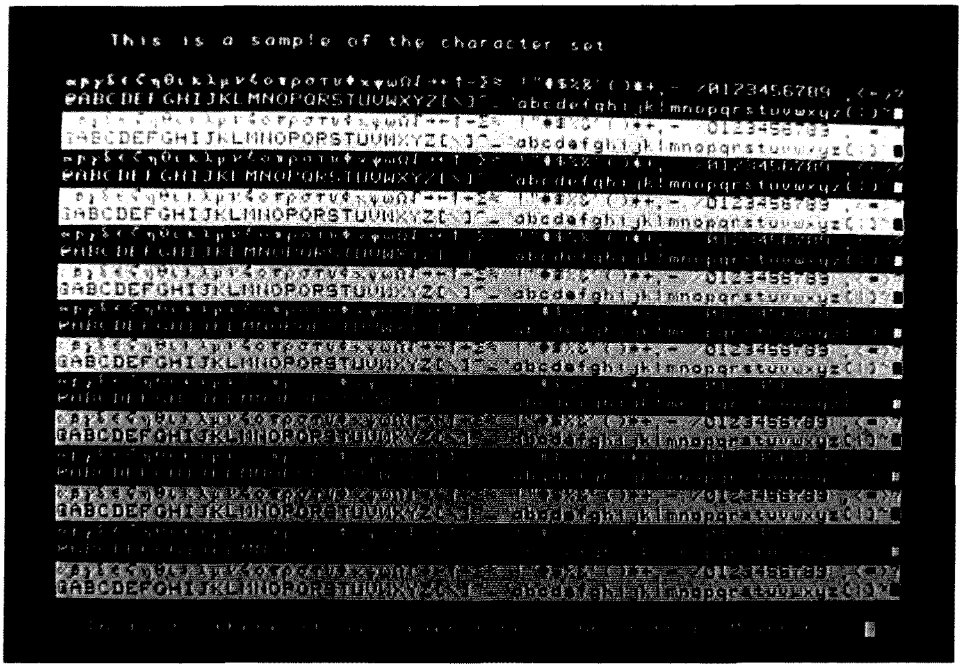
IC POWER		
IC	+5V PIN	GND PIN
2102	10	9
7474	4	11
74157	16	8
74125	14	7
7400	14	7
7404	14	7
7408	14	7
7430	14	7

Fig. 4. Schematic diagram of memory circuits.

flip-flop will be clocked on the falling edge of the D output from the width counter. The output of the EOL flip-flop then inhibits any further loading of the shift register, hence ending the current line.

The reason for all this playing around with the column counter is to allow the last character to be loaded into the shift register. If you remember the discussion about the column counter being clocked to the next character before the data from the current character is loaded into the shift register, you will see that the column counter will be at 64 (representing the 65th character since the counters start at zero) when the load pulse for character 63 (the 64th character) occurs. Since I have to allow the 64th load pulse to occur, I came up with the above scheme to delay the clocking of the EOL flip-flop.

I might mention at this point that there is really no good reason to bother using the C output of the 7490 to clock the A input. The internal D flip-flop of the 7490 is already clocked by the C output, so the D output could serve as the J input to the flip-flop. In fact, by gating together the D output of the 7490 section of the column counter with the D output of the width counter (using a 7408 AND gate with the output of the AND gate clocking the A input of the 7490), the EOL flip-flop could be eliminated, the A output of the 7490 replacing the EOL signal. But you would have to use a NOT gate to derive $\overline{EOL}$ and then you would have one half of a flip-flop left over elsewhere. I mention this possibility partly for the benefit of anyone who might be making changes where it would be nice to have an extra flip-flop, and partly to illustrate that there is nothing sacred about the way I have done things. As long as you understand the purpose of each



Character set.

part of the circuit, you can modify it to suit your particular requirements or supply of parts.

Video Inversion

The Invert Video flip-flop controls inversion of the video signal to produce a black character within a field of white. Note that by inverting the video, I am referring only to inverting the character part of the video, not the sync and blanking signals.

The video may be inverted character by character, allowing the use of multiple cursors (I use an inverted blank for a cursor) or techniques such as inverting important messages (or flashing them between normal and inverted video). The display also makes a dandy checkerboard. The eighth bit of the display memory is used to control the state of each character.

Since the memory has already been advanced to the next character during the time in which dots for a given character are being drawn by the electron beam of the CRT, it is necessary to latch the eighth bit of memory in the Invert Video flip-flop. This bit is clocked into the flip-flop at the same time the load pulse for the shift register goes high. The outputs of the flip-flop control a multiplexer made from 7400 gates, thereby selecting either the Q or $\overline{Q}$ output from the shift register. The Invert Video flip-flop is forcibly cleared after the EOL signal comes on (EOL and the D output of the width counter are gated to produce a clear pulse), to assure that the brief part of a line traced by the electron beam after the last character is blank.

Note that the output of the video inversion multiplexer (the 7400 gates) is clocked by the MASTER CLOCK. The main reason for this is to eliminate the possibility of generating a wide video pulse (the top of a "T" or an inverted blank would be examples) which would cause the trace produced by the electron beam to bloom or, at the very least, appear brighter than other parts of the display. Clocking the video makes all video pulses the same width (the top of a "T" would come out as seven consecutive short pulses rather than as one long pulse) and results in a very uniform brightness over the entire display.

Video Inhibit

The Video Inhibit flip-flop prevents generation of random video pulses which would otherwise result from decoding of wrong information by the character generator during times when the processor is using the display memory. Whenever the processor makes a request for the memory (as indicated by the CPU REQUEST signal from the memory control schematic), the Video Inhibit flip-flop is cleared. The Video Inhibit flip-flop inhibits further loading of the shift register and forces the Video Invert flip-flop to the off state the next time it is clocked. Once the processor request has been cleared, the Video Inhibit flip-flop will be clocked by the end of the next load pulse, setting it back to normal. Note that the load pulse which clocks the Video Inhibit flip-flop will be ignored by the shift register, since it does not clock the flip-flop until the trailing edge. The next load pulse will cause the shift register to be loaded. The result is that video is inhibited during pro-

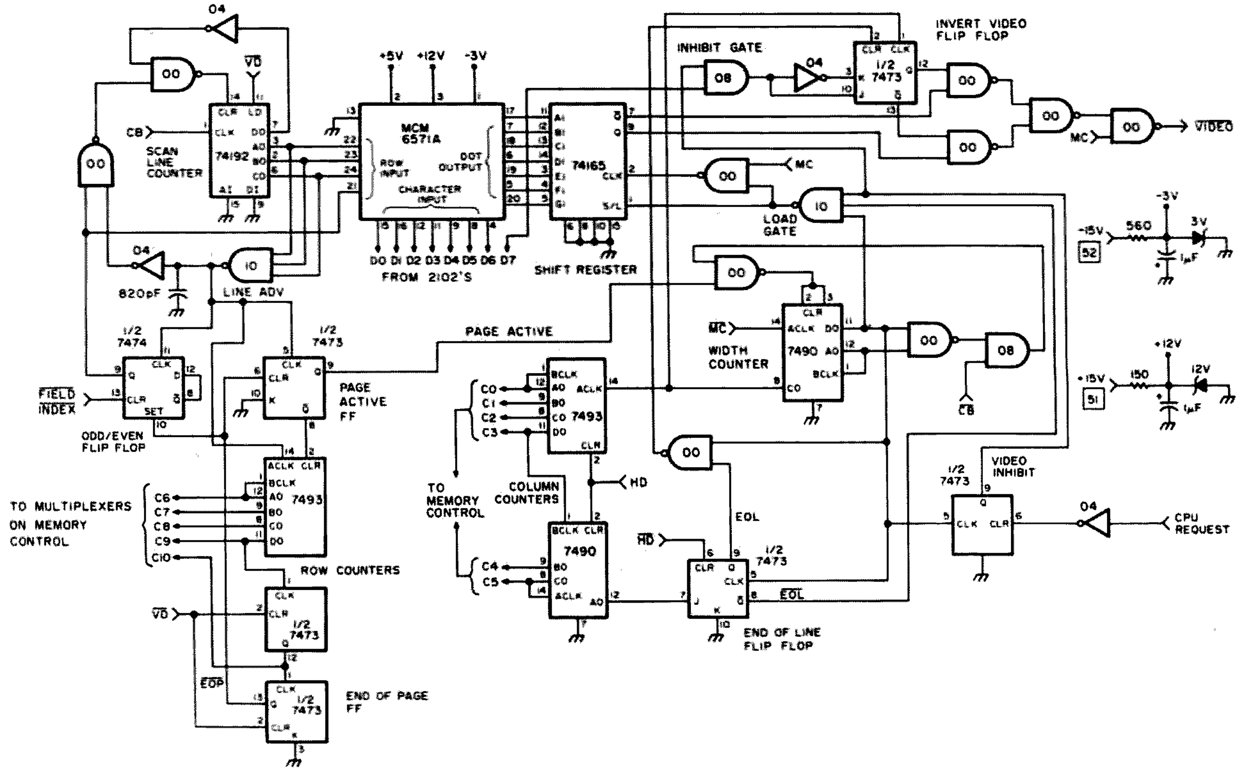


Fig. 5. Schematic diagram of display control circuits.

cessor requests for memory and for at least one complete character cycle after control is restored to the display (to assure that the memory is back in step with the display control).

The loss of a row of dots from random characters around the screen during processor requests is not a problem, since it is hard to notice the absence of a single row of dots within a single character for 1/30th of a second. The only time that the display is noticeably degraded is when the processor is making requests at a very rapid rate. But the rate is so great that it would not be possible for most people to read the display anyway.

One instance where the degradation of the display caused by cycle stealing becomes noticeable is during a line feed. The line feed (or scroll) is a software function and involves reading and rewriting almost all 2048 characters of the display. The process is very fast (50 to 100 milliseconds, depending on your software and memory cycle time) and results in a noticeable display degradation because of the large number of requests within a short time. But the degradation during a line feed is not a problem since the display would be non-readable during a line feed even if it was not degraded. Also, it happens so fast that one does not really perceive the display to have lost anything unless he is really looking for it.

One other thing to remember (to prevent heart seizure the first time it happens) is that if you stop the processor and examine the contents of a location within the display memory, then you are in effect requesting 100 percent of the memory's time, resulting in a completely blank display.

Sync Generator and Video Combiner

The sync generator schematic includes the MASTER CLOCK and the video combiner. The MASTER CLOCK is a simple oscillator made from 7404 gates, a few Rs and Cs, and a 12.6 MHz crystal.

The National Semiconductor MM5320 sync generator requires a 1.26 MHz clock, so I divided the 12.6 frequency by ten. Note that the 7490 is used as a symmetrical divide-by-ten counter by going through the divide-by-five stage and then into the divide-by-two stage.

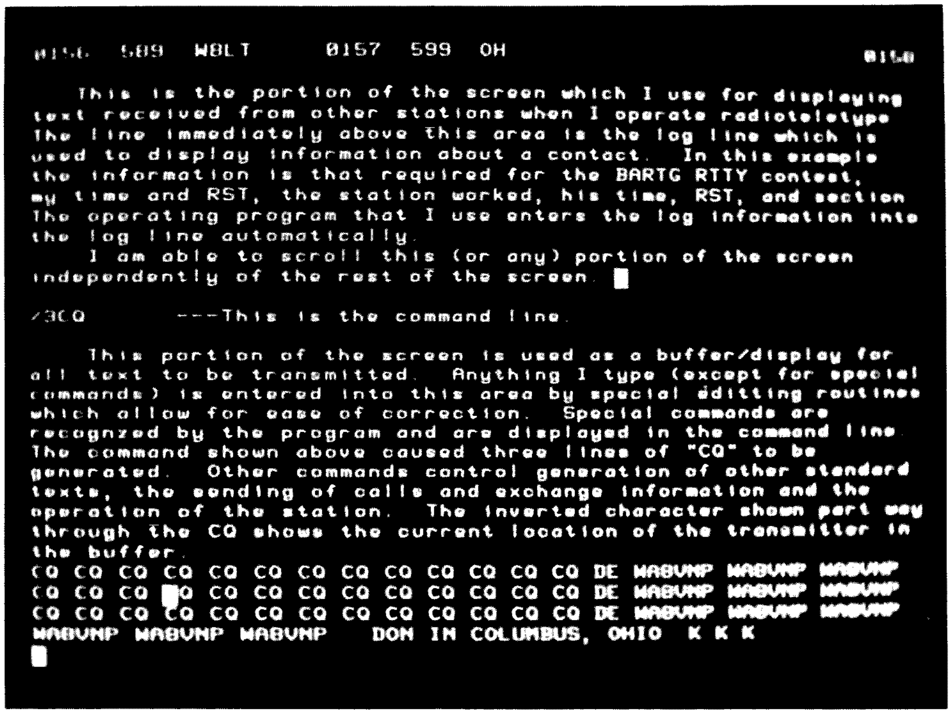
I have buffered all outputs of the 5320 except the FIELD INDEX output, which is only connected to one gate anyway. As I discussed earlier, the sync generator does all the timing necessary to generate the appropriate sync and blanking signals to produce a raster.

Putting the COMPOSITE SYNC, COMPOSITE BLANKING, and VIDEO (from the display control schematic) to form a single video signal is the function of the video combiner. The video combiner is built from 7406 open collector inverters and some diodes. The resistors shown at the junction of each of the 7406 outputs and its respective diode determine the weight of the given signal. The resistors I have shown are not too critical and may be changed for best results. The resistor for the blanking component is chosen to produce about a .2 to .3 volt change in the output level when the blanking turns on and off. Similarly, the sync component should be around .7 volts and the video component should be a couple of volts (or whatever produces good contrast). These values seem to work well with the monitor I use, as it has a 75 Ohm input impedance.

The video monitor shown in the photographs is a Motorola M2000-1SC. It is a good quality nine inch monitor having a bandwidth of about 12 MHz. If you plan to use an old black and white TV, you may experience problems with overscan (which is built into most TV sets to make the picture look bigger) or bandwidth. The Motorola monitor costs around $115, but is well worth it for this application.

Power Supplies

The logic components will



Radioteletype contest program example (note multiple cursors).

require a good five volt supply. I used two 7805 regulators (the same as used by MITS and other Altair board manufacturers) to regulate power from the Altair bus. I use one for powering the memory and one for the logic. Be sure to install plenty of .1 uF capacitors at various points on the board, to prevent noise problems from messing up the display. If you are building the display for use outside an Altair type computer, I will assume that you can also manage the power supply.

Various other voltages required by the sync generator and character generator are provided by the zener diode regulators shown on the schematics. The amounts of current needed at these voltages are very small.

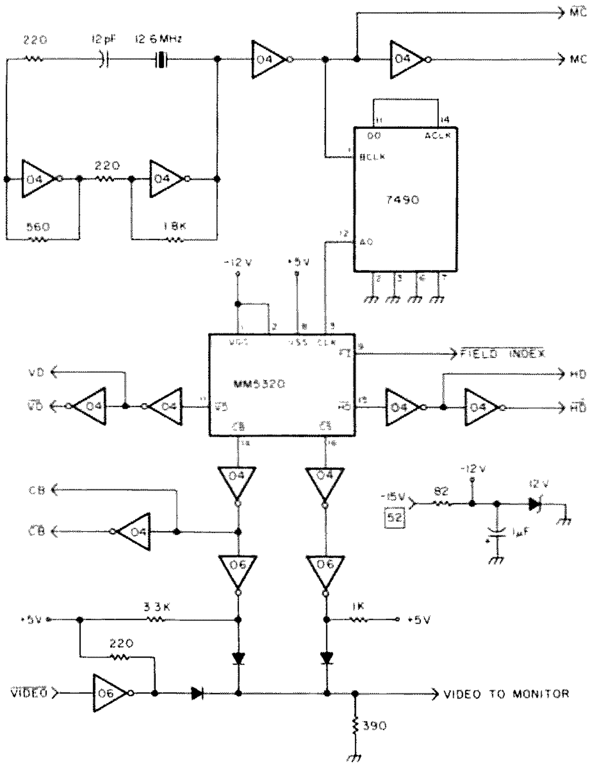


Fig. 6. Sync generator, video combiner, and clock circuits schematic diagram.

Use of the Display

The various pictures of the display show several ways for utilizing the display. I will let you read the captions rather than repeat them here, and will try instead to present a few simple ideas to get you started.

The first thing is to think of the display as a window to memory rather than as an output device. Any manipulation of data on the display (writing, erasing, updating, scrolling) involves a software process to put the desired information into the right location within the memory. There is no line feed function, nor are there any cursor positioning functions. Characters are simply stored at the correct locations. Cursors, if used, are simulated by appropriate software for the benefit of the person looking at the display. This allows the display to be configured any way you see fit. Some of the photographs depict displays where my Altair was being used as a terminal to a DEC PDP-10. A simple program was written which made the display behave as though it were a Hazeltine 2000 video terminal. But if you read the text in the picture of my radioteletype application, you will see that the display is being used in a way few, if any, other displays or terminals could duplicate.

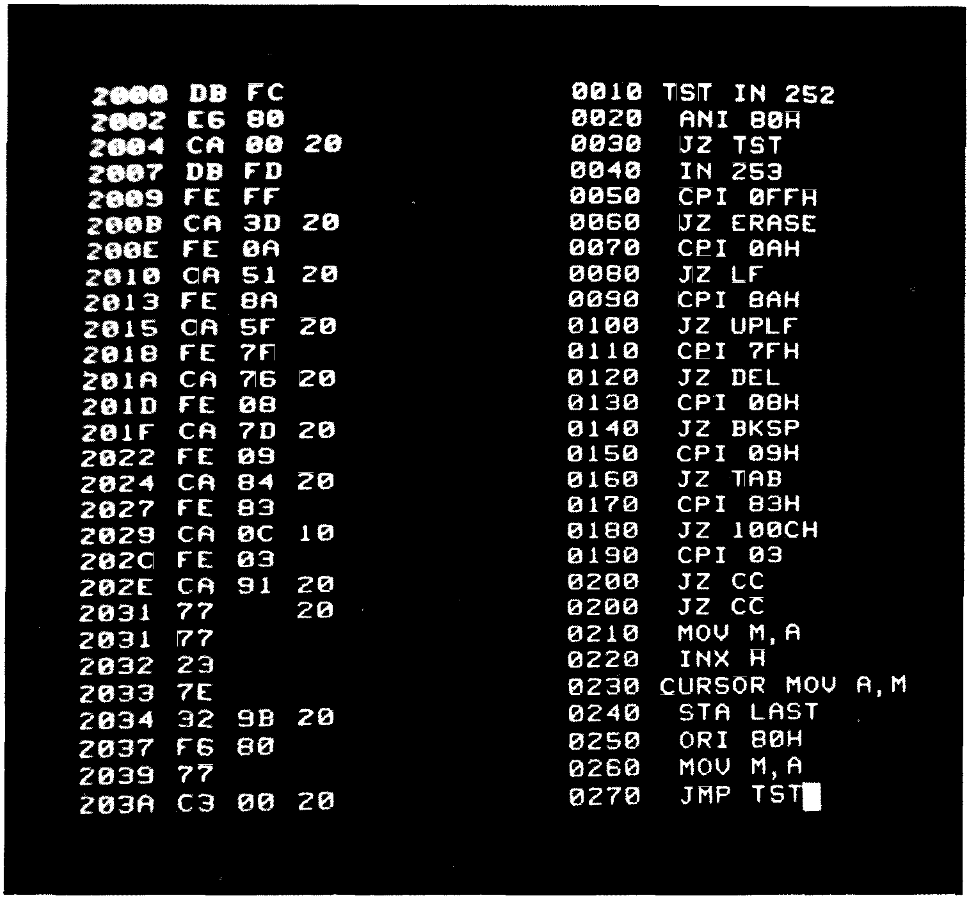
Some specific methods to accomplish normal functions are:

1. ERASING – Simply store blanks throughout the display memory. Note that selective erasing is just as easy.
2. SCROLLING – Read a character from the second line and write it back in the same location on the first line (i.e., move it back 64 places). Continue reading and writing characters until you have rewritten the last line into the second to last line. Then erase the last line. Note that it is a simple matter to scroll only a part of the display instead of all of it.

Construction Ideas

Before you begin building the display, you should make copies of the schematic and make any changes you think necessary to adapt the display to your system. Then assign numbers (or letters) to all of the ICs and number the pins. If the IC numbering scheme is devised to represent a socket coordinate, you will have less trouble when you begin to wire-wrap the board. Then make all power and ground connections. Then finish the

Example of split screen capability.



board by making all wraps associated with a node on the schematic at the same time, indicating (by small colored slashes or otherwise) that you have completed a node.

Testing

There is very little I can mention here, as there are so many things that can be wrong from a misplaced wire-wrap. I suggest checking the sync generator to be sure it is working and then proceeding to the various counters and flip-flops to see which are working. The memory may be tested for proper operation by writing a memory diagnostic program. Obviously, for any real trouble-shooting or debugging you will need an oscilloscope — and you will need to be able to think through the operation of the display. Beyond this, I think I would be writing in vain except for saying, "Good luck!" ■

New Products

from page 27

repeater operation will stretch below 146 MHz. The FCC's intent to deregulate is clear with Docket 21033, and if it does become law, operating requirements for 2m FM will radically change.

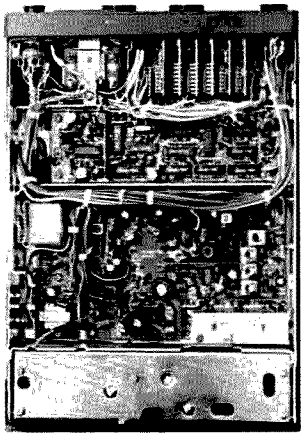
It will be necessary for 2m FM rigs to cover the *entire* band, not just the current repeater segments. Squelch systems employing continuous tone, tone burst, and the variations that go with them will become essential for accessing repeaters and repeater links. It may not be long before repeaters will have multiple links: 2 to 20m, 2 to 40m, and so on. The dream of driving across town working Europe or Australia via a 2m to 20m link might not be a dream much longer. (Wayne Green did it years ago here in Peterborough before the FCC outlawed it.)

One 2m FM rig capable of handling the new repeater revolution *now* is the Kenwood TR-7400A. It covers the entire 2m band and offers one of the most flexible squelch systems going — continuous tone-coded squelch (encode and decode or encode only with common frequency active filters), tone burst, and normal carrier squelch. The TR-7400A is delivered set up for normal carrier operation, with a series of optional modules available for the other squelch modes. A front panel selector switch allows for all three variations with an LED indicator to remind you when the TR-7400A is in the continuous (encode and decode) tone-coded mode. Kenwood has tried to eliminate the characteristic time lag in tone squelch circuits through the use of an active filter. Other squelch modes selected from the same control include tone burst and subaudible (encode only) tone. In all, Kenwood offers 25 different modules covering the tone squelch and tone burst modes. Only one frequency of each type can be used at a time, but the use of computer type connectors would allow easy modification for outboard selection of several different frequencies.

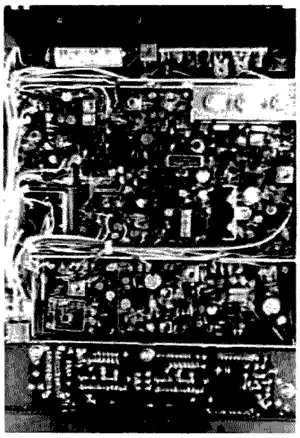
Back to that price war I mentioned earlier. Kenwood had originally announced the TR-7400A in the $450 to $550 price class. Considering its features (PLL synthesized, 25 Watts, full 2m coverage, digital readout), that sounds about right . . . right? Wrong! When the units began to trickle into dealers just after Christmas, the price tag was down to $399 and the war was on.

It's not hard to understand why Kenwood is finding it hard to keep up with demand. The TR-7400A offers you a lot for your money. Aside from the unique squelch design and full coverage synthesizer, Kenwood decided to go beyond the normal 10 Watt output of most transceivers. Despite published specifications of 25 Watts out, the TR-7400A delivered more than 30 Watts into a 5/8 wave antenna, and the low power position yielded 5 Watts out. I was easily able to adjust low power up to ten Watts and drive my 10 by 70 Watt amplifier (a necessity in the low lands up here). In most cases, I found the 25 Watt position more than adequate to access repeaters I couldn't use with 10 Watt rigs, but it was real nice to have three levels of power to choose from. Kenwood uses the Motorola MRF-208 as a driver, and the 2N6083 for the final, which may explain the massive Motorola-like heat sink. The finals are protected by *reducing* output when faced with impedance mismatches, instead of shutting down the radio completely. The front panel meter reads output, so just operating the Kenwood will tell you something about your antenna system. According to the manual, a reading of 8 in the high power mode on a scale of 10 indicates an swr of less than 1.5:1. Low power, factory adjusted for 5 Watts, reads a 3 on the meter scale. Tests with antennas purposely put out of tune reduced high power output to as low as 5 on the meter without excessive heat or transmitter shutdown.

Audio reports were good, with many stations responding that the Kenwood's talk power exceeded everything else on frequency. A deviation meter showed plenty of audio to spare; the 5 kHz spec proved to be quite conservative for my voice characteristics, and the mike gain had to be adjusted. Quality-wise, the Kenwood's audio drew compliments, although several other TR-7400A users objected to the factory supplied dynamic microphone, claiming it was too small for comfortable operation. It took a bit of getting used to, but the palm-size mike actually became preferable after a period of time. (Other large microphones were tried, but reports did not indicate any change in the audio level or quality.) Hooking up a touchtone pad couldn't be easier, since Kenwood included side panel jacks (mini type) for pad input and external speaker output, thus eliminating the need for hard to connect octal type sockets. (Ever tried to put your radio in the car at night and line up those darn pins without bending them?)



TR-7400A, top view. The shielded compartment houses the final amp.



The TR-7400A, bottom cover removed. Squelch modules go into computer connector near the ceramic filter.

The TR-7400A synthesizer is the phase locked loop (PLL) type, with LEDs for digital readout. The PLL divides the 4 MHz bandwidth into 400 channels every 10 kHz, with a push-button 5 kHz offset. Two frequency selector switches allow 100 kHz and 10 kHz switching respectively, with a four position switch for choosing band segments. A three position switch sets transmitter offset at 600 kHz up or down, plus simplex. A dual concentric volume-squelch control completes the package.

One way to measure a mobile radio's quality is what happens when the lights go out . . . can you use it in the dark? Or do you have to pack a flashlight to find out what frequency you're on? Not with the Kenwood. *Every* switchable function, from the synthesizer to the various squelch modes, has its own LED indicator. Six bright red 1" high LEDs tell you what frequency you're on, another LED indicates when you're transmitting, while still another warns that the synthesizer PLL has unlocked and the radio has automatically shut down. The TR-7400A even indicates what transmitter offset you're using, with an LED showing red for -600 kHz, green for +600 kHz, and no indication when in the simplex mode. What all this means is that the Kenwood makes after dark mobiling a snap — no fumbling, no confusion to take your attention off the highway. After a few hours of operating the radio, it only takes a quick glance to see what frequency you're on, what offset you're using, and which squelch mode is engaged. During daylight operations, you won't have to squint to read the LEDs; all controls are well calibrated independent of the LEDs and are easy to find by touch. Counting from one repeater pair to another is made simpler by Kenwood's use of stops on the frequency selector controls, allowing you to only go once around before being forced to reverse direction.

As previously mentioned in these pages, my car suffers from a bad case of ignition noise. I've tried a number of "cures" with mixed results, and have come to accept that weak signals will have to be passed by until warmer weather allows a new assault on the MGB. Kenwood included a well-bypassed power input and it seems to work; my ignition noise is clearly lower with the TR-7400A than previous 2m rigs I've had in the MGB.

You may be wondering by now . . . what about the receiver? A glance at Kenwood's specifications on the TR-7400A shows impressive figures: more than 0.4 uV sensitivity for 20 dB quieting, image rejection of more than 70 dB, and spurious interference down more than 60 dB. The radio's performance certainly backs those claims, with trips into Boston, Hartford, and New York revealing no problems with desense and intermod. The sensitivity, compared to other current rigs, is highly competitive. Kenwood uses a double conversion superheterodyne with a 10.7 MHz 1st i-f, and a 455 kHz 2nd i-f. Large helical resonators, a 10.7 MHz monolithic crystal filter, and a MOSFET front end are also used.

In the mobile, the sensitivity and noise filtering add up to a surprising combination: strong, clear signals whether the strength is S1 or against the pin. There's plenty of audio on receive, more than enough to drive a good size remote speaker . . . or the one Kenwood built in. And unlike many squelch circuits I've used lately,

Kenwood's new TR-7400A 2m transceiver.

dynamic range was outstanding, allowing me to squelch out unwanted repeaters that other radios received with the squelch fully engaged.

The TR-7400A comes complete with mounting bracket, microphone, and power cable. The mount is unique, with guide slots on both sides of the radio, and clamp snaps to secure it. Hasplike protrusions extend from the sides of the radio, allowing you to padlock the rig into the car if desired. Most users will probably choose to take the TR-7400A with them, and the bracket makes for easy removal. The device includes an angle adjustment, allowing for tilting the radio in accordance with your dashboard. By some standards the Kenwood is large, measuring just over 7 inches wide by 3 inches high and just over a foot deep. It weighs about 6 pounds, but I had no trouble mounting it in my small sports car (as the photograph indicates) and did not find its size or weight objectionable. To the contrary, the TR-7400A is a high quality radio in the best Kenwood tradition (a tradition established by the TS-520 and reinforced by the TS-820). At a price under $400 it would be less than honest to deny Kenwood's new 2m radio is one heck of a deal . . . in fact, it's a steal! *Trio-Kenwood Communications, Inc., 116 East Alondra Blvd., Gardena CA 90248.*

Warren Elly WA1GUD
Associate Editor

HEATHKIT HD-1982 MICODER™

The process of using repeater autopatch facilities while mobile has always been a frustrating experience. Between holding in the mike button, grappling for the tone pad, and attempting to continue to drive the car, it often seems like at least three hands are needed.

The Heath Company has vastly simplified the situation through the introduction of their HD-1982 Micoder. At first glance, the unit looks like a standard microphone, but the surprise comes in turning it over. Built into the back is a miniature tone pad. Suddenly, making a call from the ol' buggy is a much easier process.

The Micoder is an easy one evening kit. Although assembly is not too difficult, it does require a steady hand and a light touch since the parts are crowded together on a rather small circuit board. The circuit consists of four ICs, a few resistors and capacitors, and an LED. By the time you add the microphone element, 9 volt battery, and tone pad, you end up with a packed case, giving you a handful that's just a hair larger than most mikes.

The circuit is simple and straightforward. The tones are generated by two NE555 timers, one for high tones, one for low. The pad itself is a miniature tactile type that makes it easy to be sure that you actually hit the button. Another little extra is an LED above the pad that tells you that a tone has been generated. Warning . . . be *very* careful when bending the LED to fit it into the circuit board. I broke two of them.

The microphone itself has not been skimped on. In fact, this high impedance capacitor type with built-in audio amplifier is better than standard mikes supplied with many rigs. When the pad is being used, the mike is automatically disconnected from the output circuit.

Heathkit's HD-1982 Micoder.

After construction, one of two methods can be used for alignment. By far the easiest is the use of a frequency counter. Two miniature pots are used to set the high and the low tones, a process that only takes a couple of minutes.

For those without access to a counter, method two is a little more complicated. It requires access to a repeater site receiver with tone decoding circuits. In that way, tones are set by trial and error.

The Micoder worked famously the first time it was hooked up. I ran into no problems accessing and using the autopatch of the Keene NH repeater. Reports of crisp audio were received. Best of all, I was able to drive safely while punching up the number.

The Micoder can be mated to just about any transceiver on the market with a low impedance input. It worked well with several rigs owned by *73* staffers.

In our age of increased miniaturization and utility, the Micoder continues with the trend of smaller, lighter, and easier to use mobile equipment. The price of $49.95 is quickly repaid in both safety and convenience. *Heath Company, Benton Harbor MI 49022.*

Stan Miastkowski WA1UMV
Associate Editor

HAM RADIO CENTER'S HAM KEYS

With the granting of Novice privileges to Technician class licensees, the Novice bands have become considerably busier. Manufacturers are doing a booming business in high band transceivers and related accessories, including keys.

The Ham Radio Center in St. Louis MO manufactures a line of keys that are called, interestingly enough, the Ham Keys. There are two basic models, the HK-1 and the HK-3. The HK-1 is a dual lever squeeze paddle designed for use with any electronic keyer. The paddles are easily adjustable for personal preference of contact spacing and can be reversed for wide or close finger spacing. The HK-3 is the old standard straight key. This deluxe model is a smooth performer and worked extremely well at the close contact spacing that I like to use.

Both the HK-1 and the HK-3 are mounted on heavy cast iron bases with rubber feet that keep them solidly planted without the need for attaching them to a table or an ugly piece of board.

Variations on the same theme are provided by the model HK-2, which is simply the squeeze key without a base, and the HK-4, which has both the straight key and squeeze model mounted together on a large heavy base.

The Ham Radio Center also markets the Ham Keyer, the model HK-5 electronic keyer. This little unit features an iambic circuit for squeeze keying, self-completing dots and dashes, and dot memory. It can be operated by the built-in battery or external power, has built-in sidetone, and can be used for grid-block or direct keying.

Unlike many other manufacturers, the Ham Radio Center doesn't have a bewildering array of similar models. The Ham Keys and Ham Keyer are simple and solidly built, an investment that should last for years. *Ham Radio Center, Inc., 8340-42 Olive Blvd., St. Louis MO 63132.*

Stan Miastkowski WA1UMV
Associate Editor

NATIONAL SEMICONDUCTOR TO MARKET DIGITAL CLOCK MODULE FOR AUTOMOTIVE, AVIATION, AND MARINE USES

A new 12 volt dc digital clock module intended primarily for automotive applications has been added to National Semiconductor's line of digital timekeeping modules.

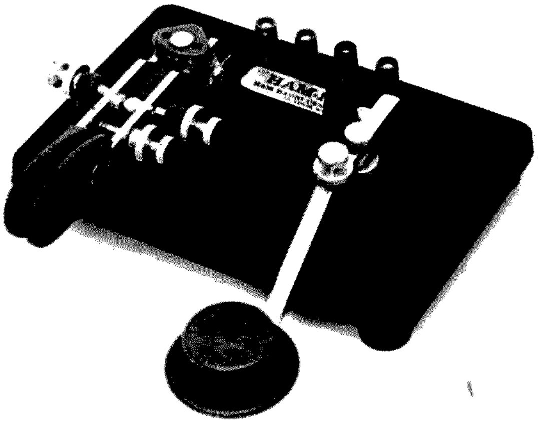
According to module products marketing manager Jerry Zis, the clock module, which is fully protected against automotive transients and battery reversal conditions, is ideal for use in manufacturer-supplied car dashboard clocks, after-market clocks for autos and recreational vehicles, in aircraft and marine clocks, and in 12 volt dc and portable and battery-powered instruments.

Known as the model MA1003, the module is a complete digital clock for all 12 V dc uses. It employs National's model MM5377 monolithic MOS-LSI clock circuit, along with a 4 digit 0.3 inch green fluorescent display, a 2.097 MHz crystal, and supporting components.

"The new module joins National's existing line of digital clock modules for clock radios, alarm clocks, and instrument panels," Mr. Zis said. "With the MA1003, all you need are a few switches and a lens to have a complete ready-to-use automotive clock."

The device features low standby power consumption, an internal crystal timebase, and an automatic display brightness control logic that blanks the display when ignition is off and reduces brightness to one-third when park or headlamps are in use, also following the dash lamp dimming control setting.

Timing accuracy is excellent, typically within one-half second per day, or only a quarter of a minute per month. The display features leading zero blanking and has a blinking colon activity indicator. Display color is filterable to blue, blue-green, green, or



Ham Radio Center's HK-4. Note the heavy cast iron base.

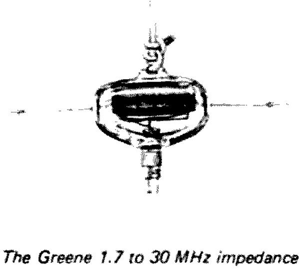
The National Semiconductor digital clock module.

yellow shades. In order to prevent tampering, the hours-advance and minutes-advance switches are disabled when the display is blanked. With ignition or lights off, the display turns off but can be activated by closing a switch. This feature minimizes power consumption in portable applications. A built-in 6 pin edge connector allows easy interconnection to the module.

The MA1003 12 V dc automotive clock module, priced at $25 in lots of 100, is available from stock through National Semiconductor Corporation and its franchised distributors. *National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara CA 95051.*

GREENE INSULATOR AIR WOUND TRANSFORMER

Greene Insulator has introduced a new air wound transformer that doubles as the center feedpoint for wire antennas. This device is destined to replace the old egg insulator/taped coax mess that usually adorns the feedpoint of amateur dipoles and inverted "V" antennas. The transformer, which is air wound with #14 wire, not only provides a 1:1 impedance match between antenna and 52 Ohm coaxial cable, but also serves as the "start point" for any wire antenna. The Greene transformer is constructed of high impact polystyrene, and is virtually indestructible. The face of the 4" x 3" "egg" is clear, allowing the user to see the coil inside. An eyelet is moulded into the top for easy antenna support (handy for inverted "V"s), and the coil is terminated with a standard PL-259 connector, complete with waterproof gasket. It is impossible for this device to leak. The ends of the coil extend about two inches from each end of the transformer, and consist of hard drawn #12 copper wire with hooks at the end, ready to be soldered to the antenna sections.



The Greene 1.7 to 30 MHz impedance transformer.

In actual use, the transformer worked well. The device was tested with a long wire inverted "V" beam on twenty meters, and no tune-up or operating problems were observed. One operator indicated that the receiver noise level was lower when using the antenna with the Greene transformer, as compared to one with an unbalanced coax feed arrangement. Possibly this was due to decreased outer shield pickup in the antenna system using the Greene transformer, which allows the dipole to be correctly driven as a balanced device. By any standards, the Greene air wound transformer performed exactly as advertised, and no problems were encountered. *Greene Insulator, W1-CPI, 3 Pilgrim Drive, Bedford NH 03102.*

John Molnar WB2ZCF
73 Magazine Staff

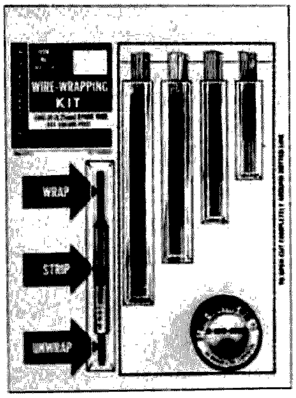
THE SYSTEM 4000

A computer system designed specifically for the ham operator has finally been developed. Curtis Electro Devices, Inc., has introduced their SYSTEM 4000, a turn-key minicomputer consisting of CPU, keyboard, 1K of RAM, input and output ports, and TTY serial interface. The system also has provision for up to 8K of ham applications programs, which are contained on PROM. The self-contained system also has provision for accepting four additional PC cards, compatible with the popular Altair bus.

The system presently supports the following programs: an automatic Morse code reader (6-300 wpm), a software paddle keyer, a keyboard keyer with 200 character buffer, and a full or half-duplex ASCII terminal. The monitor device, a TVT or Teletype, is not included with the basic computer. General programs such as an 8K BASIC are also available.

A general ham applications module is also available for those already owning a computer capable of supporting the Altair bus system. This module supports the features of the SYSTEM 4000, and is called the HAM-S100.

The devices are available from *Curtis Electro Devices, Inc., Box 4090, Mountain View CA 94040, (415) 964-3136.*



OK Tool's new Wire-Wrapping Kit.

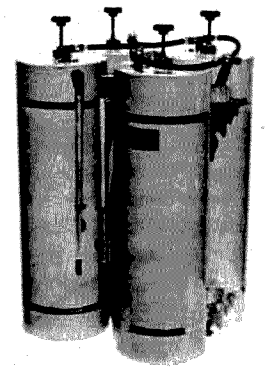
OK TOOL WIRE-WRAPPING KIT

OK Tool's new Wire-Wrapping Kit features selected items of particular value to the prototype engineer and hobbyist alike. It includes a unique new wire-wrapping tool, a roll of wire-wrapping wire, and pre-stripped wire in 4 popular lengths.

The tool, Model WSU-30, is a combination tool that wraps *and* unwraps 30 AWG (0, 25mm) wire on .025 (0, 63mm) square pins, *plus* strips 30 AWG wire using handy built-in stripper. The wire is top quality Kynar® (Pennwalt) insulated silver-plated copper. Supplied in the kit are a 50 ft. (15m) roll plus pre-cut and stripped wire in insulated lengths from 1-4 inches (25-100mm) stripped 1 inch (25mm) on each end. Available with blue wire as Model WK-2B, white wire as WK-2W, yellow wire as WK-2Y, and red wire as WK-2R. Conveniently packaged and available for immediate delivery from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

BpBr CIRCUIT DUPLEXERS

Wacom Products, Inc., of Waco TX has announced a new line of duplexers which include the use of a new exclusive circuit developed by the company. When used with a high Q filter, the "BpBr Circuit" provides superior suppression of spurious and sideband noise between and adjacent to the duplex frequencies, particularly when the duplex frequencies are close spaced. A patent is pending on the new circuit.



Wacom's Model WP-641.

Model WP-641 consists of four 8" OD cavities with the BpBr Circuit and is designed for use with duplex stations in the 144-174 MHz band when the Tx to Rx frequency separation is 500 kHz or more. It provides bandpass characteristics near the pass frequencies and band-reject cavity characteristics at the frequencies to be attenuated. Superior Tx to Rx isolation is a feature of the new model.

For additional information contact *Wacom Products, Inc., P.O. Box 7307, Waco TX 76710.*

YAESU SERVICE MANUAL AVAILABLE FOR FT-101 SERIES

A 200 page technical service manual, written in layman terms, covering the various models of the FT-101 series transceivers, is available from Yaesu Electronics Corporation of Paramount, Calif., and their dealers throughout the United States.

Available in February, 1977, it is priced at $25.00 U.S. dollars, F.O.B. Paramount. Send orders to (or you may contact their U.S. dealer organization): *Yaesu Electronics Corporation, P.O. Box 498, 15954 Downey Avenue, Paramount CA 90723.*

The Curtis SYSTEM 4000, a computer designed specifically for the ham.

Mickey and Foxy Ferguson
PO Box 11104
Chattanooga TN 37401

Save Time with a Micro OS

-- isn't that what computers are for?

So what's an operating system (OS) and why do I need one? I don't actually know the "dictionary" definition of an OS, but my understanding is that an OS is rather similar to the family of programs we commonly call monitors, except an OS is much more powerful and has more bells and whistles. The Mikbug* monitor in the SWTPC M6800 is an example of a nice little monitor; it removes much of the work of using a computer (no bootstrapping, just turn on the power), but leaves much to be desired. Mikbug will load a program from tape, but if you have several programs on the same tape, it loads the first one it encounters. You still have to find the desired program before telling Mikbug to load it. The WA4KDC OS will search a tape for the desired program, loading only the one you've chosen. This is but one feature of the OS. The reason I felt the need for an OS is twofold: First, I happen to believe that a computer should do as much as possible because second, I'm lazy. The WA4KDC OS is not meant to replace Mikbug but to be used along with it.

No listing has been provided with this article. Instead, a dump has been provided. This was done in the hope that Wayne would find room to print it, as a dump takes up less page space than a listing of the same information. Should you desire a listing, the OS itself can provide you with one!

As the OS was written for my system, several assumptions are made:

1. The Mikbug monitor ROM and its associated 128 byte RAM are in place in the system.
2. An SWTPC CT-1024 is used as the control terminal.
3. Tape read and write facilities are available at

*Mikbug is a registered trademark of Motorola, Inc.

0000	42	4C	4F	43	4B	20	4D	4F	56	45	04	43	41	4C	4C	20
0010	42	41	53	49	43	04	44	55	4D	50	04	4C	49	53	54	04
0020	4D	49	4B	42	55	47	04	52	45	41	44	04	57	52	49	54
0030	45	04	20	54	41	50	45	04	5A	45	52	4F	20	4D	45	4D
0040	4F	52	59	20	3F	20	04	54	4F	04	53	54	41	52	54	04
0050	53	54	4F	50	04	53	39	04	10	16	04	0D	0D	0A	04	CE
0060	00	58	7E	E0	7E	8D	FB	CE	00	5C	20	F6	8D	F4	CE	00
0070	43	20	EF	8E	A0	42	8D	E7	CE	00	00	8D	E8	CE	00	0B
0080	8D	E3	CE	00	16	8D	DE	CE	00	1B	8D	D9	CE	00	20	8D
0090	D4	CE	00	27	8D	CC	CE	00	32	8D	CA	CE	00	2C	8D	C2
00A0	CE	00	32	8D	C0	CE	00	38	8D	B8	BD	E1	AC	81	42	26
00B0	04	8D	3B	20	BE	81	43	26	03	7E	01	40	81	44	26	05
00C0	BD	01	5B	20	EE	81	4C	26	05	BD	02	11	20	E5	81	4D
00D0	26	05	BD	E0	E3	20	DC	81	52	26	03	BD	02	A6	81	57
00E0	26	03	7E	02	DD	81	5A	26	CA	BD	03	BA	20	C5	BD	00
00F0	5F	CE	00	00	BD	E0	7E	CE	00	47	BD	00	6C	BD	E0	47
0100	FF	A0	00	BD	00	67	CE	00	4A	BD	00	6C	BD	E0	47	FF
0110	A0	02	BD	00	67	CE	00	50	BD	00	6C	BD	E0	47	FF	A0
0120	04	FE	A0	02	A6	00	BC	A0	04	26	06	FE	A0	00	A7	00
0130	39	08	FF	A0	02	FE	A0	00	A7	00	08	FF	A0	00	20	E1
0140	CE	01	00	FF	A0	00	CE	C0	00	FF	A0	02	CE	D1	50	FF
0150	A0	04	8D	CD	BD	00	5F	7E	01	00	01	BD	00	5F	CE	00
0160	4A	BD	E0	7E	CE	00	16	BD	00	6C	5F	37	20	24	5F	37
0170	BD	E1	AC	81	53	26	07	CE	00	5C	8D	59	33	39	81	46
0180	27	19	CE	A0	0C	4F	AB	01	A7	01	86	FF	A9	00	A7	00
0190	20	09	BD	E0	55	B7	A0	0C	7F	A0	0D	CE	00	5B	8D	35
01A0	CE	A0	0C	8D	1C	5F	FE	A0	0C	8D	18	5C	C1	08	26	F9
01B0	FF	A0	0C	33	5C	C1	10	27	B5	37	CE	00	5C	8D	16	20
01C0	DF	8D	06	8D	04	86	20	20	21	A6	00	8D	0F	A6	00	08
01D0	20	0E	8D	16	08	A6	00	81	04	26	F7	39	44	44	44	44
01E0	84	0F	88	30	81	39	23	02	8B	07	FF	A0	14	37	CE	80
01F0	0C	C6	FF	E7	00	C6	3F	E7	01	8D	05	33	FE	A0	14	39

the control terminal, and are under software control.

4. An SWTPC PR-40 printer is used for hard copy, and is located at I/O slot #3 (if your PR-40 is at another I/O slot, memory locations 01EF-01F0 will have to be changed to the address of the slot you are using).

As it appears in this article, the WA4KDC OS is assembled to run at 0000-03EB, but it is not really intended to be used there. It was designed to be placed into PROM (along with your favorite version of BASIC) and moved somewhere at the high end of memory, OS 8C00 and BASIC C000-DFFF in my system. All functions except CALL BASIC may be used as it appears here, but the OS will have to be moved higher in memory if the CALL BASIC feature is to be used as will be explained later. The reason the OS is shown here assembled for the low end of memory is because the author has no way of knowing where in memory you will wish to use it, and most people seem to find it easier to relocate a program from the low end of memory.[1]

The WA4KDC OS contains several subroutines for the purpose of outputting data to the PR-40. They are equivalent to subroutines contained in Mikbug and may be called by user programs. They are listed below by address along with the name of the Mikbug subroutines to which they are equivalent.

01C1 – OUT4HS
01C3 – OUT2HS
01C5 – OUTS
01D5 – PDATA1
01EA – OUTEEE

Once you have loaded the OS into memory, set the program counter (A048-A049) to 0073 while in Mikbug; then type "G" to go to the operating system and begin execution. The OS should respond by issuing a "home-up" and "erase to end of frame" on the control terminal, then print the following:

BLOCK MOVE
CALL BASIC
DUMP
LIST
MIKBUG
READ TAPE
WRITE TAPE
ZERO MEMORY ?

The OS will now respond to the following commands: "B", "C", "D", "L", "M", "R", "W", or "Z" (the first letter of each function); typing anything else on the control terminal will cause the OS to repeat the above cycle. Let's examine each function of the OS in a bit of detail.

BLOCK MOVE: Suppose we have a routine located A04A through A060 that we wish to relocate to another area of memory beginning with a starting address of 0200. From the OS main loop, we type B for the BLOCK MOVE function. The OS will then prompt:

MOVE TO ? (we type) 0200
START MOVE ? (we type) A04A
STOP ? (we type) A060

The OS will then move the data, leaving the data in A04A through A060 (in our example) intact, and return to the OS main loop to wait for further commands. The BLOCK MOVE function will move as little as one byte or as much as ½ of the available memory. This function is accomplished very rapidly and irrespective of the amount of data moved; it appears to the operator to instaneously return to the OS main loop!

CALL BASIC: Typing C while in the OS main loop causes BASIC to be automatically block moved from some high location in memory to the low end of memory where it is to be used. (This is the reason the OS cannot be located at the low end of memory if the CALL BASIC function is to be used – it would try to move BASIC on top of itself!) The following addresses should contain the information shown below:

0141-0142 – Address BASIC is to be moved to (as in the "MOVE TO?" of the BLOCK MOVE function)
0147-0148 – Lowest address of BASIC ROM
014D-014E – Highest address of BASIC ROM
0158-0159 – Starting address of BASIC

[1] Relocating the WA4KDC OS is made easy by using the BLOCK MOVE and the LIST functions of the OS to identify those addresses that have to be altered, even though relative addressing has been used extensively.

0200	A7	00	C6	37	E7	01	C6	3F	E7	01	6D	01	2A	FC	E6	00
0210	39	BD	00	5F	CE	00	4A	BD	E0	7E	CE	00	1B	BD	00	6C
0220	BD	E0	47	FF	A0	02	BD	00	67	CE	00	50	BD	00	6C	BD
0230	E0	47	FF	A0	04	FE	A0	02	FF	A0	0C	CE	00	5C	BD	01
0240	D5	CE	A0	0C	BD	01	C1	FE	A0	0C	A6	00	B7	A0	0B	BD
0250	01	C3	FF	A0	0C	BD	01	C5	5F	B6	A0	0B	81	8C	27	18
0260	81	8E	27	14	81	CE	27	10	84	F0	81	20	27	0B	81	60
0270	25	08	84	30	81	30	26	01	5C	5C	F7	A0	0A	27	10	7A
0280	A0	0A	27	05	BD	01	C1	20	03	BD	01	C3	FF	A0	0C	B6
0290	A0	0C	B1	A0	04	27	02	20	A2	B6	A0	0D	B1	A0	05	23
02A0	F6	86	0D	7E	01	EA	BD	00	5F	CE	00	27	BD	00	6C	8D
02B0	1E	86	3C	B7	80	07	86	11	BD	E1	D1	CE	A0	4A	BD	E1
02C0	AC	A1	00	26	F6	08	A6	00	81	04	26	F2	BD	E0	13	CE
02D0	A0	4A	BD	E1	AC	A7	00	08	81	04	26	F6	39	8E	A0	7F
02E0	BD	00	5F	CE	00	32	BD	00	6C	8D	E4	BD	00	67	CE	00
02F0	4A	BD	E0	7E	CE	00	32	BD	00	6C	BD	E0	47	FF	A0	02

0300	BD	00	67	CE	00	50	BD	E0	7E	CE	00	32	BD	00	6C	BD
0310	E0	47	FF	A0	04	BD	00	67	CE	00	4A	BD	00	6C	BD	E0
0320	47	FF	A0	48	86	12	BD	E1	D1	8D	2A	CE	A0	4A	BD	E0
0330	7E	8D	2E	CE	A0	48	FF	A0	02	08	FF	A0	04	8D	22	8D
0340	0E	8D	0C	8D	0A	8D	0E	86	14	BD	E1	D1	7E	00	73	CE
0350	00	55	7E	E0	7E	5F	86	00	BD	E1	D1	5C	C1	FF	26	F6
0360	39	FE	A0	02	FF	A0	0F	B6	A0	05	B0	A0	10	F6	A0	04
0370	F2	A0	0F	26	04	81	10	25	02	86	0F	8B	04	B7	A0	11
0380	80	03	B7	A0	0E	CE	E1	34	BD	E0	7E	5F	CE	A0	11	8D
0390	24	CE	A0	0F	8D	1F	8D	1D	FE	A0	0F	8D	18	7A	A0	0E
03A0	26	F9	FF	A0	0F	53	37	30	8D	0B	33	FE	A0	0F	09	BC
03B0	A0	04	26	B3	39	EB	00	7E	E0	BF	BD	00	5F	CE	00	4A
03C0	BD	E0	7E	CE	00	38	BD	E0	7E	BD	E0	47	FF	A0	02	BD
03D0	00	67	CE	00	50	BD	00	6C	BD	E0	47	FF	A0	04	FE	A0
03E0	02	6F	00	08	BC	A0	04	26	F8	6F	00	39	00	00	00	00
03F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

Upon completion of the CALL BASIC function, system control is given to the BASIC interpreter instead of returning to the OS main loop. This function is also accomplished very quickly with the BASIC prompt seeming to appear as soon as the "C" command is typed – no more waiting for fifteen or twenty minutes for BASIC to load! (Tom Pittman's TINY BASIC and the WA4KDC Operating System will fit into 3K of PROM with room to spare!)

DUMP: Suppose we desire a "Core Dump" beginning with address 1000. Typing D while in the OS main loop will cause the OS to prompt with:

START DUMP ? (we type) 10

The OS will then print (using the PR-40) 128 bytes in standard core dump format beginning at address 1000. After dumping 128 bytes to the PR-40, the OS looks for one of three commands:

B – Dump the next frame back (lower address)
F – Dump the next frame forward (higher address)
S – Stop dump and return control to OS main loop

LIST: The LIST function of the OS, while similar to the DUMP function, uses the following format: address, OP code, operand. Suppose we wish a listing of 01BA through 01BF. Typing L while in the OS main loop will cause the OS to prompt with:

STARTLIST ? (we type) 01BA
STOP ? (we type) 01BF

Assuming that we have the OS in memory locations 0000 through 03EB, the OS should then print (using the PR-40):

```
01BA CE 005B
01BD 8D 16
01BF 20 DF
```

Upon completion of the LIST function, control is returned to the OS main loop. It should be noted that ASCII encoded strings tend to confuse the poor OS. Once beyond the strings, it will usually recover rather rapidly.

READ TAPE: As mentioned earlier, the OS will search for a particular program on tape and load only the desired program (assuming the tape is formatted with a header record for identification – see WRITE TAPE). While in the OS main loop, if an R command is typed, the OS will prompt with:

READ ?

At this point, the OS is requesting the name of the program you desire it to load into memory. After entering the name of the program, type a "Control D" to indicate to the OS that the entry is complete. The OS will then turn on the tape reader and begin searching for the desired program. When it is found, it will be read into memory; everything encountered on the tape before the desired program will be ignored. After the program has been read into memory, system control is given to Mikbug, so typing "G" will run the program.

WRITE TAPE: The WRITE TAPE function of the OS outputs programs to tape in the following format: header, header record, program, program counter starting location, three S9s, trailer. The header, a series of nulls, gives a cassette recorder time to reach normal tape speed before any data is output to tape. The header record (name of program) identifies the program to the READ TAPE function when, at some later time, it is desired to load the program from tape. The three S9s indicate the end of program to the OS when the tape is later read into memory. The trailer, a series of nulls, is added to provide some physical spacing between programs on tape. Let's assume we have Star Trek in memory from 0000 to 1FFF, with an entry point of 0100, and we desire a tape of it. While in the OS main loop, we type the WRITE TAPE command, "W", and the OS prompts with:

WRITE ? (we type) STARTREK "Control D" ("Control D" indicates end of entry to the OS)
START TAPE ? (we type) 0000 (lowest address of program)
STOP ? (we type) 1FFF (highest address of program)
START ? (we type) 0100 (program entry point)

The OS will then turn the recorder on, generate the tape (formatted as described above), turn the recorder off, return control to the OS main loop.

ZERO MEMORY: This function will clear any amount of memory from one byte up to the entire RAM memory in the system; it appears to the operator to perform its task even faster than the BLOCK MOVE function! The first time you use the ZERO MEMORY function, you may wish to go to the Mikbug memory examine function and do some random checking to prove to yourself that the OS actually did clear the memory! To clear the memory used in the Star Trek example above, type a Z (while in the OS main loop, of course). This will cause the OS to prompt with:

START ZERO MEMORY ? (we type) 0000
STOP ? (we type) 1FFF

Upon completion of the ZERO MEMORY function, system control is returned to the OS main loop.

MIKBUG: This function turns system control to the Mikbug control loop. You may, while in Mikbug, return to the WA4KDC OS by typing G.

Although considerable effort has been expended to assure that the WA4KDC Operating System is "bug free," and it has been running on our system for some time with no known bugs, we would be most interested in hearing about any bugs you may find. ■

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1330 W. 54 St. C-112
Hialeah FL 33012

PROM Message Generator for RTTY

- - keyboards are obsolete!

This article describes what started out to be a simple CW identifier mainly for repeater use. The circuit, however, can easily be changed to send almost any length or type of message. Some possible uses are a CW identifier, Morse code message generator, RTTY test message generator (RYs, the quick brown fox . . .), RTTY message generator, and an automatic telephone dialer.

Three of the basic CW identifier circuits have been built. The first one has been operating in the WR4AKK repeater since Christmas of 1974. The second one was built for WB4CCB, who uses it to identify himself on VHF. And, finally, seven months after the circuit was designed, I built one for myself. I should mention that the first two identifiers were a combination of TTL and CMOS logic. But, because most hams are not yet familiar with the peculiarities of CMOS, I redesigned the circuit using all TTL.

The Memory Unit

For the memory unit, I chose to use a field programmable read only memory or PROM. PROMs are now appearing on the surplus market at prices that the average ham can afford. PROMs are smaller and easier to work with than a diode matrix, are easy to design with, and – believe it or not – most are easy to program.

A PROM can be thought of as a black box that has X number of inputs and Y number of outputs. What goes on inside during operation really doesn't need to concern us at this point. PROMs are sold with all the output stages in the same logic state, either 1 or Ø. Whether the output stages are initially all 1s or Øs depends on the manufacturer. During the programming process, you, the user, decide for a

Address	Output state	Represents:
0	1	dit
1	0	space
2	1	
3	1	dah
4	1	
5	0	space
6	1	
7	1	dah
8	1	

Table 1. Address locations and memory content to send Morse code W.

Address	Output state	Represents:
0	1	
1	1	dah
2	1	
3	0	space
4	1	dit
5	0	space
6	1	
7	1	dah
8	1	
9	0	space
10	1	dit
11	0	
12	0	letter space
13	0	
14	1	
15	1	dah
16	1	
17	0	space
18	1	
19	1	dah
20	1	
21	0	space
22	1	dit
23	0	space
24	1	
25	1	dah
26	1	
27	0	
28	0	word space
29	0	
30	0	
31	0	
32	0	
33	1	
34	1	dah
35	1	
36	0	space
37	1	dit
38	0	space
39	1	dit
40	0	
41	0	letter space
42	0	
43	1	dit
44	0	space

Addresses 0 through 10 send a C
Addresses 14 through 26 send a Q
Addresses 33 through 39 send a D
Address 43 sends a E

Table 2. Address locations and memory content to send CQ DE.

 March 1977

Address	A_3	A_2	A_1	A_0	
	8	4	2	1	= binary weights
0	0	0	0	0	
1	0	0	0	1	
2	0	0	1	0	
3	0	0	1	1	
4	0	1	0	0	
5	0	1	0	1	
6	0	1	1	0	
7	0	1	1	1	
8	1	0	0	0	
9	1	0	0	1	
10	1	0	1	0	
11	1	0	1	1	
12	1	1	0	0	
13	1	1	0	1	
14	1	1	1	0	
15	1	1	1	1	

Fig. 1. A simple four input, one output (16 x 1) PROM showing address decoding.

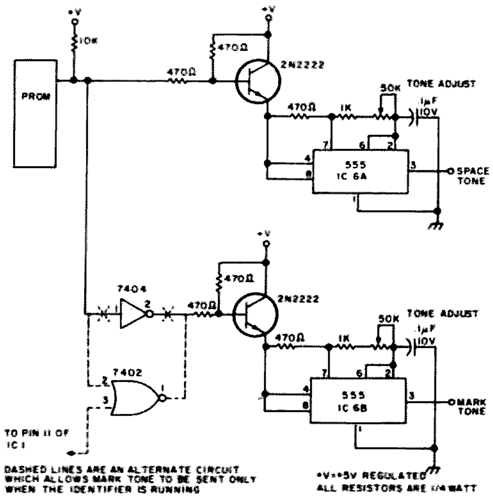


Fig. 3. A modification to the tone generator of Fig. 2 to allow two-tone operation for RTTY use.

specific address what the output states will be and program accordingly. For example, if you want output one to be a Ø for address 3, and the PROM has all outputs initially at Ø, you do not have to program anything into address 3. If, however, you want output one to be a 1, you must apply a programming voltage to the PROM to cause this output to change. (For programming information see the specific manufacturer's spec sheet.) Once an output has been programmed, it cannot be changed. (Some of the newer MOS PROMs can be erased and reprogrammed, but the entire PROM must be erased – not just one word or one bit at a time.)

The input lines to a PROM are called address lines. Each address selects one word. For example, a Ø on all address lines selects word zero. An address is the sum of the binary weights of the address lines. Address line AØ has a binary weight of 1, address line A1 has a binary weight of 2, address line A2 has a binary weight of 4, and so on. Fig. 1 shows a four input PROM and its address table. This PROM has a maximum capability of sixteen words, with addresses zero through fifteen. For every input address there is at least one output stage which is unique to that address. The output stages are tied to each other in groups. That is, if there are four outputs for each address, all of the output one stages (for every address) are tied together, all of the output two stages are tied together, and so on. Even though the output stages for every address are common to each other, only the output stages corresponding to the selected address are active. For example, for a four output PROM every address activates four outputs. These outputs can be any combination of 1s and Øs and are programmed separately.

PROMs are available with three types of output stages: Totem-pole, open collector, and Tri-state (Tri-state is a trademark of National Semiconductor Corp. for their three-state output devices). The Totem-pole output PROM is a new product just released by Harris Semiconductor. It features a standard TTL output stage.

Three-state PROMs have an enable input which, when it is taken high, will force all of the outputs to a very high impedance. This allows several outputs to be bused together. Three-state PROMs also have internal pullup resistors on the output lines. These resistors insure that when an output is high, the output will be close to +Vcc.

Open collector PROMs also have an enable input. When this input is high, all of the outputs are forced off. Open collector PROMs do

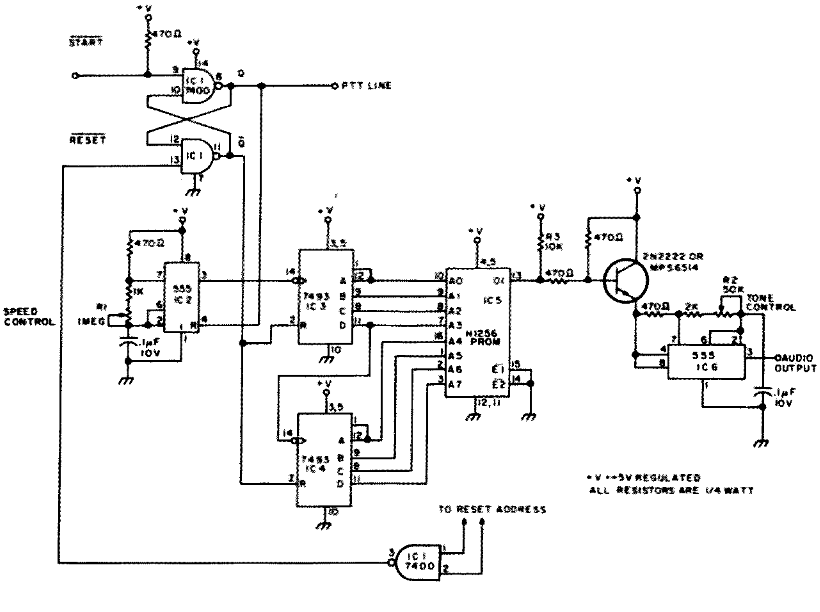


Fig. 2. The basic CW identifier. This circuit features adjustable speed, adjustable tone, and up to 256 bits of memory. The PROM pinout is for a Harris 1256, 256 x 1 PROM.

not have internal pullup resistors. To insure that the output does go to a logic 1 when we want it to, an external pullup resistor must be connected from the output to the +Vcc supply.

A PROM with four inputs and one output is called a 16 word by 1 bit (16 x 1) PROM. If a PROM has eight inputs and four outputs (a common configuration), it is a 256 word by 4 bit (256 x 4) PROM.

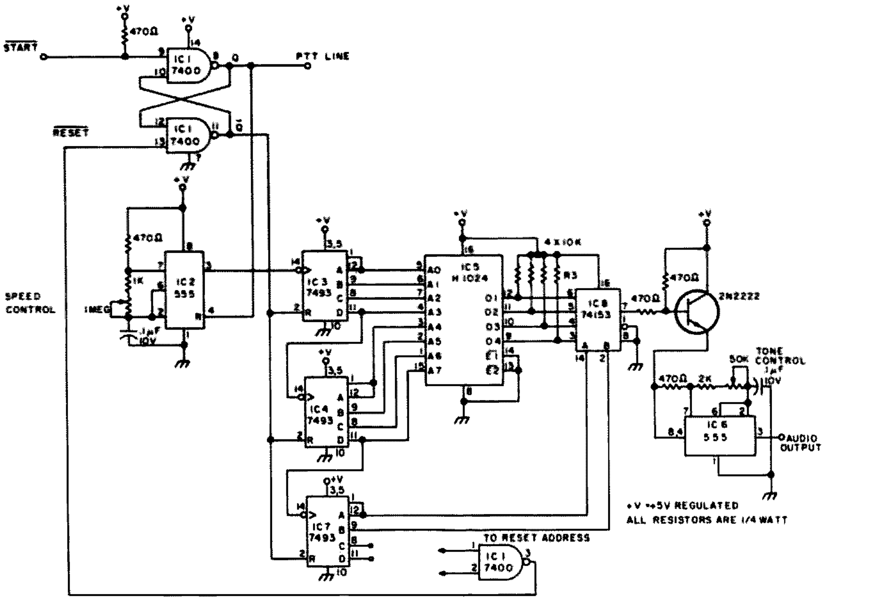


Fig. Ø. An expanded identifier. This circuit features adjustable speed, adjustable tone, and up to 1024 bits of memory. The PROM pinout is for a Harris 1024, 256 x 4 PROM.

Circuit Description

IC1 is a 7400, two gates of which form the ID start flip-flop (Fig. 2). If pin 9 of IC1 is momentarily taken low, pin 8 of IC1 goes and stays high. This high level turns on IC2, a 555 astable multivibrator, which provides the clock signal for driving the counters. At the same time that pin 8 goes high, pin 11 goes low, allowing the two 7493 four bit binary counters to begin counting. IC3, a 7493, counts on the negative transition of the clock. IC3 addresses the PROM from Ø (A0-A7 low), to address 15 (A0-A3 high, A4-A7 low). When the next negative transition of the clock occurs, IC3 changes back to Ø and IC4, another 7493, advances to count 1. This corresponds to address 16 (A4 high, A0-A3 and A5-A7 low). In this manner the PROM is sequentially addressed starting at address Ø and ending at the maximum address of the PROM. In the case of this 256 x 1 PROM, when the counters reach 255, the maximum address has been reached. At clock count 256 the PROM will be back at address Ø. The counters will continue counting and the PROM will be addressed through its entire contents again and again. To stop the counters and reset them at the end of your message, one, two, or three address lines are decoded with a NAND gate to detect the reset address. When all of the inputs to the NAND gate are high, indicating the reset address has been reached, the gate's output goes low, applying a reset pulse to pin 13 of IC1. When pin 13 is taken low, pin 8 of IC1 goes low, stopping the 555 clock, and pin 9 goes high, resetting the 7493 counters. For example, to send my call, WB4EHG, requires 6Ø address locations. Sixty is represented by address lines A2, A3, A4, and A5 being high at the same time. To reset at address 6Ø would require a four input NAND gate. But, if I were to reset at address 64 (A6 high only) instead, I can use one of the unused gates in IC1. For addresses 61, 62, 63 and 64, the PROM output must be Ø. If the output were 1 for these addresses, a tone would be sent by the tone generator. It's a good idea to program a few addresses low after your message, to insure that the message is complete and the tone generator is off before and during reset.

Resistor R3 provides the pullup current to the output stage of the PROM. The use of this resistor was discussed earlier in this article. When the output of the PROM is high, as it is when you wish a tone output, transistor Q1 is turned on, which turns on IC6 by raising its Vcc line from +2.5 V to +5.0 V. IC6 is a 555 astable multivibrator which serves as a tone oscillator. By using Q1 as a keying switch and keying the Vcc line, the oscillator turns on without producing a key click. R2, the 50k Ohm pot, is a tone control. The tone frequency can be varied between 100 Hz and 2.5 kHz.

An external tone oscillator may be used as long as you properly interface it to the PROM output. Most PROMs will drive ten standard TTL loads (16 mA output); but, if you are in doubt, check the manufacturer's specifications.

If you are building a RTTY message generator, the tone generator circuit of Fig. 3 can be used. This circuit has two 555s, one to generate the mark tone and the other to generate the space tone. An inverter is needed between the PROM output and the mark tone generator. The fourth gate of IC1 can be used or you can add another IC.

Code Programming

Now that we know how the addressing is going to take place, let's take a look at what each address is going to do. Morse code is made up of dits and dahs. Each dah is equal in length to three dits. Each address, therefore, will be equal to one dit length. If one lone address has a one programmed in its output, it will turn on the tone oscillator for one clock period, producing a dit. If three addresses in a row are turned on, the tone oscillator will be turned on for three clock periods, producing a dah. The space between dits and dahs of the same letter is equal to the length of one dit. The space between letters of the same word is three dits (one dah), and the space between words is six dits (two dahs). For example, to store a W in memory takes nine addresses (Table 1). Since address zero is on and address one is off, the tone oscillator will be on for one clock period and off for one clock pulse, thus forming a dit. Addresses two, three, and four are on and address five is off, so the tone oscillator will be on for three clock periods and off for one, thus forming a dah. Table 2 shows the address locations to send CQ DE.

I would suggest that you program the first five or so addresses as zeros. This will give a slight delay from the time the generator is started until the code starts rolling out. In a repeater, this delay

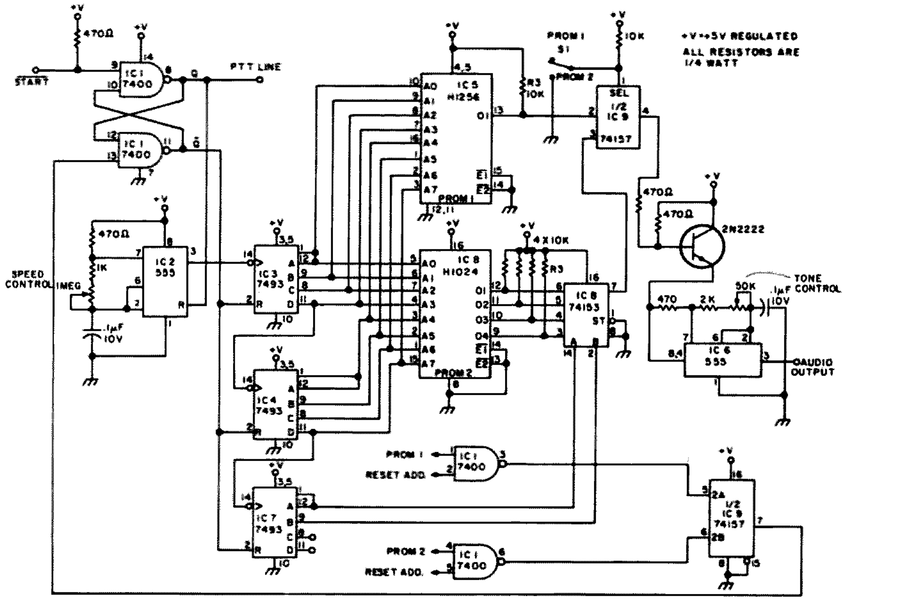


Fig. 5. A combination of Fig. 2 and Fig. 4. This circuit features adjustable speed, adjustable tone, and selection of two PROMs. Switch S1 selects PROM 1 or PROM 2. Each PROM has a separate reset address. The PROM pinout for PROM 1 is a Harris 1256. PROM 2 is a Harris 1024. I use PROM 1 to send my call and PROM 2 to send my name and address.

will give the transmitter time to come up, eliminating the possibility of chopping off the first part of the first letter sent. This is a matter of personal choice. If you do not want a delay or have a very long message to send, start your first letter at address one. Address zero must have a zero programmed in it. This address is selected when the identifier is in the reset condition and a one here will cause the tone oscillator to be on constantly. If you use this circuit as a RTTY generator, this will cause a mark tone to be sent while the generator is in the reset mode. If you do not want the mark tone sent during reset, use the alternate circuit of Fig. 3.

Selecting a PROM

Of all the PROMs on the surplus market, the 32 x 8 is probably the most common. This PROM is good for use as an automatic telephone dialer, but as a simple CW ID generator it requires too much extra circuitry (although an adaptation of Fig. 4 could be used). A 256 x 1 PROM is more than enough for sending your call and QTH. If you have a long message or several different messages to send, a 256 x 4 or 512 x 4 can be used. A 256 x 4 has a total of 1024 bits of memory and a 512 x 4 has 2048 bits. A 256 x 4 is large enough to send my name, full address, and even the name of the company I work for.

If you obtain a PROM with more memory than you need, you don't have to program all the memory at one sitting. You might, at a later date, want to send something different and, by changing your counter circuit, or by using a different output of a multiple output PROM, you can program the unused addresses.

Expanding the Basic PROM Generator

Fig. 4 shows a modified Fig. 2. The circuit has been modified to use a larger PROM (more outputs). The start, clock, and tone generator circuits are identical to the basic generator circuit. Now, however, instead of using a single output PROM, I am using a four output PROM. The 7493 binary counters count and address the PROM as before, but a new counter has been added so that when clock count 256 occurs, the PROM address is back at zero and pin 12 of IC7 goes high, causing the second output of the PROM to be connected to the tone generator through IC8. IC8, a 74153, can be thought of as a four position electronic rotary switch; the position of the switch is selected by IC7. On clock count 512, the PROM address is back at zero again and output three is tied to the tone generator. Likewise at address 768; output four is tied to the tone generator and the PROM is at address zero again. This scheme allows sending 1024 bits of data in an unbroken stream. Resetting is done as before by decoding the reset address line with a NAND gate and taking the reset line of the start flip-flop low.

RTTY Message Generator

To build a RTTY message generator you can use either the circuit of Fig. 2 or that of Fig. 4. Every RTTY character consists of seven parts: a 22 ms start pulse, five 22 ms data pulses, and a 31 ms stop pulse. The total time for a 60 wpm RTTY character is the sum of these pulses, which is 163 ms. By adjusting the period of IC2 to 11 ms and letting two addresses represent the stop pulse, a RTTY character can be sent in 165 ms. Because with this timing the stop pulse is 2 ms longer than normal, the generator will be sending at about 1% slower than 60 wpm. I doubt that you will be able to see any difference. The longer stop pulse does not affect the TTY timing because if no character is sent, the machine

Address	Output state	Represents:
0	1	space tone (start)
1	1	space tone (start)
2	1	space tone (data)
3	1	space tone (data)
4	0	mark tone (data)
5	0	mark tone (data)
6	1	space tone (data)
7	1	space tone (data)
8	0	mark tone (data)
9	0	mark tone (data)
10	1	space tone (data)
11	1	space tone (data)
12	0	mark tone (stop)
13	0	mark tone (stop)
14	0	mark tone (stop)

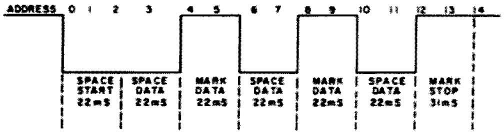


Table 3. Address locations and memory content to send the RTTY character R. Note that each RTTY character requires fifteen addresses.

Configuration	Bits	Maximum no. of RTTY characters
32 x 8	256	17
256 x 1	256	17
64 x 8	512	34
256 x 4	1024	68
512 x 4	2048	136
512 x 8	4096	273

Fig. 4. An expanded identifier. This circuit features adjustable speed, adjustable tone, and up to 1024 bits of memory. The PROM pinout is for a Harris 1024, 256 x 4 PROM.

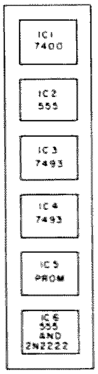
sees a constant stop signal. Either the two-tone generator of Fig. 3 can be used or you can use your own AFSK oscillator. Table 3 gives a programming truth table for sending a RTTY R. As you will notice, because every RTTY character is of the same fixed length, it will take fifteen addresses to send a RTTY character. There is no need for spacing between characters due to the existing start and stop pulses. Table 4 shows the maximum number of characters you can store in some of the available PROMs.

Construction

The layout and wiring for these circuits is not critical. All voltage lines should be bypassed where the lines enter the board and at several points on the board, directly at the Vcc pins of the ICs. If you plan on using this circuit as a repeater identifier, shielding the whole circuit board may be necessary to keep rf from triggering the circuit or causing the counters to count extra counts.

I have built one of the identifiers using wire wrap and two using circuit stick. I would suggest that unless you like the messy job of making printed circuit boards, you use circuit stick. Circuit stick is adhesive-backed copper patterns that are used with predrilled boards. Patterns are available for all kinds of circuit elements. I also suggest that you use sockets for the ICs. The extra cost of the IC socket will be forgiven the first time you have to unsolder a soldered-in IC. Fig. 5 shows the layout I used for the two circuit stick boards. Wire wrap is great if you can afford the cost of the wrap gun and wire wrap board. For the ham interested in only an occasional circuit board, I don't suggest you invest in a wire wrap outfit.

Fig. 6. This is the layout of the circuit in Fig. 2 when using circuit stick.



Conclusion

The most obvious use for this circuit is as a repeater identifier. But because of the versatility of the PROM, this circuit can have hundreds of uses. Some examples are:

For the repeater — automatically dialing police and fire phone numbers in following with the 911 plan; automatically bringing up the repeater and sending an alert message in the case of someone breaking into the repeater site.

For the ham shack — an automatic station identifier; automatic CQ caller; automatically send QSL information; touchtone frequently dialed telephone numbers.

For the RTTY station — all of the above plus as an RY generator, the quick brown fox generator, and to store RTTY pictures. ■

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FCC-Approved Microprocessor

-- use it for the code test

Would you believe that you can build your own portable semi-solid state minicomputer, take it to an FCC examination, and use it with the inspector's blessing? You may think there is some catch to this, but your curiosity is aroused. Or perhaps you think, "Code's a cinch, so who needs it?" Well, let's just listen up here around 50.4 MHz for a minute.

> "Yeah, Al, I went down to the candy company a couple of times to try for the General, but I finally decided that this class of license is nothing to be ashamed of. We got it pretty good here on six meters. It's not crowded. In fact, the band really needs the activity. We're performing a public service, the way I look at it. Anyway, cee-dubble-yew isn't really like talking to somebody. The low bands are way too crowded now with all those sidewinders squawking away on top of each other down there. Yes sir, six is the only band where you can still have a good old-fashioned QSO any more."

Now let's read the mail on the repeaters. Sounds like the gang on 16/76 is heatedly discussing mobile rig rip-offs. Gee, what happened? Bill just asked Stan if he had worked any of that hot DX on twenty meters last night and nearly everyone destinated or got a land line all of a sudden. Aw, come on, why would they be embarrassed?

OK, I admit it. I was one of those dudes until about a year ago when I rediscovered *73 Magazine*. Wow, there was a bright new world out there! Wayne Green had built a bridge which made international Morse code at 13 wpm attainable. I could stop pretending I was as real a ham as those others. That inspired the experiments which led to Codebuster. You can build a similar system, and there's no reason why it can't take you on to 20 wpm and the Biggie if that's what you really want. I wasn't kidding about Codebuster. This is actually a construction article, so let's get started.

A black box of any convenient size will be appropriate for housing the unit. Just think of it — that black box with its sophisticated microcircuitry smoothly converting audio input into video and graphic output. When properly programmed, the speed of translation is limited only by the physical response time of the graphics drive. Now that wasn't hard, was it?

Nikola Tesla, it is told, designed his ac motors and generators by carefully assembling scale models in his mind. When they were later built, the real prototypes were found to perform in every respect as Tesla had imagined they would. Even the patterns of wear on the moving parts had been predicted.

It is apparent that each of us has a built-in bioelectronic microprocessor of fabulous capability. Each second it performs routinely feats of information processing and retrieval unequalled by the largest solid state machines. Some of its input channels haven't even been identified yet. What we've done is to dedicate one tiny partition of it to serve temporarily as our black box. Building Codebuster is a snap. Now all we have to do is program it properly.

Operating as designed in its normal state, our master computer should be as capable as any physical device of executing flawlessly and instantaneously any desired function. We simply feed in a lookup table of sound equivalents for the various characters and we're in business. Dit dah is A, dah dit dit is B, and so forth. Did I hear you say that it isn't that simple?

All right, why not? There are two reasons, basically. One is scattered attention. The input data gets mixed with so many thousands of bits of other data each second that our computer gets confused. The other reason is the existence of many levels of previous programming, much

of it contradictory. This is called conditioning, and unfortunately most of the documentation for it is not readily available. That makes debugging something of a challenge at times. But despite all this, it's not difficult to prove that the inherent functional capability is there.

Experimentally, normal subjects like you and I have been asked to watch a passenger train as it roars through a suburban station in a featureless blur of motion. Later when their minds were properly relaxed, they could recall in complete detail what was seen in each window of the passing train. Features of the passengers, their hair and clothing, could all be accurately described. Verification was provided by comparison with slow motion movies or independent accounts of other observers. Explain this however you will, our minds can be shown to possess fantastic capability when allowed to perform as designed. Obviously there's no problem with the computer itself. It is the programming and output that will make our Codebuster function properly.

Although we began a small debugging operation earlier in the article, it will be necessary to go much farther. Let's have a look at that old program. Who told you that code was hard? When did you decide that you'd never be able to copy 13 (or 20) words per minute? How many times can you remember saying, "I hate code"? Are these attitudes of any help to you now? Perhaps the time has come to put that old program out to pasture and replace it with a new one.

Code is very much alive. Most resistance to it appears to stem simply from unfamiliarity with it. You could begin to think about its advantages and usefulness. Thumb through a copy of the Callbook some time. It is fat with the names of thousands of hams throughout the world who have used and enjoyed CW. Listen to CW on the ham bands or commercial transmissions on a general coverage receiver. Nobody makes any of those people use that mode of communication. So whether you intend to use code or not, deliberately reprogram your attitude toward it. And know, deeply and *firmly*, that what hundreds of thousands of others have done, you can do – and will!

Any successful endeavor requires first of all a clearly defined goal. We need to visualize exactly what we want to accomplish. And secondly, we must generate and maintain a strong desire to reach that goal. We can't just pretend that we want to learn code. If hangups or attitudes of self-depreciation stand in the way, we want to recognize and change them. There are new methods, new tools, new FCC examinations, and we need a positive and confident attitude to go with them. You want to be able to send and receive 13 or 20 words per minute so bad that you can taste it. Good, that's the operating system for the Codebuster. Keep it that way.

If you have ever had any kind of amateur license, you were able to send and receive at least 5 words per minute. That may be an asset. But you could have learned code at that speed by sight. Those little tables of letters followed by dots and dashes are murder. If you never studied one, thank your lucky stars. We want to establish an automatic motor response to an audio signal – not translate the sound for each character through some visual delay circuit. A is simply the sound dit dah, nothing more. Hear it, write it. This way we place no artificial limitation on the speed of comprehension and your Codebuster will function as it should from the beginning.

Many years ago, an old-time railroad telegrapher confided to me the secret of his expertise. "It's easy," he said. "I just read a stream of beautiful purple characters which passes across my mind's eye like a tape." He had created a Codebuster in his mind and it did all the work for him. He programmed his computer creatively in a way that was efficient and esthetically pleasing to him. Now purple letters may not appeal to you. You may prefer direct graphic output via the old pencil. But you may find that some form of visualization helps you to concentrate, at least in the beginning. So experiment with it if you like.

Since you're going to be copying code at 13 wpm, it makes sense to use instructional material in which components of the characters are spaced at that speed. This avoids having to relearn the code at each successively higher speed. It is a good idea to review from the beginning anyway, since most people have neglected numbers and punctuation. For this reason, an investment in the *73* code tapes, including the 5 wpm learning tape, is very worthwhile. If you think that this new system is only Wayne Green's advertising gimmick, perish the thought. It's the biggest advance in learning code since Morse invented it. It even worked for me!

Have you considered the optimum form of output for your Codebuster? Please, seriously consider writing the characters. Printing is quite difficult for most people at 13 wpm and next to impossible at 20. On the other hand, ordinary handwriting is smooth and easy even at 25 wpm. You will never regret learning to write code and the FCC could care less. They won't even read your copy under the new system. So why place an unnecessary limitation on the graphic response time of your machine?

The first sessions will be fun. In a relaxed way, build your mental table of sound equivalents and write the characters as you listen to them. Soon you'll move on to the 6 wpm tape and be copying code groups, at least some of them, pretty well. But code groups don't seem to be much fun. Thirteen wpm still sounds like white noise to you – all you can make out is a period now and then. And you just heard Joe calling QRZ on the repeater. Hold on there – the voltage on your ICs is dropping. We'd better check the power supply.

You know that it takes voltage and current flowing in a circuit to produce power. If our resistance is too high, nothing can be accomplished. So whenever we detect resistance rising, we must increase the voltage and reduce the resistance. We need, in other words, both a clearly defined goal and a powerful incentive to reach it. Remembering these principles can save us a lot of sweat and tears. The primary challenge for most people studying code, aside from arranging regular study periods, seems to lie in this area. You can grit your teeth, get out the old horsewhip and do it the hard way, or you can do it the easy way and enjoy it.

Code study will become a habit in a surprisingly short time if you make a regular time for it each day. Many people find it convenient right after the evening code practice transmission of W1AW. Practice less often than every other day may make the road a long one for you. Once you begin to copy smoothly at any speed, you should find the period pleasant in that it mobilizes enough attention to relax your mind. But to get back to that power supply, let's consider some ways that you can crank up your voltage and decrease your resistance.

Why not arrange some activities that you enjoy to serve as rewards? Listen to some SSB on the low bands, for instance, and frankly admit to yourself how much you would like to talk to

those hams. Thumb through the ads in *73* and drool over some new gear. Picture your dream shack in your mind. You're sitting there working a beautiful YL (or a handsome OM, if you are a YL) in some exotic QTH halfway around the world – or maybe in the next town. "U HAVE A NICE FIST BUT PSE QRS," you copy. Don't laugh. You've got to psych yourself up a little. After all, if you don't, who will? So invent some incentives.

One ham who finally made General after a real struggle at an age when most people wouldn't have tried is fond of telling newcomers, "If you want that ticket bad enough, you'll get it!" Well put, Mac. Wanting it badly enough is indeed the secret. So want it. Want it so bad you can taste it. And keep on wanting it while you prepare to get it. Isn't that easier than a negative, half-hearted approach which may get lost in the QRM halfway through the schedule? Start saving for that low band rig. Plan the antennas you'll put up. Dream a little – or a lot – but engineer it to stimulate rather than distract from your code practice.

OK, we've gotten over the first barrier and have progressed right along. Straight text at a challenging speed has been alternated with code groups and reversed text. You can copy most of what you hear in the Novice bands, and isn't it swell that the Techs can finally get in there and increase their code speed with on-the-air practice? Or can they?

Let's be honest with ourselves now. Increasing proficiency requires challenge. Do you deliberately work someone who is too fast for you, or are you embarrassed to ask for repeats? "SORRY, BAD QRM OM, 73." And consider the format of a typical Novice QSO. Everything but the handle and address identical each time, and those are sent three times at about four words per minute. You could work stations that are comfortable for you to copy for years without increasing your speed at all. So it will take regular schedules with practice material being sent at higher speeds and regular sessions with your tapes to do the job. It's great that you enjoy CW QSOs, but use them as a reward after a solid study session instead of a delusion.

Now you're copying 10 solid, and 80% or so at 13 wpm. But in the last two weeks it doesn't seem that you've made much progress. In fact, some nights you are actually worse, and you're getting discouraged. Is it that dreaded plateau you've heard about? Don't worry. That used to happen with the old methods of studying code when it had to be relearned at each higher speed. But characters built with 13 wpm spacing circumvent this difficulty. Let's keep up the incentives while we troubleshoot the problem.

Is your practice challenging but not exhausting? Do you always follow it with some pleasant activity as a reward? It might precede your nightly QSO with John on six meters, or a TV program you are fond of watching. Or maybe it's that cold 807 and a bedtime snack that you look forward to. This kind of human engineering will help you over the rough spots. Don't force practice to the point where you build up more resistance than you can handle. Analyze the problem. You're only going to have to copy five minutes of code for the test. The length of time you can copy without strain will increase along with your proficiency. Stop and relax whenever you feel yourself tensing up. Take some deep breaths. Try to keep it pleasant.

Your progress may not be even. With most people it's not. There are some procedures you can try if it seems slow. Listen to very fast code as though it were music, code at a speed much faster than you can begin to copy. Pretty soon you will start to recognize a character here and there. Some people begin each session with a few minutes of fast code even though they can copy only 20 or 30% of it. Then when actual practice is started, it sounds very slow and leisurely by contrast.

Think code whenever you can, at least several times a day. Read license plates or street signs into code while driving to the salt mine in the morning. What would the menu sound like in code at lunch? Relate code to things you do each day so that it becomes part of your life rather than some minor extraneous activity. And visualize yourself, particularly just before you go to sleep, easily and enjoyably copying code at your desired speed. This need take only a few seconds, but it does a great job of programming Codebuster at a subconscious level.

Now we are ready to make the final push, to surmount the last barrier. To do this, we will employ fast code as a diagnostic tool. A warning here – this will cause you to memorize and render worthless as practice material whatever you use. Therefore work with only a short portion of your code group tape at 14 wpm, or better yet some other similar material. Do the best you can to copy it. Then listen to this section over again as many times as necessary to correct your errors of omission and commission, noting each one. You'll probably find, as I did, that only a few characters are giving you all the trouble. When you hit one of these and aren't certain of it, you hesitate to think about it and then skip several succeeding characters. Once these troublemakers are identified, you can work on them specifically. In a short time, you'll be copying code consistently at a much higher speed.

Each person has some individual hangups on certain characters. I had difficulty telling B from D and H from S. Many people find 7 and 8 confusing, or 2 and 3. Characters such as Z or Y are less often used in straight text, so they are practiced less. Code groups which use each character with the same frequency overcome this liability. Once you have identified your particular stumbling blocks, spend about half of your practice time working exclusively on them.

Now don't tell me you can't stand to listen to your own sending. After all, other people will have to listen to it, including the examiner. You know that speech is improved by feedback in sales training and speech therapy. The same method will improve your code sending. You will need a chance to listen carefully to these particular characters and analyze them so that you can tell them apart. The only way to do this is to break out your key and record them on tape. Begin at a speed which you can ordinarily copy. Since these characters are probably the same ones you were having trouble sending, you'll bag two birds with the same stone.

If it is H and S which you find confusing, send H H H H S S S S. Repeat each character you find difficult several times to afford ample opportunity to study it, and group confusing characters together. Copy this tape for several days, until you are thoroughly bored with it. Then mix all these characters up on a new tape at a slightly higher speed. Work on this one until you have them all down pat. Increase the speed again, adding other characters that might be similar to them. Construct code groups in which at least half of the characters consist of those still giving you trouble. You can repeat the diagnostic process to identify these as necessary.

As you send and listen to them, note the relationship between the characters in the following groups:

A R L AS AR
N D X /
S V 3 SK
A U V 4
M G Q,
T M O 8
H 4
A W P
T N D B 6 -
E I S H 5
N K Y
G Z 7,
A W J 1
P X Y Q
I U F / 2
,?
N K C.
R L U F

Using this approach, analyzing your hangups and making specific study tapes to overcome them, your improvement will be fast and continuous. If you are working with a buddy, so much the better. You can send each other this type of material.

By now you copy all characters equally well and your code speed is really up there, but the problem is consistency. You can copy half a minute or so perfectly but then something happens and you miss several words. Or you can find yourself writing *modulator* when the word being sent turns out to be *modulation*. The name of this game is anticipation, and it can be a problem indeed. The mind tries to avoid effort by guessing from the context what is coming next. When that turns out to be wrong, confusion results and characters are missed until the copy can be picked up again. Trying to correct the missed copy only makes things worse. You are reading the message instead of copying the code. Your job is to disconnect the analytical process temporarily and let your Codebuster produce copy automatically.

During World War II, Algerians were trained to copy code in English although they did not understand the language. This is the process which must occur in your mind initially. Comprehension while receiving will develop later on as the process becomes an automatic response. It is like being able to talk to someone while driving a car. At this point, comprehension is not the objective. You can always read your copy later. Since anticipation is a serious liability with straight text, work with code groups or reversed text to overcome it.

If you are able to receive W1AW, their daily code transmission can furnish you with good practice if a few lids stay off the frequency. All too occasionally they send text in which the order of the words is reversed. This is far superior to straight text for practice and easier to take than code groups. Tapes of such material can be used several times, in contrast to straight text. So if you can, get someone to send you reversed text. Make your own tapes if you have to. But stay away from copying straight text until you have whipped anticipating.

Since anticipation is a process of thought, we can devise methods to prevent it. Some people find it helpful to keep their attention focused on a blank screen in their mind. When a letter is completed, it appears there and they copy it. Or you might try to become aware of the stimulus-response process as it occurs. Instead of focusing your eyes on your copy, direct your attention internally to Codebuster wherever you feel it is located. With your eyes unfocused you can still write a straight line on the paper, but can't read it. Like the operators in Algeria, you are not concerned with its meaning at that time. You hear it and you write it.

Learn to maintain an intense state of detached curiosity about the next character you are going to hear. Be willing for it to be whatever it will be. Simply let it be written effortlessly and instantaneously as soon as it is complete. No thoughts distract your attention. If you miss a character, just let it pass and wait placidly for the next one. You are, for the moment, The Codebuster, efficiently transforming audio signals into graphic output. Once you get the hang of this, believe it or not you will actually enjoy copying code. Then as your proficiency increases and the process becomes fully automatic, you will find yourself understanding what you are receiving without anticipating it.

At this point you've almost got it made. Straight copy at 15 wpm is a breeze and you're ready for the code test. Or are you? Let's not kid ourselves at this stage of the game. In the first place, the FCC will not send you cream-puff straight text like you get from W1AW. And you won't be in your quiet familiar room. You'll be in a large, strange room listening to a tone higher or lower than you prefer from a speaker at some distance from you, probably a little nervous and surrounded by other people. Have you given yourself any practice under such conditions? Your actual code speed is not what you can copy with easy material occasionally under ideal conditions. It is what you can copy with difficult material consistently under somewhat adverse conditions. So take your recorder with you on trips and practice in a motel. Copy code at work during your lunch break. Vary the BFO note frequently. Turn on the TV or radio in the background. Check your speed when you're tired or upset, and with other people around. You will know whether you're ready or not.

Many people have fallen into the trap of having memorized their practice material. You may have recorded a large collection of tapes and used them only infrequently, but your computer never forgets. At a subconscious level you are familiar with material you have only heard once. Don't fool yourself into thinking that you are better than you are. You are just as good as you can copy new, unfamiliar material. Even reversed text becomes familiar after several hearings, so don't neglect the code groups. They are your insurance and the ultimate test of your ability.

Make sure you can copy material sent at several speeds. A number of people who could copy 15 or even 18 wpm solidly were unpleasantly surprised to find that they were very inconsistent at 13 wpm. The less challenging slower speed gave their minds time to anticipate. So while the fastest progress seems to be made practicing with material at a speed high enough to be quite challenging but not discouraging, it is a good idea to spend part of your time working at the speed at which you will be examined.

So it's back to the code groups for the last push. When you can copy that 14 wpm tape consistently under less than ideal conditions, then you are really ready, and not before. Of course, the experience of taking the code test can be valuable if your location is convenient. You're not even out $4 now if you don't make it. On the other hand, it can be discouraging to fail in public. You know your own reactions and will have to weigh the pros and cons for yourself.

Speaking of examinations, how do you feel about that? If just thinking about it makes you apprehensive, you need some practice. The next time you prepare to copy 5 minutes at 13 wpm, imagine yourself taking the FCC exam. Feel how important it is that you pass. Although you have been programming yourself to copy code in a relaxed manner, an occasional session which is deliberately mocked up in this way will prevent nervousness on the big day. Others around you will be nervous and that can be catching. So practice "taking the code test." Get someone else to time you. And when you no longer feel tense in this situation, you

will be cool, calm and collected during the real examination.

With comprehension testing for code receiving proficiency scheduled to be adopted by the FCC in 1977, your goal should be somewhat closer. Although designed to permit rapid grading of code tests by machine or template, the new examination will be easier on applicants who miss an occasional letter. No more will 65 successive error-free characters be the criterion for passing, but 16 out of 20 correct answers to TRUE/FALSE questions based upon the material sent in five minutes. Numbers, of course, will continue to be crucial.

What can you expect when you take the new code test? In the past, a disaster or accident of some type has often been the subject, liberally sprinkled with figures such as latitude and longitude, dates and times. Descriptions of equipment and distances might appear. The story may be interrupted with Q signals or an abrupt change in subject, as though a transmission were suddenly subject to QSB or QRM. You can assume that you will encounter the question mark and slant bar as well as the usual periods and commas.

You will be allowed to copy five minutes of code at the speed being tested and can then refer to your paper to answer the true or false questions which will subsequently be distributed. The usual practice of sending one minute of code for tone and volume adjustment can be used for warmup. You may be able to deduce a word even though some characters are missed, but copying numbers wrong will be more serious. Expect the questions to be paraphrased from the text. An example? Supposing you copy, "The transmitter is located 29 feet from the antenna." A question might be, "The antenna is located 28 feet from the transmitter." You would mark the answer FALSE.

Knowing what to expect will foster a calm and confident attitude conducive to good performance. But there's one last bit of programming that remains to be done. The Examiner! How do you visualize this individual? Is your mental image that of a terrible ogre, all-powerful, breathing fire while laser beams shoot from his eyes, gleefully chortling as he fails one hapless applicant after another?

Let's do something about this right now. Of course you can expect the examiner to be efficient and unbiased, but altogether human. He'll probably be courteous and hopeful that everyone is prepared to pass. Consider that he is there to help you, to make it possible for you to achieve that goal of a higher class of license. And it is your taxes that pay for it all. The image of the steely-eyed government inspector may sell Wayne's 14 wpm tape, but it won't do much for your sweaty palms. So expect to see a human being just doing his job, and that's what you will find. And when it's all over, he may even seem like a pretty nice guy. Mine was. After he said, "Congratulations, you've passed," I told him that he didn't look very steely-eyed. He smiled and said, "We're trying to change our image."

By communicating those techniques which have proven most helpful to some people, it is hoped that the path may be made a bit smoother for others. Certainly no special expertise is pretended. Each individual must find through experiment what works best for him or her in building their Codebuster.

To those fellow hams who shared, knowingly and unknowingly, their travails and triumphs, I express sincere thanks. And to those readers who are inspired to challenge the paper tiger whose name is Thirteen, good luck and Godcodespeed. See you on the low bands. ■

LETTERS

from page 61

"THANK YOU"

I have seen many letters in *73* which mentioned the number and quality of construction projects. The writers, however, fail to mention how much of the material for those projects is available from *73* advertisers. In the Holiday issue, I counted 17 suppliers of components for "home brew" projects. This does not include kits and parts of systems (Robot, Seals, Paia for instance). I believe this is more than the other 3 magazines combined (I get all 4 ham magazines, but have not counted).

Another big plus is the arrangement of the advertising. It *is* something of interest to the average reader, and so you distribute it among the articles. In turning from one article to another, it is easy to stop and see just what this ad is about. When advertisers are pushed to the back (the usual place), very few people will bother to look them up.

One policy you have which merits a big "thank you" is that of putting all of each article together. This probably helps more with construction articles than it would (for instance) with fiction, as the reader will find more need for referring to "the first paragraph" or "Fig. 1."

At times I do not agree with your editorial opinion, but at least you do express it. I doubt whether you would agree with me.

One more little thing I would like to mention. CB operators have been cussed and discussed a lot. I wonder how many hams ever stop to think — the CBers do the same thing we do. They get on the air and follow the example of others.

Thanks for letting me unburden myself.

Lester W. Ulch WB4HPB
Birmingham AL

WHAT HAPPENED?

One comment, if you please. Early in November was the ARRL Hudson Division Convention. I didn't go (I can't afford that kind of hamfest); however, I heard that it cost $4.00 to get into the flea market! The buyers paid the $4.00 (I have no idea what the sellers paid; I hate to think of it). Personally, I don't think *any* hamfest is worth paying $4.00 to get into. Maybe that's one reason so many people are going CB instead of ham. Who wants to pay that much for a get-together when they get into CB fests free? (I understand hamfests used to be that way — what happened?)

Bob Billson WA2TXY
Westfield NJ

P.S. I sent a similar letter to *QST*. I'm curious to see if they'll print it — hi!

Hey, Bob, it's a nonprofit organization, right? — Ed.

MILWAUKEE WINTER

In your Holiday, 1976 issue is an article by Scott Smith, entitled, "S22 for a Regulator? Never." Probably by now his car has failed to start in the Milwaukee winter.

First, he mentions that the alternator should put out 13.6 to 13.8 volts. This would hardly allow enough charge for summer, let alone winter. Typical voltages, these for a 240Z, range from 14.25 at 104 degrees to 15.00 at 14 degrees Fahrenheit. This brings up a second consideration — temperature corrections. As zeners have positive temperature coefficients, Scott's regulator will reduce voltage with lowering temperatures.

So far as the circuit goes, *neither* transistor is operating as a switch as the author says (*try* that with an emitter follower sometime). Also, the field can never get full voltage as needed for low speed charging. An average field is about 4 Ohms, an average 2N3055 has a gain of about 40, yielding a field voltage of about 8 volts *maximum*! Commercial solid state regulators use PNP pass transistors, which can be put into a saturating configuration.

David S. Powell WA4BRI
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MA BELL — AGAIN

I had one heck of a noise burst forth on the low end of 160. It sounded like LORAN, but didn't synchronize with any of the local LORAN transmitters on either 2 MHz or 100 kHz. It was a 60 cycle buzz, changing now and then to 120 cycles.

I tried to find it, without success, on the power lines; finally had it reappear when I approached the telephone lines. Using a hand-held broadcast radio, it showed a fairly large standing wave on the phone lines. Investigation with a wideband receiver showed its fundamental frequency to be about 900 kHz. No trace on 450 kHz.

I went to the nearest telephone

Continued on page 111

How Counter ICs Work

-- the next step is a micro

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In the past 2 to 3 years, projects that have been coming out of ham shacks across the nation have undergone some dramatic changes.

One of the reasons for this is that integrated circuits of increasing complexity have become available at a price that makes it practical for more and more amateurs and experimenters to build with them. And when amateurs start to build, fascinating things can happen: digital clocks, frequency counters, frequency synthesizers, microcomputers and much, much more.

One of the ICs that is used in many of these projects is the counter chip. It is the counter chip that I am going to be looking at in this article and you will see that it can do more than just count.

Let's start by going into one of the more popular counters, the 7490. This IC is made up of four flip-flops which are internally connected in such a way that the IC can divide by 2 or divide by 5 and, by making an external connection, can divide by 10, or count pulse inputs and give a BCD coded output.

The flip-flops also have a clear and preset which are connected through 2 input NAND gates. The clear and preset are called Reset "0" and Reset "9", as they put the counter in the BCD output condition of "count 0" or "count 9" respectively.

A diagram and pinout of the 7490 are shown in Fig. 1.

To use the 7490 in divide-by-two operation, put the input on the "A" input (pin 14) and take the divided output off the "A" output (pin 12).

To use the IC in divide-by-five operation, put the input on the "BD" input (pin 1) and take the divided output off the "D" output (pin 11).

Notice that the two divide operations are separate inside the IC, so the 7490 can be used as a divide-by-two and as a divide-by-five section at the same time, using a common clear and preset.

For the divide-by-ten operation, both of the divide sections are used. First the signal is divided by five, then fed into the divide-by-two section. To connect the IC for this, connect the "D" output to the "A" input. Input pulses applied to the "BD" input (pin 1) will appear divided by ten at the "A" output (pin 12).

Count	Output D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Fig. 2. BCD output count sequence.

To use the 7490 in its normal mode of operation as a decade counter with BCD output, the "A" output (pin 12) is connected to the "BD" input (pin 1). The pulses to be counted are applied to the "A" input (pin 14) and the output count will appear as BCD code on the "A", "B", "C", and "D" outputs (pins 12, 9, 8, and 11).

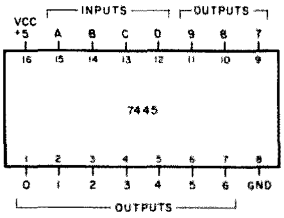

Fig. 3. Pinout of 7445.

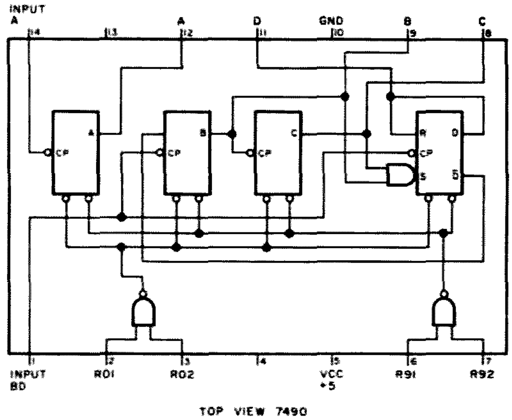

Fig. 1. Diagram and pinout of 7490.

Inputs D	C	B	A	Outputs 0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	1	1	1	1	1	1	1	1	1
0	0	0	1	1	0	1	1	1	1	1	1	1	1
0	0	1	0	1	1	0	1	1	1	1	1	1	1
0	0	1	1	1	1	1	0	1	1	1	1	1	1
0	1	0	0	1	1	1	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1	0	1	1	1	1
0	1	1	0	1	1	1	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1	1	1	1	0	1	1
1	0	0	0	1	1	1	1	1	1	1	1	0	1
1	0	0	1	1	1	1	1	1	1	1	1	1	0
1	0	1	0	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1	1	1	1	1	1
1	1	0	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1

Fig. 4. 7445 truth table.

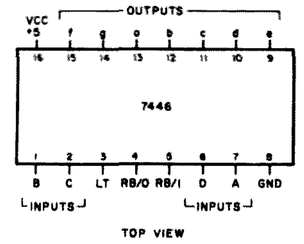

Fig. 5. Pinout of 7446.

Inputs						Outputs								
LT	**RBI**	**D**	**C**	**B**	**A**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**RBO**	**Function**
0	X	X	X	X	X	0	0	0	0	0	0	0	1	Test
1	0	0	0	0	0	1	1	1	1	1	1	1	0	Blank
1	1	0	0	0	0	0	0	0	0	0	0	1	1	0
1	X	0	0	0	1	1	0	0	1	1	1	1	1	1
1	X	0	0	1	0	0	0	1	0	0	1	0	1	2
1	X	0	0	1	1	0	0	0	0	1	1	0	1	3
1	X	0	1	0	0	1	0	0	1	1	0	0	1	4
1	X	0	1	0	1	0	1	0	0	1	0	0	1	5
1	X	0	1	1	0	1	1	0	0	0	0	0	1	6
1	X	0	1	1	1	0	0	0	1	1	1	1	1	7
1	X	1	0	0	0	0	0	0	0	0	0	0	1	8
1	X	1	0	0	1	0	0	0	1	1	0	0	1	9
1	X	1	0	1	0	1	1	1	0	0	1	0	1	10
1	X	1	0	1	1	1	1	0	0	1	1	0	1	11
1	X	1	1	0	0	1	0	1	1	1	0	0	1	12
1	X	1	1	0	1	0	1	1	0	1	0	0	1	13
1	X	1	1	1	0	1	1	1	0	0	0	0	1	14
1	X	1	1	1	1	1	1	1	1	1	1	1	1	15

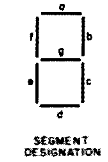

Fig. 6. 7446 truth table.

The BCD output count sequence is shown in Fig. 2.

In some circuits we may be able to use the output as is. That is, in the BCD format. In other circuits, we may need to decode the BCD to decimal form. This may be done with a decoder such as the 7445 decoder/driver which will take the BCD code as it is input and give an output in a decimal form.

A pinout of the 7445 and its truth table are shown in Figs. 3 and 4.

In other circuits, a seven-segment code may be needed to operate one of the seven-segment displays. A decoder such as the 7446 or 7447 BCD to seven-segment decoder/driver may be used.

A pinout of the 7446 and its truth table are shown in Figs. 5 and 6.

In most circuits using the 7490, it will be necessary to reset the counter to either "9" or "0" at certain times. To reset to the BCD count of zero, both reset "0" inputs must be at logic "1", while at least one of the reset "9" inputs is at logic "0". To reset to the BCD count of nine, both of the reset "9" inputs must be at logic "1", while at least one of the reset "0" inputs is at logic "0".

For proper counting, at least one of the reset "0" inputs and at least one of the reset "9" inputs must be at logic "0". Counting of the 7490 will occur on the negative-going edge of the input pulse. That is when the pulse goes from high to low. See Fig. 7.

Fig. 7.

A second counter IC is the 7492 divide-by-12 counter. It is similar to the 7490, but the second section is connected internally to divide by six and there is no reset to "9", only a reset to "0".

A diagram and pinout of the 7492 are shown in Fig. 8.

With no external connections, an input at "A" (pin 14) will give an output divided by two at the "A" output (pin 12). An input at the BC input (pin 1) will give an output divided by six at the "D" output (pin 8) or divided by three at the "C" output (pin 9).

For the divide-by-twelve operation, output "A" is connected to the "BC" input – an input at the "A" input will then give you a division by twelve at the "D" output.

To reset the 7492 to BCD count of zero, both reset "0" inputs must be at logic 1. At least one of the resets must be at logic 0 for proper counting. Like the 7490, the 7492 counting occurs on the negative-going edge of the input pulse.

Another counter which is similar to the 7490 is the 7493 4-bit binary counter, which can count to 16 or divide by 2, by 4, by 8, and by 16.

The diagram and pinout of the 7493 are shown in Fig. 9.

With no external connection, an input at "A" (pin 14) will give an output divided by 2 at the "A" output (pin 12). An input on the "B" input (pin 1) will give an output divided by 2 at output "B" (pin 9), divided by 4 at output "C" (pin 8), and divided by 8 at output "D" (pin 11).

For the divide-by-16 operation, output "A" is connected to the "B" input. An input at the "A" input will then give you a division by 16 at the "D" output.

To reset the 7493 to count zero, both reset "0" inputs must be at logic 1. At least one of the resets must be at logic "0" for proper counting. Counting will occur on the negative-going edge of the input pulse.

The 74176 is a divide-by-2, divide-by-5 or divide-by-10 counter with an added feature over the other counters we have looked at. It has the ability of strobed parallel entry. This lets the counter be "programmed," and also lets it be used as a 4-bit latch.

The 74176's diagram and pinout are shown in Fig. 10.

To use this IC as divide-by-2 or divide-by-5, no external interconnections are required. The strobe (pin 1) and the reset (pin 13) are held at logic 1. An input signal at input Cp1 (pin 8) will give an output divided by 2 at output Qc (pin 2). An input at Cp2 (pin 6) will give an output divided by 5 at output Qd (pin 12).

For use as divide-by-10, connect the D input (pin 11) to the Cp1 input (pin 8). A clock input signal at Cp2 (pin 6) will give an output divided by 10 at the Qa output (pin 5). As in the divide-by-2 and 5 operation, when used as divide-by-10, the strobe and the reset are held high.

To use the 74176 as a

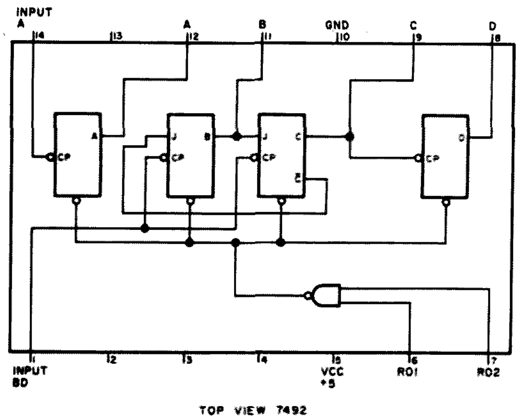

Fig. 8. Diagram and pinout of 7492.

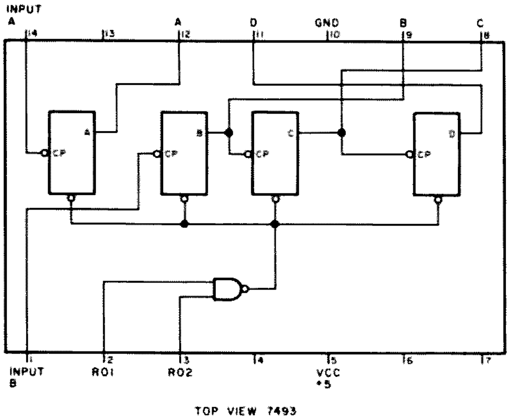

Fig. 9. Diagram and pinout of 7493.

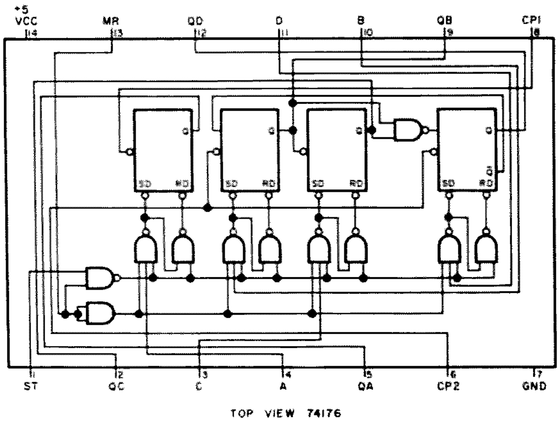

Fig. 10. Diagram and pinout of 74176.

counter, the Qa output (pin 5) is connected to the Cp2 input (pin 6). The input is applied to the Cp1 input (pin 8) and the count is obtained at outputs Qa, Qb, Qc, and Qd (pins 5, 9, 2 and 12). The reset (pin 13) is used to reset the counter to BCD count "0". Put high for counting and low to reset.

The strobe input is used for the parallel entry feature of the 74176. When the strobe (pin 1) is high, inputs A, B, C, and D (pins 4, 10, 3 and 11) have no effect on the outputs. When the strobe is put low, the outputs will change to agree with the data inputs independent of the state of the clock inputs. This feature will allow the IC to be "programmed" or preset to any count, not just "0".

The parallel entry will also allow use of the 74176 as a 4-bit latch. The data outputs Qa, Qb, Qc, and Qd will directly follow the inputs A, B, C, and D while the strobe is low, but will remain unchanged when the strobe is high and the clock inputs are inactive.

The counters that have been discussed here are only a small sample of the ones that are available. With counter ICs, as with simple gates, the best way to find out just how they work is to use them. All ICs listed in this article are available for under one dollar from advertisers in *73 Magazine*, so pick out one or two and start experimenting and then start building. ■

References

The TTL Data Book for Design Engineers, Texas Instruments Incorporated, 1973.
Digital Integrated Circuits, National Semiconductor Corporation, 1974.
The TTL Applications Handbook, Fairchild Semiconductor, 1973.

Inexpensive Variable DC Supply

-- easy and quick

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It is extremely handy to have a source of variable dc energy in the ham shack. The usefulness of this device encompasses many areas. For instance, many of today's projects are built around semiconductors which require various dc voltages. Much of the military surplus available requires either 12 V dc or 24 V dc sources. You may not want your final conversion to operate on this source, but it can be very helpful to see if the equipment will function on its original source voltage before converting it. Those people active as mobilers certainly could use a husky supply to test that new mobile rig. Obviously, anything that is battery operated could be run, tested, or repaired with the help of this electronic wonder. It might even help you start your car some cold winter morning.

As you can see from the schematic, it is simply a variable autotransformer feeding a husky 30 V transformer into a bridge rectifier. The filter is a large capacitor. It would be nice to have a 30 A choke, but the filter shown has been satisfactory for all of the uses previously discussed.

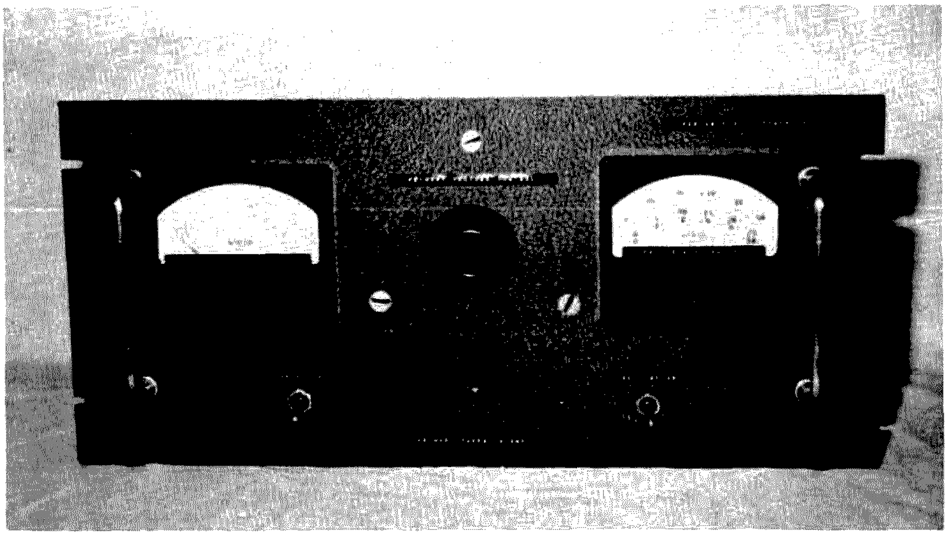
Well, now that I have established two major facts, its simplicity and its usefulness, let's build it.

You may skip this part of the article if you have a transformer or are going to purchase one. The transformer for this unit was a modified TV transformer. I located the heaviest one in the junk box. By the way, this was my first attempt at rewinding a transformer, and if I can do it, you probably can also.

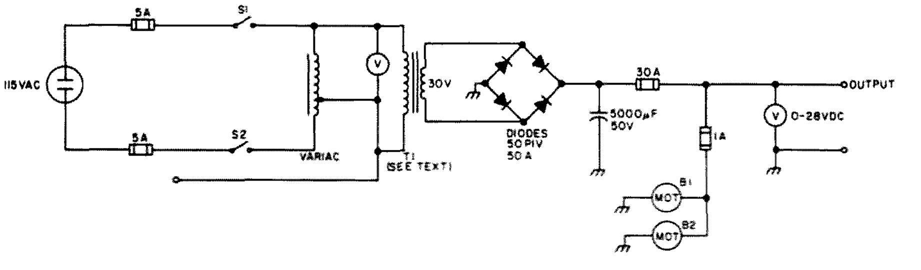
First remove the outer shell and the laminations. It may be necessary to use a little force to accomplish this. Never hit the laminations directly with a hammer; use a mallet or a block of wood with your hammer. Take care to preserve the leads from the windings.

Next, remove the secondary windings. Generally they are the outer windings. When you remove the 6.3 V filament winding, count the number of turns. It probably will consist of approximately twelve turns. Usually this type of transformer has a two turns per volt ratio. Retain this information for rewinding the secondary.

Finally, rewind the secondary; I used number 12 copper wire with a thick thermoplastic insulation. I used this wire because I had it

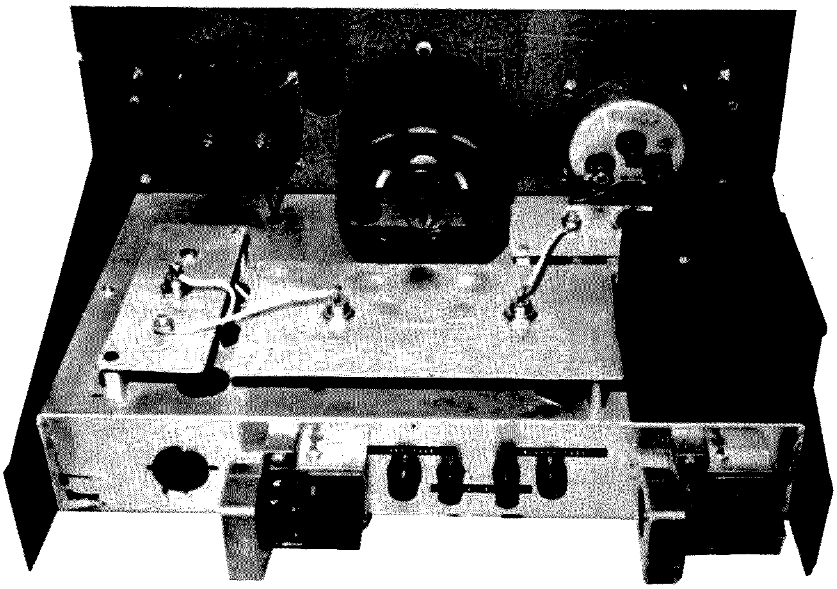


Front view showing layout of voltmeters, variac, control, S1, S2, and fuses. The handles are very functional because of the weight of the unit.



left over from wiring my wife's dryer. Obviously, an enamel or formvar insulated wire is suitable. As you are winding the secondary, check to be sure that the laminations will fit. I was able to get about sixty turns on the secondary – hence thirty volts. Using wire with thinner insulation, you can probably get several more turns.

The diodes were surplus units which were mounted on homemade heat sinks. The heat sinks were made from 1/8" thick aluminum scrap. I used about 12 square inches for each diode. The heat sinks were mounted on one inch ceramic pillars above the chassis to promote convection. Several holes were drilled in the chassis below the heat sinks; there was a bottom plate attached and two small 24 V dc surplus blowers were mounted on the back of the chassis. The output of the power supply was used to power the blowers. Even at five volts input, the blowers would move some air. The blowers really aren't necessary until the supply is run at high current output over a five to ten minute period of time.



Rear view showing general layout of diodes and heat sinks, output and blower fusing, blowers, and line input.

The toggle switch, S2, which removes the variac from the transformer and places the line voltage there instead, is used when there is a load which will greatly surpass the rating of the variac.

This unit has been used for everything from repairing transistor radios to operating dynamotor powered mobile equipment of the 12 V, 30 A variety. ■

LETTERS

from page 104

exchange, about 7 miles away at Belfair, Wa., and circled the building with a $4 BC receiver. It was easy to find the spots on the walls where the noise peaked. Local phone company employees blamed the trouble on the power people, refusing to believe that any phone equipment could cause radio interference. They were so insistent in their belief that they didn't report interference to local headquarters in Seattle. They finally told me to tell it to FCC.

FCC contacted Seattle engineering. After some days I called engineering, and they said they would do something about it. It has been 5 weeks of passing the buck, and until intervention by FCC, there was no action at all. They will tell you anything, but do nothing.

The trouble finally turned out to be the battery charger at the exchange office. They haven't fixed it yet, and I have notified them that my hobby involves circulation of audio currents through widely separated grounds.

So, in the case of a pulse type noise, or a sharp rattling noise, particularly on 160 meters, check your phone line for the source. It is to be hoped that the management of your telephone exchange will be more cooperative than the locals. I don't know if the chargers used by General Telephone subsidiaries cause the same type of interference.

Keith Olson W7FS
Belfair WA

SPLENDID SERVICE

About 4 months ago I wrote you and complained about the very bad postal service and very late delivery of the *73 Magazine*.

I don't know how you are doing it or what you have done, but I now receive your excellent magazine for 3 months in succession the first week of the current month the magazine comes out. To beat everything, I received the December issue at the end of November. Needless to say, I want to thank you and your staff very much for this splendid service.

I received this subscription to your magazine from my good friend Ed Dombert W2PCP, and this is a very valued present. Living on this island "down south of you," it is annoying how long it sometimes takes to receive the mail from up north. Here again, you beat the others, and once again, thank you and well done.

William Vander Greft PJ2WI
Curacao, Neth. Antilles

SANDY CLAWS

I received the sample copy of *73* today which I had requested some time ago when your subscription offer came.

Looks like you do have a pretty good magazine. However, it sure let me down the very first thing. You see, I have been taking another magazine for several months just to get the ad section, because I want a good used SSB/CW rig. So, right off the bat, I went to the back of *73* and searched all the way to the front. Then from the front all the way to the back. Plenty of good-looking new stuff. But if I give around $700 for something to play with, I think it should also cook my breakfast! So the answer is a good $400 used outfit.

I certainly appreciate this opportunity to see what *73* is like and after my other subscription expires and I get a new rig, perhaps I'll try it. With tax time here and the usual rough time with Santa Claus just over, things are pretty rugged, even in Dixie. (If inflation gets much worse, Sandy Claws may find himself going down the drain instead of the chimney.)

Jim Miller
Waterloo SC

THE BROAD SPECTRUM

This note is to inform you that I have been very pleased by the excellent service and response of your advertisers, namely Ramsey Electronics, James Electronics, and many others.

I might also add that your many construction articles are very FB and your publication covers the broad spectrum of amateur radio very well.

Alex Hellman W2OEQ
Woodhaven NY

29.6

I read Martin Greenbaum's article "Ten Meters: Dead or Alive?" with great interest. However, there was a gross oversight in his article, especially with the great interest there is today in FM. 29.6 MHz has for years been the FM channel on ten meters, and you haven't worked DX until you've worked someone full-quieting 3000 miles away, or worked your next-door neighbor through a repeater 3000 miles away. With the low cost avail-

Continued on page 172

Eric G. Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

Form 700 Provisional. *Number* 14120

LICENSE FOR GENERAL AMATEUR RADIO STATION

(General or restricted)

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
RADIO SERVICE

Pursuant to the act to regulate radio communication, approved August 13, 1912, E. G. Schalkhausser *, a citizen of the State of* [illegible] *, having applied therefor, is hereby granted by the Secretary of Commerce, for a period of* one *year , on and subject to the restrictions and conditions hereinafter stated and revocable for cause by him, this License to use or operate the apparatus for radio communication (identified in the Schedule hereinafter) for the purpose of transmitting private radiograms or signals, notwithstanding the effect thereof extends beyond the jurisdiction of the State or Territory in which the said station is located: Provided, That no interference other than may result under the restrictions contained in this License shall be caused with the radio communication of stations of the Government of the United States or licensed stations.*

2. The use or operation of apparatus for radio communication pursuant to this License shall be subject also to the articles and regulations established by the International Radiotelegraphic Convention, ratified by the Senate of the United States and caused to be made public by the President, and shall be subject also to such regulations as may be established from time to time by authority of subsequent acts and treaties of the United States.

3. The apparatus shall at all times while in use and operation be in charge of a person or persons licensed for that purpose by the Secretary of Commerce, and the operator of the apparatus shall not wilfully or maliciously interfere with any other radio communication.

4. The station shall give absolute priority to signals or radiograms relating to ships in distress; shall cease all sending on hearing a distress signal; and shall refrain from sending until all the signals and radiograms relating thereto are completed.

5. The station shall use the minimum amount of energy necessary to carry out any communication desired, and the transformer input shall not exceed one ~~one-half~~ *kilowatt* *

6. The station shall not use a transmitting wave length exceeding 200 meters.

7. The station shall not use a transmitter during the first 15 minutes of each hour, local standard time, whenever the Secretary of Commerce by notice in writing shall require it to observe a division of the time, pursuant to the Twelfth Regulation of the act of August 13, 1912.

8. The President of the United States in time of war or public peril or disaster is authorized by law to close the station and cause the removal therefrom of all radio apparatus, or may authorize the use or control of the station or apparatus by any department of the Government upon just compensation to the owners.

9. The Secretary of Commerce and Collectors of Customs or other officers of the Government authorized by him may at all reasonable times enter upon the station for the purpose of inspecting and may inspect any apparatus for radio communication of such station and the operation and operators of such apparatus.

10. The apparatus shall not be altered or modified in respect of any of the particulars mentioned in the following Schedule except with the approval of a radio inspector, or other duly authorized officer of the Government. 11—300

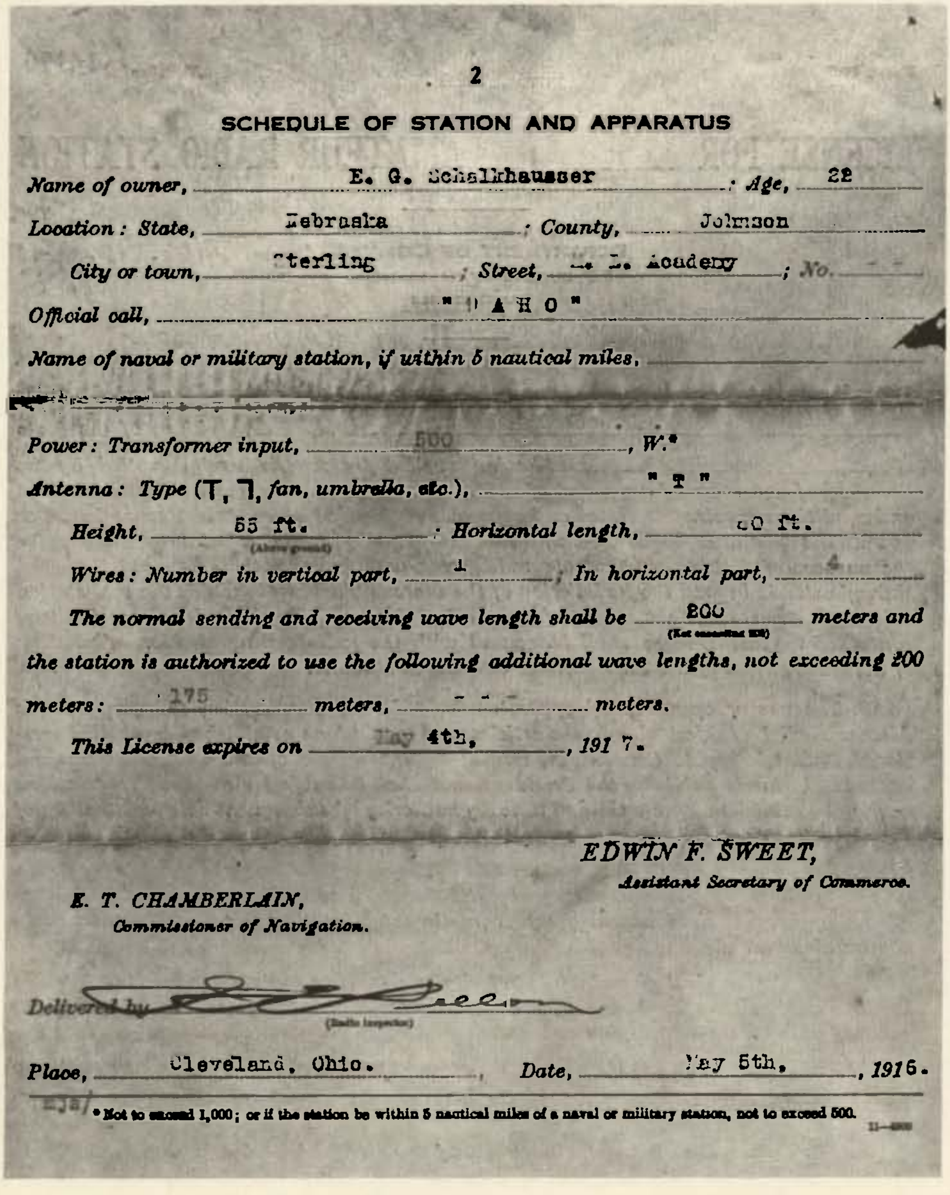
* Strike out "one" if the station be within 5 nautical miles of a naval or military station; otherwise strike out "one-half."

One of the first amateur licenses issued shortly after they were required.

The History of Ham Radio

- - part I

When trying to get just a glimpse of wireless history in a nutshell, it is traditional to lay most emphasis on the years from 1910 and on. This period coincided with radio rules and regulations, the three Rs, being formulated by the United States government. We then project the general accumulation as far as 1927-1928, after which time some degree of order was again established in the radio industry, overall.



2

SCHEDULE OF STATION AND APPARATUS

Name of owner, E. G. Schalkhausser; *Age,* 22

Location: State, Nebraska; *County,* Johnson

City or town, Sterling; *Street,* .. L. Academy; *No.* - -

Official call, " 9 A H O "

Name of naval or military station, if within 5 nautical miles,

Power: Transformer input, 500, *W.**

Antenna: Type (T, ˥, fan, umbrella, etc.), " T "

Height, 55 ft. (Above ground); *Horizontal length,* 60 ft.

Wires: Number in vertical part, 1; *In horizontal part,* 4

The normal sending and receiving wave length shall be 200 (Not exceeding 200) *meters and the station is authorized to use the following additional wave lengths, not exceeding 200 meters:* 175 *meters,* - - - *meters.*

This License expires on May 4th, *191* 7.

EDWIN F. SWEET,
Assistant Secretary of Commerce.

E. T. CHAMBERLAIN,
Commissioner of Navigation.

Delivered by (Radio Inspector)

Place, Cleveland, Ohio. *Date,* May 5th, *191*6.

* Not to exceed 1,000; or if the station be within 5 nautical miles of a naval or military station, not to exceed 500.

In telling our story, it is impossible to refrain making pertinent insertions of interest. There were many occurrences during those early years that stand out vividly in memory and need telling. Those beginning years were mostly of pioneering and exploring, bringing forth many discoveries and inventions in rapid order, in very short periods of time.

1909

To begin with, let me set the year 1909 as a reference. Why 1909? We will become aware of the reason as we review the history in relating the *magic that is wireless*.

And it sure was magic to everyone in those days, believe me! Let me take a short glimpse into the past history of wireless. There were no laws on the books. There were no rules or regulations pertaining to wireless. The general public was not even aware that radio waves existed. They had no inkling of what was meant by communicating without wires. Practically nothing was known about electricity. All this was a mystery.

1888

In 1888, just 89 years ago, a German Scientist made a discovery when he sensed

that there was something present in the vicinity of an electrical spark in a Lyden jar discharge. This elementary discovery made by Heinrich Hertz set the stage for many scientific investigations. They were carried on in university laboratories, stimulating research in the field of electromagnetic waves.

1892

About this time, along came Marconi from Italy. He was born in the year 1874. At the age of 18, while a freshman at the University of Bologna, Marconi discovered that an electric discharge from a condenser could be detected. This made possible the transmission and reception of signals over some distance. Playing around and experimenting for four years, he finally went to England, where he demonstrated his findings and equipment.

1896

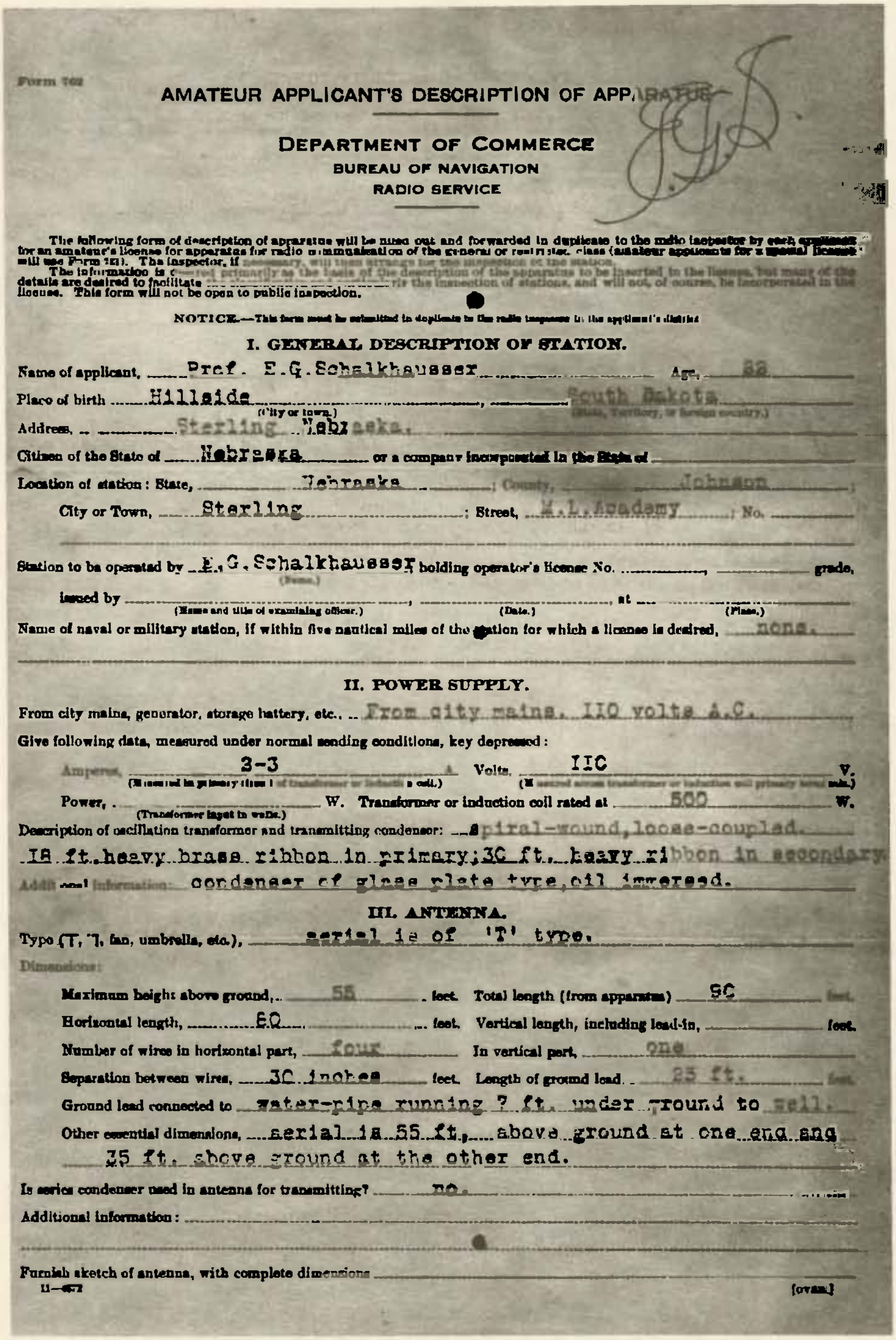
In 1896, Marconi obtained a British patent for *wireless telegraph apparatus using electricity*. How utterly novel and primitive that description sounds today. And that was only eighty-one years ago! (At that time I was 3 years old, but do not recall the incident!)

1897

Within a year, commercial interests became aware of the possibilities in the application and use of Marconi's invention and organized the Wireless Telegraph and Signal Company, Ltd., in England.

1899

In 1899, Marconi and his assistants succeeded in sending signals across the English channel with their crude equipment. The main bottleneck was their iron filing coherer for detection of signals. The use of galena, silicon, or carborundum was not yet known for detecting wireless signals. In this same year, the Marconi Wireless Company of America was established.


Form 702

AMATEUR APPLICANT'S DESCRIPTION OF APPARATUS

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
RADIO SERVICE

The following form of description of apparatus will be filled out and forwarded in duplicate to the radio inspector by each applicant for an amateur's license for apparatus for radio communication of the general or restricted class (amateur applicants for a special license will use Form 761). The inspector, if necessary, will then arrange for the inspection of the station.
The information is desired primarily as the basis of the description of the apparatus to be inserted in the license, but many of the details are desired to facilitate the inspection of stations, and will not, of course, be incorporated in the license. This form will not be open to public inspection.

NOTICE.—This form must be submitted in duplicate to the radio inspector in the applicant's district.

I. GENERAL DESCRIPTION OF STATION.

Name of applicant, Prof. E.G. Schalkhausser Age, 22
Place of birth Hillside (City or town.), South Dakota (State, Territory, or foreign country.)
Address, Sterling Nebraska.
Citizen of the State of Nebraska or a company incorporated in the State of
Location of station: State, Nebraska; County, Johnson
City or Town, Sterling; Street, M.L.Academy; No.
Station to be operated by E.G. Schalkhausser (Name.) holding operator's license No. , grade,
issued by (Name and title of examining officer.), (Date.) at (Place.)
Name of naval or military station, if within five nautical miles of the station for which a license is desired, none.

II. POWER SUPPLY.

From city mains, generator, storage battery, etc., From city mains, 110 volts A.C.
Give following data, measured under normal sending conditions, key depressed:
Amperes, 3-3 A. Volts, 110 V.
Power, W. (Transformer input in watts.) Transformer or induction coil rated at 500 W.
Description of oscillation transformer and transmitting condenser: Spiral-wound, loose-coupled.
18 ft. heavy brass ribbon in primary; 30 ft. heavy ribbon in secondary.
Additional information: condenser of glass plate type, oil immersed.

III. ANTENNA.

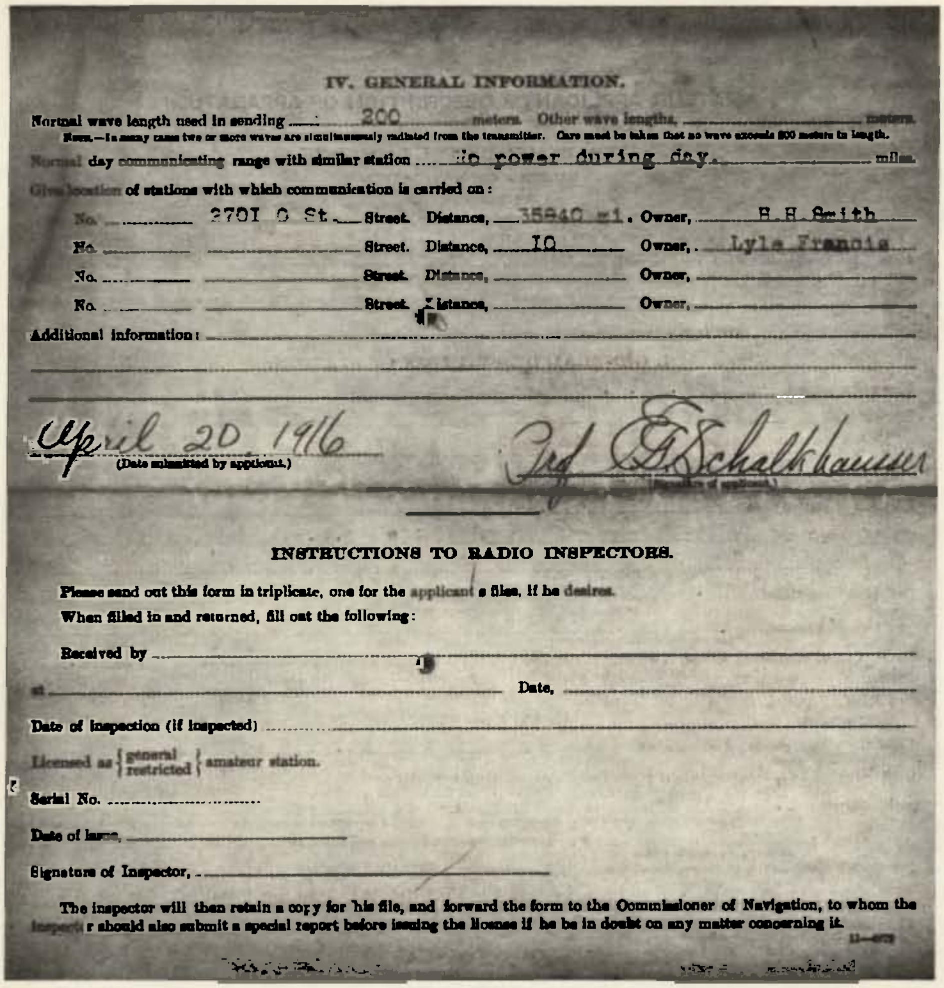
Type (T, ⅂, fan, umbrella, etc.), aerial is of 'T' type.
Dimensions:
Maximum height above ground, 55 feet. Total length (from apparatus) 90 feet.
Horizontal length, 60 feet. Vertical length, including lead-in, feet.
Number of wires in horizontal part, four In vertical part, one
Separation between wires, 30 inches feet. Length of ground lead, 25 ft. feet.
Ground lead connected to water-pipe running 7 ft. under ground to well.
Other essential dimensions, aerial is 55 ft. above ground at one end and 35 ft. above ground at the other end.
Is series condenser used in antenna for transmitting? no.
Additional information:
Furnish sketch of antenna, with complete dimensions
(over.)

1900

At the turn of the century, the English company changed its name to Marconi Wireless Telegraph Company, Ltd., to be more in keeping with current developments.

1901

In 1901, Marconi and two of his engineers came across the Atlantic to set up their wireless equipment in Halifax, Newfoundland. They succeeded in receiving messages across the waters from a station transmitting out of Polduh, England. All this on very long wavelengths, since the shorter ones were still undiscovered. By this time, many ships at sea were installing transmitting and receiving equipment and many shore and inland locations established communication centers.



IV. GENERAL INFORMATION.

Normal wave length used in sending .... 200 .... meters. Other wave lengths, ... meters.

Note.—In many cases two or more waves are simultaneously radiated from the transmitter. Care must be taken that no wave exceeds 200 meters in length.

Normal day communicating range with similar station .... No power during day. .... miles.

Give location of stations with which communication is carried on:

No. .... 2701 O St. .... Street. Distance, 35840 mi. Owner, B. H. Smith

No. .... Street. Distance, 10 .... Owner, Lyle Francis

No. .... Street. Distance, ... Owner, ...

No. .... Street. Distance, ... Owner, ...

Additional information: ....

April 20 1916 (Date submitted by applicant.)

Fred G. Schalkhauser (Signature of applicant.)

INSTRUCTIONS TO RADIO INSPECTORS.

Please send out this form in triplicate, one for the applicant's files, if he desires.

When filled in and returned, fill out the following:

Received by ....

at .... Date, ...

Date of inspection (if inspected) ....

Licensed as {general / restricted} amateur station.

Serial No. ....

Date of issue, ...

Signature of Inspector, ...

The inspector will then retain a copy for his file, and forward the form to the Commissioner of Navigation, to whom the inspector should also submit a special report before issuing the license if he be in doubt on any matter concerning it.

An apparatus description, one of the required parts of getting an early ham ticket.

1902

By 1902, a great deal of interest was shown in the application of this relatively new phenomenon. Gradually, better detecting devices were invented and larger stations were erected, in Europe, America, and other countries.

The station of 9AHO.

One should call attention to the contributions made at this time by Sir J. J. Thompson, a British scientist, who had discovered the electron, enclosed in a vacuum tube. It was a sequel to Edison's invention of the light bulb.

1904 and 1906

This led to the development of the use of vacuum tubes in detecting wireless signals, where J. A. Fleming in 1904 and Lee DeForest in 1906 made their contributions. While the sagas of the sea kept the newspapers busy and the public talking of the great wonders of wireless and its possibilities, what do you suppose was going on among the younger scientists across the country, especially in the eastern part of our United States? All of these intriguing possibilities of radio did not just belong to commercial companies – *by no means!*

Here we digress a bit and look into the back rooms and woodsheds around the country, taking note of the enthusiasm and the influence that wireless had produced among the young. We need to find out what was going on in these areas, since this part of early wireless history is vital in following the progress of the new discovery.

1909

This brings me to the year 1909, previously referred to. While the commercial interests considered wireless in terms of their restricted domain, we find a group of "wireless kids" in New York, no more than ten in number, all in their teens, getting together and forming a Junior Wireless Club on January 2, 1909. They were putting together metal plates, wires, and iron filings, making their own coherers, winding coils and other paraphernalia, and succeeding in sending dots and dashes according to the Morse code, between their homes, from block to block, and even across miles. They were listening in to what was going on, hearing the mes-

JUNIOR WIRELESS CLUB, LTD.

EACH MEMBER MUST HAVE MADE HIS OWN STATION.

W. E. D. Stokes, Jr., Its President—Headquarters at the Ansonia Contains Much Apparatus—Club to Go to Washington to Oppose Pending Bill.

It is somewhat dangerous to attempt to enter the clubroom and experimental station of the Junior Wireless Club, Ltd., without a guide, for the officer in charge dispenses with the necessity of lock and key by having the knob charged with electricity to give the unexpected and unexpecting visitor what he terms a "nice little shock."

But when proper guidance is secured from the club's young president, who maintains headquarters at his home, the Ansonia, many marvels and [illegible] may be observed with some degree of security. W. E. D. Stokes, Jr., president, aged 11 years, points out the pitfalls.

"Look out. Don't step on that zinc plate!" says he. "It's charged!" And you look out and don't step.

The clubroom and receiving station is imposing, almost formidable despite its somewhat small extent. In addition to the wireless telephone instruments at one side of the window, the sending station across the way and the aerials connecting with three conduits above, many other things more or less electric add to the effect. A big electric turning lathe occupies one side of the room; numerous vari-colored models of aeroplanes—which the manufacturer asserts really go when wound up—hang from wire complexities overhead; zinc plates, worse than they look, are not to be ignored.

In fact it is not safe to put a hand on the most innocent looking object on first reconnoitre. A big box beneath the battery and motor table filled with perfectly staid appearing earth and plants which thrive on the rays of a makeshift sun specially arranged out of a [illegible] candle power electric bulb is not what it would seem. Those plants—roots, branch, leaf or blossom—are electrified and emit sparks when invited. On the side walls high and low, on the ceiling and suspended therefrom, bulbs of every conceivable variety, shape and power transform the little room into an Aladdin cave of brilliancy.

"I'm always looking around at bulbs," says the president, "and when I see a new kind I try it."

So there they are, long and slim, short, fat and round, but all shining and beaming out dazzlingly. The blueprints of scientific aspect which adorn one side of the wall, posters of the Postal Telegraph and Cable Company variety, illuminated letter placards bearing such legends as "No Smoking," "S. W. Co." Stokes Wireless Company and last but not least printed lists of wireless signal stations and steamers with wireless equipment.

[illegible]

W. E. D. STOKES, JR., AND HIS WIRELESS TELEGRAPH

This article appeared in a New York City newspaper early in 1910. The boy in the picture is the first president of the Junior Wireless Club, later renamed the Radio Club of America.

sages floating around between ships and shore stations. This was real fascination!

1910

Naturally there were bound to be conflicts developing, especially between the commercial companies and the "interlopers." Interference occurred and became objectionable for "the big boys." So in the following year, 1910, the existing problems were brought to the halls of Congress, to find ways and means to regulate wireless communication and define domains. True, the ether was free space and belonged to everybody, but the commercials and their interests sought to have vested right in their use of this "free" space. Thus, the conflict . . .

The conflict was brought to a head in the introduction of two bills, one in the House and one in the Senate. House bill #23495 and Senate bill #7243 were introduced. The senator strongly in favor of these bills was none other than Chancy Depew of New York, which was the bailiwick where the interlopers were operating. The contents of the bills were strongly against any use of the airways by anyone except the commercials. The teenagers with their homemade equipment and their determination, organization, and above all, their spirit, had other ideas. They wrote a letter to Chancy and told him so. Here we note something which will be of interest to all of you. The boys of the Junior Wireless Club had a meeting, selected their representatives, and asked to have a hearing in Washington. They composed another letter to Chancy Depew, were granted a hearing, and on April 28, 1910, were given the privilege of presenting their case. Believe it or not, these boys won their right to go on experimenting as they had done before. This Junior Wireless Club had performed like veterans in the halls of Congress, and to them and many others went the freedom of the ether for many years to come.

1911

So in 1911, the enthusiasm on the part of radio amateurs grew tremendously. In the same year, the Junior

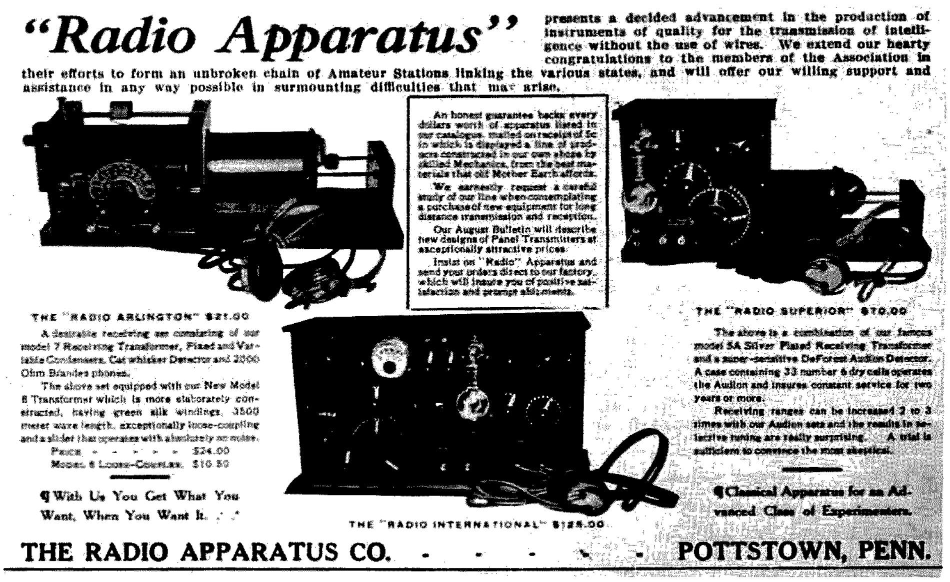
Wireless Club changed its name to The Radio Club of America, and remains so to this day. The members became notables in wireless. The club was held in very high esteem, especially after their confrontation with Congress and their display of courage and dedication for a cause dear to their hearts and right in principle.

By 1911, every wireless company and operator on ship and shore knew that regulations were a necessity to hold down interference in radio communication. An Act, dated June 24, 1910, authorized by our Department of Commerce, Bureau of Navigation, became what at that time was considered the law of the land regarding radio transmission and reception. This Act consisted of four sections, all very general, and was labeled An Act to Require Apparatus and Operators for Radio Communication on Certain Ocean Steamers.

1912

On July 23, 1912 (two years later), and then only pertaining to section one of the four sections, the Act was amended, spelling out some specific details concerning operators and ships at sea. From then on, all transmitting stations would have to apply for a license to operate. The law was not too specific. It had loopholes, and many inland stations, especially amateur radio enthusiasts and experimenters, went about hooking up induction coils and going on the air with call letters assigned by themselves. For instance, a "one inch" spark coil was considered to be limited to no further than eight or ten miles, so did not fall within the law crossing state borders! What a "primitive" concept of wireless in those days. The type of signal coming from these amateur operated coils did not conform to any known bandwidth or frequency standard. A signal was "just a signal."

At this time, a number of wireless organizations blossomed. Notable among these were 1) The Institute of Radio Engineers, 2) The American Radio Relay League, and 3) The National Amateur Wireless Association. Up to this time there was very little literature or published information available. It did not take long for these to appear. Soon small companies issued store catalogs offering everything from loose couplers to crystals and crystal holders, headphones, and all sorts of gear to get the amateur started. Enthusiasm ran high. Wireless was a new found discovery and appealed to the young as well as to the old. Wireless could be used to span great distances and for so many experiments. The fascination of distant communication without wires was gripping and overwhelming.



As soon as radio became popular as a hobby, equipment began appearing on the market. Note the flamboyant style of the copy, typical of the period. This ad appeared in 1915.

Issued in January 1917, this certificate was one of the first of the "awards" that hams have always displayed with pride on the walls of the shack.

WHAT A GOVERNMENT LICENSE IS, AND HOW TO GET ONE

The law governing the operation of amateur stations was not passed with the idea of silencing the amateur operator—on the contrary, it is an official recognition of the amateur's rights—and a Government license carries with it advantages and privileges that otherwise the amateur would not enjoy—that is, if he keeps within the law. The law as it relates to the operation of amateur stations in itself is not a strict one. If you have a receiving station only, it is not necessary for you to get a license. If you operate a sending whose power is great enough to reach beyond the boundaries of the state you are located in, or to interfere with the licensed stations in the state, the law says you must have a license. Briefly, it states that your wave length shall not exceed 200 meters and your transformer input shall not exceed 1 KW. Or if your station is located within five nautical miles of a military or naval station, your transformer input shall not exceed ½ KW.

The license is free, and the only requirements are, that you answer correctly the questions asked in the forms sent you, and that you are able to transmit and receive messages at the rate of at least 5 words a minute To get one, write the Radio Inspector, Department of Commerce, Bureau of Navigation of the District headquarters nearest you, and ask for Form 756, (Application for Operator's License) and Form 757 (Application for License for Land Station) both of which will be forwarded to you. If you have a license, Official Call Letters are assigned you which no one else can use. You know what you can do, and what you can't do, and no one can interfere with you in any way so long as you obey the law. For your own protection you should get one.

In 1915, the Central Radio Association issued its Blue Book, a reference text for early amateurs. It included this explanation of why licenses were required.

1914

Hiram Percy Maxin was one individual who could come up with the right ideas at the right time, and the ARRL was his heritage. No sooner had this enthusiasm caught fire when World War I broke out in Europe in 1914.

1917

The conflict went on for several years and sure enough, the United States became involved in 1917. All radio amateurs received notices to dismantle their equipment. Many joined the services in one capacity or other, many into the Signal Corps where their training and experience as radio operators was greatly appreciated by the government.

To be continued.

Jerrold Swank W8HXR
657 Willabar Drive
Washington Courthouse OH 43160

Remember the Windom!

-- is this the world's simplest five band antenna?

This antenna was one of the most popular antennas for amateur use, and it deserves more attention than it gets now, although it was first designed in 1929. In that year, two amateurs, John Byrne and Ed Brooke of Bell Telephone Laboratories, under the direction of Professor W. L. Everitt of the Department of Electrical Engineering, Ohio State University, experimented with and perfected this antenna. It was reported in September, 1929, *QST* by Loren G. Windom, and therefore became known as the Windom antenna.

Its chief advantage is that it may be used on all even harmonics with a single wire feed. Since amateur bands are harmonically related, except 15 meters, it may be used without change for an all band antenna. By cutting it for 80 meters, it can also be used on 40, 20 and 10, without changing the properly placed single wire feedline.

The length of the antenna is determined by the formula, 468/frequency in kHz. Thus, for 3725 kHz the length will be 125'8". The distance of the feeder from the center is approximately 14% of the antenna length, or about 17'6". At this point there are no standing waves on the feedline. By tapping the feeder up on the plate tank until the transmitter loads properly, you can tune for whatever band you are operating in. See Fig. 2. The feeder is #14 wire, any length.

To reduce the chance of getting rf in the station, the method in Fig. 2(b) can be used, with link coupling to an external tuned circuit. This antenna at the feedpoint has an impedance of approximately 600 Ohms.

There has recently emerged a similar appearing off center fed antenna which is incorrectly called a Windom, as shown in Fig. 3. The theory is that this is fed at a 300 Ohm point with twinlead, which can then be transferred by a 4-1 balun to 75 Ohm coax. There is some controversy about this, but at any rate the feedlines should come away from the antenna at a right angle for at least a quarter wave length, and the equipment should be well grounded to prevent floating rf in the station. ■

Fig. 1.

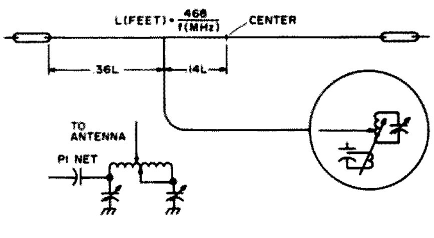


Fig. 2(a). *Fig. 2(b).*

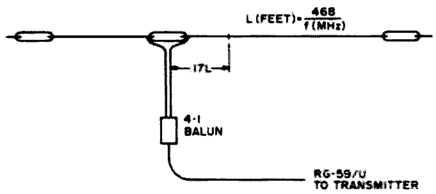


Fig. 3.

Ronald Perry WA2CGA
RD 1, Glen Avenue
Fishkill NY 12524

The Agonies of Tower Raising

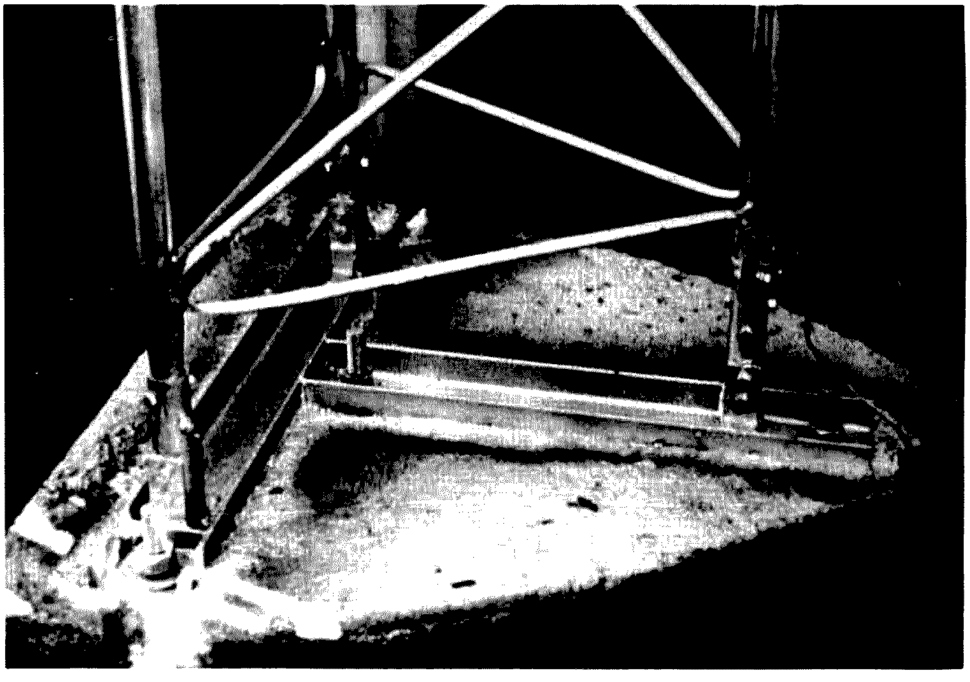
- - Murphy strikes again... as usual

For many years I debated, planned, and agonized over the purchase and installation of a decent-sized tower for my home station. Though money was a definite factor in the project, other considerations such as location, base configuration, type and size of tower, and local building ordinances presented the main concerns.

When using VHF/UHF (2 meters, 220 and 450 MHz), tower location and height become very important factors. The tower must be high for good communications and yet close to the rig since feedline losses mount with cable length. Based on this, I decided to use a 60 foot tower located a wall away from my equipment. For ease of installation and maintenance, I decided to use Universal's Model 14-60 self-standing aluminum tower with a hinged base.[1] This tower, according to the manufacturer, will support 14 square feet of antenna in an 80 mile an hour wind with a safety factor. The lack of the need of guy wires was a major consideration since guy anchors would mean more problems.

Having decided on the tower height and location, the next task was designing the tower base configuration. Normally this would not be a big deal – get some idiot to dig you a big hole and fill it with concrete – but what about a solid rock ledge of New York State granite for a backyard?

To solve this matter, I thought about employing a jackhammer to dig the hole. However, after consulting with a friend in the construction business, I decided against this expensive back-breaking procedure. I then considered a few sticks of dynamite, but notwithstanding the damage to the QTH, blasting permits were hard to come by. Discussing the matter on the local repeater WR2ABB, a friend WA2HSF advised using a core drill which bores a clean, round hole into rock. This matter being resolved, I finally checked out all local building and tower restrictions and ordinances to see that there were no laws forbidding my little project. Luckily, the laws were with me so out came the checkbook and the shovels and soon groundbreaking was at hand.


View showing the base with its four securing rods.

The photo shows the base and the four securing rods. The right side of the base is about 3-4 inches below ground level while the left side is about 7-8 inches. The holes for the rods were drilled with an electric core drill and a diamond/carbide bit. Both were rented from a local rental agency for $28/day. Each hole is 1½ inches in diameter, about 8-9 inches deep, and each took about 50-60 minutes to drill. The rods are 7/8 inch diameter steel and are threaded their entire length.

To secure the rods in the rock, commercial rock anchors (threaded Ring Wedge Cinch Anchors) were used.[2] These anchors are a combination iron wedge/metal ring/lead alloy unit. They are threaded on and over the rods and expanded within the hole through the use of a separate pipe and sledge hammer. I used three units in each hole as specified by the manufacturer. With this

arrangement, each rod can take a maximum tension test load of 14,440 pounds (57,760 pounds total) and a maximum shear test load of 36,130 pounds (144,520 pounds total). See Fig. 1.

Once the rods were set in place, the concrete for leveling the base was poured. Approximately 1¼ yards of concrete was required to make the base extend four inches above the ground level. The finished concrete had a comprehensive strength of approximately 3000 psi.

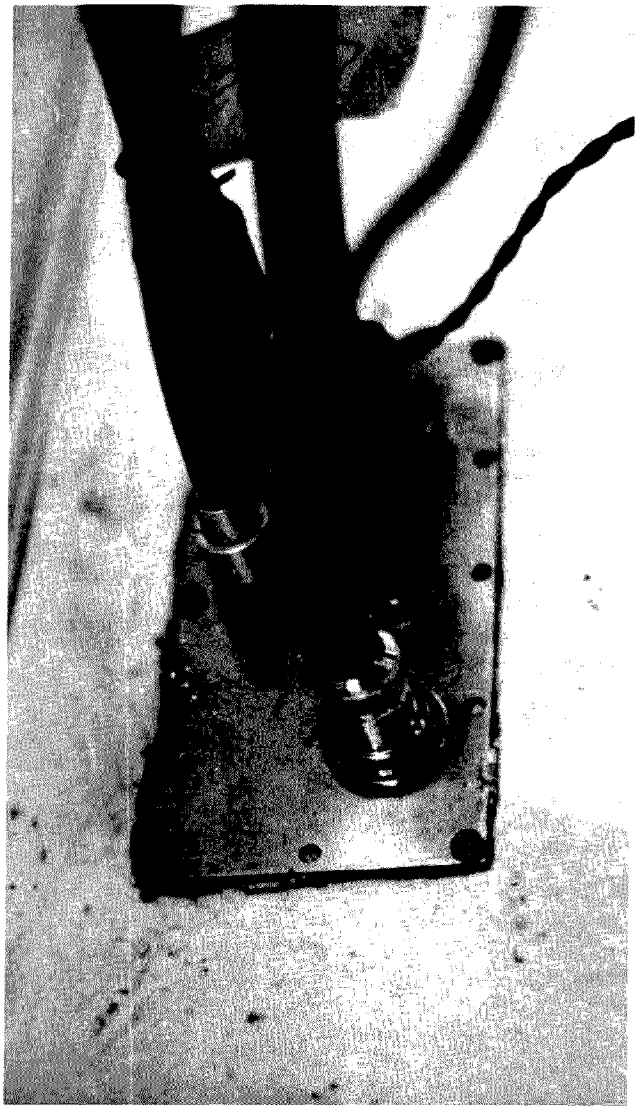
Leveling of the tower was straightforward once the concrete began to age. The flat-roof mount with hinged base was placed on the concrete and leveled. The bottom 10 foot section of the tower was put in place and leveled. Actually, this is a lie since it didn't work out that way. That is, two of the three legs were level while the third was way out of true. After a few minutes of puzzlement, the mystery was solved – the tower tapers inward from the bottom to the top to accept the next smaller section. A quick readjustment was made so that each leg of the tower was off perpendicular towards the center of the tower by the same amount. With this crisis passed, the concrete was allowed to age for seven days.

Now the second phase of the project began. A crew was assembled consisting of W2BEV, WB2COY, WB2CTH, WB2HDS, and WA2QWP. The first step was to put the tower together, 10 foot sections one at a time. Thanks to the hinged base, the tower could be constructed on the ground. Most of the sections had to be "horsed" together with a bit of grunting, but this made for a tight fit. The next step was attaching the coaxial cables and rotor wire. The cables should be placed on the inside of the tower so that they are not damaged on future climbing of the tower. This job was neatly accomplished thanks to Phelps-Dodge "Straptite" cable clamps.[3] The antennas, a commercial 8 element 2 meter yagi and an 11 element 220 MHz beam, were previously assembled on the mast and attached to the rotor at the top of the tower. A monitor-scanner antenna was side mounted on the tower completing the installation.

All of this work, however, was not without the curse of Murphy. In the process of making jumper cables between the antennas and feedlines, it was found that no one had had experience in attaching "N" connectors to RG/8 polyfoam coax. Well, as it turned out, it is almost impossible to do. Regular RG/8, no problem; polyfoam RG/8, forget it. A quick call to W2VAQ solved the jumper problem and saved the day.

The third, and most crucial, phase was now to be done – erecting the tower. Though we did not really expect it, raising the tower proved to be the biggest task of the day. Mathematically, the tower was only supposed to weigh 844 pounds at its lowest level to the horizon. This was calculated using the formula shown below, where H1 = Height from pivot point to rope attachment on tower, in feet; L1 = Length from pivot to pulling point, along horizontal, in feet; Wa = Weight of antennas, rotor, etc., in pounds; Wt = Weight of tower including cables, in pounds; A = Angle tower makes with horizontal, in degrees; H = Height above pivot point of rope pulling tower, in feet; L = Length of tower, in feet; T = Tension in rope, in pounds; and the following are assumed: 1.

$$T = \frac{L \times [\,(Wt / 2) + Wa\,] \times \cos A}{H1 \times \sin A - \operatorname{Arc\,Tan}[\,(H1 \times \sin A) - H\,] \,/\, (H1 \times \cos A + L1)}$$



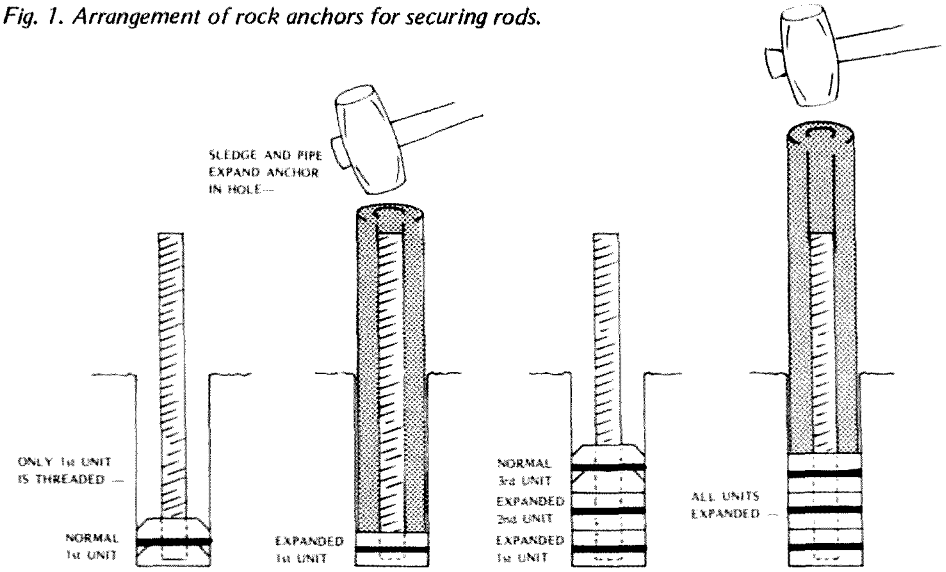
Connectors were installed on cables at the base of the tower and attached to the outside bulkhead.

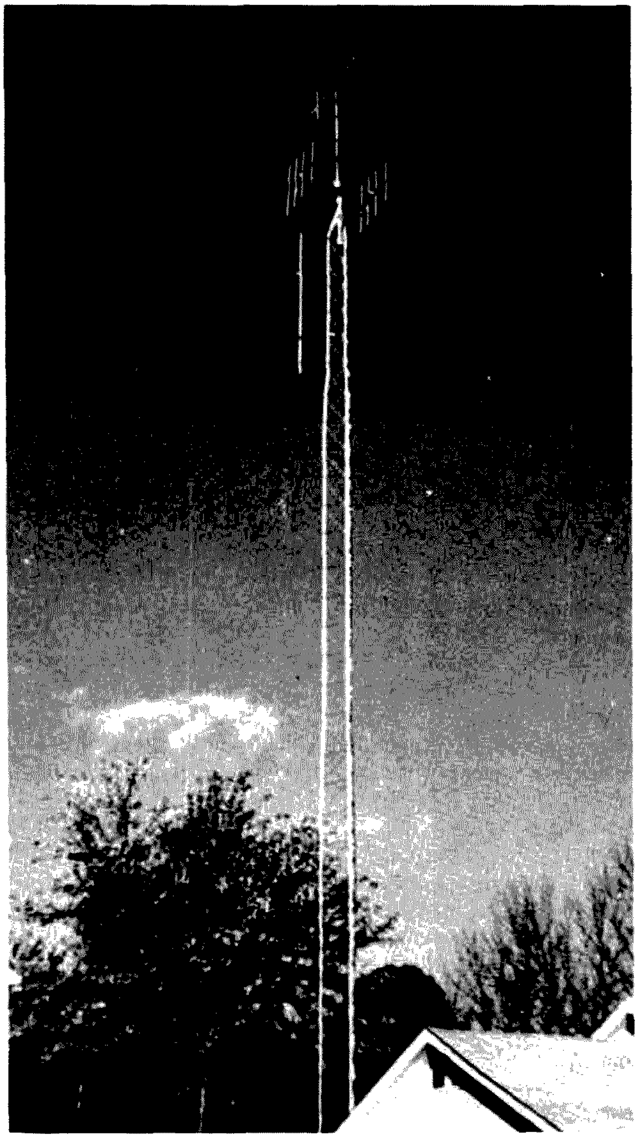
Weight of tower is uniform over entire length; 2. Weight of antennas, rotor, etc., is at top of tower; 3. No friction is involved anywhere.

In actuality, the tower seemed to weigh a great deal more. Despite the distinct advantages offered by the formula parameters "L1" and "H" – the rope being thrown over the house giving excellent elevation and fair distance from the tower base – the job proved to be a real doozy. Three robust amateurs – WB2COY, WB2CTH, and WB2HDS – were on the ropes while two other hefties – W2BEV and WA2QWP – walked the tower up. A double strand of 1/2 inch hemp proved barely sufficient – discovered, of course, about half way through the raising. Nevertheless, after much pushing, pulling, and puffing, up she went – vertical at last. With a sigh of relief, all broke into big smiles and exclamations of joy over a job well done.

BUT . . . but, all was not well. Murphy had other plans. Just a moment after the tower settled to the vertical position, a reflector element in one of the 2 meter beams slipped from its socket and fell to the ground. Luckily no one was injured, but after many hours of work this was

Fig. 1. Arrangement of rock anchors for securing rods.





The completed tower.

a most discouraging end to an otherwise fruitful day.

A few days later, upon recovering from the dropping reflector, WA2BXK climbed the tower and installed the offending rod. In the meantime, connectors were installed on the cables at the base of the tower and attached to the outside bulkhead. See photo.

As can be seen from the photo, all coax lines are fed through the side of the house via the bulkhead. The bulkhead consists of a piece of 1/8 x 2 1/2 x 5 inch aluminum plate with four double female "UHF" connectors. Type "N" would probably be better, but I could not find any locally. The interior surface of the outside bulkhead was coated with a cloth-like material similar to that which is used on water pipes to keep them from "sweating." There is a second such bulkhead on the inside wall. RG/8 jumpers between the wall connect the two bulkheads. The five-wire rotor cable is attached in a like manner, but standard male/female mike connectors are used.

Though such an arrangement contains numerous connectors, it has its distinct advantages. Should the tower have to be lowered, the cables can be easily disconnected/connected. Also, all lines can be quickly disconnected during thunderstorms. To complete the installation, both the tower and outside bulkhead are bonded together with No. 4 copper which is then run to ground – in my case, to a sixty-five foot well casing.

Finally, with all of the connections made, power was applied to the 2 meter antenna. And as you might guess, Murphy struck again. The initial swr was a horrible 2.25:1. To make a short story longer, the jumpers between the bulkheads proved to be the problem. Polyfoam RG/8 struck once more. Though there was "meter" continuity between the jumpers, not so for rf. Soldering the connectors to the coax caused minute bubbling of the foam which negated proper connection. A few more jumpers of regular RG/8, skillfully constructed by WA2BXK, and the problem was solved. The new swr was a respectable 1.38:1 over more than 1 1/2 MHz of the band. In conclusion, the antenna/tower project has proved very satisfactory. A northerly blockage with the old arrangement has been eliminated with the new tower. Direct 2 meter contacts with non-open (normal) band conditions have averaged more than 60 miles with full quieting reports. And, I can work all of the repeaters within the area – a radius of about 75 miles. Future plans call for a 15 meter beam and an 80 meter inverted "V". Many thanks to W2BEV, WZ2BXK, WB2COY, WB2CTH, WB2HDS, WA2HSF, WA2QWP, and W2VAQ as well as to WA1GFG/2 for the pictures. ■

Reference

[1] Amateur Electronic Supply, 4828 W. Fond du Lac Ave., Milwaukee WI 53216.

[2] Anchor Alloys, Inc., 966 Meeker Ave., Brooklyn NY 11222.

[3] Phelps-Dodge Communications Co., Route 79, Marlboro NJ 07746.

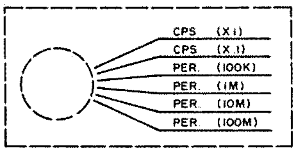


Fig. 1. Range switch scales.

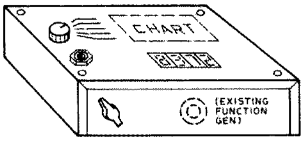


Fig. 2. Oblique view showing general outward appearance.

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The Speedy Audio Counter

- - good resolution without a long wait

The need for fast and accurate measurement of the low frequency tones in an electronic organ provided the basic drive to produce this counter. An earlier version was slightly less costly, but far too slow and lacked the needed resolution. This design works well, and should find acceptance with those wishing for precise measurements for most audio frequency applications.

Most electronic organs contain a master oscillator board that uses 12 slug-tuned coils for generating the highest tones, or the top octave. These are followed by a divider chain that provides successively lower octaves. It was decided to measure one of the lower octave ranges that spans from C6 at 1046.50 Hz to C5 at 523.25 Hz. With a conventional counter, a ten second gate would provide tenths of Hertz resolution at best, and a longer gate time is out of the question. The only reasonable approach is to count the number of higher frequency pulses that occur during one or more cycles of the frequency being measured. For example, if the number of one microsecond pulses were counted during one cycle of A5 at 880.00 Hz, you would get 1136. A ten cycle count gives 11363, and 100 cycles will read 113636. The period of one cycle of A5 is .00113636 seconds, so 100 cycles requires just over .1 second. You get the required resolution and fast update to the counter. To calculate the required display reading, just divide the reference frequency by the input frequency in Hertz.

A look at Fig. 4 shows that CMOS integrated circuits are used throughout. A four stage display counter consisting of 4026s count and decode to seven segments in decade fashion. These were used in preference to 4033s, as they have a display enable input that permits us to blank the display while resetting or counting. No latches are used as it was found a "blinking" display is actually easy to use. A new display means an updated count. 4049s are used with 680 Ohm resistors for segment drive to MAN-1 readouts. Three 4518s are used for the timebase divider to provide 100 kHz pulses, or .1 second and 1 second timebases. A 4518 is also used to divide the input to give x1, x10, and x100 ranges. Two sections of a 4001 are used for the crystal oscillator and buffer, and two sections of another 4001 comprise the input amplifier. The input amplifier is biased slightly above or below the threshold point to prevent random triggering. A 4013 and three sections of 4001 are used to provide synchronization and division of the input, reset, display gating, and clock pulses to the counter chain. This gating system requires a minimum of parts, yet provides a 50/50 gate and display cycle. The reset is one-half cycle of the reference frequency that immediately precedes the count. As the 4026s require less than .5 usec for reset, it may be possible to use a higher reference frequency.

A two section, 6 position switch permits switching between the two count modes. Position A gives a direct reading in Hertz per second. Position B gates for .1 second. These two scales give a positive reference for gross tuning adjustments or quick identification of an unknown frequency.

Switch position C provides pulses at a 100k rate and D at a 1 microsecond rate. Positions E and F bring in the input

	FREQ	PERIOD
C 6	1046.50	.00095556
B 5	987.77	.00101238
A#5	932.33	.00107258
A 5	880.00	.00113636
G#5	830.61	.00120393
G 5	783.99	.00127552
F#5	739.99	.00135136
F 5	689.46	.00143172
E 5	659.26	.00151685
D#5	622.25	.00160707
D 5	587.33	.00170262
C#5	554.37	.00180384
C 5	523.25	.00191113

Table 1. A chart for organ tuning.

FREQ	PERIOD
1200	.00083333
1275	.00078431
1445	.00069204
1500	.00066666
1700	.00058823
1900	.00052631
2100	.00047619
2125	.00047058
2295	.00043572
2300	.00043478
2350	.00042553
2400	.00041666
2975	.00033613

Table 2. A chart for RTTY, SSTV.

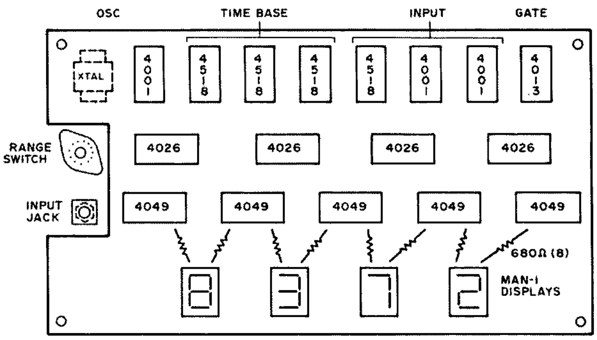

Fig. 3. Top view of component board.

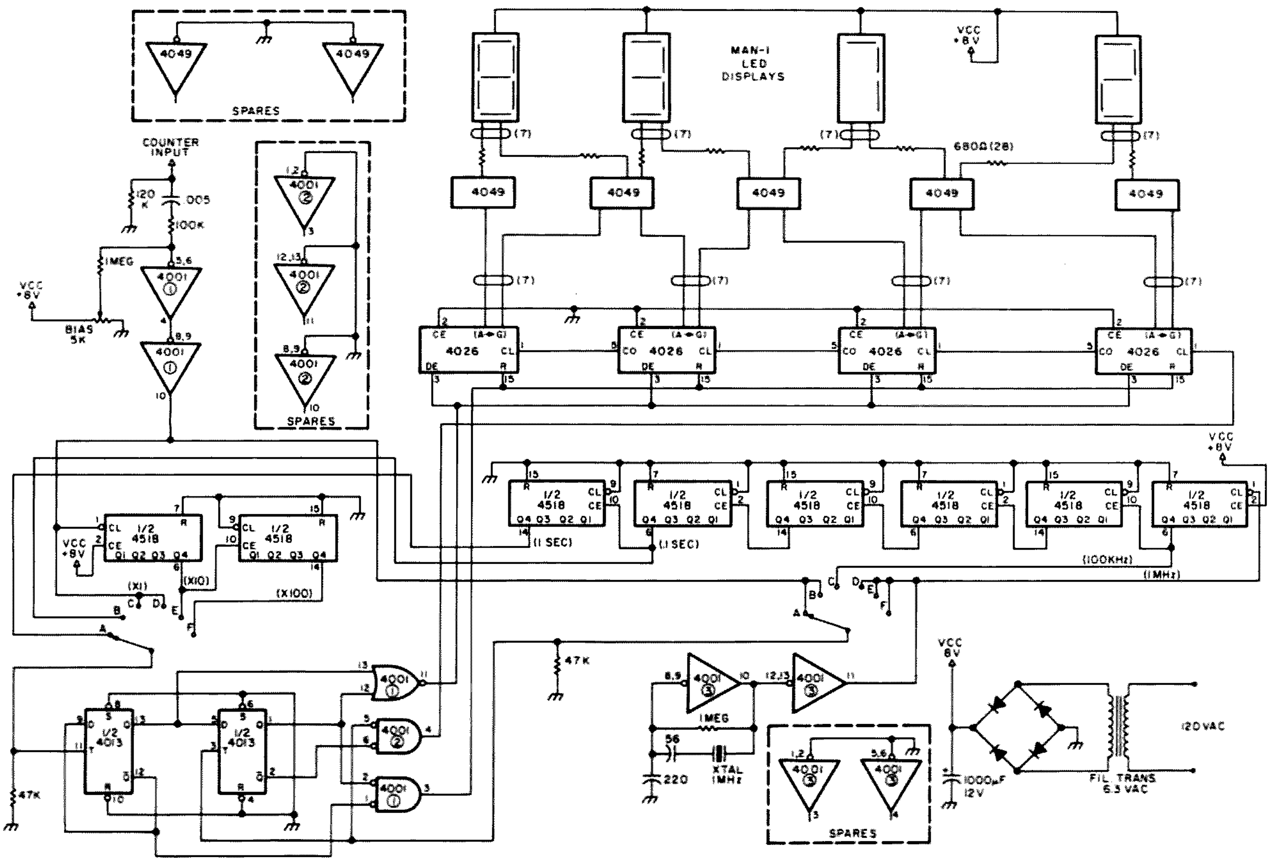

Fig. 4.

divider to give an effective x10 and x100 in resolution. An example of expected readings of A5 at 880.00 Hz would be: A – 0880, B – 0088, C – 0113, D – 1136, E – 1363 and F – 3636. The more significant digits drop off on the higher resolution scales, but it was felt that an overflow indication was not needed.

Construction was on a piece of perfboard with holes spaced .1 inch, mounted under the top cover of an existing function generator. The cabinet measured 7" wide, 5" deep and 3" high. The perfboard was slightly smaller with a section removed to permit the switch and input jack to be mounted on the top. The LEDs, ICs, and resistors were mounted on the top of the board, and point-to-point wiring used for connecting the components. The power supply is mounted on one end of the box. The crystal, originally from a BC-221 frequency meter, was removed from the metal cover and mounted on the board. If you have enough room in your cabinet, it would be better to leave it as is, and mount it with a clip or octal socket. A slot was cut out to reveal the LEDs and covered with plastic laminate for protection. A switch position scale and a chart of frequencies and their respective periods were typed up and pasted to the top, covered with more of the plastic laminate.

Sketches showing the general construction of the unit, and general layout of the circuit board are shown. A much more compact unit could have been constructed using printed circuit techniques, a two piece double-deck board, and substituting MAN-3 readouts which are smaller and would not require the 4049 segment drivers and resistors.■

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Versatility Plus for the HW-202

-- extra channel mod

The HW-202 is a fine piece of 2 meter equipment, but six crystal pairs tend to limit the operation during travel periods. In any case, I could use a minimum of nine pairs. Six would be local repeaters and direct channels; three would be out of state or repeaters that are used during vacation, etc. I originally had the tone burst assembly installed in the HW-202, but the touchtone pad gives me all the inputs I need. Therefore, there is a nice space to put in a module the same size as the tone burst assembly, using the present mounting holes and front panel component holes. The switch module can also provide inputs for a synthesizer.

Circuit Description

Fig. 1 shows the circuit and it can be seen that it is a repetition of the circuits in the HW-202 except the inductive trimmers for the receive crystals have been left out. It was found that 90% of the receive crystals tuned at the same slug position.

The circuit shows seven crystal pairs and one switch position for synthesizer inputs. It is possible that additional crystals could be added because there is some space left on the board. There are three connections to be made to the transceiver circuits: receive crystal switch S1A to Y102 pin toward front of unit, transmit crystal switch S1B to Y202 pin toward left side of unit, and synthesizer key to pin 2 of mike jack. The circuit ground is accomplished by the mounting hardware in most cases. A wire ground can be made from bus shown on Fig. 2 to the lug on the speaker of the HW-202. These connection points are shown on a schematic on page 133 and circuit boards on pages 128 and 130 in the Heath Assembly Manual. Although Fig. 1 shows a 2 pole switch, a 4 pole, 4 section switch was installed so that if the crystals were excited during synthesizer operation, the extra two poles could be used to short out the crystal circuits.

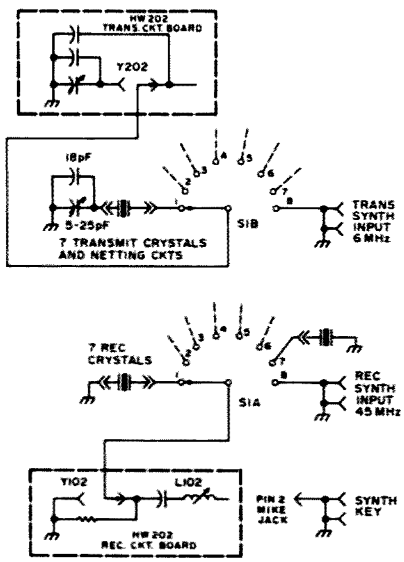


Fig. 1. Schematic of added crystal deck.

The synthesizer inputs were included to make the circuit more useful. The transmit synthesizer input (T) could be used for an outboard crystal and easily adjustable netting trimmer in a small box. The receive synthesizer input (R) could be used for a vco or vfo input. The synthesizer key (K) is to energize the transmit vco by way of a relay.

Mechanical

The module is built on 1/16" thick perforated board with .1 x .1 hole pattern. The mounting angle is made from 1/32" thick aluminum and can be bent very easily in a vise. This can be attached to the perforated board with brass rivets, eyelets or screws. Fig. 2 shows the assembly. The major dimensions are shown, as are general positions of components. All connections on the rear must be kept flush against the board or it will not fit in the HW-202. The miniature tube socket contacts or equivalent are pushed through the drilled holes and the tails bent flat against the board. Dummy crystals or substitutes must be plugged into the crystal contacts and all soldering done. The copper strip or bus ground will hold some of the components in place once it is soldered in place. Miniature crystal sockets could be used in place of the contacts shown, but must not protrude below the board more than 1/32 inch or make the height of the mounted crystal more than 5/8" above the board. The trimmer capacitors are also pushed through the drilled holes and the tails bent flush against the board. All wiring on the board was done with insulated no. 30 wire. The leads attached to the Heath circuit were no. 26. After all the soldering is done on the rear of the board, the component tabs, wire, and ground strip should be covered with Hysol Epoxy-Patch 0151 clear or equivalent, which will hold everything in place.

The wiring from the switch is routed near the crystals' top side, and then down through a convenient hole to the proper tail on crystal connector.

The front panel switch plate may be cut out and cemented to a 7/8" x 3-1/8" plate with 1/8" and 1/4" diameter holes for the switch and connectors. A thin plastic film should be laid over this for protection. Another way of fabrication is to make a clear film negative of the photo and apply to the plate using double faced clear tape. The surface of the aluminum plate should be brushed horizontally with sandpaper

previous to putting the film on for good appearance.

Installation

The disassembly instructions for the HWA-202-2 tone burst encoder on page 12 of the assembly manual should be accomplished. The crystal module can be attached in the same manner as the encoder, but use 4-40 flat head screws and standard lock washers and nuts. A thin piece of insulation should be placed between the crystal push-button assembly and the new module to prevent any shorts.

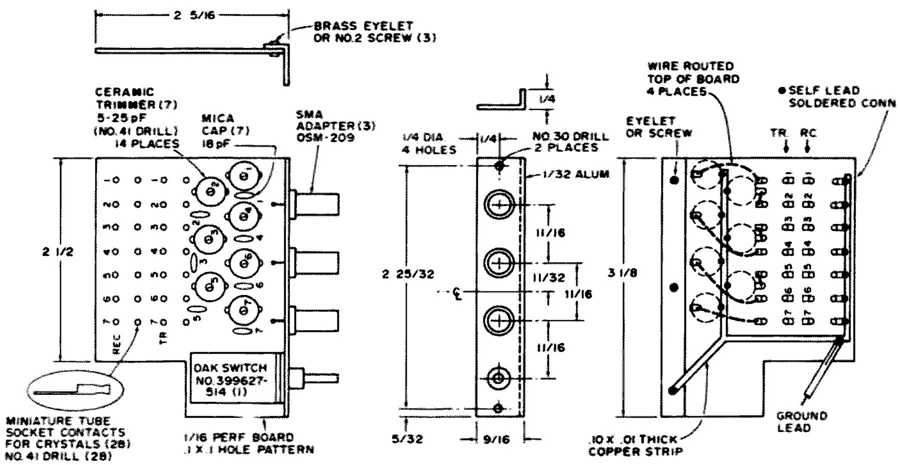


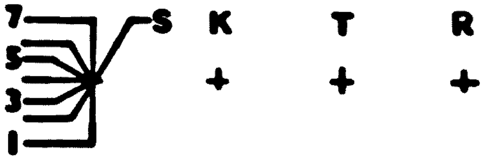
Fig. 2. Added crystal deck assembly for HW-202.

Adjustments

The receive crystal inductor L102 should be adjusted to average reception of all receive crystals in the new switch module. In my case, all crystals were very near, making an average setting easily accomplished. The transmit crystal trimmers will have to be adjusted using a counter or in the same manner as the other transmit crystals were trimmed.

Conclusions

No trouble was encountered in the operation of the switch module. The additional crystal pairs made the Heath 202 much more useful as traveling equipment. Since the space on the front panel is limited, a switch knob that can be turned in the allocated space must be used. The knob must not be more than 1/2 inch diameter and at least 5/8 inch high. This allows a firm grip with two fingers. ■



Switch plate for front panel.

73 Magazine *Staff*

The Boomless Microbeam

-- works better than it ought to

Many methods have been tried to fold, load and twist the elements of 20, 15 and 10 meter beams to make them more compact while still retaining reasonable performance. No one can or should expect a compacted beam to work as well as a full size beam. Working "well" refers to forward gain, front to back ratio, low loss and low swr over a reasonable bandwidth. Designs have been made which optimize one factor at the sacrifice of all others. For instance, a beam might be determined and loaded to produce a low swr over an entire band, but usable gain might occur over only a very narrow portion of the band. Such a beam design might look good in advertising literature — "broadband, low swr, moderate gain" — but it really doesn't deliver much. On the other hand, not many amateurs would buy the beam if it stated "very low swr and high gain over any selected 50 kHz portion of a band."

Whether it is worthwhile to go after a compact beam (either commercial or home brew) for a few extra dB obviously revolves around the cost and effort involved. Sometimes the few extra dB aren't as important as adding some directivity to the antenna system to improve the reception side of things. This sort of evaluation has to be made for specific circumstances. But, one can't make it without good details on what one is building or buying.

The boomless 2 element beam described in this article is not a cure for all problems, although variations of this design have successfully been used for over 10 years by various amateurs. Rather than make sharp compromises in any one direction, the main advantage of the design is that it makes moderate, acceptable compromises in several directions. It has a gain of several dB across a given band, the swr is low (2:1 or less) across a band, and the front to back ratio is a usable 10-15 dB across a band. Also, and perhaps most importantly, it is simple to construct. The electrical layout of the beam is shown in Fig. 1. It consists of a driven element and a director element. A reflector element for the parasitic element might produce somewhat more gain. But at the close element spacing used, a director element has only about 1 dB less gain and produces much better overall front-to-back ratio properties. The beam dimensions are as shown for 20 meters and can be scaled down or up for other bands. The dimensions have been arrived at empirically by those who have built this type of beam and seem to yield the best overall average results. Because of the loading effect produced by folding back the elements, their overall lineal length is greater than that found in full size beams, although overall the beam is much more compact than a full size beam.

The driven element is not shown separated for connec-

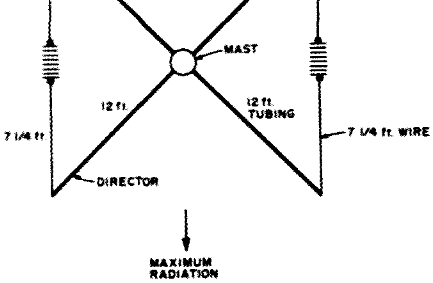


Fig. 1. Basic beam dimensions for 20 meters.

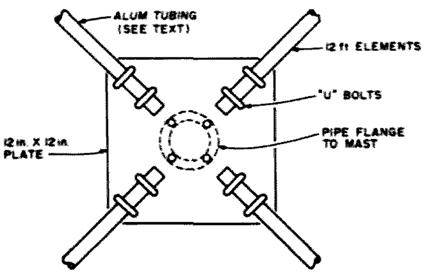


Fig. 2. Mast mounting plate.

tion to a transmission line. It could be separated in the center and fed directly, preferably through a 1:1 balun, with 50 Ohm coaxial line. The match should be a good one, producing a low swr without any matching devices. The director element is left as shown.

Feeding the antenna in the preceding manner requires, however, that the two sides of the driven element coming towards the mast be insulated from the mast. Simplified plumber's delight construction can be achieved by having all of the antenna elements coming towards the mast grounded to the mast and the driven element feed via a gamma match. Various construction techniques can be used for the purpose depending on the tools and equipment available. Fig. 2 shows one simple method which does not require any special tools. An approximate 12 by 12 inch aluminum or steel plate is used with a pipe flange which fits over the mast. Of course, it would be best if a steel threaded mast could be used. The antenna elements are nested aluminum tubing starting with 8 foot lengths of 1¼" OD aluminum. These are secured to the square mast plate by means of two U bolts on each element. The total length of 12 feet for each element is made by nesting 4 foot tubing into the 8 foot sections. Tubing clamps are used to secure the sections together. Alternatively, the 12 foot elements of aluminum are locally available. The rest of the antenna is made of #12 wire strung between the tips of the 12 foot sections. Nylon clothesline (the type without metal reinforcement) makes a good, simple insulator between the wire sections.

There is no tuning to the antenna other than matching the transmission line to the driven element. One could experiment with tuning of the driven and director elements by varying the length of the wire sections of each element, but it is doubtful if any better performance would be achieved. Transmission line matching is done most easily with a gamma match as shown in Fig. 3. A 55" length of ½" aluminum tubing is run parallel to one 12 foot leg of the driven element at 3-6 inch spacing. It is supported at one end by a metal shorting clamp to the driven element, and at the other by the housing of a plastic box which contains a series 200 pF variable. The plastic box is mounted on the bottom of the mast plate and can be supported by the U clamps which hold the 12 foot elements down. A sturdy plastic kitchen food container can be used for the enclosure where severe weather is not a problem. Otherwise, a solid plexiglas housing is needed. The metal shorting clamp is moved along the driven element a few inches at a time and the variable capacitor tuned for each setting until the lowest swr is achieved on the line. The beam should be in its final operating position or as high off the ground as practical while making this adjustment.

Any medium to heavy duty TV type rotator will suffice to handle the beam antenna. ■

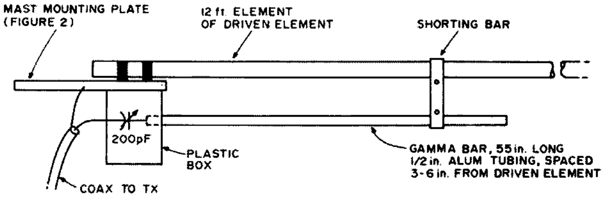


Fig. 3. Gamma match to coaxial transmission line. The gamma bar can be placed on either of the two 12' driven element members shown in Fig. 1.

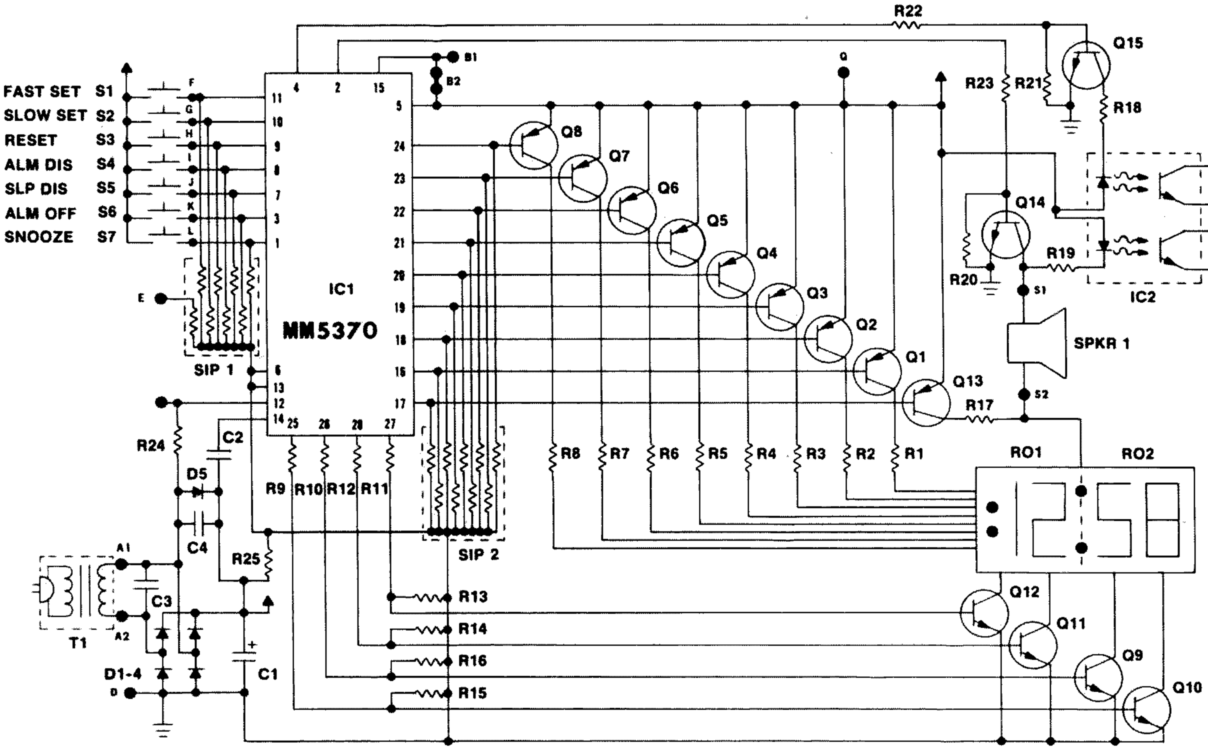


Fig. 1. Schematic diagram of the four digit clock used for illustration in this article.

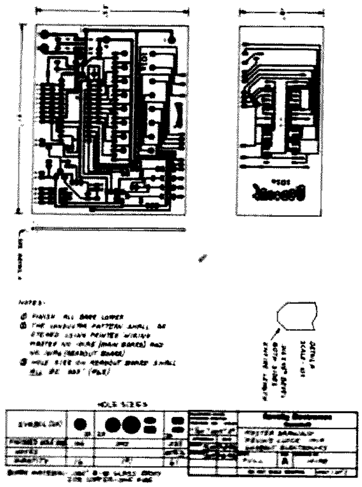
Charles F. Smith
c/o 73 Magazine

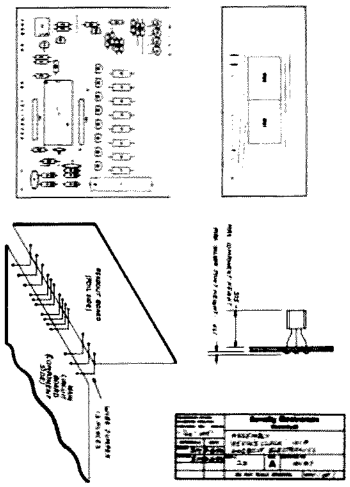
Making Your Own PC Boards

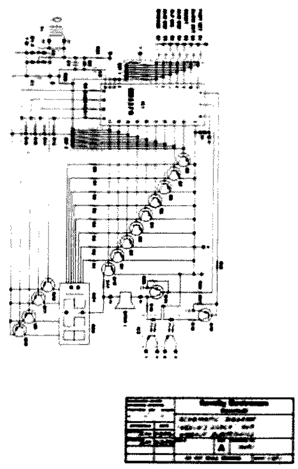
-- part I

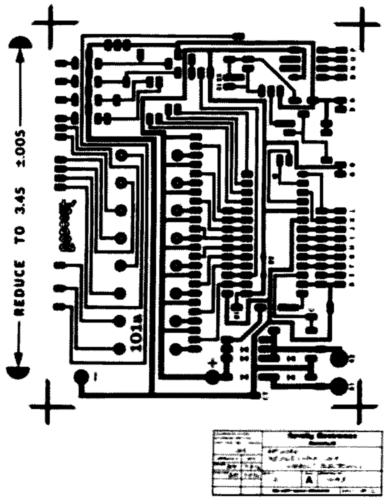
There have been quite a few construction projects in magazines lately, some without printed circuit board artwork. Oftentimes, with a simple project, a PC board is unnecessary. However, when a project starts using a lot of components and gets complex, it is usually much easier to use a board. This does not apply only to magazine projects. Home brew ideas will have a neater, more professional look if a circuit board is used.

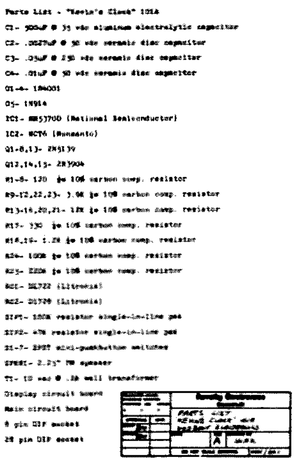
This is the first of a two part article dealing with the design and manufacture of printed circuit boards. It will

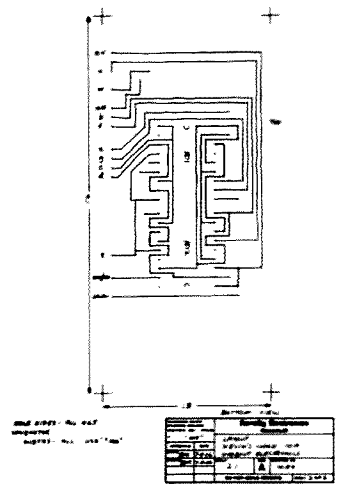


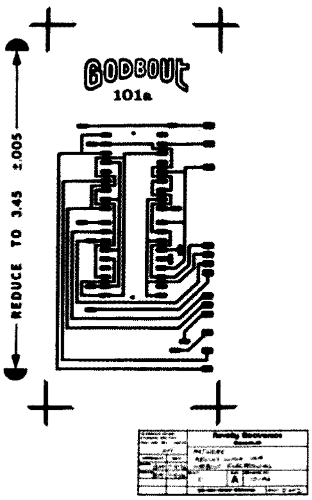


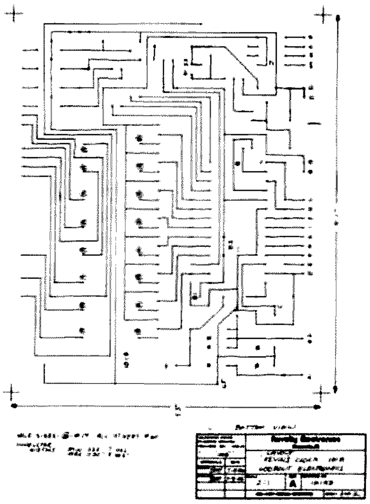












cover everything necessary for the home experimenter to produce high quality, professional-looking boards. This part of the article will deal with documentation and production of artwork for a single-sided board. Next month we will cover double-sided boards and the manufacturing process.

While the use of a printed circuit board is generally a good idea, there are times when a second thought is advisable. As with any good thing, a PC board has its disadvantages. Some arguments for and against the use of printed circuit boards are as follows:

PROS:

1. Weight reduction as much as 10 to 1.
2. Designed in performance.
3. Ease of inspection.
4. Diagnostic analysis and troubleshooting simplified.
5. Positive and straightforward parts identification.
6. Space organization and control.

CONS:

1. Volume inefficiency, space utilization poor (essentially two plane).
2. Poor repairability.
3. Conductors may be exposed, causing insulation degradation or even possible shorting.
4. Thermal design complicated and limited.
5. Design regimentation and restriction, with electrical and mechanical compromises.
6. Circuit revision dif-

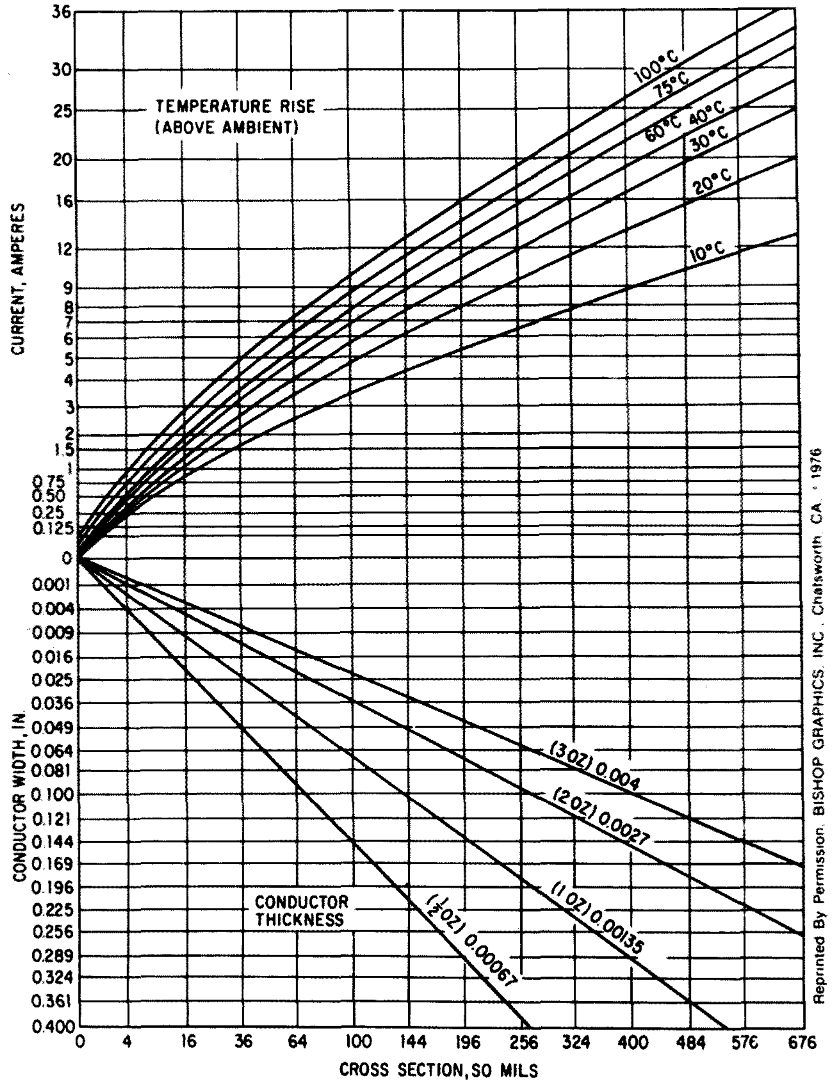


Fig. 3. Use this chart to find minimum conductor widths for the circuit board.

ficult and sometimes impossible.

Single-Sided or Double-Sided?

When you do decide to use a circuit board, you should be aware of what is available. Currently, there are four different types of printed circuit boards you can use. These are single-sided, double-sided, multi-layer, and flexible. The single-sided board has all of the wiring on one side, with the components on the other side. The laminate serves as an insulator and support. The double-sided PC board has the bulk of the wiring on the bottom, with the remainder on the top side. Components are generally mounted on the side with the least amount of wiring.

A multi-layer board is composed of many very thin boards laminated together. Sometimes as many as 19 individual layers may be found in one multi-layer board. The home manufacture of this type of board will be discussed along with double-sided boards next month.

The last type of board in common use today is the flexible circuit. Very simply, this is a single- or double-sided board using a paper thin laminate. An example of their common usage can be found in the dash of many newer automobiles.

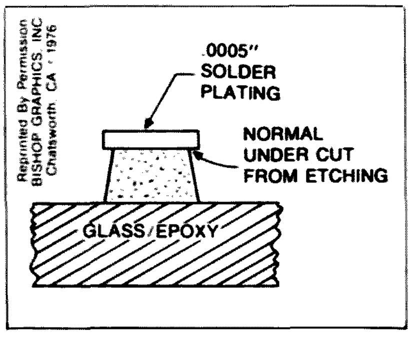


Fig. 4. Conductor edge undercut.

With a selection like that to choose from, which type of board do you pick for a particular application? Choosing is really very simple. Multi-layer and flexible circuits are the most difficult for the home experimenter to manufacture, so they are out. We are left with a choice between single-sided and double-sided boards. Single-sided is the least expensive, but can be a headache to design if the circuit is complicated. Double-sided boards offer more flexibility in design, but are a bit more expensive.

Look at the circuit you are going to design a board for. Is it complex? Does it use a lot of integrated circuits? If your answer is yes, you may want to use a double-sided board. If your circuitry is fairly simple and/or straightforward, you may want to use a single-sided PC board. This month we are going to design a single-sided PC board for the digital clock in Fig. 1.

Documentation

When you have decided to make a printed circuit board, the first thing to check is whether you have adequate documentation. This would be a schematic or logic diagram, a parts list, and any other pertinent data. This step is important, whether you are going to make a one-of-a-kind prototype or a production run of a few hundred or more. Good documentation helps prevent mistakes that may occur later in manufacturing. An example of documentation is shown in Fig. 2.

When drawing your diagrams, there are some points to remember. Signal flow should be drawn from the left to the right, with the inputs on the left, the outputs on the right. The highest voltage potentials are normally drawn toward the top, the lowest

Voltage Between Conductors DC or AC Peak (Volts)	Uncoated 0–10,000 Ft. Alt. MIL-STD-275C	Uncoated 0–10,000 Ft. Alt. IPC-ML-010
0 9 10 15 16 30 31 50	.025" (0.64 mm)	.015" (0.38 mm)
51 100 101 150		.025" (0.64 mm)
151 170 171 250 251 300	.050" (1.27 mm)	
301 500	.100" (2.54 mm)	
500+	.0002 in/volt (0.0051 mm/volt)	

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Table 1. Conductor spacing.

toward the bottom. Support circuitry is drawn on the lower half of the drawing. These are oscillators, power supplies, and other circuits not included in the main drawing. An exception to this rule is when it is easier to include a support circuit in the main diagram.

It is not necessary to follow these rules. However, most drawings tend to follow them, and standardization helps reduce possible confusion and problems later on.

When drawing a schematic diagram, it is a good idea to draw it in such a way as to keep crossovers to a minimum. This drawing is what you will be using to lay out your board. Crossovers on a PC board represent electrical connections. This will become more clearly understood when the layout has begun. A typical schematic diagram for a four digit digital clock is shown in Fig. 1.

Layout Design

The printed circuit board layout is the necessary step between the schematic or logic diagram and the master artwork. It should contain all of the circuit board design information. The component locations, interconnecting circuitry, and board outline should all be included, drawn to scale. The scale used, hole and conductor sizes, as well as all measurements, should be noted external to the board area.

The use of a grid system when doing a board layout is important. Most electronic parts are spaced on a 1/10" grid.

A grid is a "two-dimensional rectangular network consisting of a set of equidistant parallel lines superimposed upon another set of equidistant parallel lines with one set of lines perpendicular to the other." (Bishop Graphics) The most common grids, at actual board size, in use today are .100", .050", and .025" in order of preference.

All board artwork and layouts should be done at an enlarged scale. Errors in pad and conductor alignment and imperfections in drafting aids will be reduced proportionately with the reduction of artwork to finished board size.

The scales most often used for layouts are 2x, 4x, and 1x, in order of preference. 1x should always be avoided except in cases where reducing facilities are not available.

When designing a PC board, careful thought must be given to conductor width and spacing. If a conductor is too small, discontinuity may result. On the finished board, consideration must be given to possible heat problems. Narrow traces will lift off very easily. Their added difficulty in manufacturing will result in an increased cost. Narrow spacing is also difficult to manufacture and may cause short circuits. Widths and spacings that are too large may result in wasted valuable board space.

Conductors larger than .500" should be avoided. If larger conductive areas are needed, as in the case of ground planes, they should be relieved to avoid blistering or warping during soldering. More information on ground planes will be discussed later.

Conductor width should be determined by the required current carrying capacity. Width may be selected by referring to Fig. 3. Spacing is determined by the voltage present, and whether the board has been coated or not. If narrow spacing is used around high voltage, arcing may result. Table 1 shows suggested conductor spacing determined by voltages present. Typical spacing of .031" or .050" is suggested for low

AWG		FINISH HOLE	RECOMMENDED 2X TERMINAL AREA	COMPONENT
34	.0063			
33	.0071			
32	.0080	.0145		
31	.0089	#79 drill	.150	
30	.0100			
29	.0113			
28	.0126			
27	.0142			
26	.0159	.0260		
25	.0179	#71 drill	.170	1/8 Watt resistor,
24	.0201			DIP, TO-5, TO-18
23	.0226			
22	.0253	.0360		
21	.0258	#64 drill	.187	1/4 Watt resistor,
20	.0320			TO-220, TO-202
19	.0359	.0520		
18	.0403	#55 drill	.218	1/2-2 Watt resistor,
17	.0435			TO-3
16	.0508	.0625		
15	.0571	1/16, #52 drill	.250	

MACHINE SCREWS

SIZE	CLEARANCE	HOLE	RECOMMENDED SCREW	2X TERMINAL WASHER AREA
2	#44	.086	.312	.468
4	#33	.113	.437	.650
6	#28	.140	.531	.800
8	#19	.166	.600	1.000
10	#11	.191	.687	1.000

Table 2. Pad sizes. Note: All measurements shown in inches.

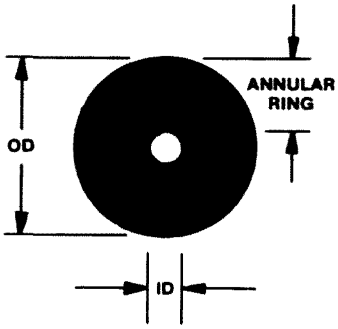

Fig. 5. Annular ring in detail.

voltage applications when space permits. Conductors should be placed no closer than .100" to .250" to a board edge or mounting hardware.

When the PC board is etched, a small amount of copper will be removed from underneath the resist or plating. This should be taken into account when selecting a conductor width or pad size. With larger conductors, this undercutting can be considered irrelevant. However, when using narrow conductors (approximately .015" and smaller), if great precision is required, add one or two thousandths to allow for this. See Fig. 4.

Pad Sizes

Choosing pad sizes is much the same as choosing conductor widths. Instead of width, however, we have what is called annular ring to think about. Annular ring is (OD-ID)/2, where OD is the pad outside diameter and ID is the hole size. See Fig. 5.

There should be a separate pad and hole for each component lead or connecting wires. Hole exceptions are made for components in a "flat-pak" configuration.

Pads should be as large as practical while maintaining minimum spacing requirements. Table 2 lists suggested pad sizes for common components.

Oftentimes mounting holes as well as component leads will have pads. When using a pad for a mounting hole, make the pad as large or larger than the screws or washer that will contact the board. In this way, when taping up the master artwork, you will have a better knowledge of where nearby conductors may be placed.

A ground plane is an area of the circuit board used as a common point between many connections. This is usually the ground of the power supply, hence its name. Rather than being a narrow conductor from one point to another, a ground plane is a large area of copper. These are often used as supply buses or shielding, especially in high frequency circuits. Ground planes are sometimes used for heat sinking, although their use for this application is somewhat limited.

When laying out a ground plane, approximately fifty percent should be relieved to prevent blistering and a heat sinking effect during soldering operations. Fig. 6 illustrates two common methods of relieving the copper. An exception to this rule could be when the ground plane is designed to be a heat sink. Under these circumstances, the idea is to have as much copper exposed as possible.

For connections to the ground plane, special pads are suggested. These are detailed in Fig. 7. A clearance is provided between the terminal area and ground plane. Where continuity is desired between the pad and the ground plane, two to four connections are made. This helps prevent a poor solder connection resulting from the heat sinking problems discussed earlier.

Special Considerations

Designing a circuit board is not always as easy as it may sound. Very often, a circuit will have many special problems to consider. Feedback, noise popping up where it should not, and uneven propagation delays in digital circuits are only a few of the many unexpected problems that may occur in the finished product if the board is not designed with thought. Conductor routing on a PC board is basically the same as wiring a circuit point to point. The same care must be taken when designing a PC board.

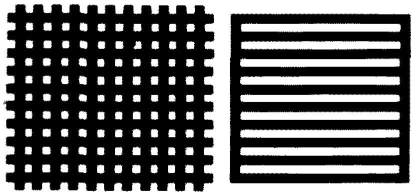

Fig. 6. Methods of relieving copper for ground planes.

When a board is designed and feedback could be a problem, you can run a ground line between the sensitive section and the area most likely to cause interference. Fig. 8 illustrates this with a few typical problems. Some other problems to watch for are high voltages, currents, or frequencies. Heat distribution may also create a headache. Be sure that heat sensitive parts are kept away from power devices.

When drawing a layout, it should be drawn looking at the bottom of the board — that is, from the foil side. This can become confusing at times, but there is a good reason. The master artwork is copied directly from the layout. When the artwork is photographed, you will want a negative with the emulsion side facing the board. The exception is when the board is to be silk screened.

As bad as this may sound, doing a layout in this manner is not really hard. All you have to remember is that everything is drawn upside down. After a while, drawing like this will become second nature.

To do a layout, you are going to need the following materials: some tenth inch graph paper, black and red pencils, and an eraser.

The graph paper should be a precision type, printed on stable material for accuracy. If the board you are going to make does not require extreme precision, any tenth inch graph paper will do.

Layout Design Techniques

Before beginning your layout, find an area in the schematic where a group of components share a common point. Draw these parts on the grid by drawing a dot where each lead will go. To avoid confusion later, the symbol or part number is drawn where the component will go. Once you have the parts drawn in, draw the interconnecting lines between the dots (pads). If the schematic diagram has been

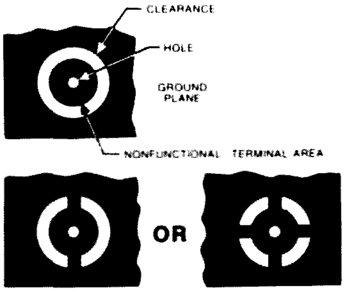

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Fig. 7. Special pads for ground planes.

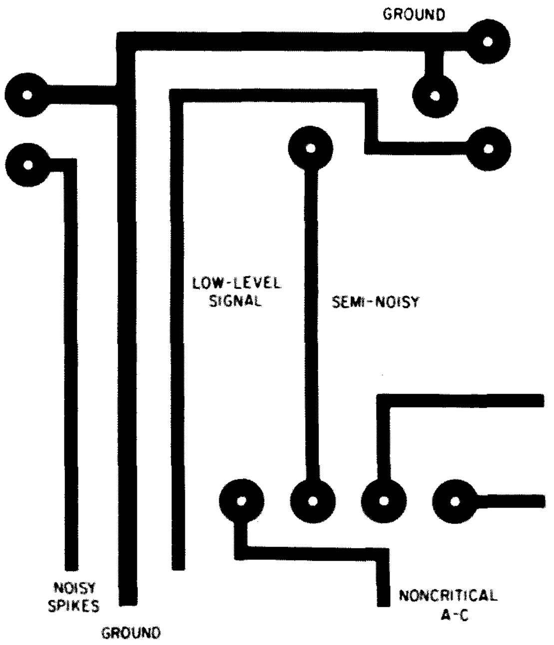

Fig. 8. Typical layout problems and solutions.

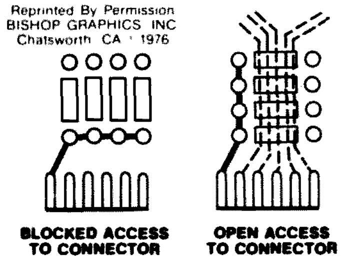

Fig. 9. Arranging parts to provide maximum access to other components or edge connectors.

drawn with as few crossovers as possible, this step will be very easy. Places where crossovers exist on the schematic may be remedied by remembering that conductors may be placed under parts and between pads. An alternate but very similar method is to lay out the board basically the same as the schematic has been drawn.

Other methods of layout design include choosing one or more multi-lead components and radiating outward from them. This is what was done with the four digit clock in Fig. 2. When using a connector, or pads for external wiring (inputs, outputs, or external parts), locate these pads first. Sometimes it is easier to do this and radiate components inward.

When laying out a board, care should be taken to keep a neat and orderly appearance. Components should be positioned to provide maximum access to other parts. See Fig. 9.

On a single-sided board, it is possible, and very likely if the circuit is complex, that you will have a crossover or two. Maybe even a few more. However, crossovers on a circuit board represent short circuits and so are not allowed. To remedy the crossover situation, we use jumpers. A jumper is a wire placed on the component side of the board to "jump" over conductors on the bottom. These should be treated as separate components. That is, they occupy space and need two holes. When a jumper is drawn on the layout, use a different color pencil to indicate placement. This helps prevent putting parts under or over a jumper wire.

After the layout is finished, carefully check it over for mistakes. Accuracy here is very important. The master artwork, and hence the board, will reflect everything on the layout. Unless you are in a hurry, it is sometimes best to let the layout sit overnight before checking it. It is surprising how many times you may overlook a mistake.

To elaborate further on layout design, I will use Fig. 10 as an example. This layout

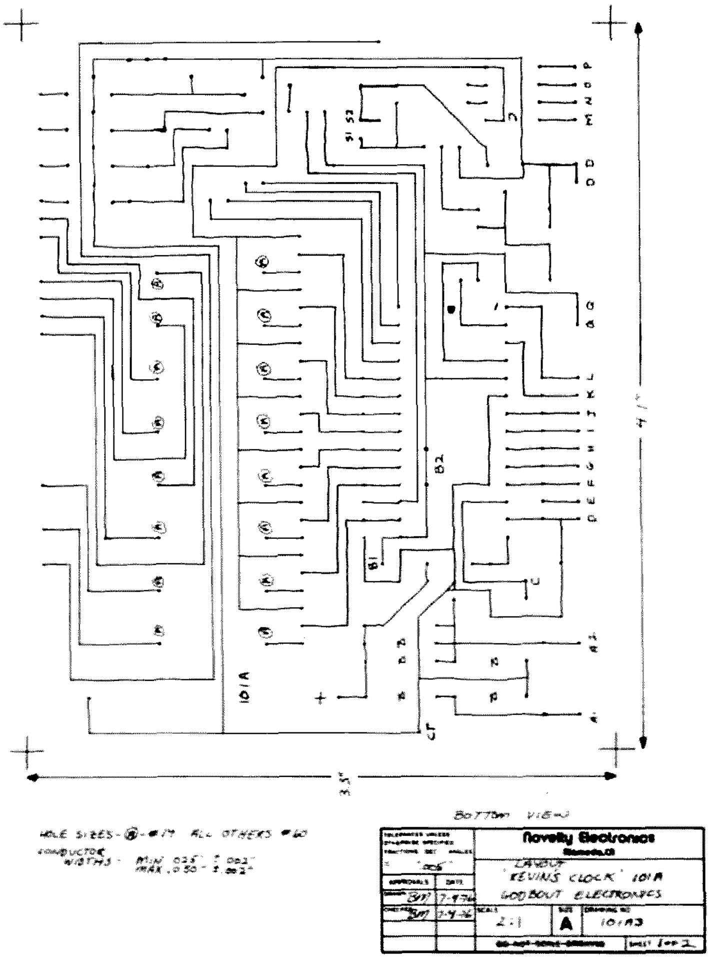

Fig. 10. Finished "main board" layout for the clock.

was drawn from the schematic diagram in Fig. 1.

Briefly, here are the steps that were taken. IC1 is the main component and also the one with the most connections. Very conveniently, the switch inputs are all on one side. This helped decide its position and placement. Pull down resistor packs SIP1 and SIP2 were placed directly opposite the segment and digit enable outputs. (The guys who decided the IC pinout sure did a nice job.) The next things to lay out were the segment enable transistors and limiting resistors. The distance the transistors were placed from SIP2 was calculated figuring the use of .050" tape (.025" conductors on the finished board). Four conductors would have to be run parallel to the IC. I counted up two tenths from SIP2 and drew my first line. Using the tenth inch graph paper as my guide, I drew three more lines one tenth inch apart. This gave me .025" conductors with .025" spaces on the finished board. Allowing two tenths again for spacing between conductors and pads, I now had the spacing needed between the SIP and the transistors. With this in mind, I centered the transistors above the SIP .350" away from it. Unless otherwise noted, by the way, these figures are layout size (2x) rather than actual board size. The rest of the segment enable parts should be self-explanatory.

Digit enable was a bit more difficult. I knew approximately where the board edge was going to be, so I worked backwards from there. The transistors were set up kind of funny because I did not want to cut or use narrow pads. This clock was designed for a kit, and large pads make it easier to assemble. I also did not want to use any jumpers here. Anyway, if you look closely at the layout, you can see basically what I did. I just worked downward, placing pull down resistors where needed as I went. After these, I put the series resistors in using the same method.

The power supply was fairly straightforward, and should not need any explanation. Perhaps the most difficult was the section with the optoisolator (IC2). Basically, I just put the parts where they would fit. The optoisolator fit conveniently in the corner. It also has four outputs that I wanted at that edge. The rest of the circuitry in this section can be best explained by careful examination of the layout. The readout board will not be explained here because of its relative simplicity.

Artwork Pattern Configurations

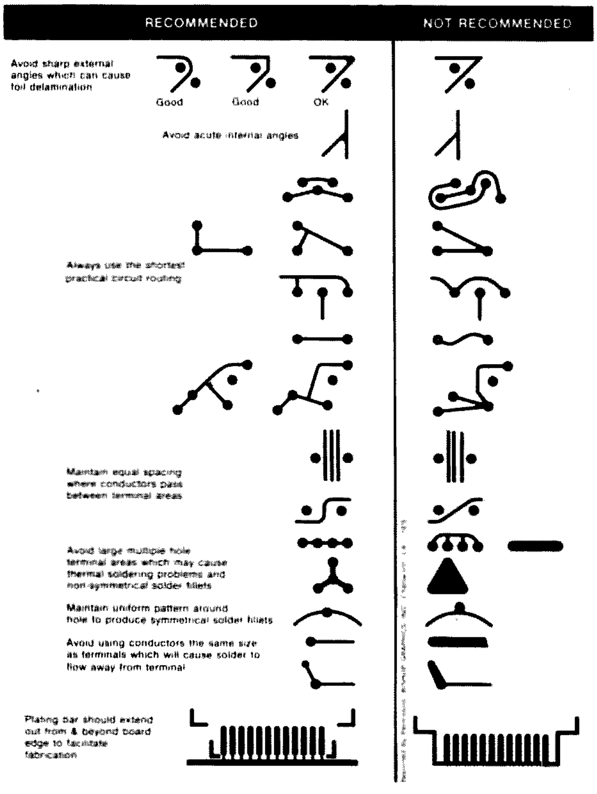

Fig. 11. Dos and don'ts for taping artwork.

Artwork Design Techniques

Before you begin taping the artwork, familiarize yourself with the different methods available. These include pen and ink, "rub-ons," drafting tape and preprinted "stick-ons."

With the pen and ink method, everything is drawn by hand on drafting vellum or directly on the blank board. This method is unreliable and produces inferior quality artwork. Therefore, its use is not recommended.

Rub-ons are symbols with gummed backing preprinted on a plastic base material. These are used by positioning the symbol over the area desired and rubbing the backing with a blunt instrument until the symbol comes off. This method is usually used on a blank board. Results are sometimes impressive, but you end up with a one-of-a-kind board. A problem common to rub-ons, however, is cracking. This produces broken conductors, split pads, and the like.

The last and by far the best method is using tape and preprinted stick-ons. This is the most common, and produces the best looking boards in the end. Stick-ons may be purchased in a large variety of configurations, with patterns available for almost all types of electronic components.

Using this method, die cut pads and stick-ons are positioned on mylar in positions dictated by the layout. Connections between components are made with precision slit artwork tape. This tape comes in standard widths from .015" to 6" ±.002" in both metric and decimal sizes. Preprinted stick-ons are also manufactured to a tolerance of ±.002".

With everything else out of the way, it is time to tape up the artwork. You are going to need artwork materials: tape and stick-ons as mentioned earlier, a razor blade or X-acto knife to cut the tape, and some drafting film. The easiest to use is mylar with a matte finish on one side. All of these things are available from Bishop Graphics in Chatsworth CA. A light table will make it easier to lay out the artwork, but it is not absolutely necessary.

There are two ways to do artwork. One is with straight lines and sharp corners. The other way has curved lines and corners. The only problem with this method is that the draftsman must be somewhat artistic. If he is not, it is possible to end up with messy-looking artwork. Using the square corner method is preferred, but it does have a drawback. When etching, you have to watch out for undercutting at the corners, though careful planning and design can take care of this.

Now you are ready to start. Finish off that cup of coffee you have been drinking, and go wash your hands. Soft drinks and food are also forbidden while taping the artwork. Believe me, the last thing you want to do is accidentally spill something on half-finished artwork. The reason for clean hands should be obvious. Fingerprints and smudges can also help ruin otherwise good artwork.

The easiest way to produce artwork is to place the layout directly underneath the mylar and tape directly over it. Another way is to

place a piece of precision graph paper under the mylar and transfer the pattern from the layout to the mylar by way of the drafting aids. This way takes considerably more time, but is the cheapest if you want or need precision. Doing layouts using individual pieces of precision graph paper could get expensive after awhile.

To apply the stick-ons, slip the knife or razor blade under one edge of the stick-on. Lift carefully until it is fully off. Position the pattern over the mylar and press down gently with a finger. For larger patterns (DIPs, connector strips), use the knife to hold one side of the pattern, and a finger to hold the other. Place the pattern in position and apply light pressure. Applying only light pressure to secure patterns in place allows you to easily remove and reposition them if needed. Die cut pads can also be applied in the same manner.

Tape is applied by placing the end of the roll over the center of a pad and applying pressure to hold it in place. Then take and run the tape down to the terminating area, applying light pressure all the way. Be careful not to stretch the tape as you go, to avoid "creeping" later on. When cutting off the ends of the tape, it is best not to "cut" the tape, as this may cause a scratch or a blemish the camera will pick up later. Instead, hold the knife, edge firmly against the width of the tape. Using the other hand, pull the tape up at an angle away from the blade. This method assures a clean cut without mangling the rest of the artwork. When cutting tape at a corner, be sure to get it all. Do not let any excess hang over, preventing a nice sharp corner. Fig. 11 illustrates some dos and don'ts for artwork pattern configurations. Fig. 12 shows the finished artwork for the clock.

To mark off the edges of the board, delineation marks are available, or you can use two pieces of tape placed perpendicular to each other.

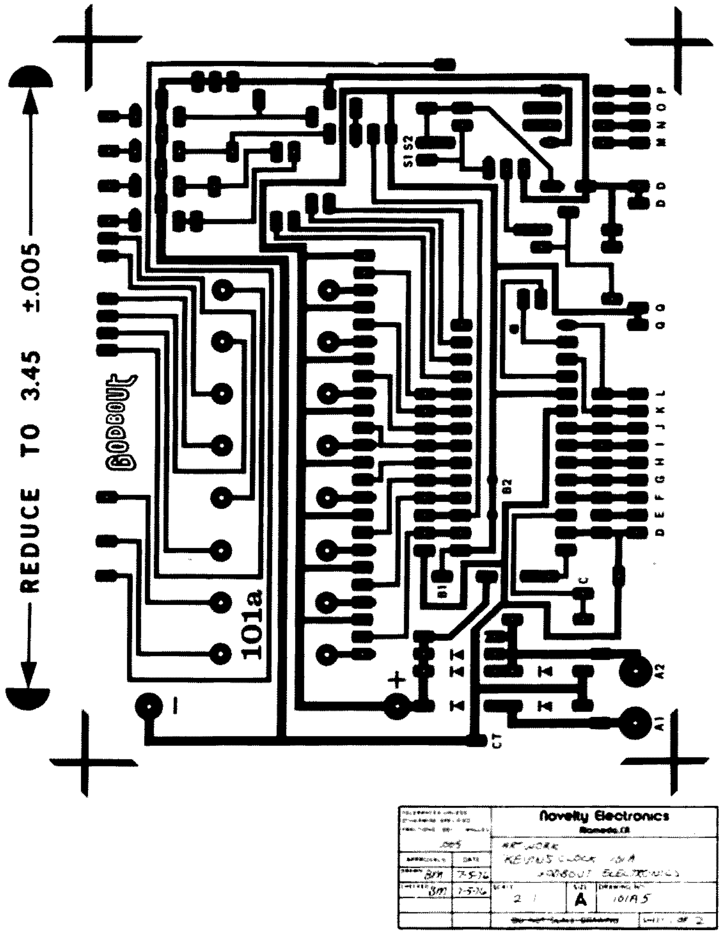

Fig. 12. Finished "main board" artwork for the clock.

When you are all finished with the artwork, check it and compare it with the layout. This is the most important step of all. Bad artwork will cause bad boards, which in turn will cause a product that does not work. Now is the time to double check and make sure this does not happen.

So now you have finished artwork and want to make a board? You are going to have to have a negative made of your artwork. Do not use a 35mm or similar type camera. Results are poor and it is not worth it. Find someone with a camera designed for copying line or halftone material. (Line material is straight black and white with no shades of gray in between. Halftones are used for photographs. A magazine photo is a halftone.) The type of camera you are after is a graphic arts process camera, and may be found in companies associated with the printing industry. Some people are in business exclusively for the purpose of making negatives for the printed circuit board industry. The camera used must be dimensionally stable and have distortion-free optics. Otherwise, your finished board may be accurate in one corner but not the other.

When making a negative of PC board artwork, a stable based film must be used. The best would be a glass plate, if you could find one. Glass is very stable under most conditions, but is hard to find and would be quite expensive. A good film for this purpose is 7 mil polyester base safety film.

When exposing the film, backlight the copyboard. This will increase the contrast ratio from about 50 to 1 to 1000 to 1. Needless to say, a backlit negative will have sharper edges and will produce a much finer board. See Fig. 13.

Finished artwork and negatives should be stored flat in a closed container. Temperature should be kept within 35 to 120 degrees F.

Conclusion

This month you have been provided with enough information to be able to go out and design a single-sided board. Next month, we will discuss double-sided and multi-layer boards, as well as the manufacturing process. In the meantime, I suggest you find a simple circuit and try your hand at designing a board. This will make it a little easier to follow next

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Announcing the PCF

-- legal aid for ham problems

In Los Angeles County, an amateur is charged with 4 criminal violations for owning a tower in excess of the local 35 foot limit and causing interference to his neighbor's television and stereo receivers. After 18 months of litigation, his legal fees exceed $18,000.

In Oklahoma, 6 licensed CBers running legal power agree to pay $100 fines each after being told by their lawyers that it will cost each of them at least $1,000 to challenge a newly enacted TVI-RFI ordinance.

In Arizona, New York, Pennsylvania, Colorado and Florida, amateurs go to court to fight denials of building permits for towers. Their average legal fees amount to $3,500.

These are not nightmares caused by too much beer and pizza during Field Day. They are merely a few of several hundred legal matters involving the Amateur Radio and Citizens Radio Services which have occurred during the last two years. The newly formed Personal Communications Foundation may be able to reduce the cost of legal services to other amateurs and CBers who encounter similar problems in the future.

Amateur radio was founded on the concept of service, both to the community and to fellow amateurs. Over the years, though noted in only a few amateur publications, numerous attorney-amateurs have literally donated hundreds of thousands of dollars of legal services to fellow hams involved in amateur radio-related legal problems. The rapid growth of amateur radio, coupled with the explosion in the Citizens Radio Service of recent years, has greatly increased the number of legal problems confronting both amateurs and CBers alike and has made necessary some form of organized assistance to the lawyers and licensees involved.

In early 1976, Wayne Green, the editor of *73*, and I exchanged a number of letters concerning a possible series of articles on amateur radio and the law. After working out the ground rules for such a series, Daniel I. Simon WA6EJW, another Los Angeles attorney, and I started preparation of the series. In order to make the articles as interesting as possible, we decided to contact a number of attorney-amateurs throughout the country to gain the benefit of their experience. Among the attorneys we spoke to was Frederick J. Lawson K6JAN, who was and still is involved in a major amateur radio case in Los Angeles County.

Shortly after our initial discussions with Fred, Robert M. Booth, Jr. W3PS, ARRL General Counsel, invited us to attend an informal meeting of attorney-amateurs to be hosted by Marshal Quiat WBØHWQ, a Colorado attorney, which was to be held during the 1976 ARRL National Convention in Denver.

In preparation for the meeting, Dan, Fred, and I prepared a written proposal suggesting the creation of a nonprofit foundation which would serve as a central clearinghouse of legal information for lawyers involved in amateur radio legal matters. This recommendation was submitted to the Lawyer's Committee at a luncheon meeting on July 17, 1976. In addition to Marshal, Bob, Fred, and myself, the meeting was also attended by B. Robert Benson VE2VW, ARRL Assistant General Counsel, Don K. Johnson W5PYA, Carl Markov K6RLP, Donald L. Royer WA6PIR, Chester B. (Barney) Scholl, Jr. K3ZFP, and Larry Perry K4EFV.

The basic concept of a clearinghouse for legal information was endorsed by the attorneys, even though we recognized that there were substantial legal, practical, and monetary difficulties with the draft recommendation. In order to give us time to work on the problems, a follow-up meeting was scheduled in Los Angeles in early September.

During the ensuing 6 weeks, substantial legal research was undertaken and on September 4th the group met at my offices, this time augmented by Richard S. Arnold W6RNP, the Honorable Maurice J. Hindin W6EUV, and Mark Weiss K6FG. Basic plans were formulated, additional research undertaken, and the decision was made to expand the organization to include the legal problems of all aspects of non-commercial, personal communications.

On November 5, 1976, Articles of Incorporation of the Personal Communications Foundation, a nonprofit corporation, were filed with the California Secretary of State. By the time you read this article, applications for tax exempt, tax deductible status will have been filed with the Internal Revenue Service and the California Franchise Tax Board.

The Foundation's principal goal is to serve as a central clearinghouse of legal information concerning all aspects of nonprofit, personal communications by radio, including amateur radio, non-commercial use of citizens radio, and shortwave listening. To avoid any misunderstanding at the outset, the Foundation is not a law firm and cannot, itself,

represent amateurs or CBers who encounter nonprofit communication related legal problems, although compiling a comprehensive list of experienced attorneys in this area is being considered.

Years ago, relatively few amateurs encountered legal problems directly related to the operation of their stations. When problems did arise, attorney-amateurs throughout the country were able to assist them with little difficulty. Today, however, literally hundreds of amateurs and CBers are encountering legal problems yearly and frequently have to turn to attorneys with little or no familiarity with either FCC rules and regulations, prior cases involving personal communications, or the technical aspects of radio. As a result, a substantial portion of the legal fees they are incurring relate to time which the attorney must devote to familiarizing himself with the law in this area and preparing the necessary legal documents. In a few unfortunate situations, the attorney has been unable to locate applicable cases and local courts, without the benefit of such cases, have rendered decisions highly unfavorable to amateur radio.

A number of cases today involve the Citizens Radio Service and some persons have questioned why amateurs should be concerned. The reason relates to how our legal system operates. Our courts follow precedents: i.e., the decisions of other courts in identical or closely related areas. If a court determines that a local municipality can fine CBers for causing TVI or can prohibit CB antennas because they are considered unsightly, other courts are likely to extend such rulings to amateur radio. Moreover, there are more than 15,000,000 licensed users of the Citizens Radio Service. When compared with 250,000 licensed amateurs, it is obvious that CBers outnumber amateurs by close to 40 to 1 and are statiscally more likely to encounter legal problems, particularly those related to zoning and RFI-TVI. It is important to the future of amateur radio that CB-related legal problems receive the same coordination and attention as those confronting amateurs.

Seated, left to right: Hon. Maurice J. Hindin W6EUV, Jon J. Gallo WA6PTM, Carl Markov K6RLP. Standing, left to right: Donald R. Royer WA6PIR, Richard S. Arnold W6RNP, Robert M. Booth, Jr. W3PS, Mark Weiss K6FG. Photo by Robert R. Jensen W6VGQ.

The Personal Communications Foundation hopes to assist all licensed amateurs and CBers who encounter legal problems by developing a comprehensive library of court decisions, legal briefs and related documents, as well as articles and studies relevant to each of these issues. To accomplish these goals, the Foundation is in the process of establishing a number of liaison and working committees. The Governmental Liaison Committee will establish lines of communication with the Federal Communications Commission, Department of Justice, and other appropriate governmental agencies. The Industry Liaison Committee will similarly establish liaison with the Electronic Industry Association (EIA) and other industry groups. Similarly, the Amateur Radio, Citizens Radio and Shortwave Listeners Committees will establish communications with appropriate users, groups, and publications, such as *73 Magazine.*

The Foundation has tentatively divided its areas of primary interest into the following sub-groups:

1. Land use regulation, including all aspects of zoning, variances and conditional use permits, building code requirements, and private deed restriction;
2. Radio frequency interference and television interference (RFI-TVI);
3. The law of nuisance as it applies to personal communications;
4. The role of the Federal Government, the Federal Communications Commission, and the States in the regulation of personal communications including the subject of Federal preemption;
5. Illegal operating practices and procedures; and
6. Miscellaneous areas.

To accomplish these goals, the Foundation plans to establish Amateur Radio, CB and Shortwave Listener liaison committees as well as working committees in each state and Canadian province. It will be the function of the working committees, in conjunction with the liaison committees, to contact both users and attorneys in their area and to secure for the Foundation copies of all relevant court decisions, legal documents, articles, and studies related to personal communications law, as well as publicizing the existence of the Foundation to both users and the legal community. Documents submitted to the Foundation will be reviewed by the Executive Director, Trustees, and other volunteer legal advisers, and will be indexed by both subject matter and state.

Upon completion of the Foundation's legal files, law-

yers, users, governmental agencies, or other individuals with an interest in personal communications law will be able to secure from the Foundation complete information with respect to all relevant decisions and legal documents in any area affecting personal communications. Such a library will greatly decrease the cost of legal services for individual users as well as assisting in the development of a uniform nationwide body of law.

The Foundation is headed by a 24 person Board of Trustees, all of whom are lawyers or judges, five Officers and an Executive Director.

Chairman of the Board of Trustees is Jon J. Gallo WA6PTM, and Vice Chairman is Richard S. Arnold W6RNP, both of Los Angeles, California. Other Trustees include Professor Jerome J. Curtis, Jr. WA6JKQ, Sacramento, California; Joel R. Kirschbaum WB7ESZ, Phoenix, Arizona; Charles Perelman WA6OGW, Beverly Hills, California; Daniel I. Simon WA6EJW, Los Angeles, California; Donald L. Royer WA6PIR, Fountain Valley, California; Chester B. Scholl, Jr. K3ZFP, Sharon, Pennsylvania; Mervyn L. Hecht WB6LEN, Pacific Palisades, California; Richard Bennett K8EHU, Reynoldsburg, Ohio; the Honorable Maurice J. Hindin W6EUV, Los Angeles, California; Harry L. Styron K6MFV, Walnut Creek, California; John A. Dundas II WA6ZCO, Los Angeles, California; Professor Stanley Siegel K8KGU, Los Angeles, California; John C. Hendricks WB9FCB, Chicago, Illinois; Howard F. Shepard W6US, Del Mar, California; Mark A. Weiss K6FG, Encino, California; Fredrick J. Lawson K6JAN, Sherman Oaks, California; the Honorable Williams L. Ritizi W6ONC, Beverly Hills, California; Robert M. Booth, Jr. K3PS, Washington, D.C.; B. Robert Benson, Q.C. VE2VW, Montreal, Quebec; G. M. Howard W5KM, Dallas, Texas; Monroe Y. Mann WA2MAJ, Port Chester, New York; and Robert H. Hajek K9LTN, Chicago, Illinois.

Officers of the Foundation are Jon J. Gallo WA6PTM, President; Richard S. Arnold W6RNP, Vice President; Carl Markov K6RLP, Secretary; William S. Finklestein WB6JAO, Assistant Vice President, Security Pacific National Bank, Treasurer; and Ronald Ruby WB6MEB, C.P.A., Controller-Accountant.

Day to day operation of the Foundation is carried out under the direction of Carl Markov K6RLP, Executive Director.

Although the majority of services are being donated without charge to the Foundation, the Foundation anticipates heavy expenses in terms of mailing, telephone costs, printing and reproduction of documents, and salaries for a limited number of part-time employees of the Foundation who handle the day-to-day administrative tasks. Contributions in any amount to offset our costs are welcome.

In addition, interested individuals or clubs may become members of the Foundation. Four classes of membership are available: associate membership for a yearly contribution of $10, full membership for a yearly contribution of $25, supporting membership for a yearly contribution of $100, and life sustaining membership for a single contribution of $250 or more. The Foundation anticipates publication of a quarterly newsletter summarizing relevant legal developments, and all classes of members will receive the newsletter.

Full, supporting, and life sustaining members will also have full voting rights for the selection of trustees.

The Foundation has applied for tax exempt status, and a favorable ruling is anticipated within the next 60 days or so.

Membership applications have not yet been printed due to lack of funds. However, memberships are available at this time and requests for membership, accompanied by your check payable to the Personal Communications Foundation, may be mailed to the Executive Director, Carl Markov, 915 West Lancaster Boulevard, Lancaster, California 93534. The request for membership should include your name, address, telephone number and FCC Amateur or Citizens Radio Service callsign, if any.

Although legal and tax considerations require that the Board of Trustees be composed of lawyers and judges, membership in the various liaison and working committees is not similarly restricted. Anyone having or willing to develop the necessary background and devote sufficient time is welcome to serve on the committees. Membership applications sent to the Executive Director may also request committee membership. Requests should specify the committee desired and set forth any special expertise which will assist the Executive Director in evaluating such requests. Committee membership is open to all, but persons holding any class of membership in the Foundation will receive priority in committee assignments.

Contributions, requests for membership, and requests for committee assignments should be sent directly to the Executive Director. Requests for other information, comments or suggestions may be sent either to the Executive Director or to Jon J. Gallo WA6PTM, President and Chairman of the Board, Personal Communications Foundation, 1900 Avenue of the Stars, Suite 2000, Los Angeles, California 90067.

The Personal Communications Foundation has been formed for you. It can only function with your assistance. ■

TO: Personal Communications Foundation
c/o Mr. Carl Markov, Executive Director
915 West Lancaster Boulevard
Lancaster CA 93534

☐ Please send more information.
☐ I would like to be a member.

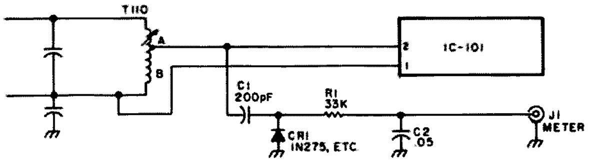
Enclosed is my contribution:
☐ Associate ($10) ☐ Supporting ($100)
☐ Full ($25) ☐ Life ($250 or more)

Name ______________________
Street ______________________
City ______________________
State ______________ Zip __________

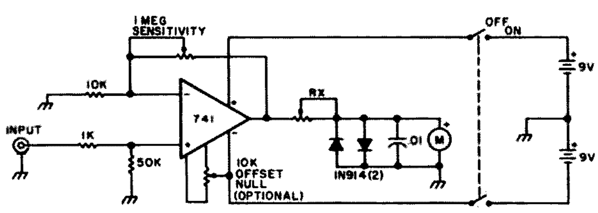
Personal Communications Foundation

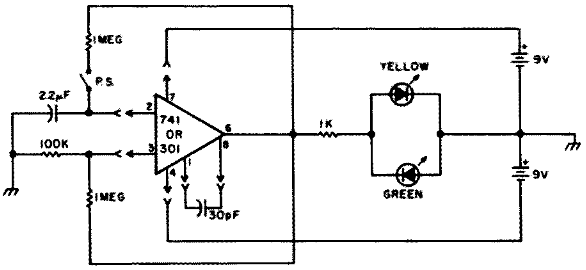
Circuits²

Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice.

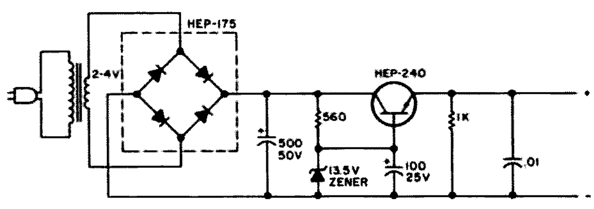


A relative signal strength meter for the GENAVE GTX-200 and GTX-10. This circuit is for a 25 uA meter movement, any style, which may be mounted external to the rig, or internally with a shoehorn (!). CAUTION . . . do not short pins 1 or 2 of IC-101 to ground or ZAP! Parts are mounted on the foil side of the board by short leads and a dab of glue. The meter lead goes to a phono socket on the rear panel under the power lead (for external meter). Be sure to use a shielded lead from the socket to the meter. If you have a meter with a less sensitive movement, say from 200 uA to 1 mA, the following amplifier circuit, wired in the meter case, will give you more than ample meter deflection with good dynamic range. $R_X + R_{meter}$ should equal 5000 Ohms. Add 10k offset null pot to 741 op amp if you want the meter to go to zero with no signal. Thanks to Larry Chrisman K9OXX (from State of the Arts, *Allen County ARTS, Ft. Wayne IN).*

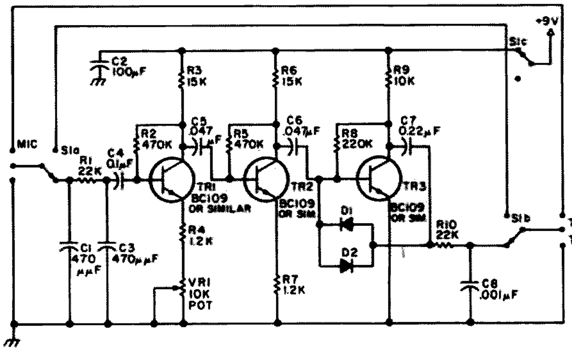




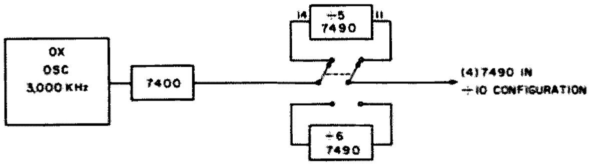
Here is a clever device to test those surplus 741 and 301 operational amps available from 73 advertisers. The two LEDs provide the necessary information when the op amp is inserted into the test circuit. If the op amp is OK, the two LEDs will flash alternately with a one second period. No flashing or illumination indicates an output fault. If one of the LEDs glows continuously, one of the inputs is faulty, and asymmetric blinking indicates a leakage problem. The circuit uses standard components throughout, and no power switch is required, as the circuit draws current only when an op amp is being tested. Thanks to J. Lawrence GW6JGA (from CQ-TV, *Journal of the British Amateur TV Club).*



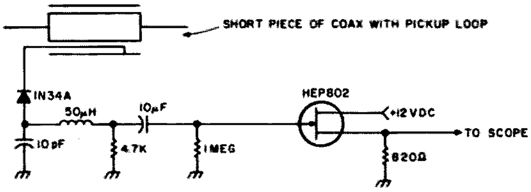
Need a simple regulated supply for your 2m rig? Try this one. The transistor may be heat sinked directly on the side of a minibox, and the transformer is any unit rated at five Amps and 24 V. Standard components are used throughout. This supply is humfree, and regulation is good — the output voltage varies only .2 V between transmit and receive. This supply is especially for smaller transceivers such as the TR-22C, used by many during relaxation TV sessions in the evening. Thanks to W8DYF.



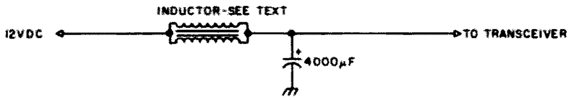
Speech amplifier and logarithmic clipper for use with SSB transmitters. The circuit reduces the speech bandwidth to about 500-3,000 Hz, thereby creating very little distortion. Power can come from the transmitter or a separate battery. Thanks to P. Burnett G4BLL (from The Short Wave Magazine, *August, 1976).*



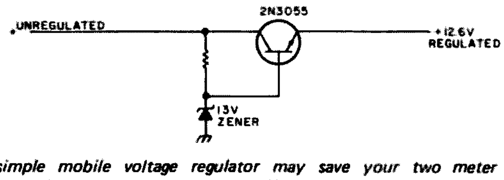
A selectable 50/60 Hz source for 12 or 24 hours with a 50250 clock chip. To have both in the same clock requires a source of selectable 50 Hz or 60 Hz frequency. A 3 meg xtal was picked because it seemed like a good choice, but a 30 kHz or 300 kHz would do as well (because when divided by 5 you get a 6 in the answer and when divided by 6 you get a 5 in the answer). Thanks to Frank W. Knottingham K7QCM.



Here's a quicky for ATV operators. This "air monitor" allows the monitoring of transmitted ATV signals with a scope. It is particularly handy in checking sync levels and shape. The pickup and detector can be mounted on a tiny PC board and installed in a minibox along the transmission line. The circuit can then be used to monitor the outgoing signal while adjustments to the modulator are made. Thanks to W3DID (from THE MILLIWATT, *a publication of the Baltimore Radio Amateur TV Society, vol. 1, no. 3).*



Bugged by alternator whine in your ham or CB transceiver? If so, try this super simple, but effective, whine filter. The LC circuit is a low pass filter which shunts the high frequency "whine" component on the dc to ground. The inductor consists of a 7 inch ferrite rod, ½ inch in diameter, wound with a single bifilar layer of No. 14 Formvar copper wire. The bifilar winding is formed by holding two wires side by side and winding the length of the rod. The two ends on each side are soldered together, resulting in an inductor capable of handling 10 Amps. The capacitor is a 4000 uF electrolytic. The negative end must be well grounded to the frame of the vehicle in order for the filter to be effective. Thanks to WB4EXW (from CVRA Repeater, *Journal of Carolinas-Virginia Repeater Association, Burlington NC).*



This simple mobile voltage regulator may save your two meter or CB transceiver if the voltage regulator fails. The 2N3055 should be heat sinked if current drawn by the rig is in excess of 2 A on transmit. This circuit will do little under normal operating conditions, but could save your rig if the vehicle's electrical system loses regulation. Thanks to WA2LPB.

W. J. Prudhomme WB5DEP
1405 Richland Ave.
Metairie LA 70001

Build Your Own Car Regulator

- - solid state

Many car owners, at one time or another, experience electrical system problems usually resulting from a dead battery. In many instances, the battery is blamed for the malfunction when, in actuality, the electromechanical type voltage regulator is the real cause of the problem. This is usually the case, even though the voltage regulator may appear to be functioning properly.

To understand why this happens, consider the fact that a properly charged and maintained lead-acid storage battery should last the life of your automobile. When an early failure occurs, it's usually due to the voltage regulator consistently undercharging or overcharging the battery in the system. In fact, more battery failures result from improper voltage regulation in automotive electrical systems than for any other reason.

Excessive undercharging will cause the battery plates to become covered with lead sulfate, commonly referred to as "sulfating." On the other hand, overcharging a storage battery raises the temperature of the electrolyte, resulting in extreme oxidation of the plates, which eventually crack or buckle. The end result of both of these improper charging conditions is the same . . . *a dead battery.*

Electronic Voltage Regulation

To overcome the above problems, it's necessary to regulate the charging voltage at the proper level. It's up to the voltage regulator to maintain the proper system voltage and, for many years, this task has been accomplished with an electromechanical device. The main disadvantages of these devices are voltage variations due to temperature changes, unadjustable voltage settings, and mechanical type failures.

Many auto manufacturers have recognized these problem areas and as a result are switching over to solid state designs. In fact, if you own a late model car, it may already have an electronic voltage regulator. However, there are still many cars in existence today with the old style electromechanical regulator. If yours happens to be one, you can easily update it with a precision, electronic voltage regulator.

For less than $10 in electronic components, you can build your own solid state voltage regulator that should outperform any electromechanical regulator on the market today.

How It Works

As indicated in the schematic diagram (Fig. 1), this solid state automotive regulator uses a minimum of components to achieve high performance without sacrificing reliability. The heart of the

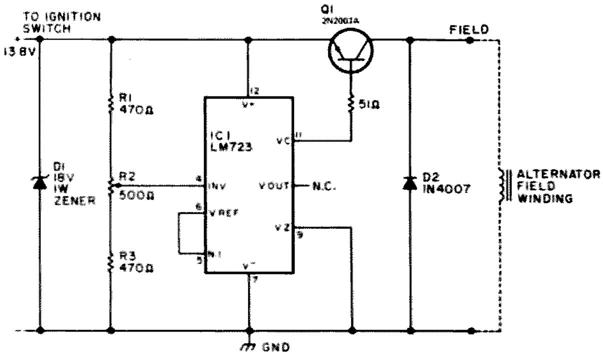


Fig. 1. Schematic. D1 — 18 volt zener diode, 1 Watt; D2 — 1N4007, 100 piv, 1 Amp rectifier; IC1 — LM723 voltage regulator (14 pin, DIP); Q1 — 2N2063A (SK3009) 10 Amp PNP transistor; R1, R3 — 470 Ohm, ½ Watt, 10% resistor; R2 — 500 Ohm, 10 turn trimpot; R4 — 51 Ohm, ½ Watt, 10% resistor; Miscellaneous — TO-3 transistor socket, 14 pin DIP socket, barrier terminal strip, TO-3 mica washer kit, PC board, minibox, optional relay (see text).

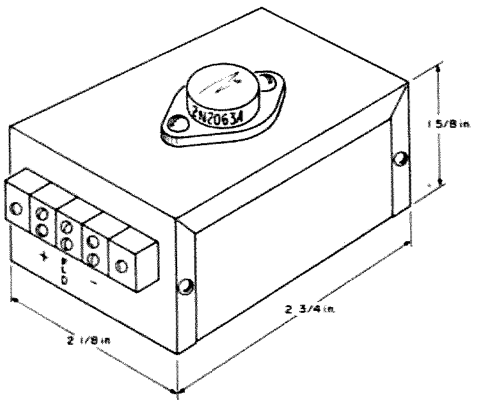


Fig. 2. Construction details.

unit is the LM723 precision voltage regulator IC, which is internally temperature compensated. This integrated circuit is connected as a switching type regulator to control current flow to the field of the alternator. Resistor R2 is adjusted to maintain a system voltage of 13.8 volts, the fully charged voltage of most standard car batteries.

If the alternator tries to produce a voltage above the set level, the LM723 turns off the pass transistor, Q1, thereby cutting off field excitation in the alternator. When this happens, the output voltage from the alternator begins to drop. As soon as the output level drops below 13.8 volts, the regulator turns the field current back on to raise the output voltage. This cycle is repeated hundreds of times a second to maintain the alternator's output voltage precisely at the set level.

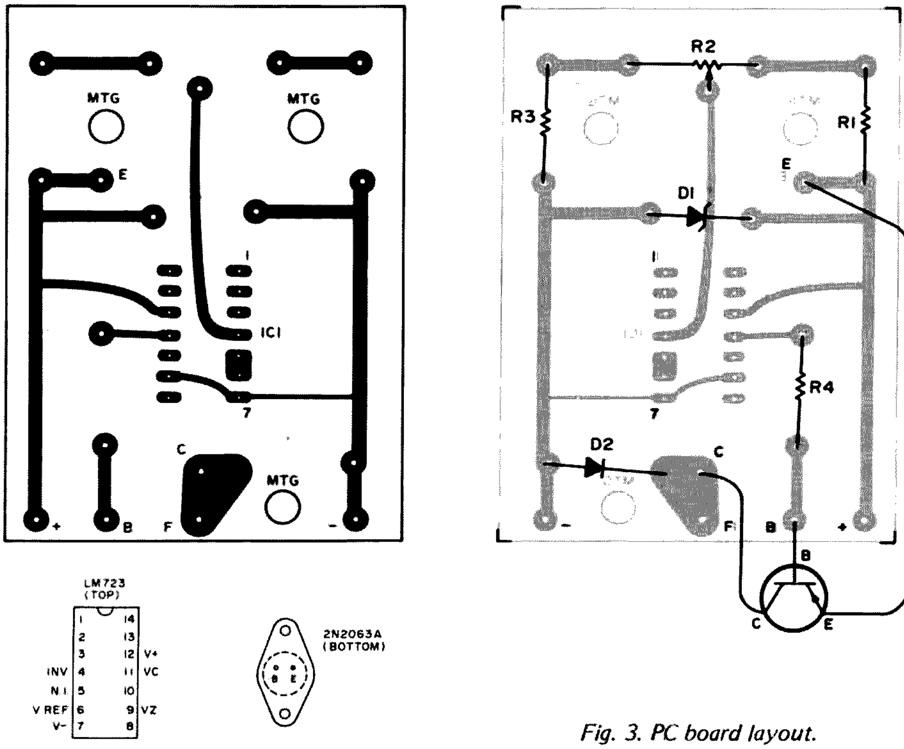


Fig. 3. PC board layout.

The external pass transistor, Q1, is required to handle the large field current of most alternators (approximately 3 Amps), since the LM723 has a maximum output current capability of 150 mA.

Construction Details

The solid state voltage regulator may be built in a small minibox (2-3/4" x 2-1/8" x 1-5/8") as shown in Fig. 2. Transistor Q1 is mounted on top of the minibox, which is used as a heat sink. Insulate the transistor from the metal case using a T0-3 transistor socket and mica washer kit. This is necessary to prevent the transistor's case (collector) from shorting to ground.

A barrier type terminal strip (3 terminal) is used to bring the BATT, GND and FIELD connections out. If a relay is required (see installation details), you may elect to construct the unit in a larger minibox to house the relay. Also, a six terminal barrier strip will then be required to make external connections to the relay.

In some installations, depending on the mounting location of the regulator, you may want to seal the enclosure for moisture protection. However, if the mounting location under the hood is carefully chosen, this should not be a problem.

The external pass transistor is not critical, and almost any 10 Amp, PNP transistor will be adequate. However, plan to use only a DIP version of the LM723 and not the T0-5 version. The reason for this is that the DIP version has an internal reference zener diode (Vz) and the T0-5 version does not. The T0-5 may be used, but you will have to add an external zener reference diode. Also, the printed circuit board layout (Fig. 3) has been designed for the DIP version.

How to Install Your Electronic Regulator

First, try to obtain a copy of the schematic diagram for your automotive electrical system. Most local libraries will have automotive manuals containing this type of information. You should become thoroughly familiar with this diagram before proceeding with the installation.

Referring to Fig. 4, determine which system best fits your own car. Four basic types of alternator systems are illustrated: Ford/Autolite, Delcotron/GM, Motorola/AMC, and the Chrysler/Plymouth system with an ammeter. With the exception of Chrysler/Plymouth, most systems will require an external relay to maintain the alternator charge indicator light function. However, if

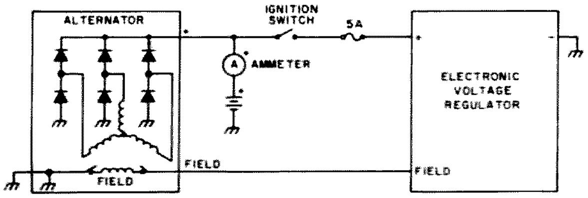


Fig. 4(a). Simplified diagram for a typical electrical system containing an ammeter in lieu of the alternator indicator light. This type of system does not require an external relay to convert to an electronic voltage regulator.

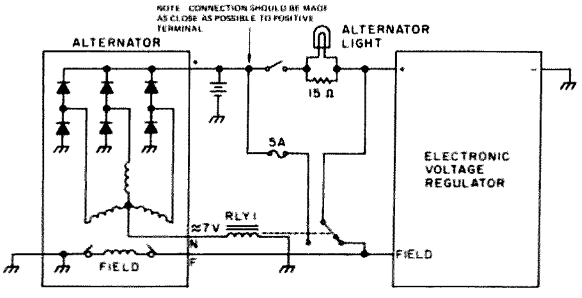


Fig. 4(b). Simplified diagram for a typical Ford electrical system with a charge indicator light. This type of system requires an external relay to maintain the function of the indicator light. RLY1 — any 6 volt relay with 3 Amp SPDT contacts.

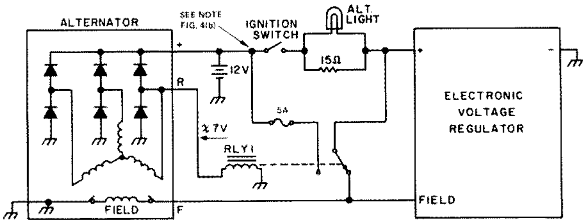


Fig. 4(c). Simplified diagram for a typical Delcotron (GM) electrical system with a charge indicator light. This system also requires an external relay if you want to maintain the function of the indicator light. RLY1 – any 6 volt relay with 3 Amp SPDT contacts.

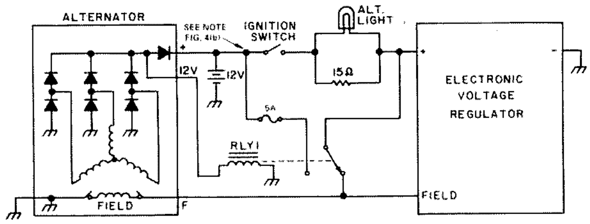


Fig. 4(d). Simplified diagram for a typical Motorola (AMC) electrical system with an internal isolation diode. An external relay will be required to maintain the function of the indicator light. RLY1 – any 12 volt relay with 3 Amp SPDT contacts.

you install an external ammeter, you can eliminate the requirement of the relay. Simply connect the regulator as shown in Fig. 4(a).

The next step is to find a suitable location under the hood to mount the electronic regulator. Preferably, this location should be near the battery and away from areas subject to moisture or excessive heat.

Disconnect the old regulator and mark each of the connecting wires for future reference, and use crimp-on connectors to connect the new regulator to the system. This will maintain the integrity of the original system connections should you ever want to convert back to the original configuration. If an external relay is required, mount it in a protected space, preferably with a dust cover or within the regulator enclosure.

After the unit is installed, recheck all wiring to insure that the system is properly connected. Before starting the engine, turn off all loads until the system voltage is properly adjusted and stable. After the engine is started, adjust the system voltage (with trimpot R2) for 13.8 volts at the positive terminal of the battery.

Check to see if the regulator is functioning properly by increasing the engine speed and adding loads to the system. The voltage should remain constant. Note: At slow idle, with loads turned on, the voltage may drop slightly, since the alternator is not producing at its rated output. At cruising speed, however, the correct voltage should be maintained if the system is operating properly.

Conclusion

This completes the installation and check-out of your electronic voltage regulator. It should provide many years of troublefree operation in addition to extending the life of your lead-acid battery.

As a final suggestion, you may want to monitor the system voltage on a continuous basis for the first few weeks after installation. If no problems are experienced during this initial trial period, it can be safely assumed that the voltage regulator is compatible with your particular electrical system. ■

Hart Postlethwaite WB6CQW
1811 Hillman Ave.
Belmont CA 94002

The HAPPY FLYERS

-- fun and public service

Few hams have operated any length of time without observing interference of some type. Whether accidental or intentional, it still has the same effect on a QSO (and our blood pressure). The need for devices and procedures to locate interference – and its interrelationship with finding downed aircraft – has revealed an unexpected opportunity for hams. About 5,000 volunteers are needed, plus the cooperation of many repeater groups across the nation.

Many stories have been passed from father to son and mother to daughter regarding the subtle sounds of opportunity knocking. With each story comes an imaginative narration of the consequences and/or blessings that occurred as a result of someone's reaction to the particular opportunity. Many of us have dreamed of that special opportunity that would open the door and make a dream come true.

In 1979, the International Telegraphic Union (ITU) will convene a general World Administrative Conference in Geneva, Switzerland. During the conference all the ITU rules, regulations, and frequency allocations applicable to the orderly use of the spectrum from 10 kHz to over 300 GHz will be examined in detail – and this includes the amateur radio service. In light of their voting structure, many knowledgeable hams are concerned about the outcome of this conference. The performance of some U.S. amateurs during emergencies (the Guatemala quake) and their daily operating practices leave something to be desired if we wish to make a good impression on our valuable voting friends in the ITU. On the list of attributes most likely to influence friends and votes: bad manners, poor operating practices, excessive power, and intentional interference.

It was the increasing problem of intentional and accidental interference that led the HAPPY FLYERS to the door of opportunity that now awaits opening by all U.S. amateurs everywhere (HAPPY stands for "Hams And Pilots Piloting & Yakking." – Ed.).

Our first two years were spent in organizing, recruiting, bimonthly fly-ins, our annual fund-raising "Flying Poker Party" (pick up a playing card at five airports – best hands win numerous donated prizes), public service flights, transporting hams and families in emergencies, and flying in Civil Defense drills. The number in Squadron #1 had nearly reached 200 when jamming became a severe problem on our local repeaters. Somewhere around the same time, Congress passed the ELT (Emergency Locator Transmitter) law for all U.S. aircraft. They failed, however, to make proper provision for finding downed aircraft fortunate enough to have a squawking ELT and a survivable crash.

It was the culmination of all these events and facts that caused me to accept an invitation to attend a meeting of the San Mateo County Sheriffs Air Squadron. Word was out that they had a state-issued RDF unit to issue to the proper pilot for installation in his plane. He would be the official search pilot for the county. I was greatly interested in the possibilities of adapting this special equipment to the 2 meter FM band, in order to locate jammers.

The long and short of it is that I acquired the job and the unit. Jim Williams K6HIO and I took it apart before installing it in our plane. We made numerous test flights on the amateur and aircraft frequencies. To our amazement, no modification of the state unit was necessary, provided we kept the FM rig out of saturation with a step-attenuator. We found all signals we looked for in the experimentation. The first real test was the Western States Sheriffs ELT search competition. Deputy Don Short and I located the signal in 6 minutes. I won 1st prize – and then was barred from all future electronic search competition (due to our excessively rapid find compared to the competition). Our first real plane wreck took 16 minutes from signal contact. Later, we believe we located the first jammer by airborne RDF – 22 minutes flying time straight over his house (Don Smith W6NKF, Vice Commander, Squadron #1, Dick Smith WB6WPZ, and Art Sinclair W6FKQ were at his door within the hour).

We soon developed our own inexpensive RDF printed circuit boards – one for simple AM and one with an automatic attenuator for FM/AM. We were all set to end jamming in our area. Soon many units were being built, and the jamming was shortly cut about in half (apprehension capability has a decided effect on jammers).

Then we began to see the problems in the ELT program. Poor construction standards of the first ELT units caused so many false alarms that the program went into almost immediate disrespect. Real accidents often failed to trigger the ELT, and those that did were not found easier. Few people had RDF equipment, and many who did were unable to find the signals due to their lack of understanding reflections, multipath, and the operating characteristics of the new

equipment. Experienced hams had little trouble, but seasoned pilots trained to fly low and look could not make the fool things work properly (but then that's another story we usually cover in our free RDF seminars).

As time passed, more and more problems began to surface. The HAPPY FLYERS had already begun their free RDF seminars for pilots and hams. Then a plane crashed, two miles from at least 5 ham repeaters and within VHF range of at least 5 FAA facilities that should have heard the ELT. Twelve hours elapsed before they were found. The *Oakland Tribune* reported that they were found by teenagers by accident – not by modern RDF or search personnel. Subsequent investigation turned up the fact that the FAA has officially ceased monitoring the 121.5 emergency frequency in many metropolitan areas, due to the numerous falses and tests.

We had been working on remote RDF for our repeaters to quickly locate jammers. When I read how one survivor was pinned, bleeding in the wreckage, with his brother thrown clear and unconscious, I thought about what a shame it was that we didn't have the remote RDF finished and a command at the repeater to switch to 121.5 for DF. This incident began a fabulous series of events.

Members of Squadron #1 turned their efforts from the jammers to an analysis of ELT problems. We sought input from other hams and HAPPY FLYERS through our regular column in *Worldradio News.* What we came up with is the outline and nucleus of a proposal that could save the future of the ELT program, save untold lives, and give amateur radio operators, their equipment, and their ingenuity a needed boost in the eyes of the general public (and the WARC for the '79 conference).

Opportunity knocks loudly at your door. We can save lives, save a worthwhile ELT program, save billions of dollars in search and satellite funds, restore 121.5 to its useful emergency value, impress the public, and prove beyond the shadow of a doubt that we are capable of providing services for free that are not presently available by any other means. In addition, the equipment is usable on the ham bands and will give instant readout to buttonpushers and jammers. Interested? Read on.

The artist's conception drawn by our International Vice Commander Paul Hower WA6GDC shows a broad integrated ham monitoring proposal. It is a simple and logical approach originally envisioned as an areawide, interclub plan to obtain instant bearing information on jammers through the use of our HAPPY FLYERS remote RDF and an organized intergroup coordinator. Due to the design of our DF device, we can get instant readout to even a "buttonpusher."

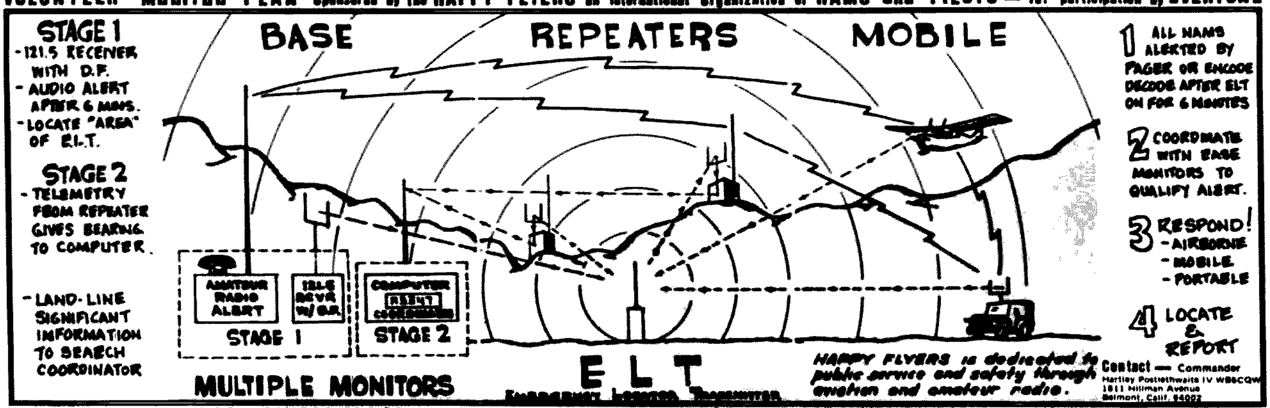
We presented a general outline of our plan to Rick Goodman, Vice President of the National Association of Search and Rescue Coordinators, at their '76 convention in Cheyenne, Wyoming. Rick, an active Albuquerque ham, informed me that his repeater club had already installed a 121.5 receiver at their repeater. He was greatly enthused about the comprehensiveness of our plan. They had no time-lockout and were rebroadcasting the ELT tones as the alert. They are now incorporating our ideas into their system. His ham group had made a terrific sound/slide show on amateur participation in search and rescue. We purchased a copy, added slides and sound covering our proposal, and are showing it in our RDF seminars and at civic groups – Rotary, Jaycees, Lions, etc. – a tremendous PR boost for amateur radio. Our group has the motto, "There is no limit to what you can do if you don't care who gets the credit." It is a great pleasure to work with people like Rick, Ray Andrews K9DUR, Bruce Gordon of CAP, Bob Kolsters, Commander, Western States Sheriffs, and our international squadrons of hams and pilots, the HAPPY FLYERS. Everyone will have to work together on a local scale, but within a national set of standards and guidelines for the program.

Due to the construction delays expected, we plan to set up the ELT Monitor Program in two basic stages. The first stage might be described as the "Alert and Elimination" stage, as shown in the drawing. Used commercial tube receivers are being made available to hams by a nationwide aircraft radio company through the HAPPY FLYERS. These receivers will be distributed to repeaters and to volunteer low band hams who live in remote wilderness areas not covered by repeaters, FAA, or military facilities.

We then hope to secure volunteers who live near the nearly 5,000 U.S. airports, to get inexpensive 121.5 receivers. Repeater and individual receivers will be equipped with a time-lockout decoder (such as the one designed for the HAPPY FLYERS by Jim Williams K6HIO), to prevent false alarms by voice communications or ELT tests. ELT tests are authorized by law, the first five minutes of every hour. The lockout decoder (parts cost under $5) will be set for about six minutes to eliminate additive individual

Nation-wide E.L.T. Program

VOLUNTEER MONITOR PLAN Sponsored by the HAPPY FLYERS an International Organization of HAMS and PILOTS — for participation by EVERYONE



STAGE 1 - AREA WIDE MONITOR PROGRAM

1. Exsisting Ham & CAP repeaters install 121.5 receivers with special time lock-out decoder to by-pass ELT test period and voice communication for 6 minutes. This provides high level, wide area coverage, thru thousands of exsisting repeaters.
2. Low-band Hams and interested citizens would install low cost monitors in homes in remote wilderness areas not covered by repeaters, FAA, or military facilities.
3. Every airport in the Country to hove an individuol volunteer monitor with same lock-out decoder. Receiving range cut to hear only one Airport. Purpose of these monitors to immediatly localize false Airport triggering of ELTs.
4. When 6 minute test lock-out exceeded, repeaters to generate emergency tone (2000 and/or 200 cps) to "Silent Monitor" decoders and paging receivers alerting Search and Rescue personnel and Coordinators alike.
5. Proper coordinator will assemble information from repeater and individual monitor reports. Airport falses would be immediatly identified by Airport volunteer.
6. Individual alert of all SAR personnel via wide coverage repeater tone-alert will cause pilots and ground crews to remain available while validity of emergency is verified by coordinators. Call-up can be accomplished thru repeaters or phone. Acquiring crews at odd hours will be greatly simplified.
7. SAR personnel can be reached at social functions, work, in car, or during sleep hours via extensive coverage of repeaters and use of its tone alert. Airborne search pilots would also be able to be contacted. TIME SAVED, SAVES LIVES.

STAGE 2 - ELECTRONIC DIRECTION FINDING

1. Remote RDF capability will be added to repeaters and be available an command of coordinators. Bearings from two or more repeaters will be plotted for probable area of trouble. Low cost tone telemetry has been developed for this.
2. Remote individual wilderness monitors will add low cost RDF to supply bearing information with reports via radio or telephone.
3. Airport monitors will odd portable RDF capability & assist in locating offender.
4. Hams to assist in equipping more planes with low cost RDF capabilities.
5. Computer equipped Ham repeaters will inter-link for rapid calculation of more precise intersections of multiple bearings.
6. Continue free educational Seminars for Hams, pilots and other interested people.
7. Encourage pilots to report their own accidental triggerings (to cancel searches)
8. Encourage more pilots to monitor 121.5, in flight, and at shut-down.
9. Continue conducting free check rides for pilots & observers in RDF techniques.
10. Issue gold embossed DF rating cards for passing writen & flight/ground checks.

ADDITIONAL PROPOSED GOALS

1. Visit with Congressional leaders, FAA, FCC officials to effect necessary changes.
2. Establish a legal proceedure to silence illegal ELT transmissions.
3. Provide Scott AFB with current lists of volunteers, capabilities, and locations.
4. Continue to seek donors of used commercial equipment, receivers, pagers, etc. to minimize overall costs to SAR volunteers in the program.

tests which would be possible with monitors who may have many airports in their receiving area.

ELT signals exceeding six minutes will trigger a tone oscillator (suggested frequencies are 2,000 and/or 200 Hz) which can be decoded by silent monitor tone decoders and belt paging receivers of participating search and rescue personnel – hams, volunteers, FAA, CAP, and Official Area Coordinators.

The elimination process will be automatically started by the tone alert. Participating airport volunteers could report to the coordinator an "all clear" or "I hear it." In less than 30 minutes, all airports would be checked. 100% "all clear" would signify a possible valid emergency. Repeater coordinators from various high location repeaters would then be polled and a second elimination process would give the general location by absence or presence of the ELT alert tone.

Little imagination is necessary to see the many benefits of stage 1 – high level monitors, airport monitors, wilderness monitors, personnel notification, general search area probabilities, 24 hour reliability by the silent monitor and lockout timer, rapid response, multigroup participation, favorable ham PR with the community, further evidence of the value of the amateur bands and the technology that has historically shown that hams can often fill design gaps.

Stage 2 will add RDF (Radio Direction Finding) capability to repeater and individual monitor stations. Computer-equipped repeaters will link for automatic processing of bearings. Hams will help train non-electronically oriented pilots and search personnel in the techniques of transmitter hunting (present airborne RDF equipment is now accurate to a couple of feet at crossover). Hams will continue designing the special electronic devices needed (like the VOX audio repeaters designed by the HAPPY FLYERS and Rick's New Mexico group).

As you remember, I mentioned earlier that this all ties in with our jammer problem. The same DF equipment will work on ham, aircraft, and marine frequencies. We will have an established interclub group, with equipment, procedures, and skills sharpened by experience. We will have assistance from other groups (members of Western States Sheriffs Air Squadrons have volunteered to assist in airborne jammer hunting with their ELT RDF units). Jammers think twice before pushing the button when the chances of being caught are high. You don't park in the same illegal parking space if you get a ticket every time.

Where do *you* fit in? Each area will need to set up its own program. This means leaders, workers, builders, listeners, donors, and equipment. You have the choice as to how much you can or will do to further this program. The HAPPY FLYERS is an international volunteer organization of hams, pilots, and flyers (those interested in flying but not necessarily hams or pilots). We are a no dues, no fees organization, with no paid employees.

Due to our nonprofit structure and our no staff operation, we hope to see as much accomplished at the local levels as possible. We will provide information and all other help possible. A self-addressed stamped envelope on all correspondence will be greatly appreciated – both from the time and money standpoint. As you begin to organize, we will need to know who is in charge of the operation in your area. As we receive word that used commercial equipment becomes available either through donors or at drastically reduced prices, we will need to know whom to pass the information on to. Many companies would rather not be bothered by calls from individuals, but will make master arrangements with groups like ours. Our thanks to those who have already called.

As you can see, we are really "into" this. I think you have the main ideas. Your suggestions are also solicited. You've got the ball – do something with it. ■

John H. Nelson
4 Plymouth Drive
Whiting NJ 08759

10 and 11 Meter Predictions

- - buy your stock now

For the past several months, I have been planning to write an article on the next sunspot cycle (which, by the way, appears to have started last November, very slowly) and its effect on CB radio. But prudence has held me back. I have lived with the sun through three high sunspot periods as the Propagation Analyst for RCA Communications and have learned to have a great deal of respect for the whims of this great ball of atomic fire. However, I have today thrown caution to the wind and have decided to go through with it. Some stories that have appeared in newspapers and magazines recently are responsible for this change of mind.

The stories that I have read were telling the CBers that their band (11 meters) is likely to be in a shambles during the next sunspot high due to long distance co-channel interference on account of sunspots and that the CBers will be all fouled up. I do not agree with this pessimistic view. If the forthcoming high was going to be like the high we had in 1957-58, I would tend to agree with them somewhat, but I do not think that it is. In fact, I expect the next high period, which should run from 1979 to 1982, to be the lowest we have had since the early 1800's.

I estimate that the yearly mean of the forthcoming cycle high of 1979-82 will be about 20 to 25 spots higher than the cycle high that took place between 1802 to 1805. I have increased the number by 20 to 25 because the astronomers will probably count more spots today with better telescopes than the astronomers did in the early 1800's. The comparison is given in Table 1.

My own experience with sunspot numbers and frequency variations has indicated to me that a count of 90 to 100 is necessary to bring the 10 and 11 meter band into operation *with any degree of consistency*, although temporary bursts of sunspot activity can bring it to life for shorter periods of time. Old time hams are, of course, well acquainted with the relationship that exists between sunspot numbers and the maximum usable frequency (MUF), and no doubt many of the CBers are also, but for the benefit of those who do not know this, perhaps a few words of explanation are in order.

Ultraviolet radiations from the sun create and sustain the ionosphere, which makes it possible to communicate over great distances with high frequency radio (HF). Since sunspots radiate very strongly in UV, it stands to reason that the more sunspots the sun produces, the stronger the ionosphere will be. A strong ionosphere will reflect back to earth the higher frequencies and, if there are enough of them, the 27 and 28 MHz band of frequencies (10 and 11 meters) can be used for communication over vast distances – often six to eight thousand miles. And this they can do with very low power. When sunspots are scarce, these frequencies are usually good for short distances only.

When operational, the 10 and 11 meter bands of frequencies are at their best when the sun is shining on both the transmitter and the receiver at the same hour. They are rarely useful for long distances when a part, or all, of the ionosphere is in darkness between the transmitter and the receiver. In addition to a sunspot number effect upon the MUF, there is also a very pronounced seasonal effect. For any given sunspot number, the ionosphere will reflect a higher frequency in December than it will in June . . . all the winter months are higher than the summer months.

I have the actual frequency records on commercial radio circuits for June and December, 1968, wherein the highest useful frequency was recorded every two hours of the day. June, 1968, had a mean sunspot number of 110 and the average of the highest frequency useful during the daylight hours was 22.2 MHz, while in December with a mean sunspot number also of 110, the average of the highest frequency useful during daylight hours was 25.3 MHz. In June, the highest frequency during the month was 26 MHz, and that appeared for only one day. In December, the highest frequency was also 26 MHz, but was useful for 18 days. These recordings were taken on high speed commercial circuits working at 240 wpm (four 60 wpm teletypes on multiplex) and had to provide good copy for several hours per day. Circuits with less stringent performance parameters could be used above 26 MHz; therefore, we can say that 26 MHz was not the full MUF, but it was close.

We will now pick a year with about 70 sunspots in December and analyze that for the December frequencies under these sunspot conditions. The sunspot number records show that December, 1966, had a sunspot count of 70. My frequency records show that the monthly average of the highest frequencies used was 21.5 MHz, with 24 MHz being the highest, but it appeared for only one day during the month. The next highest was 22 MHz, which appeared in the records for 16 days. This gives us an idea of what to expect during the winter months of the next sunspot high if my predictions are right.

An interesting comparison can be made for December, 1957, with a sunspot number of 239. The records show

RECORDED		PREDICTED		COMPARED WITH 1958 HIGH	
Year	count	Year	count	Year	count
1802	45	1979	65-70	1956	142
1803	43	1980	63-68	1957	190
1804	48	1981	68-73	1958	185
1805	42	1982	62-67	1959	159

Table 1.

that the monthly average of the highest daylight frequency observed was 27 MHz. The highest frequency observed for the month was 28 MHz (the ham band frequency of 28 MHz was checked every day to see if it was there). We had no way of knowing what the real MUF was, however, because of frequency limitations. Also, these observations were made on east-west transatlantic circuits.

A ham friend of mine read this manuscript up to the end of the preceding paragraph. When he had finished, he turned to me and said, "Well, what's it gonna be? You forecasters are all alike – ambiguous and evasive, nobody can pin you down." (This fellow was an insurance agent – imagine an insurance agent calling somebody else ambiguous.) He told me to put my neck on the block. So here it is, October to February, 1979/1982, daylight paths only on east-west circuits:

A. The 10 meter band (28 MHz)

This band will be spotty, coming to life with periodic bursts of sunspot activity. Far below 1958 and 1968 qualities.

B. The 11 meter band (27 MHz)

The CBers will not have any important co-channel interference problems (unless somebody decides to put his on a high gain antenna).

C. The 15 meter band (21 MHz)

This band will be the workhorse band for DX.

D. The 20 meter band (14 MHz)

This band will also be useful as a secondary workhorse band and with performance pretty close to that of the 15 meter band.

Forecast completed December, 1976. ■

BE MY GUEST

visiting views from around the globe

from page 11

had, along with a good idea of how his rig could be identified (off frequency, lousy quality, and cold solder joints).

Sorry, Dave; just kidding.

It turns out that Dave's follow-through was of great interest to the police in Hanover. It appears that the "Bad Guy" was a suspect in a number of unsolved cases, and they had never had enough evidence to search his home. With the information that Dave and the 07/67 "Mission Impossible Team" furnished, a Heathkit two meter rig was recovered, along with a few CB rigs and a stolen gun. I understand the investigation even led to recovery of several thousands of dollars of household items and put an end to a housebreak ring in the South Shore.

So to those of you who may encounter a "breaker," play it cool . . . give him the low key approach, and then pass the information along to the proper authority. Who knows, you might catch a thief . . .

By the way, the 2,000,000 to 1 odds did pay off. It was Dave's rig and he has it back on the air (except for when he leaves his car, he is the guy seen wandering around the South Shore with a Heathkit under his arm).

Breaker, breaker six . . . 10-4, good buddy.

Bandwidth Revisited

It appears that the FCC is at it again. The controversial "bandwidth" proposal, Docket 20777, has been shelved for the present time. FCC Chief Engineer Ray Spence indicated to *73* that a large amount of amateur interest has been generated by the proposed docket. This proposal would have, among other things, excluded AM from segments of the low bands and restricted bandwidth in the 420-450 spectrum to 35 kHz, thus banishing ATV as it now exists.

Spence indicated that a large amount of the comments were critical, especially those from the ATV enthusiasts. It was indicated that the FCC will develop another proposal concerning bandwidth; however, Spence said it would be "quite a while" before action is taken.

73 has received a considerable amount of input from interested hams concerning the bandwidth docket. Much, much more data is required, as we are being given a golden opportunity by the FCC to create our own proposal concerning bandwidth and the whole general topic of amateur radio deregulation. We at *73* are prepared to act as a clearinghouse for comments, proposals, and suggestions relating to amateur deregulation. The bandwidth question is presently the hot subject. However, please do not overlook other aspects of deregulation, such as repeater rules relaxation. (Refer to this month's "Briefs" in *73*.) Let's get going! Talk up deregulation and bandwidth proposals at club meetings and over the air — the ball is back in our hands. Organize your thoughts on paper, and send them to *73*.

A questionnaire is being prepared by the *73* staff concerning repeater coordination, deregulation, and bandwidth. This will initially be sent to those who originally commented on 20777. Repeater coordinators will also receive a form, as well as the clubs listed in our files. Any individual or club requesting a questionnaire should write *73*, marking the card or letter "Bandwidth Questionnaire."

In a few weeks (time is short), we will compile a proposal based upon your suggestions. This will appear in *73* and will aid us in our conversations with the FCC. Start planning!

John Molnar WB2ZCF
73 Magazine Staff

Amateur Antidote

"Break . . . Emergency . . . ZP5NP." That distress call broke into what had been an ordinary day for amateur George B. Riley, who was on a QSO with several other hams in the Virgin Islands from his home in Linden NJ.

Riley, an engineering supervisor at WOR-TV in New York City, became a link in a communication chain to the Food and Drug Administration's National Clearinghouse for Poison Control Centers in Bethesda MD.

ZP5NP was Paraguayan Army Sargeant Nelson Guadalope, who was attempting to connect with any American ham who could reach proper medical authorities to aid in treating a six year old girl who had swallowed a chemical herbicide known as Tributon.

A local doctor had originally treated the girl for a severe cold. Only after she had become gravely ill had the doctor discovered that she had drunk the poison. The doctor needed information about the ingredients in Tributon and was unable to get it locally. So he turned to the U.S. for aid.

While still in contact with ZP5NP via another amateur in the Virgin Islands, Riley was able to contact the FDA's Division of Poison Control where pharmacist Larry Trissel had just reported for duty. Trissel consulted his index cards where products are listed alphabetically by brand or generic name. After some initial confusion over the spelling of the product, the ingredients and proper treatment were found.

Only about ten minutes had passed between Riley's original call to the hospital and the prescription of treatment. However, transmission difficulties delayed the relay of the information to Paraguay by almost an hour. Nevertheless, the information was received in time to save the girl's life.

Riley later received a letter from the U.S. ambassador thanking him for helping in the girl's recovery. Through Riley's efforts, amateur radio received valuable publicity.

James Wilson

Reprinted from The Catholic Digest, *January, 1977. The article originally appeared in the* FDA Consumer.

Trevose Tower - Plus Eight

It was back in June of 1969 that Preston Funk had his famous tower built in his backyard at 4860 Magnolia Avenue in Trevose.

The tower is 229 feet tall. It has become a landmark in more ways than one in the nearly 7½ years since it was constructed.

It seems as though there have been as many hearings to decide what to do about the tower as there are feet in its height.

A neighbor of Funk's started a long list of complaints shortly after the tower was finished and Funk began using it for his "ham" radio operations.

The neighbor complained he was receiving radio signals from Funk's station over his home radio, television set, and telephone.

The Federal Communications Commission got into the proceedings. The FCC suggested a complaint also be filed with its office in Philadelphia. The FCC also told Funk's neighbor that a filter of the proper kind installed on the TV set would eliminate the interference.

20 Meetings

In the first year, there were more than 20 meetings held by Bensalem governing bodies in an attempt to clarify the situation. That number has doubled.

There are more than 90 stories in the files of the Bucks County *Courier Times* concerning the tower since it was completed around June 25, 1970.

On March 25, 1970, the Bensalem Township Zoning Hearing Board ordered Funk to take down his tower.

As anyone who has driven by the imposing structure lately can see, it still is there, poking its way into the sky.

In May of 1974, a Bucks County Court ruled against Funk's appeal in March, 1970, agreeing with the Bensalem zoners that the tower had to come down.

He followed his defeat in the Bucks court by appealing to the Commonwealth Court of Pennsylvania. In February of 1975, the state court, too, ruled the tower should come down.

Helping Victims

In between the two court rulings and appeals, Funk's ham radio station proved its worth.

When Hurricane Agnes brought the state's worst flood in June of 1972, hundreds of people made use of Funk's ham radio facilities to send messages to relatives in the flood-stricken areas.

Later, when earthquakes devastated Managua, Nicaragua, Funk again acted as a go-between for messages to and from the stricken area.

Meanwhile, new homes have gone

up on Magnolia Avenue. One of them is directly across the street from Funk's tower. Mr. and Mrs. Edward H. Kolb live there.

Mrs. Kolb said today, "We moved from Philadelphia about a year and a half ago. I see the tower every day. It's right across the street. But it doesn't bother me. And we haven't had any interference problems on our television or radio."

A few houses down the street, Charles W. Conley echoed Mrs. Kolb's remarks. "No, we haven't had any trouble, either. The tower doesn't bother me at all."

Hearing Rescheduled

Last night, the Bensalem Township Zoning Hearing Board scheduled another meeting to hear Funk's bid for a variance that would allow his tower to remain up, despite the adverse rulings by the courts.

This hearing was postponed from April, scheduled for May, when it was postponed again — until last night.

Two members of the board couldn't make the meeting. So, once again, a decision on Funk's tower has been put off.

On hand last night were a lawyer or two, a reporter, a couple of persons who had other business to transact with the zoning board, but no spectators.

It would appear Preston Funk and his tower have outlasted the opposition. After 7½ years, even Muhammad Ali would get weary of battling the same foe.

Reprinted from Courier Times, *Bristol PA, November 18, 1976. Thanks to* X-MITTER, *Journal of the Penn Wireless Association, Bristol PA.*

LF-Still Many Questions

Simultaneous observations by three satellites have confirmed that long waves in the earth's magnetic field, which spread the disruptive effects of magnetic storms on earth, are generated far out in space by energetic particles from the sun.

Drs. Joseph N. Barfield of the National Oceanic and Atmospheric Administration, R.L. McPherron of the University of California at Los Angeles, and W.J. Hughes of London's Imperial College, reported the results of their satellite measurements at the fall annual meeting of the American Geophysical Union in San Francisco early in December.

They found that the low frequency waves are generated by the solar wind, the constant stream of energetic particles that flows outward from the sun. When the solar wind strikes the magnetopause (the boundary where the earth's magnetic field loses its dominance and bows to the sun's), it generates waves in much the same way as wind does over water, according to Barfield. These waves travel earthward, enter a "resonant region" where they are amplified, and propagate down to the ground. In ways that are still poorly understood, they are involved in magnetic disturbances, which disrupt communication and power transmission on earth.

But they also have some pragmatic uses, in oil and mineral exploration. By monitoring the waves as they travel through different spots on earth, prospectors can learn something about the substructure, such as the location of ore bodies. Paradoxically, the waves may also aid communication. Since they penetrate the ocean, they may someday be used to communicate with submarines, which now have to surface to make contact.

Hughes, Barfield, and McPherron detected the waves from magnetometers aboard three satellites in synchronous orbit 22,200 miles (35,720 kilometers) above the earth, the first time several satellites had been used to make such measurements simultaneously. The environmental satellites SMS-1 and SMS-2, and ATS-6, a research satellite, are in a line along the earth's equator, each orbiting at a speed that keeps it poised above the same spot on earth. Hughes, Barfield, and McPherron used this satellite arrangement to determine the origin of the electromagnetic waves.

The magnetopause curves around the sunward side of the earth, with a "nose" pointing toward the sun. The three space scientists predicted that if the low frequency waves were generated at the "nose," as they believed, the first satellite to detect the descending wave front should be the one closest to the sun at the time. They found that the wave front did pass each satellite in the predicted order.

The satellite measurements also showed how the waves are amplified and propagated, according to Barfield, a researcher with NOAA's Space Environment Laboratory (one of the Commerce Department agency's Environmental Research Laboratories). Originally, it was thought that the lines of force of the earth's magnetic field would vibrate like a guitar string, setting up the waves.

Early ground-based observations also had suggested that as a wave generated at the magnetopause travels inward toward earth, its amplitude decreases until it reaches a certain altitude, a "resonance region," where it is amplified.

The three satellites are located right at this resonance region. "For the first time we could look at things right where they were happening, with multiple probes," Barfield said. Measurements from the satellites confirmed the existence of the resonance region by observing the change in amplitude of descending waves. The "guitar string" theory was not all wrong, but the waves do not originate at a magnetic field line; they are amplified there. "A wave travels earthward until it finds a magnetic field line that responds to the particular frequency of the wave," McPherron explained. This is the resonance region.

The scientists used the amplitude changes of the waves to infer some of the characteristics of the resonance region. By noting how changes in amplitude of the waves differ between the satellites, the researchers found that the resonance region is very narrow on a magnetospheric scale — about 750 miles (1,200 kilometers) thick.

The next step in the research, according to Barfield, is to look at the characteristics of the waves; what are the spatial limits of where these waves occur and how do they relate to local features of magnetic disturbances?

The scientists hope to study the wave frequencies to learn something about how matter is distributed along magnetic field lines. First, it is necessary to calibrate the waves—to learn what different wave characteristics perceived at earth reveal about what is going on farther out in space. For that, the satellites, with their direct measurements, are needed. But later, it may be possible to use the waves that reach earth to study the magnetic field thousands of miles above.

Louise A. Purrett
Boulder CO

On the Verge

The other day, listening on 75 meters, I came across a QSO that really jostled me. Two fellows were discussing the "sorry" state of ham radio. "All I do is work the same people, night after night," said one guy. His buddy replied that he "was having more fun on the way to work in the morning on the CB band." I've been listening to those two for years, and they never leave 75. Night after night the same QRM, the same dull conversation, and the same holding pattern.

It made me a little angry to hear them blaming ham radio for their fading interest. Neither of them (as near as I can tell) ever venture off 75, and until a year ago, they were running AM day and night, with the expected results. When the going got tough, they just kept on transmitting, carrier and all, trying to cover the 30 or 40 miles between them on a frequency filled with 9s and 5s. I guess it never occured to them to QSY to 10 or 15 when nighttime conditions on 75 got too rough. Or, how about VHF . . . couldn't they make it on 2 meter direct?

The real hangup these fellows seem to have is no interest in trying some of the other activities ham radio has to offer. Neither of them apparently realizes they could listen for OSCAR, and key a 2m HT to get into it. They probably never thought of running QRP, or trying 160m, either. And they both will probably continue until their dying gasps, squeaking out 50% QSOs on 75.

There has to be a way to save these guys. Otherwise they will be lost forever, just like those 64 thousand some odd satellite frequencies lost in the last WARC. Maybe we're too involved in pulling new amateurs into the fold, and are passing by hundreds of old-timers who've been buried in new technology.

When I think of all the things those two are missing out on, I feel kind of sad. It's the same feeling I have when I think of 19 CBers in the Baltimore-Washington area facing federal charges, because they tried the easy way into ham radio. The HFers, as they call themselves, may have the upper hand in numbers (when you consider the meager forces of the FCC). But sooner or later they will be caught, and I wonder how many Novice or other class amateurs will be among them.

The SSB outlaws and 75m hangers-on both have the same problem. Their collective lack of incentive must be a reflection of their lives. They stand on the verge of all ham radio has to offer, but take the easy way out . . . whether it be complacency or lawlessness. Think about it.

Warren Elly WA1GUD
Associate Editor

LETTERS

from page 111

ability of 30-50 MHz commercial equipment, I'd like to see more activity on this channel.

I've been monitoring 29.6 for the last 3 years, and I can tell you that 10 is open much more often than most hams believe. How about it OMs? More 29.6!

Michael R. Downing WB6OIM
Canoga Park CA 91306

A LITTLE PUSHING

I would like to take this opportunity to commend the author of "Hutchinson's Remedy," an article which appeared in the Holiday issue of this magazine. VE3CWY did an excellent job describing his cure to VFO chirp. The article was concise, explanatory, and interesting to read.

It seems this article could be a hit with those who don't like to use ICs and other solid state components, yet want to cure their home brewed VFO of chirp.

This is the type of article I believe will be popular among some *73* readers, who want practical applications for these new ICs, etc., to make them use them — I know I am one who needs a little pushing in this direction.

John Pilson WA1UZK
Saunderstown RI

INSPIRATION

I want to thank you for sending me your recent advertisement. It has inspired me anew.

For years now I have neglected my ham radio hobby, yet I continued to pursue studies of electronics which opened the door for a very rewarding career. I owe it all to a couple of "old hams" and publications such as yours for sparking a desire within me to want to know!

Now, more than ever before, I feel the need for promoting, practicing, and enjoying one of the most stimulating hobbies ever conceived. Perhaps I can spark that "want to know" in someone through ham radio and its many facets that have touched, changed, and made more rich our lives.

Keep up the good work and much luck to you in your efforts.

Kenneth R. (Randy) Lewis WB4NIH
Summerville SC

HELPING OUT

I am presently studying to get my Novice class license and your magazine and its articles are really helping me out. I've tried to read and understand *QST*, but find it very hard for someone who wants to become a ham. I know that your magazine can do a lot for someone who wants to become a ham.

Louis Zimmerman
Mexico City

THE ABOVE MENTIONED

Just thought I would drop a few lines and let you know how much I enjoy the construction articles in *73*. Just finished building K2OAW's 11C90 prescaler as well as the solid state subaudible encoder in your Dec. '76 issue.

I do wish that all your authors who go to the trouble to build PC boards for their construction articles would provide layouts for duplication such as the above mentioned did.

Although I do believe that microprocessors and such are the way of the future, I think the bulk of your I/O articles would be better suited for your new publication *Kilobaud* and not taking up space in an amateur publication.

Allen Jones K9DZE
Michigan City IN

QUICK, CLEAN HEAT

How come you don't have a regular Hints & Kinks column? Would seem to complement your "Circuits" section which I like so well.

Anyway, my idea that I'd like to share is keeping one of the throwaway butane cigarette lighters like the Cricket with my shrink tubing. It's a fine source of quick clean heat.

John Diebold W7SCU
Seattle WA

ANOTHER CHARTER

At it again, eh? Some people chase butterflies. Some collect stamps, others dabble in the stock market. And still others seek Billy Holliday Records.

But you! None of the above are good enough for you. Your hobby is starting magazines! No complaint, mind you. Just an observation.

I can't complain. As a *73* lifer and a (forgive me) charter *Byter*, I feel I'm ahead of the game. Add me to the list of charter subscribers to *Kilobaud*.

Ralph O. Irish Jr.
Utica NY

Social Events

MARSHALL MI
MAR 5

An unconventional Swap Fest will be held by the Southern Michigan Amateur Radio Society in conjunction with the Marshall High School Radio Club on Saturday, March 5, 1977 at the Marshall High School, Marshall, Michigan (near I-94 at I-69). Tech sessions, computer sessions, DX, VHF, YL meetings, plus a home tour of Historical Marshall, and dine at the world famous Win Schulers. Details and reservations: Goodrich, 117 Parrott Drive, Marshall, Michigan.

LAFAYETTE LA
MAR 5-6

The Lafayette Amateur Radio Club is holding its 17th Annual Hamfest and Banquet on March 5th and 6th. This event attracts hundreds of amateur radio operators throughout the south. For more information contact Lafayette Amateur Radio Club, 413 Kim Drive, Lafayette LA 70501.

STERLING IL
MAR 6

The Sterling-Rock Falls Amateur Radio Society Hamfest-77 will be held Sunday, March 6, 1977 at the Sterling High School Field House, 1608 4th Avenue, Sterling, Illinois. Free coffee and donuts 7:30-8:30 am. All indoor facilities and plenty of room. Plenty of parking area, including parking lot to accommodate campers and mobile trailers. First table free, second and third table $5.00 each. Limit three tables to a party or bring your own. Lots of prizes. For tickets and reservations for more than one table, write Don Van Sant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071. Make checks payable to Sterling-Rock Falls Amateur Radio Society. Talk-in on 146.94 simplex. Advance tickets $1.50, door tickets $2.00.

PHOENIX AZ
MAR 6

The Winter Hamfest will be held March 6 at South Mountain Park at the south end of Central Avenue, Phoenix. Featuring swap meet, eyeball and pot luck. Sponsored by the Amateur Radio Council of Arizona.

BRIDGMAN MI
MAR 6

Blossomland Amateur Radio Association will hold the 11th Annual Spring Swap-Shop, Sunday, March 6th at Bridgman Middle School gym, Lake St. at Tower, Bridgman, Michigan. Exit 16 on I-94. Expanded facilities, refreshments, prizes, and fun. Talk-in on 22/82 and 94. Table space restricted to radio and electronic items only. Advance ticket donation $1.50. Tables $2. Write: John Sullivan, PO Box 345, St. Joseph MI 49085. Make checks payable to Blossomland A.R.A.

NORTH TONAWANDA NY
MAR 15

The Amateur Radio Association of the Tonawandas Annual Auction and Flea Mart will be held March 15th at 7 pm, at the Payne Avenue Christian Church, Payne Avenue, North Tonawanda, New York. Please tag all gear to be sold with seller's name or call, and minimum opening bid. If you have gear to sell please bring it. Admission free.

MAUMEE OH
MAR 20

The Toledo Mobile Radio Association, Inc. is sponsoring its 22nd Annual Ham Auction, Sunday, March 20, 1977 at the Lucas County Recreation Center, Maumee (Toledo), Ohio. Auction, flea market, commercial displays and good eyeball QSOs. Time: 8 am to 5 pm. Admission: $2 advance, $2.50 after March 1, 1977 or at the door. Talk-in on 52-52 and all Toledo area repeaters. Send SASE, Toledo Mobile Radio Association, Inc., Box 7548, Oregon OH 43616.

WHITEWATER WI
MAR 20

The Tri County ARC (Whitewater, Wisconsin) Hamfest will be held March 20, 1977 in the Whitewater Armory. Donation: $1.50 in advance, $2 at the door. Reserved tables $2 in advance. Write Doc Walters WB9EMR, 81 N. Main Street, Fort Atkinson WI 53538.

MIDLAND TX
MAR 26

The Midland Amateur Radio Club will have a Swap Fest on Saturday and Sunday, March 26th and 27th. It will be held in the County Exhibit Building on Highway 80, just East of Midland, Texas. Pre-registration will be $3.50 per person, and $4.00 at the door. Please send pre-registration fees to Midland Amateur Club, Box 4401, Midland TX 79701. There will be lots of door prizes.

EAST RUTHERFORD NJ
MAR 26

The Knight Raiders VHF Club presents its world famous Auction and Flea Market to be held at St. Joseph's Church in East Rutherford, New Jersey on Saturday, March 26, 1977. Free admission – free parking. Refreshments are available. Flea market tables: in advance – $5 for full table, or $3 for half table; at door – $6 for full table, or $3.50 for half table. For further information call Bob Kovaleski at 473-7113 (evenings only). Talk-in on 146.52. Send reservations and checks payable to Knight Raiders VHF Club, Inc., PO Box 1054, Passaic NJ 07055 (reservations close March 20).

CHARLOTTE NC
MAR 26-27

The 5th Annual Metrolina Hamfest will be held Saturday, March 26 from 12 pm to 6 pm, and Sunday, March 27 from 8 am to 4 pm. New location this year: North Carolina National Guard Armory, Douglas Municipal Airport, Charlotte NC. Door prizes: both Saturday and Sunday. Tickets: $3.00. Talk-in 34/94, W4BFB. For further information write: Mecklenburg Amateur Radio Society, 2425 Park Road, Charlotte NC 28209.

GRAND RAPIDS MI
APR 2

The Third Annual Swap and Shop will be held at the Northeast Jr. High School, 1400 Fuller Ave., N.E., Grand Rapids, Michigan, on Saturday, April 2 from 9 am to 5 pm in the cafeteria. Featured will be: CBs, monitors, ham equipment and electronic parts. For further information contact Grand Rapids React at the above address.

COLUMBUS GA
APR 2-3

The Columbus, Georgia Hamfest will be held April 2 and 3, Palm Sunday weekend, at the Fine Arts Building at Fairgrounds, 9 am to 4 pm daily. Flea market, ham auction, prize drawing at 1:30 pm Sunday, talk-in 28/88, 3975 kHz, buffet dinner Sat. at 8 pm. For more information write K4JNL. Advance tickets: K3MTY/4, Rt 5, Box 750, Phenix City AL 36867.

ST. CLAIR SHORES MI
APR 3

The South Eastern Michigan Amateur Radio Association is holding its Nineteenth Annual Hamfest on April 3, 1977 from 8 am EST to 3 pm EST. It will be held at the South Lake High School in St. Clair Shores, Michigan, 21900 Nine Mile Road and Mack Avenue. For further information contact Dorothy Spilski WB8PRJ, Secretary S.E.M.A.R.A., 11906 Riad Avenue, Detroit, Michigan 48224, 313-521-6646.

MOBILE AL
APR 16-17

The Mobile Amateur Radio Club will hold its annual Ham Fest and Computer Fest on April 16 and 17th – all the newest equipment on display, computers too. Swap & Shop all day Saturday from 9 to 5, banquet at 7 pm, doors open Sunday at 9 am, prizes, drawing at 1 pm. Activities for the ladies and children, campsites available, over 1500 people expected, the biggest Fest on the Gulf Coast. For more information contact Marvin Uphaus K4BVG, 512 Tuttle Avenue, Mobile AL 36604.

LIBERTY MO
APR 23-24

The P.H.D. Amateur Radio Assn., Inc., of Liberty MO (Kansas City area) will sponsor the Eighth Annual Northwest Missouri Hamfest on Saturday and Sunday, April 23 and 24, 1977 at the Kansas City Trade Mart, Exhibit Hall 2 (Municipal Airport terminal building). There will be a complete program of forums both days, a large

number of commercial exhibits, swap tables, YL-XYL program. Doors open from noon to 6 pm on Saturday, April 23; and from 9 am to 5 pm on Sunday, April 24. Setup time for commercial and swappers will be from 10 am to noon on Saturday. There will be a Saturday night banquet at the world famous Gold Buffet, with ARRL president Harry Dannals W2HD, as guest speaker. Pre-registration is $2, admission at the door will be $2.50. Pre-registration including banquet is $8. Talk-in on 146.34/.94 and 3.925 MHz. For information and pre-registration write to: PHD Amateur Radio Assn., PO Box 11, Liberty MO 64068.

SULLIVAN IL
APR 24

The Moultrie Amateur Radio Klub will have its 16th Annual Hamfest Sunday, April 24th at Wyman Park, Sullivan, Illinois. Heated indoor area and large outdoor parking area. No charge to vendors. For information write: MARK Radio Klub, PO Box 327, Mattoon IL 61938. Talk-in 146.94.

AMBOY IL
APR 24

The Rock River Radio Club Hamfest will be held April 24, 1977 at Amboy, Illinois (Lee County), at the 4H Center, Routes 30 and 52. Same place as last year. Tickets $1.00 advance. $2.00 at gate. Camper parking available at a nominal fee. Write: Carl Karlson W9ECF, Nachusa IL 61057. Indoor and outdoor facilities.

LAS CRUCES NM
APR 24

The Mesilla Valley Radio Club sponsors Whitey's Bean Feed and Swap-Fest Sunday, April 24th, at 10 am. Located near Las Cruces, New Mexico at La Mesa with talk-ins on 16-76, 04-64 and 3940 kHz. Fun for all the family with big prizes, plenty of food and the usual beverage truck. All included for $5.00 for adults, $1.75 for kids. Eat, drink and win a prize with Whitey K5ECQ as host. Free overnight parking at grounds so come for a spell. All correspondence should be made to: Thomas B. Rapkock Jr., 640 W. Las Cruces Avenue, Las Cruces NM 88001.

DAYTON OH
APR 29

The 8th Annual FM B*A*S*H will be held on the Friday night of Dayton Hamvention, April 29, 1977, at the Dayton Biltmore Towers (hotel), Main at First Streets, from 8 pm til midnight. Admission is free to all hams and their friends. Sandwiches, beverages, snacks and C.O.D. bar will be available. A live floor show will be presented by TV personality Rob Reider WA8GFF and his group. It will be followed at 11 pm by a fabulous prize drawing featuring an Icom IC-245 and many others. See you where the action is!

MEADVILLE PA
MAY 7

The Third Annual Northwestern Pennsylvania Hamfest will be held May 7 at Crawford County Fairgrounds, Meadville PA. Free admission. Flea market begins at 10 am. $2 to display — hourly door prizes — refreshments — commercial displays welcome. Indoors if rain. Talk-in 146.04/64 and 146.52. Details C.A.R.S., PO Box 653, Meadville PA 16335.

BINGHAMTON NY
MAY 7

The 18th Annual STARC Hamfest will be held Saturday, May 7, 1977 at Binghamton, New York. Take exit 71N from NY-17, go 3.8 miles north on Stella-Ireland Road. Flea market, tech talks, hourly door prizes. General admission $2.00/person. Banquet by pre-reservation at $6.00/person. Indoor exhibit space by pre-registration at $5.00 per table. Outdoor exhibit flea market space free. Talk-in 146.22/82 and 94/94. For details and reservations, contact STARC, PO Box 11, Endicott NY 13760.

NEW YORK NY
JUN 12

The 4th Annual Hall of Science A.R.C. Flea Market and Hamvention. Dealers booths, test bench, refreshments, zoo, museum. A fun day for the whole family. Sunday, June 12 (rain date June 19), 9 am to 3 pm. Admission: $2.00. Free parking. Directions: .34/.94 repeater; information: (212) 699-9400.

PLAIN CITY OH
AUG 14

Hamfest 77 is to be held on Sunday, August 14, 1977 at the Plain City Fairgrounds, Plain City OH. Talk-in on 146.16/76 or 146.52. Advance tickets $1.50 — gate $2.00. For additional information or reservations, write UCARC, 13613 U.S. 36, Marysville OH 43040, or call Gene Kirby W8BJN 513-642-9861.

ERIE PA
AUG 27

The 2nd Annual Erie Ham Jam will be held Saturday, August 27, 1977 at the Erie County Fieldhouse, Route 8 (Parade Street) and I-90. Flea Market — large indoor display area — forums — camping and motels nearby. For more information contact RAE Ham Jam, Box 844, Erie PA 16512.

MADISON WI
SEPT 25

The 5th Annual Madison Swapfest will be held Sunday, September 25 at Dane Co. Expo Center Youth Building, Madison WI. Rain or shine — inside facilities — doors open at 8 am. 12,000 sq. ft. of electronic equipment and components for hams, computer hobbyists and experimenters. Bring the whole family for delicious food and entertainment. Excellent overnite camping accommodations. Tickets — advanced $1.50; at door $2.00. Tables — advanced $2.00; at door $3.00. Make check or money order payable to M.A.R.A. — mail to M.A.R.A., Box 3403, Madison WI 53704. Reservations must be in by Sept. 10, 1977.

Ham Help

Let me congratulate you for the progress that the *73 Magazine* has made. You have struck me with lightning three times. My son Gurbux Singh at Rochester (WB9TTN) will take care to ground the electrical buildup. I have passed your *73* to a lot of people and it has been a pastime with me to read over and over again some of the articles. Your September issue arrived yesterday and was wonderful. You made history and let me congratulate Sherry Smythe for the wonderful photographs.

Wayne . . . could you put me on "Wanted Help" column? We need radio magazines and other reading matter. Please do not send any equipment for amateur radio is still under suspension. Our license is however renewed.

Let me wish you more success and when are we two going to have an eyeball QSO? 73 to *73*.

Tara Singh
XZ2KN and XZ2TA (mobile)
187 Eden St.
Rangoon, Burma

I am interested in getting my ham ticket. Please enter my name and address in your Ham Help column. Thank you.

Norman Malinky
405 W. Walnut St.
Painesville OH 44077
216-352-4162

I am in the service, and in Germany, C8 is going to the birds more than ever. I'm enclosing my order for your set of *73* tapes, and will need help pretty soon. I've heard that the Conditional class license is no longer available. How can I get my license if this is true? I'm stationed in Augsburg and hope there is a ham nearby. I've even gone to the extent of getting a credit account with SWAN.

SP5 Tim Y. Woo
483d Med. Det. (Vet Svc)
Augsburg, FRG
APO New York 09178
Phone (2582)-4484

I am trying to get into the CW world, but only have old equipment, some working, some not. I need the following: (1) instructions (literature) for Lysco, mod. 600 xmtr; (2) i-f can, coils (parts) for Hammarlund mod. HQ-110 receiver.

I'll be glad to send $1.00 for postage to the first ham to help me out.

Dale McMindes PJ4DM
T.W.R. Box 37
Bonaire,
Netherlands Antilles

I badly need the schematic and owner's manual for the HQ-100 general coverage receiver.

Robert M. Johnson
36 Wolcott St.
Camden NY 13316

I read the article in the December issue about the Friden-8800 problem, and since that time I have acquired one of these things. I was quite wary for a while, as if something went awry with the electronics, I would be up the creek. The only thing that the vendor supplied was the operational manual, which tells you how to change the ribbon, etc.

Well, after much hunting, I was able to locate some more information on the thing, and I am sure that others will be glad to hear of it. I have schematics of printed circuit boards, with interconnecting wiring data, power supply schematics, and all other data which will help anyone in solving logic problems within the unit. I am offering these copies at $6.00, which includes shipping. This is done mostly on a cost basis and shipping.

Tim Ahrens WA5VQK/5
2200 Sorret Tree Ct.
Austin TX 78744

You are my last hope. Can you please put my letter in your Ham Help column? I subscribe to your magazine and reading the article on those hams in Weisbaden (Oct., 76), I tried to contact them! No answer. If you have any info that can help me, that would be great!

I am looking for an American ham who is stationed or living in Germany and is licensed to operate in that country who can help me get my license over here. I am a special radio and electronic devices repairman for the Army. On my last leave, I didn't have enough time to get my ticket. I've been trying feverishly for a year and all my leads have been dead ends. I still have 3 years over here! PLEASE HELP ME!!! Anyone.

PFC Robert Milback
504th Maint. Co.
71st Maint. BN
APO NY 09139

Anyone know how to improve the receiver section of the Swan 350?

Is there such an animal as a wideband low gain preselector? This circuit would have to be inserted between the antenna relay and the rf amp tube of the receiver section and be capable of covering 80 through 10 meters. I would like a small circuit which could be mounted inside the transceiver housing.

Thank you.

Lloyd Gosa WB8TNC
1423 Upland Dr.
Kalamazoo MI 49001

I have obtained a set of wiring diagrams (45 sheets) for the Friden TM20K715 and TM20K714 printer and controller, and I am interested in sharing the information. The cost would depend on how many people are interested and, hopefully, if enough people want copies, the cost would be about $35.00.

Bill Dries
1908 Parmenter
Middleton WI 53562

Repeater Update

Compiled by Stan Miastkowski WA1UMV

ARIZONA

WR7AHJ	Phoenix	53.96	IN 52.96
WR7AIM	Tucson	146.94	Autopatch

FLORIDA

WR4AUR	Sarasota	146.73	

GEORGIA

WR4AZU	Cedartown	147.72	
WR4AYM	Toccoa	52.525	IN 52.025

HAWAII

WR6	Kailua	146.76	

ILLINOIS

WR9AIU	Peoria	146.97	Autopatch
WR9ACS	Jacksonville	147.00	
WR9AAA	Joliet	146.82	
WR9AAA	Joliet	223.82	IN 222.22
WR9AAA	Joliet	442.20	IN 447.30
WR9AIA	Park Ridge	146.64	PL

INDIANA

WR9ADI	Fort Wayne	146.76	
WR9ADA	LaPorte	146.61	Autopatch
WR9AFN	Logansport	147.18	
WR9AFN	Logansport	146.94	
WR9AEG	Indianapolis	146.97	Autopatch
WR9AEP	Indianapolis	147.06	Autopatch

KENTUCKY

WR4ANE	Hawesville	146.88	

MICHIGAN

WR8ANT	Cadillac	146.97	
WR8AJV	Belleville	146.94	Autopatch

MINNESOTA

WRØADT	Fridley	146.67	PL
WRØAKF	Shoreview	146.73	PL
WRØAMS	Andover	147.06	

MISSOURI

WRØAHX	Kansas City	146.97	

NEW JERSEY

WR2AOA	Belmar	146.775	
WR2AGK	Franklin Lakes	146.79	
WR2AMC	Titusville	224.82	
WR2	Toms River	147.255	

NEW MEXICO

WR5AQR	Santa Fe	444.20	IN 449.20

NEW YORK

WR2ANN	Fredonia	53.57	IN 52.57
WR2ACF	Fredonia	146.67	
WR2AMB	Fredonia	146.85	Autopatch
WR2AHK	Farmingdale	147.135	
WR2AMD	Jericho	146.50	IN 147.50
WR2AKC	Staten Island	147.045	
WR2AHX	Manhattan	147.27	
WR2AJJ	White Plains	146.775	

NORTH CAROLINA

WR4AJX	Indian Trail	147.90	IN 147.30 VOX
WR4AJG	Jacksonville	147.00	Autopatch
WR4AON	Rocky Mount	147.12	Autopatch

PENNSYLVANIA

WR3AFZ	Pittsburgh	147.09	Autopatch
WR3AFZ	Pittsburgh	444.40	IN 449.40
WR3AHR	Lancaster	224.90	IN 223.30
WR3ABE	Philadelphia	52.64	IN 52.72/52.76
WR3ABE	Philadelphia	443.80	IN 448.80
WR3AFQ	Acme	146.67	Autopatch
WR3AIJ	Sharon	147.15	Autopatch

SOUTH CAROLINA

WR4AQY	Orangeburg	147.09	Autopatch

TENNESSEE

WR4AGX	Nashville	146.94	
WR4ANU	Germantown	147.09	Private
WR4ADO	Kingsport	146.76	Autopatch
WR4AXQ	Bristol	147.00	IN 147.60
WR4AFS	Chattanooga	147.00	

TEXAS

WR5AET	Houston	146.82	
WR5AJY	Houston	147.21	
WR5AFK	Houston	147.09	Autopatch
WR5	Dallas	147.09	
WR5	Seguin	147.21	

Oscar Orbits

Oscar 7 Orbital Information					Oscar 6 Orbital Information			
Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W		Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W
10478 B	1	0134:03	76.0	NA	20003 BTN	1	0144:55	85.8
10490 AX	2	0033:24	60.8	NA	20015 BTN	2	0044:51	70.8
10503 B	3	0127:41	74.4	N	20028	3	0139:46	84.5
10515 A	4	0027:01	59.2	NA	20040 BTN	4	0039:42	69.5
10528 B	5	0121:19	72.8	N	20053	5	0134:38	83.3
10540 A	6	0020:39	57.7	S	20065	6	0034:34	68.3
10553 Q	7	0114:56	71.2	N	20078	7	0129:30	82.0
10565 A	8	0014:17	56.1	NA	20090 BTN	8	0029:26	67.0
10578 BX	9	0108:34	69.7	NA	20103 BTN	9	0124:21	80.8
10590 A	10	0007:54	54.5	N	20115	10	0024:17	65.8
10603 B	11	0102:11	68.1	NA	20128 BTN	11	0119:13	79.5
10615 A	12	0001:32	52.9	N	20140	12	0019:09	64.5
10628 B	13	0055:49	66.5	S	20153	13	0114:05	78.3
10641 A	14	0150:06	80.1	N	20165	14	0014:01	63.3
10653 B	15	0049:27	64.9	NA	20178 BTN	15	0108:56	77.0
10666 X	16	0143:44	78.5	NA	20190 BTN	16	0008:52	62.0
10678 B	17	0043:04	63.4	N	20203	17	0103:48	75.8
10691 A	18	0137:22	76.9	NA	20215 BTN	18	0003:44	60.8
10703 B	19	0036:42	61.8	N	20228	19	0058:40	74.5
10716 A	20	0130:59	75.4	S	20241	20	0153:36	88.3
10728 Q	21	0030:20	60.2	N	20253	21	0053:31	73.3
10741 A	22	0124:37	73.8	NA	20266 BTN	22	0148:27	87.0
10753 BX	23	0023:57	58.6	NA	20278 BTN	23	0048:23	72.0
10766 A	24	0118:14	72.2	N	20291	24	0143:18	85.8
10778 B	25	0017:35	57.1	NA	20303 BTN	25	0043:14	70.8
10791 A	26	0111:52	70.6	N	20316	26	0138:10	84.5
10803 B	27	0011:13	55.5	S	20328	27	0038:06	69.5
10816 A	28	0105:30	69.1	N	20341	28	0133:02	83.3
10828 B	29	0004:50	53.9	NA	20353 BTN	29	0032:58	68.3
10841 AX	30	0059:07	67.5	NA	20366 BTN	30	0127:53	82.0
10854 B	31	0153:25	81.1	N	20378	31	0027:49	67.0

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

Review

AUDIO FREQUENCY TESTERS
The 73 Test Equipment Library, Published by 73, Inc., $4.95

This book, the second in the *73* series on test equipment for the radio amateur and experimenter, approaches the subject of audio frequency testing from every angle.

It is appropriate that this second book in this series be devoted to audio frequency test equipment, since this area plays such a large part in so many facets of amateur radio. From voice transmission (SSB, FM or AM) to ham TV, the precise measurement and generation of audio frequencies is essential to the testing and operation of all equipment. For the RTTY operator, whether he uses AFSK or FSK, this book should be invaluable for the proper maintenance of his station.

Through the 39 separate articles, the reader is instructed on how to build such items as audio sine wave generators, attenuators, two-tone generators for SSB testing, tone generators for RTTY, RTTY monitorscopes, SSTV and FSTV sync generators, oscilloscopes, and more.

No complete ham shack or workshop should be without a copy. There is no better source available on the subject for so reasonable a price or with such clear, concise easy-to-build projects.

Rich Force WB1ASL
Associate Editor

RADIO FREQUENCY TESTERS
The 73 Test Equipment Library, Published by 73, Inc., $4.95

The generation of radio frequency waves is the one common denominator throughout all of ham radio. No matter what your specific interest in this fascinating hobby, without the correct generation and radiation of radio waves your enjoyment will be frustrated. In this book, which is the third in the *73* Test Equipment Library series, the editors of *73* have put together some of the best articles they could find, all aimed at assisting in achieving the best possible on-the-air signal.

With the inclusion of 77 articles, the book covers such subjects as swr measurement, rf impedance measurement, rf power measurement, field strength, frequency measurement, rf signal generators, crystal calibrators, grid dip oscillators, noise generators, attenuators, dummy loads, and more. Each subject is illustrated with various pieces of equipment which can be built to fit your specific needs.

By addition of this book to a station library, any ham can be well on his way to having one of the best signals on the band.

Rich Force WB1ASL
Associate Editor

HOW TO MAKE BETTER QSLS
by Jack Janicke K2JFJ, Published by 73, Inc., $4.95

Jack Janicke in his new book published by *73* appeals to the artistically minded ham by guiding him on his way to making original unique QSL cards. Janicke contends, and it is true, that the "special" QSL is the one that gets answered first by DX stations. One chapter is devoted entirely to boosting QSL returns.

All types of printing processes are included, with special emphasis being placed on the silk screen method. Plans and pictures are included to allow the reader to construct, with the utmost ease, the necessary equipment for silk screening QSLs, as well as other items found around the normal ham station. Many other uses for the silk screen materials are explored.

This book should also appeal to the beginning art student, who is just starting into silk screening. All silk screen techniques are thoroughly covered.

In addition to silk screen, the methods for producing photographic, mimeograph, and letterpress cards are also examined. Janicke goes into detail on each.

So if the high cost of having "unique" QSLs has you down, try rolling your own, but first learn how from an expert in the book, "How to Make Better QSLs."

Rich Force WB1ASL
Associate Editor

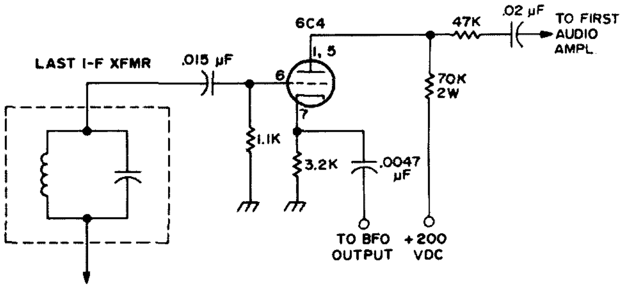
DIGITAL INTEGRATED-CIRCUIT OPERATIONAL-AMPLIFIER AND OPTOELECTRONIC CIRCUIT DESIGN
Texas Instruments Electronics Series, Published by McGraw-Hill Book Company, $16.50

If microprocessor design and interface techniques are your thing, Texas Instruments has the reference book you have been needing. More than just a collection of IC specifications and pinouts, "Digital Integrated-Circuit, Operational-Amplifier, and Optoelectronic Circuit Design" provides practical circuits and applications using the devices specified in the title. Eighteen chapters cover an entire range of devices, from introductory TTL and Schottky logic, counters, and converters, all the way to optoelectronic devices used in computer interfaces. If you have ever puzzled for hours over a tiny aspect of circuit design, the answer to your problem may rest in this book, a necessary addition to any computer hardware enthusiast's library.

John Molnar WB2ZCF
73 Magazine Staff

Novice Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.

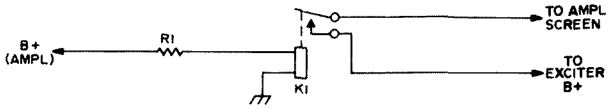


Q. Is there a practical SSB detector for most receivers?

A. The circuit in the figure is simple, but will not disturb the set. Your regular detector can be switched in or out and the simple detector used, or not. A stable bfo signal is required. This circuit will work with older receivers when the voltage to the bfo tube is stabilized.

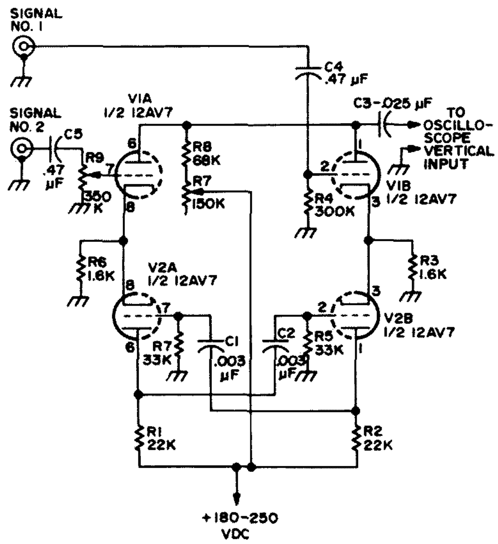
Q. What frequent check should be made of self-powered VTVMs?

A. From time to time the VTVM should be opened and the battery examined. It should be firmly seated in the holder and the battery contacts should not be corroded. Check the tightness of all bracket held-down screws. If you cannot zero-set the VTVM, replace the battery.



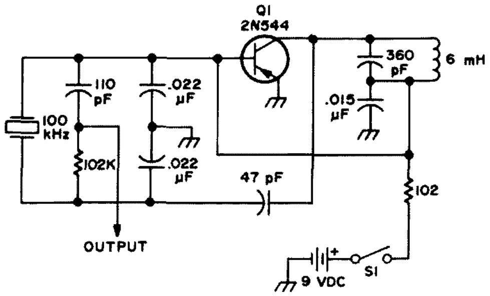
Q. How can amplifier screen voltage be removed during periods when the transmitter is operated with the final plate supply turned off?

A. The circuit in the figure permits safe operation of the amplifier screen-grid circuit when powered by the exciter supply. K1's coil is connected in series with the bleeder resistor (R1) for the amplifier's plate supply. Contacts are connected in series, with the lead running from the exciter supply to the amplifier screen circuit. In this manner, screen voltage is only applied to the final when the HV supply is turned on. Common 5k to 10k relays can be used. The value of R1 must be chosen for satisfactory bleeder operation plus an appropriate drop in B plus for the relay coil.



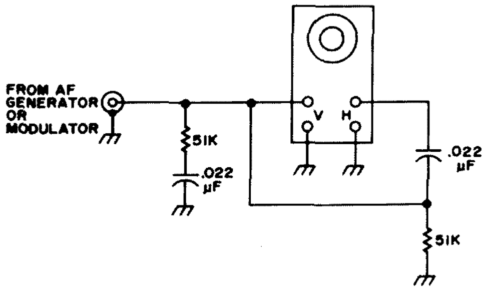
Q. Is it possible to see two signals simultaneously presented on a CRT screen by using a special type of electronic switch?

A. Refer to the figure. Two signals are alternately switched to one input of the scope so rapidly that you seem to "see" two presentations. But actually there is only one signal shown at a given time on the screen. This is a handy gadget for checking input and output waveforms.



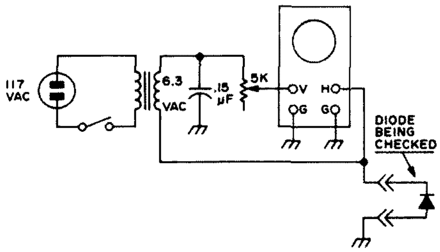
Q. How about a simple transistor 100 kHz calibrator for my ham band transceiver?

A. Refer to the figure. The output of this simple crystal calibrator should be connected at the receiver's antenna input side — not at the antenna terminal you would normally use.



Q. To get an elliptical pattern from an af generator, what is the proper method for connecting the scope?

A. Refer to the figure. Modulation can be added to the Lissajous pattern either on a vertical or horizontal form.



Q. Is there a simple scope setup to make it easy to check and match diodes?

A. When checking diodes of the same type, with the circuit in the figure, a comparison can be obtained by utilizing the same pot setting and noting the relative sizes of the traces obtained. Choice of a transformer is not critical. In addition to scope conventional traces, look for any indication of "fuzz" or ripple. Even if the basic trace seems good, do not rely on a diode exhibiting either fuzz or ripple.

Q. How can a transmitter be easily modified for CW operation?

A. By feeding an af oscillator into the mike jack, a transmitter can be used for CW operation. The oscillator can also feed a pair of phones for sidetone monitoring. The output of the keyed oscillator should be a good clean sine wave and care should be taken that the modulator is not overdriven.

Q. What causes the exciter meter to deflect to the left when the transmitter is on and the PTT is actuated?

A. A diode in the metering circuit may develop a reverse leakage which will permit some of the positive delay bias to appear in the exciter alc circuit. This causes down-scale deflection of the meter. To correct the condition, simply replace the diode with one which has a much higher voltage rating and it will block the delay bias completely.

Q. Regarding batteries: When should a mercury or a manganese battery be used?

A. Where long shelf life, steady output voltage and size are important, the mercury battery should be used. The manganese battery should be used only when you need both high surge capability and good shelf life. Both batteries are far superior to the old lead-zinc cells. Although more costly, the newer batteries are worth the price difference.

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud in exchange for a spot on your ham or computer club newsletter mailing list. Deal?

Briefs

from page 21

Amateur Radio Club, will be sponsoring an AMSAT net on one of the club repeaters, WR2ADM–146.25/85, at 2000 hours local time, each Wednesday. The net will be educational as well as conversational with exchanges of information between net members. The basic objective of the net is to get complete operating information to new and potential OSCAR users.

In the near future, the net will also operate on 2m sideband at 145.70. Stations who are not located in the immediate area should aim their antennas toward Bellmore, L.I., located in Southcentral Nassau County. Net control is Hank WB2ALW with assistance from Barry WA2BOP. Thanks to WB2ALW.

Duane Hill of Peoria, Illinois, is the first new radio amateur in the United States to qualify for a special Bonus Award offered by Yaesu Electronics Corporation of Paramount, California.

Mr. Hill, who received his amateur license call letters, WB9YNQ, last month, entered amateur radio as a hobby for the first time last month. After purchasing a new Yaesu FT-221 two meter transceiver from Klaus Radio, Inc., in Peoria, he received a $25 bonus gift from Yaesu and was also reimbursed for the $4 license fee paid to the Federal Communications Commission.

Amateur radio operators offer many worthwhile services to their communities and the nation. Yaesu Electronics Corporation instituted its award plan as an added incentive to encourage shortwave listeners, CBers, and others to expand their interests into such services while being able to converse worldwide.

The idea of a 2 meter SSB DX contest proposed and promoted by Yaesu Electronics Corporation has been put to rest by the FCC. Yaesu had planned a one month contest in April that was to have offered thousands of dollars of prizes.

When the company approached the FCC field office in Los Angeles several months ago, they were told that officials there saw "nothing wrong with the idea." On that basis, Yaesu began to develop the contest. Early in December, they wrote to the FCC in Washington asking that the verbal approval be confirmed in writing. Nearly a month later, after receiving no reply from Washington, Yaesu National Sales Manager Glenn Malme W6OJF called the FCC and was told by a high-placed official that the contest would have to be cancelled because it was "wrong to give monetary reward to amateurs for doing what they normally do."

Yaesu immediately sent a memo to all dealers cancelling the contest and attempted to pull ads from ham magazines. Because *CQ* went to press early, the ad will appear in that magazine.

The contest was to have been run and results verified by the nationwide network of Yaesu dealers. Malme told *73* that the company was disappointed because of the large investment in advertising and printing. He said that, "Possibly the idea is to qualify hams for sainthood after they become silent keys."

Allied Electronics is offering its *1977 Engineering Manual and Purchasing Guide* to *73* readers free! The book lists hundreds of parts: industrial type electronic parts, components, supplies, and equipment. The 1977 edition uses metric measurements on many listings for the first time. There's wire, cable, solid state devices, test equipment, resistors, trimmers and potentiometers, transformers, switches, timers, connectors, relays, tools, capacitors, new solar energy products, and even a microprocessor. In all, 212 pages . . . and free for the asking. Write Allied Electronics, Dept. 77-F, 401 East 8th Street, Fort Worth TX 76102.

Genave is modifying GTX-202s at its own cost, after "the advertising department got ahead of the production department." A letter from Genave Executive Vice President Claude Henderson WA9CQS went to all customers: "We goofed. Our Advertising Department got ahead of our Production Department on the GTX-202, and we advertised some features which had not yet been incorporated in the rig. If you return your rig to us, we'll rapidly modify and update it for you. P.S. We'd like to give you a set of rocks to offset this inconvenience. Please specify your choice, and if they're in stock, we'll install them while we have your rig." An internal memo released to *73* warned employees at Genave: "Let us not goof again by losing radios, charging for crystals, or taking three weeks or longer to turn these radios around." Need we say more?

In the best ham tradition, Art Householder K9TRG, president of Spectronics in Oak Park, Illinois, left the hospital and proceeded directly to the store after suffering a stroke on December 28. In a discussion with Mr. John Perry of Spectronics, it was indicated that Art "will not be kept down" and is ready to return to work. However, he is suffering from slight paralysis of the left leg and requires a crutch to move around the shop.

An 800 channel hand-held? It's about to become reality. As soon as FCC certification is granted, Wilson Electronics will start marketing the WE800 synthesized 2 meter portable. The rig weighs two pounds, measures 8 ¼" by 6 ¾" by 1 7/8", and features an internal nicad pack that gives output power of 2 Watts. With external dc, power jumps to 12 Watts. The CMOS synthesizer circuit features low drain and covers 144-148 MHz in 5 kHz steps. The price has not yet been announced.

Wilson has also announced a line of crank-up towers: the 64 foot SST-64 guyed four section, the TT-45 free standing two section, and the GT-46 46 foot economy tower. They are priced from $219 to $375.

The new Wilson WR1000 rotor is the largest amateur unit on the market, capable of turning over one ton of balanced weight. Suggested list is $429.00.

The Barnstable MA Amateur Radio Club, located on Cape Cod, is currently raising funds for a station to commemorate the 75th anniversary of Guglielmo Marconi's feat of the first two way radio transmission between the United States and Europe. The original rotary spark gap station was located in South Wellfleet MA. The historic transmission took place on January 18, 1903.

The club plans an all band operation that should be ready for tests by this year's field day. Amateurs in England are setting up their own station.

Commemorative envelopes are being sold at ten for $1.50. Contributions can be sent to the station's trustee, R.J. Doherty W1GDB, RFD #1 14 Pine St., Sandwich MA 02563.

The Rochester NY hamfest, largest in the northeast, continues to grow. The 1977 event, to be held May 20-22, will be three days long. The program will be mailed to nearly 10,000 people who have attended in recent years. Plans call for a Friday afternoon flea market to continue through the weekend outdoors, with an indoor flea market open at the same time. Exhibitors will be set up all day Saturday and Sunday in the Rochester Dome Center.
RaRa Rag, *bulletin of the Rochester Amateur Radio Association.*

Normally most of us think of safety in the ham shack as watching out for high voltages inside of equipment, or determining its potential points of appearance at unplanned places due to possible component failure. In this particular instance, this is not the case. We are considering safety with regards to the mobile ham shack, with safety of the shack of prime importance. How many times have you missed your turn-off because you were too engrossed in a QSO? We all probably have at one time or another. Good thing there wasn't anyone in the way at the time or we might not have "seen" them!

Besides paying attention to the driving (it might be better to leave the driving to someone else), you need a good mounting location for your rig, being sure it is stable (i.e., it won't fall on the floor), and within a comfortable reach of the normal driving position.

A channel switching knob shaped so you don't have to look to find the frequency, and can go by feel, is highly recommended.

A touchtone pad is even more difficult to operate if you need two hands (who's steering now?!). It's best under these conditions to pull off the road completely to make the autopatch call. If a call is that important, it's worth stopping for.

So, in conclusion, use common sense and keep the mobile shack and its contents alive. We know of one CARA member who was distracted by his rig falling off his front seat, managed to take a half inch off a telephone pole and about $700 out of the right side of his car, breaking a $3 connector on the rig. So keep your priorities straight!
Reprinted from QRZ, *bulletin of the Middlesex (MA) Amateur Radio Club.*

Those of you scratching your heads over similarities between the October *73* article, "The Hybrid Quad," and "A Hybrid 20 Meter Quad" in January, '77 *QST*, scratch no more . . . they are in fact the same article by the same author. A letter from League headquarters apologized for the error, pointing out that the author had submitted his article to both magazines at the same time. A word to the wise . . .

At deadline, FCC sources told *73* that the WARC comments deadline on the third notice of allocation proposals (see Special Report, February) had been extended to February 7th, with a reply comments limit of February 25th. A petition from the National Association of Broadcasters (NAB) for a 90 day extension was reportedly the reason for the new dates. On the allocations front, our sources say that there is some hope for improvement at the HF level, namely in the 10 MHz range. Chances appear good for a 200 kHz sharing arrangement with fixed services at 10 MHz, based upon the lack of usage there. Incidentally, of our assessment "The WARC Disaster" on the February cover, more than one FCC official said it was *reasonably accurate*, considering the WARC situation.

Broadcasts from station WWV in Fort Collins CO were terminated on 20 and 25 MHz on February 1st. It had earlier been reported that broadcasts on 2.52 and 5 MHz were to also be discontinued, but John Milton, WWV Engineer in Charge, told *73* that the decision was made to retain the frequencies after comments from users indicated a heavier use than had been estimated.

Congratulations to the publishers of the *West Coast DX Bulletin*, located at 77 Coleman Drive in San Rafael CA. This informative weekly newsletter on DXpeditions and DX conditions has passed the 1600 mark in circulation.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	7	7	7	7	7	7	7	7	7A	14	14
ARGENTINA	14	7A	7B	7B	7	7	14	14	14	14A	21	14A
AUSTRALIA	14A	14	7B	7B	7B	7	7	7A	14	14	14	14
CANAL ZONE	7A	7	7	7	7	7	7A	14	14	14A	21	14A
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	7A
HAWAII	14	14	7B	7	7	7	7	7	7A	14	14	14
INDIA	7	7	7B	7B	7B	7B	7A	14	14	7	7	7
JAPAN	14	7B	7B	7B	7B	7	7	7	7	7	7	14
MEXICO	14	7A	7	7	7	7	7	7A	14	14	14A	14
PHILIPPINES	14	7B	7B	7B	7B	7B	7B	7	7A	7A	7B	14
PUERTO RICO	7A	7	7	7	7	3A	7A	14	14	14	14	14
SOUTH AFRICA	7A	7	7	7	7B	7B	14	14	14A	14A	14	14
U. S. S. R.	7	7	7	7	7	7B	7A	14	14	14	7B	7
WEST COAST	14	7A	7	7	7	7	7	7A	14	14	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	7	7A	14	14
ARGENTINA	14	14	7B	7B	7	7	7B	14	14	14	21	14A
AUSTRALIA	21	14	7B	7B	7B	7	7	7	14	14	14	14A
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	21	21
ENGLAND	7	7	7	7	7	7	7B	14	14	14	14	7B
HAWAII	14A	14	7B	7	7	7	7	7	7A	14	14	14A
INDIA	7	7A	7B	7B	7B	7B	7B	7B	14	7	7	7
JAPAN	14	14	7B	7B	7B	7	7	7	7	7	7	14
MEXICO	14	7A	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	7	7A	7A	7B	14
PUERTO RICO	14	7	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	14	14A	14	14
U. S. S. R.	7	7	7	7	7	7	7B	7B	14	14	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	7	7A	14	14
ARGENTINA	14	14	7B	7B	7	7	7B	14	14	14	14A	21
AUSTRALIA	21	21	14	14	7B	7	7	7	7A	14	14	14A
CANAL ZONE	14	14	7	7	7	7	7	14	14	14A	21	21
ENGLAND	7	7	7	7	7	7	7B	7B	14	14	14	7B
HAWAII	21	14A	14	14	7	7	7	7	7A	14	14	14A
INDIA	7	14	14	7B	7B	7B	7B	7B	7	7A	7	7
JAPAN	14	14	14	7B	7B	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7	7	7	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	14	14A	14A	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7A	14	14	14	14
U. S. S. R	7	7	7	7	7	7	7B	7	7A	7A	7B	7B
EAST COAST	14	7A	7	7	7	7	7	7A	14	14	14A	14

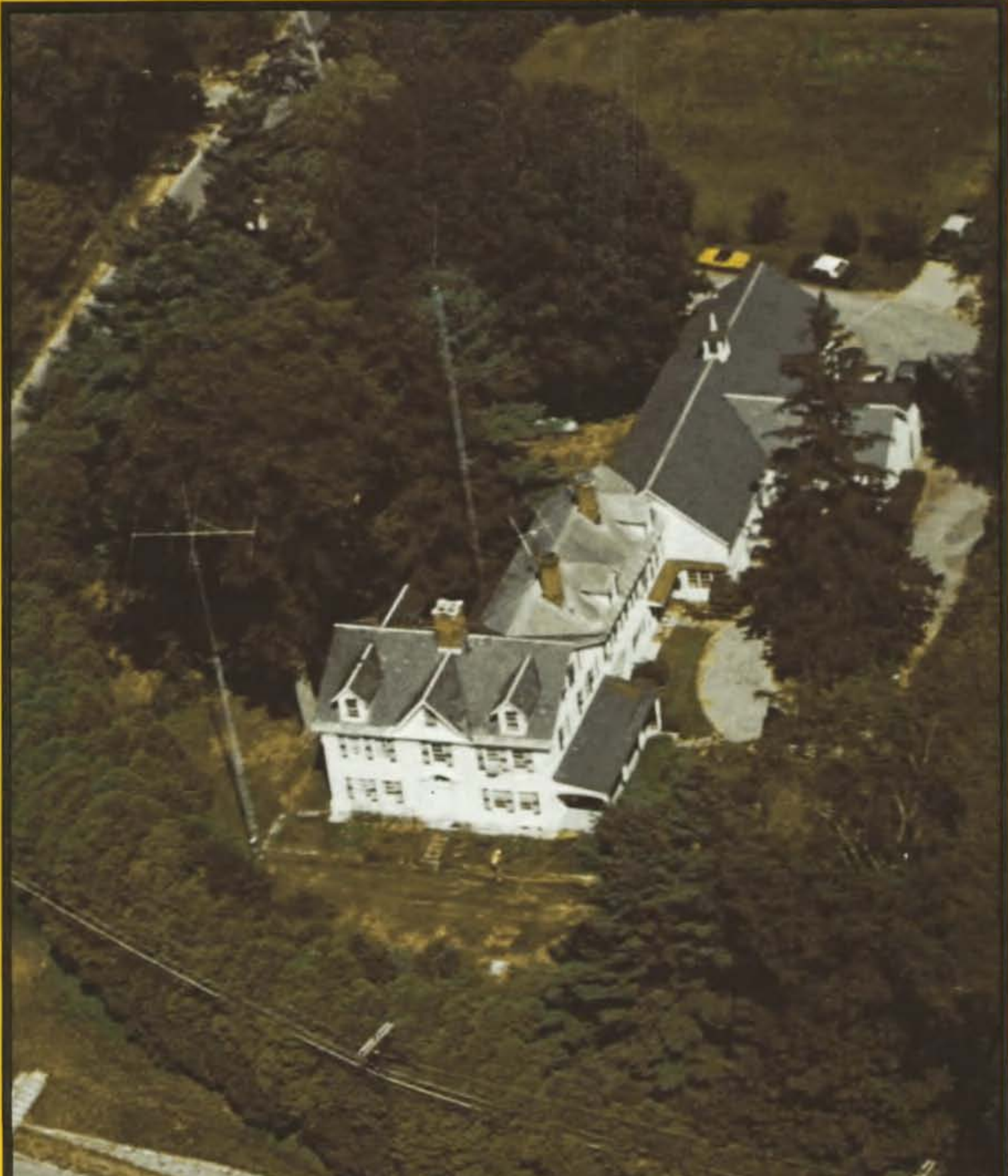
A = Next higher frequency also may be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

MARCH

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1 F	2 G	3 G	4 F	5 P
6 F	7 G	8 G	9 G	10 G	11 F	12 P
13 F	14 G	15 G	16 G	17 F	18 F	19 F
20 P	21 G	22 G	23 G	24 G	25 P	26 F
27 F	28 F	29 P	30 P	31 F		

73 AMATEUR RADIO

APRIL 1977
$2.00



BE MY GUEST

visiting views from around the globe

Buffalo's Worst Winter

Paragraph A of the FCC Rules and Regulations part 97.1 says that one of the fundamental purposes of the amateur radio service is "Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications."

During the snow disaster in Buffalo NY at the end of January, amateurs proved their worth by taking over the job of emergency coordination of medical, food, and fuel supplies to the stricken city. The WR2ABU 31/91 repeater located in Buffalo was the focal point organized at the outset of the snow emergency on January 28. Repeater director Gilbert Boelke W2EUP, in a *73* interview, said that the week before the blizzard, the group had installed an emergency power system at the site. The new system received a test when it kept the repeater on at reduced power during four extended power failures. In another coincidence, the simulated emergency test scheduled for that weekend turned into the real thing.

Two other repeaters of the Buffalo Amateur Repeater Association were also used for coordination during the emergency: WR2ADR on 13/73 and WR2ACA on 40/00. WR2ACA is powered completely by a wind-driven generator. Gusts of up to 65 miles per hour during the blizzard kept it going at full capacity.

W2EUP said that over a hundred Buffalo area hams were involved in the emergency net, many of them on the air for over twenty hours a day. In the worst winter in the Buffalo area in 80 years, the area received over fifteen feet of snow in a three week period, prompting the city's 56 year old weatherman to give up and take early retirement. Driving in the downtown area was banned for over two weeks, and delivery of emergency supplies was undertaken by snowmobile.

Last fall, the Buffalo Amateur Repeater Association joined the local CB REACT group (Radio Emergency Associated Citizens Band Teams) in a cooperative effort aimed at keeping area motorists informed of traffic emergencies. The idea was the brainchild of a group of amateurs employed by radio station WBEN in Buffalo. The station received permission from the FCC to tape and rebroadcast repeater transmissions. They set up an emergency control center in the studio building. At the center, members of the REACT group and amateurs continually monitor CB channels and repeaters. When a traffic accident or hazard is reported, the message is immediately relayed to the announcer on duty via a video terminal. The police are also notified. Tapes of amateur transmissions are used when time and the situation warrants.

WBEN technical director Jerry Klebunde said he's happy with the results of the setup and feels that the station has been successful in reaching motorists without the capability of receiving hazard reports via amateur or CB radio.

Stan Miastkowski WA1UMV
Associate Editor

The Ban Moves Closer

Drastic changes are in the works concerning the way amateur equipment is manufactured and sold. At deadline, the FCC was releasing two notices of proposed rule making that would make a 180 degree turn-about in the current trend towards deregulation. At issue is the plague of interference complaints (see "C'mone Texas Salt Rat" in guest editorials, March, '77) and unprecedented pressures on the FCC to do something to stop it.

One of the dockets would completely ban the manufacture and sale of linear amplifiers that operate in the 24 through 35 MHz range. It is a direct result of widespread violations of the CB power limit, use of amateur equipment out of band by CBers, and the use of broadband amps made only for the CB market under the guise of 80 through 10 meter coverage. (Input power required by the bogus amps is usually only 4 Watts.) Many of the so-called "black boxes," when tested in the FCC lab, showed incredible amounts of spurs. Several makes actually couple raw ac into the power meter circuit, in an attempt to raise indicated output!

The FCC has tried several approaches to slow down the distribution and use of the illegal amps, but the complaints have only intensified. That leaves the Commission with little choice: Unable to control their use, the FCC has decided to turn off the pipeline. In throwing the switch, however, amateurs everywhere will begin to feel the pinch.

No matter who you talk to, there is strong feeling at the FCC that they don't want to hurt the amateur. But the bottom line, in face of growing political pressure to do something about interference, is that the situation leaves the FCC no choice – limits on linears and type acceptance of *all* amateur equipment are soon to be reality.

There are some loopholes in the FCC proposals. For one thing, home brewing will be allowed for. The linear ban proposes that any licensed amateur may build *one* linear amplifier covering 24-35 MHz for use at a licensed amateur station. The linear can then be sold, but only to another licensed amateur. Here again, the FCC appears to be relying on the amateur community's long standing ability to be self-policing in terms of enforcement.

The second proposal will have an even greater impact on amateur radio as we know it. The FCC wants to make all amateur transmitting equipment and amplifiers subject to type acceptance. The proposed guidelines would roughly follow the same specifications applied to the land mobile service. The means the formula 43 + $10_{\log}$ of mean power is used to determine the permissible level of spurs. For a 10 Watt transmitter, spurs would have to be 53 dB below the output. For a 100 Watt rig, 63 dB; 73 dB for a 1000 Watt transmitter. This, in effect, puts a 50 uW limit on spurs at 100 Watts output. To put it another way, at the 53 dB figure, it would take nearly *two million* Watts for the spurs to equal 10 Watts. As for home brewing, the FCC proposal would allow any licensed amateur to modify commercial equipment, or build his own, which would not be subject to specs.

The reaction to all this was slow in coming at deadline. One of the first groups to react was ARMA, the newly formed Amateur Radio Manufacturer's Association. ARMA had attempted to derail the linear ban (see guest editorials, March, '77), but succeeded only in delaying it. Comments on the proposal will undoubtedly push for alternative methods of limiting illegal use of amplifiers and amateur equipment, but the FCC seems most reluctant to consider anything but a blanket ban. As ARMA spokesman Dennis Had of Dentron Radio put it in a *73* interview, "We have an incredible task ahead of us . . . first there is the need for our comments on the proposals . . . and then counterproposals. There is also the problem of existing production runs, and how to decide when the new measures must take effect." Had estimates that if type acceptance becomes law, it will up the cost of commercial equipment somewhere between $150 and $300 per rig.

There is strong feeling among manufacturers and amateurs alike that the amateur community is being made to pay for the past mistakes of both the FCC and "black box" manufacturers. Our hobby, they point out, has never been fully represented in Washington, because of the ARRL's tax exempt status (which prevents the League from being an effective lobby). ARMA is representing us now, but is facing off against some of the most powerful "money" lobbies in Washington – the broadcasters (who share an attorney with the ARRL) and the TV manufacturers.

The NAB (National Association of Broadcasters), represented by ARRL General Counsel Robert Booth W3PS, is putting strong pressure on Congress to do something about TVI. NAB says too many stations are losing viewers because of the interference . . . people

switching from TVI-prone channel 5 or 2 to some other . . . while the industry types are arguing against anything that might force more stringent design regulations (low pass filters in every set and so on), and the higher prices that go with them. Amateur radio doesn't have any of the big money or influence NAB or EIA (Electronics Industry Association) have, so it looks like we may get to foot much of the bill through manufacturing and sale constraints.

Another issue is the FCC's perspective on the technical capabilities of the average amateur. Some sources indicate the Commission is likely to have its doubts after reading the ARRL comments on Docket 20777, the now defunct bandwidth proposal. The League was making strong arguments against the docket, and relying heavily on the question of the need for spectrum analyzers to insure compliance with the proposed limitations. The League reply pointed out that each amateur would need a spectrum analyzer to constantly measure bandwidth, and that the estimated $12,000 expense of such an item would put it out of reach for most amateurs. The ARRL argument was so strong, in the view of some, that it could be construed to cast doubt on our individual abilities to measure anything . . . whether it be bandwidth, harmonics, or even power output. It must be said that since many FCC staffers are amateurs themselves, it is unlikely that doubts about the amateur community's technical competence would fester very long. But, on the other hand, in the current context of linear amplifier bans and Capitol Hill pressure, a little misinterpretation could go a long way. It is important to remember that although ham radio does have many representatives working at the FCC, their interest could turn on them, decreasing their ability to speak for us.

So, what can amateurs do? For one thing, we can be more cooperative when it comes to TVI and RFI complaints. It won't kill anybody to stay off the air for a week and try to cure an interference problem. We have to remember that just as we have a right to operate our stations, the guy next door has a right to watch "Hogan's Heroes" or whatever. Our clubs have to revive TVI committees, call them interference committees, and rekindle the interference fight. Point is — we've done a great job attracting new amateurs (just look at what the clubs have been doing with Novice classes), but now it's time to put the same effort into improving our public image. And the best way to do that is not necessarily more shopping plaza exhibits or being there in times of emergency — it's probably more important to clean up our act interference-wise.

The magazines can help, too. We here at *73* are looking for some good articles on harmonic suppression and TVI. It is time to show the public (and the FCC) that hams really are a cut above . . . to show them we are capable of cleaning up *our own* interference problems. Otherwise, the RFI-TVI steamroller may run us over.

Warren Elly WA1GUD
Stan Miastkowski WA1UMV
Associate Editors

The Latest on WARC

February 7th was the big day — the deadline for comments on the FCC's WARC proposals. Two days later, an FCC spokesman went over the high points in a *73* interview, describing the response as nothing short of immense — a seven foot high stack of comments from sources ranging from the Utilities Telecommunications Council (UTC) to the ARRL. It will take 20 man-months to sort out the comments, and figuring that the Commission has 5 staffers working on the WARC proposal, that adds up to about 3 to 4 months work ahead.

To begin with, the Commission had already extended the deadline to February 7th in answer to a petition from the National Association of Broadcasters (NAB had requested a 90 day extension). Then the comments went into the public record for inspection, with a reply comments deadline of February 25th. The bottom line is that the actual US proposal for the WARC meeting set for 1979 will not be final until late spring or early summer.

Meanwhile, the Canadian DOC was about to make its WARC plan public at press time, but there were still no signs of activity abroad. It looks more and more like the bulk of the WARC delegations won't even see their country's final proposals until the eleventh hour. That doesn't leave much room for strategy.

Here at home, the conference staff office at the FCC in Washington is a busy place these days; the five staffers do not have a secretary, but they do have hundreds of comments to pore over, evaluate, and pass along to the full Commission. By and large, as one staffer put it, the comments are predictable. Among the adverse ones (from amateur radio's point of view): The Utilities Council is critical of the FCC proposal to open up 160-190 kHz to amateurs. UTC complains that its member utilities, who use portions of the 160 kHz band for power grid transmissions, will suffer interference from amateur operations there. The E.F. Johnson Company, which used to be a major manufacturer of ham gear but now makes CB equipment, is pushing for 220 MHz mobile allocations, arguing that the door "ought to be kept open" for future domestic CB use. Also supporting the 220 MHz mobile allocation is the Citizen's Radio Service working group. One surprise was the Electronic Industries Association (EIA) advisory group on consumer electronics, which *opposed* 220 MHz CB, on the grounds it would force the factor Installation of high pass filters on TV sets!

Further opposition to amateur allocations came from the radiolocation industry, which is strongly against expansion of 160m. They argue that 1800 kHz and below is used for offshore location (a non-emergency service according to the regulations). The radiolocators say interference from amateurs would render their installations less reliable, but amateur sources counter they are already sharing 160m with the much more crucial radio direction finding services, which are emergency oriented.

As for the ARRL, Newington's prime thrust seems to be a push for additional ham bands at 10, 18, and 24 MHz, possibly on a 300 kHz sharing basis with fixed services. ARRL wrote the FCC that the new HF allocations proposed by the amateur service working groups were not adequately considered. Then the League goes on to argue that fixed point-to-point HF is dying anyway. That may be true so far as North America, Europe, the USSR, and Australia are concerned, but in Africa and South America the League assessment may be in trouble. The poorer nations are more interested in cheap, uncomplicated HF circuits than multi-million dollar satellie earth stations and overland phone lines. It is, of course, far cheaper to buy fixed channel SSB transceivers.

The League proposal calls for a modified sharing arrangement with fixed HF services at 10, 18, and 24 MHz, and will probably gain support from the track record on 80m, where fixed services have shared frequencies with amateurs for years. An interesting argument advanced by ARRL is that the FCC, in calling for fixed allocations at HF, may be violating the ITU (International Telecommunications Union) regulations — article 6, section 413. That article says, in essence, "members of the ITU recognize that long distance propagation is prevalent between 5 and 30 MHz and agree that those frequencies should therefore be used for long distance communications, leaving short haul circuits to other means . . ." The League seems to be saying that the ITU's own regulations would force fixed operators to seek frequencies elsewhere, but whether that argument will stand the pressure of the third world nations at WARC remains to be seen.

Over 50 pages in length, the League WARC reply goes on to suggest a new solution to the 40m short wave broadcast problem. Complaining that the FCC plan did not address the 40m situation, ARRL proposes moving the broadcasters above 7.3 MHz, up to 7.5 MHz. (That would again cut into the fixed services allocations.) The League also calls for reduced sharing on 75m, while backing the rest of the HF FCC proposals, with one exception — 15m.

The FCC plan called for moving 15m down in frequency, running from 20.7 through 21.2 MHz. The League called that unnecessary and undesirable and worthy of reconsideration. ARRL wants to retain the current 15m allocation from 21.0 through 21.450 MHz, the compromise being that maritime allocations would be moved below 21 MHz, again taking from the fixed allocation that already exists.

A theme of the League reply then seems to be another assault on the new HF bands, opposition to inclusion of any 220 MHz mobile (CB) allocations, decreased sharing of the ham bands with broadcasters, but increased sharing with fixed services. The League position is apparently that hams can share bands with fixed services (as on 80m) or radiolocation, but not with CB or mobile services, which in the League view would justify separate allocations within any band allocated to both services. One major stumbling block, come 1979 (and provided the FCC sees things ARRL's way), will be the League proposal's apparent reliance on the fixed services' willingness to share with hams. If our sources have the correct interpretation of the third world's plans for HF (plus feedback from manufacturers who are selling African and South American countries thousands of fixed channel HF transceivers), it would be safe to say new HF ham bands may be hard to come by at WARC. On the other hand, ARRL may well succeed in gaining FCC support with the sharing argument.

Warren Elly WA1GUD
Associate Editor

Continued

New Life?

In his editorial entitled, "The 75 Meter Follies" (Holiday, 1976), WA6ITF demonstrates a misconception, or folly if you will, about a certain type of operation that many amateurs enjoy not only on 75 meters, but on any frequency where amateurs join together to communicate, in the true sense of the word. This style of operation is based on the discussion of topics of interest which deal with problems of today's world. It seems that Mr. Pasternak doesn't realize that there are a significant number of amateurs who choose not to participate in the chatty repeater style of operation in which he feels comfortable and secure. This, in itself, is nothing unusual. Even the embarrassment he and others like him feel when they stumble across people who "spew forth their personal and sociological ideals" (sic) isn't really unusual. What is, to me, extraordinary, is that Mr. Pasternak has the audacity to claim that this style of operation is an embarrassment to amateur radio in general. This is simply incredible.

First of all, in the third paragraph, Mr. Pasternak recognizes that, from a legal point of view, those who "spew forth their rhetoric" are not committing any unlawful acts by merely doing so. Thus, it follows from his argument that the fact that amateurs discuss sociology, politics, and other issues not directly relating to amateur radio makes them guilty of some nebulous crime, and further, brands them as being undesirable. I wonder how any American, whether an amateur or not, can accept this reasoning and, worst of all, its conclusions.

My own personal opinion is almost the complete opposite of Mr. Pasternak's. In these days of a dwindling amateur population and an increasing demand on the frequencies we now hold, some kind of revamping of amateur radio is obviously needed. This is necessary not only as a defense against other services desiring our frequencies, but also as a kind of enrichment to keep those who are already amateurs interested and active in their hobby. Also, incentives are needed to attract newcomers and to motivate them into getting a license. I believe that by expanding the range of "acceptable" topics of conversation and encouraging the discussion of topics that are important in view of today's world, the number of amateurs who allow their licenses to lapse because they "just plain lost interest" would decrease dramatically. The policy towards more permissiveness in the accepted and encouraged modes of transmission, i.e., FM, SSTV, 2M SSB, etc., has already proven to have caused a noticeable flurry of activity on the amateur bands and has caused many non-active hams to become active again. In general, I believe that what ham radio vitally needs is a push in a direction that encourages individual expression, both technical and expressive. What Mr. Pasternak is advocating will only result in making amateur radio more sterile and lifeless than it already is.

John Forrest WB6EDM
Isla Vista CA

Too Late

Some time ago, the FCC banned the sale of the linear amplifiers designed specifically for the 11 meter CB band. Some, of course, were "25 to 50 MHz" and carried a statement "Illegal for CB," but everyone knew what they were for. That didn't stop the manufacturers and stores. Now they are broadband, 3 to 30 MHz jobs, designed for AM and SSB with 4 Watts input. That got them around the law.

Now the FCC sees no other good alternative than banning linear amplifiers altogether.

What will this do to ham radio? Well, it will obviously raise the price of equipment. Since there will be no way for someone to raise the power of his transmitter (a Ten-Tec Transceiver for example), he will have to buy a higher power transmitter to start with. The used value of low power equipment will fall off, as very few will want it. Newcomers to our hobby will also tend to have to buy a high power rig, whether they want to or not, since they will want to plan for the future. Only the avid QRP enthusiast may benefit from this ruling, as prices on low power equipment drops.

This type of rule making will really do little good to stop the illegal high power operation on 11 meters. Linear amplifiers are now passé. Ten years ago was when the rule should have been considered. Now, buying the SSB transceiver for CB is the only way to go. Some say for every 10 Yaesu FT-101s sold, 9 are purchased by non-amateurs for 11 meter use.

Most of you who are reading this were not licensed in 1958 when there was an 11 meter ham band. If you were, you probably, like most, never used the band anyway. So the FCC said 11 meters will become a band for small businesses to set up inexpensive two-way radio systems. Great for the small businessmen, but someone found out it was like a party line, and you can chat among yourselves. WOW! By the time the FCC reacted, as usual, it was too late. Now the band is useless for any serious business use, but nevertheless it serves a useful purpose for many. The emergency reporting of highway emergencies alone has justified the existence of CB.

But the offshoot of CB has been punishment for the amateur. Our rigs get stolen because the crooks think they're CB rigs. The insurance companies don't know much better, so they increase our insurance rates. TVI complaints are high, so the hams get the blame. When the hams do perform some good public service, the CBers get the credit. When a CBer misbehaves, the press calls him a "ham operator."

One small ray of hope is seen glimmering, however. The newly formed Amateur Radio Manufacturer's Association is trying to do something. They appear to have made some progress already. For many years the Electronics Industry Association (EIA) has been the spokesperson for all. But their "standards" are getting tarnished.

Maybe they can exert some force not only at the FCC, but also to help get some of these "money-hungry" merchants squared away and teach them right from wrong. I suggest they start right here in Milwaukee!

Dave Barquist K9PAK
Hartland WI

Ham I/O

When the integrated circuit microprocessors first came out, they caused quite a flurry because they promised to allow the hobbyist to have his own computer (with capability that would have cost thousands of dollars not many years ago) for a few hundred dollars. Up to now, the main emphasis in the hobbyist field has been on building computers; however, the professional journals lean much more toward the use of microprocessors as controllers and not as computers. In fact, the use of microprocessors as controllers is usually given as their primary use in these circles.

I recently heard a prediction that untimately there will be several microprocessors in the country for every citizen. The basis for this prediction is that many things we will own, from automobiles to dishwashers, will be controlled by a microprocessor.

This concept seemed strange to me at first. I was used to thinking of a microprocessor as primarily a computer for solving mathematical problems and the idea of using it as a controller didn't make much sense.

While at the ARRL National Convention in Denver this past summer, I started to get the idea while attending the microcomputer seminars where they demonstrated several applications for microcomputers in amateur radio. Programs for both sending and receiving both Morse and RTTY were demonstrated.

These programs had provisions for storing messages such as "CQ" and could be quickly reprogrammed to allow changing the function of the computer so that it operated as if it were a completely different device. One particularly interesting program converted slow scan TV into a TTY picture such as they transmit on 20 meters on Saturday morning. Several persons had their pictures taken that way.

An important thing to notice about these applications is that none of them are primarily for the solution of mathematical problems, but are really for producing a particular function that traditionally would have been done using a hardwired device. It was stated at this seminar that a microcomputer that cost several hundred dollars could replace hardware devices costing more than two thousand dollars. The replaced equipment would be a CW keyboard, a CW decoding system, a RTTY system and perhaps parts at least of a slow scan system. Another important thing to notice is that all these programs were implemented using a general purpose microcomputer with a CRT terminal.

Even though the computer was used to simulate hardware devices, this still was not the same thing the professionals are talking about when they say the microprocessor will be used to control a dishwasher; they obviously are not going to build a complete computer just to control a dishwasher!

The way it will be done is that the microprocessor will be instructed to execute a particular sequence by a program stored in a read only memory. The microprocessor chip will be connected to some sort of interface that will allow it to control the operation of the dishwasher by turning on the hot water, the heating element, etc., and to receive inputs such as temperature sensors, water

level, etc. This type of system is not designed to be a general purpose computer, but is dedicated to doing the logic required for a particular job.

I have recently been thinking of ways to build something related to amateur radio using a microprocessor as the heart of the device, but with the idea of not building a computer. A very logical candidate for me is a keyboard keyer. I have done some designing and programming of such a keyer using the 8080 as the microprocessor. This keyboard keyer would use about 12 ICs and would cost less than $70 to build. The microprocessor would do everything from scanning and decoding the keyboard to generating the Morse characters. The memory would be used to store messages such as "CQ FD DE W5PAG." Because the device is programmable, it could be used in several ways with little additional effort.

These are several of the possible programmable modes of operation that occur to me:

1. Normal CW keyboard where the operator types in the text and the keyboard converts the text to CW. A buffer could be easily implemented to allow the operator to type faster than the CW was being transmitted.

2. A code practice mode where the operator types in the text but CW would not be generated immediately. A long text could be loaded into memory and edited. When ready, the text could be dumped onto mag tape or transmitted on the air. The code speed and spacing between letters and words could be easily programmed to make the CW sound like W1AW if desired.

3. A code teaching machine that could operate in several modes: The keyboard would be programmed to send a set of characters at random to the operator. When the operator hits the key corresponding to the letter being sent, the device would go on to the next letter, or text would be loaded into memory from the keyboard. Whole words would be sent and repeated until the operator signals he has received the word. The next word would then be sent. This mode would be good code practice for high speed CW.

In addition to the CW modes, the keyboard could be programmed to be a RTTY keyboard and send Baudot or even ASCII code.

While a microprocessor controlled keyboard has a lot of applications and would be interesting to build, I probably won't have time until next fall. When I build it, I will let you know how it works!

Roy Gould W5PAG
El Paso TX

Reprinted from The Beam, *bulletin of the Sun City ARC, El Paso TX.*

Rated "R"

While it is not this writer's intent to in any way limit anyone's inalienable right to freedom of expression, it does seem to me that said freedom has become somewhat strained in recent months on Denver-area repeaters. It may be that street language has its place on the street, but I don't agree with some amateurs' proclivity in transferring these phrases to the amateur radio bands. Prude I am not, nor have I led such a sheltered existence that I am unaware of the meaning of these outbursts which have graced our repeater systems in the later hours of the evening, but doesn't it make sense to keep "R" rated material in "R" rated movies? At least those attending such fare are prepared for stronger language than might be encountered in polite conversation — and those of tender age are not admitted. While the Federal Communications Commission speaks clearly as to the use of "doubtful" language on the public air, it admits that there is some question as to what is profane and what is obscene by popular judicial interpretation.

I wonder how much doubt exists in the minds of most amateurs as to what is what. Of course, we always have the excuse that some repeaters in other areas of the country are "far worse than we are." And we can say that the FCC does little or nothing about those. But haven't radio amateurs always been proud of their ability to self-police, as compared to other services? And haven't we done so most effectively in the past? If so, why don't we address ourselves to this problem? "Well, it doesn't bother me," many say, and perhaps that's true, but it does bother others. I have heard several complaints from husbands and fathers of potential amateurs that their wife or child has been "turned off" by some of the things which they have heard on the two meter band . . . some to the extent that they no longer wish to become radio amateurs. Is this an example of our vaunted recruiting effort? Is this the way we convert citizens banders to amateur radio? Is mine a lone voice, or are there others who share my concern? If so, can we do something? WHAT?

Harry Landon WØJGL
Castle Rock CO

Reprinted from Grid Leak, *publication of the Pueblo CO Ham Club.*

European DXpedition

DC-8 Charter Flight 1832, Overseas National Airlines, left Detroit at 1820, destined for Frankfurt, Germany. The flight itself was uneventful, except for the two meals that were served. My Wilson HT was lying underneath the seat ahead of me, along with an Imperial quart of vodka given to me when I boarded the airship. I lugged the bottle all over Germany and Austria only to find, when I returned, that customs in Detroit was going to charge me four or five dollars duty to bring it back into the US. I told them to keep it; I don't drink the stuff anyway.

The flight went quite well — airspeed over 600 mph, at 37,000 feet. A good jet stream had us touching down in Frankfurt in 8 hours. Coming in over Scotland made me wonder if my Wilson could be picking up any Scottish repeaters. But I refrained from turning the rig on, for fear of disrupting the airship's navigational system.

We landed at Frankfurt's main airport, and in a few minutes I was standing on level II in the arrival terminal, in a 90 degree plus temperature. I set the luggage down, screwed in the rubber duck, and turned on the transceiver. The needle on the S-meter pinned and a loud voice in German came booming over the little speaker. No time to talk, so I listened.

I made reservations for a hotel room and grabbed a cab for the city of Frankfurt. The airport is about 15 miles from the city. My hotel was eight blocks from the main banhof — ten dollars a day, including breakfast. The room was small, but comfortable. No air conditioning in Germany, so it was quite warm. I ordered a large lemonade (a sweet sour drink, a little like Fresca) and turned on the Wilson. I set the crystal selector switch to 145.15/.75 and heard a conversation in German. I listened for a while, and in about ten minutes they signed off.

Now, my turn. I "kerchunked" the repeater and brought it up. "W8WLQ/DL in Frankfurt listening on .15/.75." Dead silence. I listened for about five minutes and the repeater came to life. In a couple of minutes, several DLs were talking to each other. They were talking about me. "Did you hear the W-W on the frequency?" They had heard me, but hadn't answered. At first I didn't know why they called me the W-W. But I guessed it was because of the two Ws in my call, and it was hard to include the 8 due to pronunciation. When being talked about, I was called the W-W numerous times in Germany and Austria.

A little while later, I "kerchunked" the repeater and got a reply from Fred DK8ZF. Fred spoke perfect English and was associated with the repeater operation and the Frankfurt Radio Club. He was very congenial, and invited me to the Frankfurt Radio Club meeting. He told me that the repeater was located at one of the railroad stations. Their repeater was strong and had clean audio. There wasn't any timer on it. It was COR and had a W.W. identifier. The identifiers on it were set very fast. I found out that the members of the repeater groups like fast identifiers and no timers, so that they have more time to talk, with little or no interruptions. The repeater activity is heavier during the day and early evening hours.

While in Frankfurt, I talked to several English-speaking stations. Some of them spoke fluent English and others broken English. At times I did speak German, but only if absolutely necessary. DL8MG, Fred Number 2, was a TV engineer for the Frankfurt station. At the time, he was working on programming the Olympics via satellite. The last time I talked to him, he was sitting in his backyard, trying to beat the heat by drinking a tall glass of cold beer.

The first night in Frankfurt, I talked to a number of stations, including a YL. Her name was Lonnie DB5UW. She was located about 40 kilometers from Frankfurt and was a real ardent QSL collector. She broke in on one of my QSOs and requested a QSL. Everyone collects 2 meter QSLs in Europe. It doesn't make any difference whether it's through a repeater or not. I expect a deluge of cards from the QSL bureau one of these days.

Button-pushers: If you "kerchunk" a repeater in Frankfurt and don't say anything, you are apt to get told about it. The standard statement to button-pushers is, "The repeater works. If you don't want to talk, don't push the button." The call CQ is used universally and frequently on repeaters in Europe as well as some English words such as "Break," "portable or mobile," "OK," "cheerio,"

Continued on page 30

Looking *West*

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SCRRBA DEMANDS EQUAL TIME – ARRL GIVES PAPER BOX

While the "equal time" provision no longer seems to bother most politicians looking for office, another new demand for "equal time" (equal time to give the nation what they feel is a far more technically competent approach to advanced relay communication band planning) is being sought by the Southern California Repeater and Remote Base Association. It is the feeling within this group (an organization composed of amateurs who lie at the very foundation of amateur relay communication) that in adopting the band plans they have for 10 meters, six meters, and 450 MHz, the ARRL has reacted to pressure rather than providing the proper technically competent leadership necessary. SCRRBA feels that the ARRL judges all forms of relay communication from the narrow viewpoint perceived in Newington, and is willing to make decisions affecting vast numbers of amateurs based on this limited input.

SCRRBA feels that it is a far more competent organization to aid in making such decisions. They cite the fact that, while they have been around and organized since the late 50's, first as the California Amateur Relay Council and now as a regional subdivision of that organization representing every aspect of advanced format amateur relay communication, the ARRL is a latecomer to FM and does not possess, even within the structure of VRAC (VHF Repater Advisory Committee), the necessary and diverse talent to accurately make determinations that affect so many on such a wide scope. Since numerous attempts at educating those in the ARRL have to date failed, SCRRBA has decided to take a new approach and take their ideas directly to the amateur populace to be judged by all, based upon technological competence rather than upon what League leaders feel is the easiest road to follow.

This decision was reached at a general membership meeting held January 22, 1977, in Burbank, California, and attended by about 120 concerned members. During the course of the meeting, a poll was taken that revealed the following figures. 90% of the membership present had been involved in advanced format relay communication for at least three years, with over 50% being involved more than five years, and at least 25% having ten or more years of experience behind them. At least 75% of those present hold a 1st or 2nd class radiotelephone license, and at least 50% of the membership is directly involved in some facet of commercial radio communications, with representatives from all major manufacturers of such equipment. Based on this background and overall experience, it is the feeling that there is an obligation within the ARRL to be responsive to the needs and concerns of those amateurs who feel there is far more to relay communication than running down to the local radio emporium to purchase a multi-channel two meter radio or packaged repeater all ready to go on the air. Their concern is with the future, the proper controlled growth of 10, 6, 450, and the microwave spectrum. They feel that these bands must be developed on a technological level that will negate and avoid the problems faced on two. They also feel that to accomplish this, some basic changes in attitude and structure will be necessitated both back in Newington and within the VRAC. One proposal is that the VRAC be expanded to one representative per division, elected by the coordinating councils rather than appointed by the league from within. In this way, a far higher level of technological leadership can be achieved and a greater base can be established upon which such decisions of this high a magnitude can be made.

You will be hearing a lot more from SCRRBA; do not be surprised to see them at various conventions and the like running booths explaining who they are, what they stand for, and what their goals and the goals of advanced relay communication are. For the first time, there is an open and direct challenge to the ARRL in FM and FM relay communication leadership. For more information write to: SCRRBA, P.O. Box 5967, Pasadena CA 91109.

TWO METERS FALLS SILENT IN LOS ANGELES

At 4 pm on New Year's Day, 1977, a rather bizarre event took place in the vicinity of the "City of Angels." At that hour, the majority of this area's open two meter repeaters went silent to oberve a five day hiatus billed as "Repeater Appreciation Week." The purpose of the action, while simple in nature, did reflect an undercurrent of discontentment on the part of a group of concerned amateurs for the way operating practices had decayed on our many VHF repeater systems. A simple question had to be answered: Was a repeater, any repeater, the property of the person or persons who built, licensed, and owned it (and, therefore, was it their right to object to the rather poor operating procedures of many amateurs), or was a repeater, by virtue of its accessibility to the general amateur populace, a public utility? Further, was it within the province of amateurs who had great and total respect for the rules and regulations that guide the amateur service to take direct action to try and stem the tide of deterioration before it infested every nook and cranny of open format amateur relay communication in this area? In short, it was a case of those who cared about the future survival of the amateur service saying to all, "It must stop here," and organizing direct action toward that end.

Those of you who have followed this column the past few months are aware of a rather interesting experiment in "users attitude adjustment" undertaken by Mr. Bob Thornberg WB6JPI to clean up operation on WR6ABE, now WR6AMD. I devoted my last column to publishing the entire set of guidelines that users of WR6AMD are forced to adhere to. At this time, some three weeks after WR6AMD returned to full time service under its new callsign and licensee, the AMD experiment seems to be fairly successful. However, during ABE/AMD's off period, the "garbage" started to spread like butter melting in a hot frying pan. Even the private systems were not safe from the attack. For years, ABE had acted as the "friendly jail," but now that was gone and the sick abusive minds needed a new home. Worst hit by these attacks of jamming and vulgarity seemed to be WR6ABB, the Palisades Amateur Radio Club repeater, WR6ABN, and WR6ABQ, though no system seemed safe from "attack."

Perhaps this is the reason that the "Ad Hoc Committee For Open Repeater Appreciation" was able to get the cooperation it did in bringing this event off. You see, this is a case where repeater users organized and requested the assistance of system owners in what might be considered "a last stand" against those who would abuse the privilege of operating a repeater and maybe instill enough anger into the majority of good but apathetic users to take a strong and vocal stand against those doing harm to the survival and utility of our repeaters. While small in number, the committee was able to garner the necessary support among the owners/-licensees/trustees to make Repeater Appreciation Week at least 80% successful.

Listening in, it was amazing how many people discovered that it was not necessary to use a repeater 40 miles away to talk between autos that were less than a hundred feet apart on the freeway. It was also funny (but pathetic) to hear some of the comments, such as the following from 146.52: "There must be something wrong with the repeater part of my radio. I can't reach any of the repeaters." While a sad commentary on some of today's amateurs, this is in itself a part of the problem that those who care are fighting — apathy, lack of education, unwillingness to take an active part in policing repeaters, jamming, and at times even foul language. These are the crux of the issues that led to the rather drastic action we have already described.

Results: What, if anything, did this experiment accomplish? One of the prime objectives was indeed made crystal clear to all. The fact that a repeater is the responsibility of the one who holds its license and that that person has the legal right to determine how his repeater will operate, and to what standard, has now been established. I think that we all learned a valuable lesson to the end that 1) Repeaters are a privilege that we must never take for granted because nothing, even open amateur relay systems, lasts forever, and, if abused, they can easily disappear; 2) The purchase of a radio, regardless of how much we might spend for it, does not bring with it "a right to use any repeater at any time and in any way we may see fit"; and 3) Repeaters are in effect a gift from other members of the amateur community, a gift that we must cherish, respect, and support, perhaps not financially but, more importantly, morally and sociologically. We all learned that to permit the lowest common denominator in operating procedures to prosper only leads to decay, which in turn leads to chaos and anarchy. I think that in the end, we all learned a valuable lesson about the responsibility that deregulation imposes upon all of us.

However, while there was much on the positive side of the ledger, it would be unfair not to discuss the negative aspects and reaction. To the latter, there were more than a few amateurs who felt that "the cleanup was not worth the imposition" and have vowed to use, but never again support, any repeater, either morally or financially. Also, an obvious "cold war" has developed between those who habitually abuse repeater operation and those who have proper respect in that quarter. While most of the habitual abusers still hog repeater time and stand upon "their right to use," they no longer go unchallenged. Many of those who were once apathetic are now challenging this so-called "right," and for the first time are standing up and being counted. I say a "cold war" in that it's one of those things that you can't put your finger directly on. It's in the tone of voice, the inflection, and in the very nature of the fact that many people who had disappeared from two, people who had given up the fight in total disgust, are now back and are vocal.

Another obvious negative aspect of this has been a polarization of owners and users. There are still a lot of vocal amateurs running around yelling "user rights." This to be interpreted as, "Since I regularly use this repeater, you must give me a voice in the way you, its owner, will run it." This in itself brings with it a Pandora's Box of where responsibility of an owner to his users begins and ends, if such exists at all. It is my personal feeling that the only time a user has any legal right to demand anything is when he or she operates as a user on a repeater owned by a club or organization that is a legal corporation, and then only when such a person is a paid up dues-paying member of said organization, thereby becoming a legal stockholder or shareholder in the corporate structure. Even this, though, is dependent upon the particular state in which one resides and the corporate law of that state. Since I am an electronics technician and not a lawyer by profession, I will cut this here and again state that this is my opinion, not meant to set any form of legal precedent. However, this ques-

tion of user rights is starting to surface out here where I live, and where it will lead is anyone's guess. It would be interesting to hear from you on this topic.

Finally, there was a lot of complaining that "it was impossible to handle emergencies and was unfair to transients." On the latter, I agree only in part. I feel that our prime responsibility is to clean our own house so that we can provide high quality relay communication to visiting amateurs. What good is having as many open repeaters as we do if they become useless due to constant harassment and abuse? What kind of an impression will that visitor get if he is greeted with a barrage of garbage rather than a warm welcome? Our first responsibility was to ourselves, and to anyone visiting who suffered any inconvenience, I can only hope you understand the reasons. As to emergencies: It was well announced which major systems had remote/base facilities and would be handling emergency calls using that mode. All one had to do was call on the input of a number of systems, declare an emergency, and he would receive an answer on the output. A control station would handle his traffic, but he would not be repeated to the output. Though not confirmed, my information sources have told me that a good number of such occurrences were handled that way and expedited with greater speed and efficiency than when one normally requests another station to handle such traffic during normal repeater operation.

Now, where did the SCRA stand in all this? Officially, as an organization, it did not take part in this operation, although it is obvious that individual systems/members within the organization did take part. SCRA, being an organization formed as a body to handle technical frequency coordination and as a political forum for repeater owners to interact within, is not at this time geared to tackling user problems, as this has traditionally been the province of the individual licensee. They, therefore, took a wait and see attitude and neither condoned nor condemned the action, since at this time it is not their province to do either. Again, remember this was a "concerned user action," not the action of any single system owner. System owners cooperated in this venture, but did not organize it. For obvious reasons, it is best that I do not divulge the names of the individuals who put the whole kettle of wax together and made it a good if somewhat limited success; however, if you have any comments for them, they can be sent to me and I will forward them. Please mark any correspondence on this topic "Attention: Repeater Appreciation Week Committee."

Well, that's the story as of today — January 21, 1977. No one ever thought it could ever happen, that 80% of this area's amateurs would lose the use of repeaters, if only for a while. Then again, very few people last fall ever thought that California's most liberal open repeater WR6ABE would disappear and then reappear in the form of WR6AMD as possibly the most tightly controlled open system in the nation. Then again, many of us hoped that action such as this and other things that are yet to come would never have to come to pass. At least one group of people stopped saying "we have to do something," and went out to do it. In this alone a new precedent has been set.

THE ROAD UP NORTH

"Hey there, Lightnin' Rider . . . You got a copy on the 73 Man KKU4645 . . . come on." Not exactly the lingo I am used to using via a two way radio, but it was proper for the situation at the moment. We were on highway 101 at about 8 pm. It was just dripping California winter sunshine and we still were about a hundred and fifty miles from home, but heading in that general direction. Road conditions were far from good and, as one might guess, there was not a repeater to be had though my Denshi CL-144-FMCAX had 10 repeater pairs and two simplex channels in it. It was one of those times when having a CB radio along can be a godsend. The quick QSO I was looking for brought more than just road conditions. We chatted for a while and I caught up with this 18 wheeler (tractor-trailer) and asked if he minded if I passed him. He gave me a go-ahead and as I did, he called and asked what all the antennas were for (my car now has antennas for 11, 6, 2, and 220 and looks like a pincushion). I explained I was an amateur and was surprised when he asked if I had 147.57. Told him no, but I did have .52 and .94. We went to .52 and I found that my newfound CB friend was actually a "1" out of Connecticut and licensed for almost a year. We QSOed all the way into Santa Barbara and one of the things I discovered was that, according to my new ham/CB friend, quite a few truckers are getting disillusioned with CB and all its problems and are turning to amateur radio, specifically two meter FM. In fact, do not be too shocked to be driving along an interstate some day and hear activity on 147.57 out in the boonies. Seems that .57 is fast becoming the unofficial truckers' intercom channel for ham truckers. Best of all, if the guy I ran into is any example, they are far and away some of the best operators I have run into. None of this "10-4 good buddy" stuff like on 11. They seem to have a lot more respect for amateur radio than perhaps any other new group coming into it. According to what I learned, the handles and southern accents are gone, while clean operation is in. They value repeaters as a link to the outside world, and therefore the overall respect level is high. After all, most of the time they are the transient guest and want to be made welcome the next time through town. I wanted to learn more about this new phenomenon, but Sharon was hungry, the car needed fuel, and he had a schedule to keep. We parted when we reached Santa Barbara, but I was a lot richer for the knowledge I had gained. This was but one of the interesting encounters I had as we headed north to San Francisco.

Radiowise, I think I had set up the car pretty well. Normally, around town the car carries a trunk-mounted Motorola two channel plus slide mounts that accommodate a variety of radios. The fine piece of Motorola equipment was augmented this trip with the Denshi on two, a Clegg FM-21 for 220, and an Audiovox CB-2000 which is self-explanatory. We therefore carried 10 standard repeater pairs plus 2 simplex for two, augmented by the two L.A. channels in the Motorola, one simplex and five repeaters for 220, and channels 1 through 23 on 11 meters. Between radios, luggage, gifts, Sharon, and myself, the car was well loaded for the trip. It was noon Monday when we got on the road. Since this was to be a fact-finding mission as well as a vacation, I had installed a Panasonic RQ309S portable cassette recorder to take notes. This was possibly my best move, for as I listen to the tapes, I not only have the information I need, but a lasting memory of new friendships we made as the miles rolled on.

There was one question specifically that I wanted answered. It has been claimed that since we have reserved a number of common repeater pairs for simplex use, the transient visitor with his 12 channel radio does not really have a chance. The transceiver I had along carried the following channel pairs: .01/.61, .07/.67, .13/.73, .16/.76, .22/.82, .25/.85, .28/.88, .34/.94, .84/.24, and .72/.12, plus both .52 and .94 simplex, remembering that in and around L.A. and environs both .76 and .94 are reserved for simplex and that one must travel a good distance in any direction to find a repeating machine on these channel pairs. While it's true then that both these channel pairs are indeed useless in and around L.A., and that only a traveling ham residing in this area ever bothers to procure them, once out of this area and into the Central Valley .34/.94 especially begins to hold forth as a major channel. So, if you are planning to visit L.A. only, I still suggest that you pull both .16/.76 and .34/.94 to make way for a couple of far more useful pairs for this area, such as WR6ABN on .84/.24 or WR6ADH on .72/.12. On the other hand, if you plan to drive elsewhere, especially to the North, then carry both the .76 and .94 repeater pairs with you.

Next month I will get into the specifics of the trip. I will explain which repeater is where, what it covers, and tell you about some of the interesting people we ran into, but for this moment I'll just make a few rather general statements about repeater operation north of Los Angeles and in the Bay Area. First, while friendly, operation is tightly controlled and, with little exception, there is usually a full time control operator around when a repeater is on the air, or the repeater is just not on the air. This seems to hold especially true for the Bay Area. I found only one exception to this rule. Another thing I noted was that the Bay Area has no 24 hour a day open system on any of the channel pairs I had with me. Around midnight, most of the systems seem to go to sleep till the dawn's early light. Maybe this has changed since November, but during Thanksgiving week, this is what I found on the channels available to me.

Another aspect of Bay Area operation is very tight user control and guidance. The user is not permitted to take a repeater for granted and therefore the problems of both user abuse and user apathy seem much lower than in L.A. Operation in general is far more conservative and it's not uncommon to hear a user sign off by thanking the repeater for the use of the system and its time. In fact, I was told, though I never confirmed the fact, that on a few of that area's systems, such acknowledgements are mandatory. In short, once north of L.A., operation seems to be far more conservative, extremely tightly controlled, and problems (where they exist) are less pronounced. One thing was evident: "Right to use" on the part of the average ham seemed to hold no precedence whatever. Wherever I went, I noted that both repeaters and the people who ran them were treated with more than just respect; in some places, is was close to reverence. Yet, as a transient, everyone I met, owners and users alike, went out of their way to make me feel welcome. I came away with the feeling that with proper education and guidance, problems of repeater abuse, malicious interference, and the whole gamut of repeater-oriented problems can be conquered. They need not exist.

Now, a few notes on how the WR6AKG school repeater is doing and on a convention that failed. Keith WA6TFD and company planned to make February 20 the ribbon-cutting day. At around noon that date, his dream of a tie between school-aged amateurs should have become a reality. You know, with all the current furor about busing children, integration, and the like, I have to ask myself what better way to achieve the true purpose of integration — the interaction of peoples of different race, ethnic, and socio-economic backgrounds — than by radio. Rf does not know such bounds, and I have come to wonder if through technology we can more easily accomplish the goals of the directive of our Supreme Court than by forcing physical travel upon the children of the nation. In a city with as diverse an ethnic makeup as Los Angeles, WR6AKG may be a first step in that direction. Now, that's one to ponder.

I have looked for a nice way to say it, have analyzed all aspects of this year's Las Vegas get-together, but keep coming up with the same conclusion: SAROC this year was a bust. Now I speak specifically of the convention itself, and not the peripherals such as the hotel, the accommodations therein, the hospitality centers (for which the effort put on by Wayne Maynard WB6BFN and Shelly Chelsey WB6KED for the Palisades Amateur Radio Club has got to get the blue ribbon), or the fun that a trip to the "Live Entertainment Capital of the World — Las Vegas" brings with it. All

this was great, but SAROC itself was just not worth the cost of registration.

However, I suspect that I can give you the reason. In the past, SAROC has, at least on the surface, been a non-political, let's have fun get-together. This year, however, the politicians from Newington made sure to place themselves in full view of the world and were verbose enough so as to be sure that all in attendance were aware of their presence. There was a lot of surface politicking and, combined with what I feel was a poorly organized convention effort overall, I find it hard to give SAROC '77 anything other than a poor rating.

There were a few bright spots, however, including a booth run by the FCC and staffed by a bunch of knowledgeable people who were willing to listen to questions and give concise, to-the-point answers wherever possible. The brightest spot of all was a seminar on hidden transmission direction finding sponsored by the Happy Flyers organization in Northern California. I have intentions of devoting at least a full column to the work of this fine organization in the very near future, in that I feel they hold the key to something big for amateur radio's future. In general, though, SAROC just was not SAROC this year.

Our closing story for this month deals with a band that is not normally thought of as being VHF; however, a new form of activity that is growing like wildfire brings it into the limelight. The band is 10 meters and the activity is a widespread revival of Amplitude Modulation at low power. It seems that the latest craze to hit Southern California is based upon the easy conversion of inexpensive CB transceivers to channelized 10 meter operation. At this writing, there are already a few hundred area amateurs either operating already or busy at work converting their $29.95 Publicom I CB sets to 10.

According to Norm Lefcourt W6IRT, one of the pioneers of this project, the plans are to establish 16 national channel pairs starting at 28.760 and then every 10 kHz on up through 28.960 kHz. It is felt that this is a good low cost substitute to 2 meter FM, and as it grows, it is hoped that some of the pressure now on two due to excessive channel loading will be alleviated. So if you happen to be tuning across 10 meters one of these days and hear some AM, bet you dollars to donuts it will be about five Watts emanating from anyplace from San Luis Obispo to San Diego. Thanks to the FCC expanding CB to 40 channels, thus making the current crop of 23 channel jobs obsolete to a great extent, and to the willingness of the mass merchandizers to part with

them for next to nothing, a new "old" rage is taking hold at a rate to rival the growth of two meter FM relay communication. If you want more info on this event, I suggest you write to Norm W6IRT, who is in the callbook. "AM lives on 10."

Corrections

I am quite pleased with the way you handled my articles, "Give that Professional Look to Your Home Brew Equipment," and "DVMs Get Simpler and Simpler." Quite a difference from the treatment I get from *EE, PE, RE,* and the rest. Would you believe that a creative soul at *PE* took a fairly complex digital circuit I designed and changed all the IC part numbers?!? I guess he didn't like the CMOS I used.

There are few things I would like to point out to the readers. In "Give that Professional Look to Your Home Brew Equipment," a series of photos were left out which illustrated the steps in building the power supply. Also, part of the first paragraph under "Select the Cabinet" was transposed, so reading is a little confusing at this point.

A few errors cropped up in "DVMs Get Simpler and Simpler." Chalk it up to the wrong set of notes! Move C3 (0.01 uF) over to pin 9 of IC2, then switch pins 1 and 2 on IC3. You see, pin 1 is the MSD and pin 2 is the LSD. Nothing seriously wrong with Fig. 1, but operating the circuit without these mods will cause confusion during calibration! In Fig. 3, the 9k, 0.1% resistor should be 10k, 0.1% for proper calibration. That's it!

Gary McClellan
La Habra CA

Reading the article "See Yourself Talk" brought back a lot of memories, because I used a monitor like this with almost exactly the same setup for many years, until I built me a scope.

Reading the article and looking at the schematic diagram, I discovered two errors in the last.

First, the line coming from the RX connector running to the 455 kHz coil should cross the line coming from contact 5 of S2A and thus not be connected.

Second, the capacitor (.01 uF) which is shunting the 220k resistor in the first grid circuit of the CRT should be grounded at one side in such a manner that the wiper of the intensity pot will be at ground potential for ac. As it is now, the amount of flyback suppression is depending upon the position of the wiper, because in a lower position of that wiper, the flyback pulses are more or less ac grounded via both 8 uF capacitors in the power supply circuit.

For the benefit of the American hams, here are the equivalents for some items: EF91 = 6AM6; 800 piv/1 A = 1N4006 or 1N4007, eventually 1N521B or 1N5214; OA81 = 1N38, 1N98A, or 1N270; OA210 = 1N3194 or 1N4004.

Further, I'd like to give some hints. When using an old i-f transformer for the 455 kHz coil, do not short the second coil! This will lower the Q of the coil in use considerably, so remove it completely.

The two capacitors in series, via which the flyback suppression pulse is supplied to the first grid of the CRT, can better be replaced by one capacitor with a value of something like .01 uF, 1 kV. Two capacitors in series practically always have unequal charges, and if one becomes leaky due to overvoltage, the other will follow too. I found out too late and I ought to buy me a new CRT because the tube didn't like a positive grid voltage of around 400 volts.

Be aware of the very high potential difference between the filament and ground. Most filament transformers cannot withstand 800 volts. So better use a transformer with a very good isolation layer between primary and secondary windings. I did remove the original filament winding, put some extra layers of isolation material of PVC wrap over the primary, and rewound the secondary. The splattering was gone. It is very handy to add an i-f outlet on any receiver you have. To prevent loading or detuning the i-f transformers, a simple cathode, emitter, or source follower should be added to the receiver.

Anyway, the monitor scope is a very useful and cheap instrument and sure worth it to build!

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The Netherlands

CARF

Canadian Amateur Radio Federation, Inc.

The Canadian Amateur Radio Federation Inc. is pleased to announce the following awards available to all radio amateurs worldwide.

CANADAWARD: A colorful certificate will be issued to any amateur who confirms two-way QSOs with all Canadian Provinces and Territories. All QSOs to be on one band only. This certificate is endorsed as to band. Separate awards are issued for each band on which the applicant qualifies (12 cards per band).

A mode endorsement is available if all QSOs are made on the same mode (CW, SSB, RTTY, SSTV). Contacts made after July 1, 1977, only will count for this award. Submit the 12 cards with one dollar ($1.00) Canadian or U.S. funds or 10 IRCs plus sufficient funds for return postage. CARF members need send only funds for return postage.

5 Band CANADAWARD: A special plaque will be issued to any amateur who confirms two-way QSOs with all Canadian Provinces and Territories on each of five separate bands (total of 60 cards — 12 cards per band).

Contacts made after July 1, 1977, only will count for this award. Submit the 60 cards with seven dollars ($7.00) Canadian or U.S. funds or 70 IRCs plus sufficient funds for return postage. All CARF awards are free to CARF members. CARF members need send only funds for return postage.

6 Band CANADAWARD, 7 Band CANADAWARD, ETC.: Special endorsements to the basic 5 band CANADAWARD will be issued to any amateur who confirms two-way QSOs with all Canadian Provinces and Territories on more than 5 bands. Submit the additional cards with sufficient funds for return postage.

All amateur bands may be used. Each distinct satellite mode (432 in/144 out, 144 in/29 out, 144 in/432 out, etc.) will count as a separate band.

NOTE: These awards do not conflict with the WAVE and WACAN awards sponsored by the Nortown Amateur Radio Club.

Mail all applications for the CANADAWARDs to: P.O. Box 76752, Vancouver, B.C., Canada V5R 5S7.

Tracking the Hamburglar

RIPPED OFF: Clegg FM-DX 2 meter FM transceiver, s/n HM-298 and microphone were stolen from the van of WA3BGN on Feb. 5, 1977, in downtown Bridgeport CT. Anyone with information please contact Jon P. Zaimes WA3BGN, 681 Longhill Ave., Shelton CT 06484 (phone 203 929-4659) or the Bridgeport police department, file no. 6856.

LETTERS

AR73L?

Just a short letter to commend your fine effort in the area of amateur radio. In my opinion, *73* is the best magazine on the market. You always have up to the minute news on what's happening in our hobby. You also solicit people to write guest editorials if they disagree with you, and unlike other magazines, you even print them.

If there was one thing to be changed in *73*, it would be the computer I/O section. Though it is the up and coming trend in amateur radio, and although I have a great interest in the subject as a beginner, I feel the computer articles should be reserved for your new magazine, *Kilobaud*. I think there is nothing wrong with material about computers; I just believe construction and programming should be kept in the magazine that was designed for the specialist — *Kilobaud*. Computers just aren't everybody's bag of capacitors.

These are just my own personal feelings and I thought it might do some good to let you know where I stand. In all other areas, Wayne, just keep up the excellent work, and in the future we just may have the AR73L for the betterment of our hobby. Thanks for listening and for a super magazine.

Neil Kelly VE6CFI/W4
Temple Terrace FL

SPREAD THE WORD

I am in FULL accord with your opinions about Docket 20282 (and those numbers sound like the last mile). Did it ever occur to anyone (I know you caught it) that the individual who will apply for a freebie Communicator license — and pays his money — must *first* be interested in amateur radio? Therefore, and accordingly, someone MUST interest him! Without that interest nothing happens to the grand idea of the amateur cup running over. There is where the League has consistently dropped the hot potato — public relations. This little item requires pros and real ones. The Podunk Valley Radio Club cannot possibly get amateur radio into the media, but with all the affluence of the ARRL, it can do it — *if* it will set up the proper department and hire pros. Every other national organization I have heard of and joined spends money on just that! Nevertheless, the boys in the back room have hidden themselves in their Newington digs and repeatedly ask the young outsiders to spread the word. It cannot be done effectively in that manner. This I have written, discussed, and informed the Director and everyone I meet. I have received no solid reply except that it is a good idea.

If you interest the students, the Boy Scouts, the Girl Scouts, the Sunday schools, and even the stamp clubs, then and only then will there be a run for the licenses.

One minor comment: I have spoken before Ruritans, Kiwanis, Rotary, et al, and shown the much touted "Ham's Wide World." It's an interesting movie but *not* a movie to interest new hams. As I tried to tell some friends the other day: My shack is open any time you have someone you would like to exhibit ham radio to. However, if you show a youngster all the gear that has been accumulated in 35 years, you will immediately scare him away. He will either be so awed or so confused that he will immediately conceive the idea that the hobby is for the rich and the mighty. What really has to be done is to simulate the old 6L6 and oatmeal box and show them how it works.

Gay Milius, Jr.
Virginia Beach VA

LEARNING

This letter should really go to Peter Kendall WN3ZRG (Letters, Jan. issue, p.154), because it is for people like him that I am writing it. Pete, I completely disagree with your views, and actually take offense with your criticism of *73*. It seems as though you are *still* a neophyte to ham radio — not in the technical sense, but in the fraternal sense. You are selfish. Just because *you* have no interest in computers, you think they should not have a section in *73*. In thinking this way, you are depriving others that *do* have an interest in them the opportunity to learn more about them. If you ". . . see no need for (a computer) . . ." in your shack, fine — don't buy one. But there are others, with a little more upstairs than you or me, that *find* a need for one. I, too, don't need a computer in my shack (yet), but that doesn't mean I want to hack every I/O article in *73* to pieces with a meat cleaver. I'm a Tech and don't want a low band rig in my shack. I prefer VHF, but I don't want to sit in front of a fire and burn articles on keyers and CW filters. I want to read articles on the low bands — maybe I'll find some facet of operating that I'll be interested in. Enough of this self-glorification.

My point is that I don't think we should deprive others of something that they enjoy just as much as you enjoy the "distant station," or something I enjoy as much as bringing an old taxi radio to life on six meter FM. If terms like byte, ROM, RAM, etc., leave you in the dust, get up and try to learn them. If you don't want to, then lie there and be trampled by others who are not "conventional hams."

Please do write some articles on code speed, observations on the ham bands, etc. I'd enjoy reading them. Not because I care about operating at 40+ wpm, but for the same reason that I read the I/O articles — I want to learn.

Jim Heid WB3CWY
Pittsburgh PA

THE MENTAL BLOCK

Yesterday's arrival of *73* was a pleasant surprise, what with the mail tie-up during the holidays. As usual, it was interesting and informative. Read the Letters section; I used to agree with W5GOS about I/O articles. It took a tech talk by WA2PJS at the Dec ARATS (W2SEX — listen for us during FD '77) meeting to kindle a keen interest. By the way, took a digital course at college recently, found it easy and interesting, got a "B". Anyway, I/O is more interesting to me nowadays, but not enough to cause me to subscribe to a new magazine. I will, however, purchase the "Bugbooks" when time and finances warrant.

Having heard all the arguments for and against CW, I'd like to say that CW is just plain enjoyable operating. I like it. The *73* tape was a great assist in qualifying at 20 wpm at Rochester this spring. I'm an Extra now. Those who cry about the code probably have a mental block (they have programmed themselves *not* to learn it by thinking to themselves that it is impossible; I've been through *that* myself on occasion).

Whatever happened to SSTV? Editorials rambled on about it at length some time back, and now — nothing. Granted, there are many subjects to write about, and SSTV probably won't come up for some time again. Oh well.

Steered two CBers toward their ham tickets this summer and fall. One is an avid DXer; when he learned that several hundred mile QSOs are possible daily on the ham bands, he dug in and studied, attended an ARATS-sponsored ten week class. The other fellow always knew about ham radio, finally found the time and the help, and is nearly ready to try his code test. Met him in a barroom where he tried to pick my mind for antenna info. He's built several CB antennas so far, will grow into the HF ham bands soon. It's a good feeling, helping these guys. They'll still keep their CBs for utilitarian communications, though. The darn things *do* have a practical value.

Having recently passed my FCC Second Class Radiotelephone ticket and my Extra, and not having time for hamming, I'm still volunteering myself to help anyone in the Honeymoon Capital area toward obtaining a ticket.

Jeffry Blackmon WB2UYI
7714 Lindbergh Ave.
Niagara Falls NY 14304

BUS-MOBILE

Thank you for a most interesting issue, #195, Holiday, 1976.

Enclosed is a photo which I hope will be of interest to you, depicting as it does how readily one can adapt amateur radio to one's job given enough imagination! Working mainly night runs ("owls"), I found my Standard hand-held to be a welcome diversion during my layovers, as well as a convenient supplementary communications means in event of an emergency.

This photo was taken for a QSL card I am designing. Unfortunately, my having to be at the business end of a 1950 Exakta with a cantankerous self-timer precluded my being photographed in the bus with the Standard.

I would be most interested in hearing from other radio amateurs who may be similarly involved in the transportation industry.

In this area, "Locomotive Mobile" is also known!

Thank you for a very stimulating year one of my three year subcription. I read both *73* and *HR*, and find they complement each other nicely.

E. G. (Ernie) Kenward VE7BYK
North Vancouver BC

NAG MOBILE

I thought you might be interested in my system of mobile communication: Nag Mobile. In a world of machines, electronics, and computers, the west is still able to blend modern technology with the traditional western mode of travel — the horse. The Appaloosa pictured is able to differentiate between an antenna and a whip and is undisturbed by my mobile communication. There is no ignition noise or alternator whine — just an occasional whinny.

The transceiver, a Drake TR-22, is secured to the saddle horn, the coax is run under the saddle, and the antenna is a Larsen Mag (Nag) Mount secured to a metal strip which is affixed to the back of the saddle. In flat desert areas, the system is ideal, with no brush or trees to entangle the antenna — and it helps to have a cooperative horse. Long live the west!

Horse mobile is not unusual here in the west. The local repeater group helps with parades, and most trail rides utilize handie-talkies, but I have never seen a horse-mounted antenna. Hope you enjoy the photos.

Carol Sears WB7CUF
Phoenix AZ

P.S. My father, Stan Sears, (W2PQG) suggested your magazine, as it has a better reputation for printing articles than *QST* or other ham magazines.

Beats walking! — Ed.

see page 193

WARC

I read the writeup on the proposals for the WARC conference with considerable interest. I'm glad you went into detail on it in the February issue. I don't think the analysis went far enough, though; in the case of all but the HF bands, it didn't say much about the implications of the proposed changes, or the pros and cons. I hope there will be space in the future to educate us about bands we don't work, or haven't worked in the past. One question that comes to mind is: What's the purpose of satellite allocations in the HF bands?

Now, several comments. First, if it's argued that we need some spectrum space at in-between places to get reliable propagation when the present bands are out, for such jobs as handling the traffic arising out of the Nicaragua earthquake, maybe we don't need whole bands. As accurate as ham gear is getting, a few spot frequencies might be enough. Making them open only to traffic nets would keep them quiet most of the time, so high-priority traffic could get through, and letting the nets on would get them listened to periodically. Naturally, any ham should be able to declare an emergency and call. Next, I think it would be helpful all around if there were a few spot frequencies shared with other users. How about a common emergency frequency for hams, aircraft, inshore boats, and land mobile? FM on 144.000 MHz would be an obvious choice. Putting all the crash beacons on that frequency would free up 121.5 for urgent voice calling, as well as simplify WB6CQW's proposal for equipping 2m repeaters to detect ELTs. Now, a really radical suggestion, as wild as anything that ever came out of Peterborough. Has anyone considered the idea of trying to steer the EIA's grabby mitts away from 220 by suggesting that CB expand into 6 meters? Being right next door to channel 2, the TVI potential makes any significant amount of power a nearly hopeless proposition except for those who live far from cities. So 6 meter DX, while sometimes possible when propagation is right, is never going to be a workhorse. I've never heard more than half a dozen stations on the band, and none above 51 MHz. Meanwhile, as 2m fills up, the next logical place to put repeaters is 220, so we're likely to want it very soon. From the CBers' viewpoint, 6m would make a much better mobile band than 220, because the longer wavelength gets around obstructions better, and being closer to 11m, it would be easier and cheaper to make one transceiver cover both — probably as one continuous series of channels. By the same argument, ham gear could treat 2m and 220 almost as one band. Shared use of some low end channels on 6m could be a really cool idea, too. We could end up with a common emergency channel with direct input to police departments, and the chance to both demonstrate superior operating practices and rub noses in the benefits of such ham privileges as equipment modification and high power. Incidentally, I think any new CB channels should be sideband only, and not just to save spectrum. With all the benefits of having radio in everything that moves, carrier heterodynes make channel 19 pretty hard on the ears.

John A. Carroll K6HKB/1
Bedford MA

LONESOME SAILORS

I am a Coast Guard radioman, stationed onboard the *USCGC Ingham*. I have noticed that *73* has brought up some good suggestions for things to keep a sharp lookout for at the next ITU conference coming up shortly. Here is another one: the expansion of the use of present amateur bands in international waters, especially region 2.

There are a lot of things that us poor lonesome sailors miss out on, as far as I know, for no good reason at all. It would be great, for instance, if we could make use of the local area nets on 75 meters during the evenings, as a source of available operators for phone patches in our home port towns. 40 meters in the evening is too crowded with broadcast stations; even if the skip were short enough, that only leaves the 20 meter band, which gets expensive. (Do you suppose that could be the reason we can't use 75 meters? Hummm!)

In addition to this, it would be nice to be able to use all modes of OSCAR; presently we are restricted to inputs below 148 MHz.

Then there is that 1600 meter band the FCC has proposed. Experimentation from international waters on 1600m would be severely limited by the /mm limitation. The Navy has been using this band for a long time now for maritime (submarine mostly) workings, and I believe it would be a very dependable maritime amateur band.

Yes, there is a problem with LORAN on 160 meters, but with today's receiving gear, and a reasonable power limit (say 50 or 100 Watts), there is no reason to completely forbid working on that band either. Most of the other bands we are talking about are exclusively amateur, and would bother no one.

Enough criticism. I just want to say thanks for publishing the best, most open, and outright honest amateur magazine going, and I mean that from the heart. Keep up the good work; it is appreciated.

Mike Warner WA7LZQ/4
Portsmouth VA

ASCII

Radio hams have used teletype machines to communicate for many years, adapting the 32 character, 5 level machines that became readily available after World War II. Teletype communication was formally written into the FCC amateur regulations in 1953, specifying the 5 level Baudot code and standard speeds of 60 words per minute. Hams were not satisfied with the mechanical contraptions and paper tape storage, and with the advent of ASCII code, CRT terminals at low cost, and the 8-bit microprocessor, we look to modernize these ancient FCC regulations that encumber our development of the communications arts and sciences (if you want to use ASCII legally on the air, you can obtain a special temporary permit, but the process is slow and difficult). Hams have already established data transfer links between minicomputers in two different countries via the amateur radio satellite OSCAR 7, under special FCC permit using ASCII. Other computerized hams make regular schedules of cross-country data links by the kluge method of converting their ASCII computer output to Morse code, transmitting at more than 100 wpm, and converting back to ASCII at the other end.

Changes in radio regulations to reflect the current technology are long overdue, and a formal petition numbered RM-2771 has been entered requesting the allowance of ASCII 8 level code on the amateur bands. If the FCC hears support on this from the public, there will be a set of proposed rules made up and published for public comment. If comment is favorable, the rules could be changed in a year. Or the feds could just sit on ASCII forever if they don't hear from anybody. You can help by sending a simple comment (6 copies required by law) encouraging the FCC to act on RM-2771. Just take a note pad and a pencil and write six times: "I support RM-2771 allowing the use of ASCII code on the amateur radio frequencies." Add your name and address, and mail them to the Federal Communications Commission, Washington DC 20554. If you have access to a cheap copier, you may wish to elaborate on why ASCII radio transmission is desirable in your opinion, but a simple statement will do, as numbers seems to count more than eloquence at federal agencies. Be sure to mention RM-2771 by number.

J. R. Johnson WA5RON
Austin TX

SMOKEY

I read with interest your letter dated January 1, 1977. This letter, you may recall, was in response to a letter I wrote regarding the article "A Mobile Smokey Detector" in the Holiday issue.

As you pointed out, the United States of America celebrated a very glorious achievement last year. We celebrated the anniversary of a break

with a government that had, as Thomas Jefferson put it in the Declaration of Independence, "a long train of abuses and usurpations," one of these usurpations being "the abolishing of the free system of English laws."

Americans in 1776 were justified in doing what they did because, as noted earlier, the rule of law had broken down in the then American colonies. Today a free system of American laws is alive and well despite the best efforts of some. In fact, the rule of law is very strong, as recent political events have demonstrated. This is also something we celebrated the 200th birthday of last year.

This last achievement is perhaps the greatest of all. For in this system Americans can and do daily change the laws by both judicial and legislative action. But until a law is changed, Americans are duty bound to abide by it. For no man is above the law and no man is below it, nor do we ask any man's permission when we require him to obey it.

To the heart of the matter: I agree with you in that a discussion of the pros and cons of the 55 mph speed limit is beyond a letter such as this. In fact, such a discussion is not needed. What is needed is a recognition of the fact that murder, bribery, not using a valid callsign on the ham bands, and yes, speeding, to name a few, are against the law. Not as some people feel, just a good idea you can take or leave.

I, like you, am very proud of people who have the guts to stand up against what is wrong in our society. That is the only way change is accomplished and wrongs righted. This has held true from the patriots at Valley Forge to those who attack social injustice today.

But unlike those at Valley Forge, we do not have to resort to arms and violating the law. Instead, Americans seek to change the law through established legislative and judicial channels. This can range from an individual petition to the FCC, or a judicial challenge to the state Blue Laws, to a legislator down here in Texas trying to *legally* change the speed limit.

I have, however, absolutely no pride in an individual who attempts to either change or enforce the law by breaking it. In fact, I have only pity, for these people are the ones who have missed completely the spirit of the revolution and indeed the nation. Good examples of these folks who, as you say, did their own thing, are the HF bootleggers who have recently been apprehended by the FCC. I am quite sure those arrested think those laws are bum and will do what they can to break them down and get rid of them. But, may I ask, what will happen to radio should they and others continue operating as they were?

It is easy to see the chaos and disorder that would erupt if people only obeyed laws they personally liked. It would not only be the demise of ham radio, order, and justice — it would be the demise of the country.

I am aware, in regards to the WARC, of the one country, one vote rule. I have thought what we as a hobby have needed is a representative to spread the amateur radio cause officially. I also believe, however, that anti-ham feelings could hardly get better by selling one amateur frequency for the purpose of breaking the law. It only adds to the list of excuses available to cast a negative vote regarding amateur appropriations.

For were I a delegate who had read "The Mobile Smokey Detector," I wonder how law-abiding hams were. The case of WR6ABE is a timely, sad, and scary example. Again, those involved with causing the shutdown of that repeater probably were disregarding laws they felt were unnecessary and felt no duty to obey.

In closing, I believe *73 Magazine* has and will always be a leader in the field of ham radio. I am hoping that your code tapes will help me hang a 2nd Telegraph next to my First Telephone (with Radar Endorsement) and replace my Advanced with an Extra. I just hope that in the attempt to lure CBers to a very exciting hobby, we stress good and legal operating procedure, and not another way to beat Smokey. If not, we need not worry about WARC in 1979, for ham radio is finished.

Robert Oler WB5MZO
College Station TX

I disagree with your comments concerning "The Mobile Smokey Detector," Bob. Based on the amount of mail we have received, there are a great number of people using the Smoke Detector for what it is, a microwave receiver. Have you seen any easier method of getting started in amateur microwave communication lately? I doubt it. — Ed.

MUFON

The January issue of *73* with the article titled "The UFO Connection" by David L. Dobbs K8NQN indicates that you still maintain an interest in the UFO phenomenon, even though it may be secondary to your current hobby. Everyone enjoyed the humor of the article, but some thought it was perhaps a fictitious case due to the "spoof" address used in the "open letter" concept. As you probably noted, David simply made minor changes for literary purposes. Amateur radio friends quickly recognized the addressee, especially since Texas and the zip code were correct. Needless to say, it did confuse the post office department in some cities. However, David's address was correct and correspondence will be forwarded to MUFON (Mutual UFO Network, Inc.).

MUFON presently has two active UFO nets operating weekly. The 75 meter net on 3975 kHz meets each Saturday morning at 0800 CST with Marshall Goins WA9ARG in Quincy IL as net control. A 40 meter phone net also meets on Saturday mornings on 7231 kHz with Joe Santangelo W1NXY, in Waltham MA as net control. We invite ham operators interested in the UFO phenomenon to check into these nets not only to share their own UFO sighting experiences, but also to obtain the latest newsworthy UFO events occurring around the United States. Many of the ham operators participating in these nets are also state directors, state section directors, and field investigators for the MUFON.

We publish a 20 page monthly magazine titled *The MUFON UFO Journal*, which covers UFO sighting cases from all over the world. MUFON has members in all fifty states and in thirty-five foreign countries.

We have received, through David Dobbs, several personal UFO sighting reports made by your readers in response to this fine article. I am confident that many of the subscribers to *73* would like to have our correct address; therefore, we would appreciate having this letter published in a subsequent issue.

Walter H. Andrus, Jr. W5VRN
International Director
MUFON
103 Oldtowne Rd.
Seguin TX 78155

HILLBILLY NOVICE

I just received my first copy of your fine magazine and, wonder of wonders, it took me over an hour to just thumb through it. What a delight it was for me, a hillbilly Novice, to find all the variety of information and subjects. I even found some I could understand! Hi! It seems that someone must remember what it was like to be a unlearned, untrained, but willing *Novice* when they wrote some of your articles. Please include as many illustrations and pictures on your construction projects as possible as many of us (notice my pride) hams have no experience but want to start someplace.

I certainly got fired up when I read about "A Vest Pocket QRP Rig" by K5JRN in the January issue. When I read that he had just worked Tennessee, 500 miles with a 569 signal report, you know what I did? Yes, I checked my log, but it wasn't me he worked.

As a Novice on 40 meters, one of my best remembered QSOs was with Milt W8TZ in Columbus, Ohio, 70 years young, QRP 3 Watts on a home brew rig he made 30 years ago. QSL said it was in a 3 x 5 card file box and consisted of 117L7 tube and crystal. For me, that was some fun talking to a ham with 56 years experience and wisdom. What progress those "ex-sparkers" must have seen!

So, Wayne, hook up the old key and drift down on the Novice bands sometime and encourage others to do the same. We sure do have a big time there.

Mike Wechsler WA4SPX
Kingsport TN

I'll look for you. — Ed.

MIAMI

We did it one more time: The 17th Annual Miami Hamboree had an attendance of more than five thousand with 64 display booths. The chairperson of the Hamboree was Evelyn Gauzens W4WYR and the sponsor was the Dade County Radio Club.

Guest speaker was Armin H. Meyer W3ACE, Ambassador to Iran and Japan.

Bill Halligan W4AK/W9AC, former owner of Hallicrafters, was on hand to greet some friends from up north.

Of course *73 Magazine* had an excellent display and was one of the most busy booths in the Hamboree.

Larry Price W4RA delivered a couple of speeches representing his position as Southeast Director for the ARRL. The ARRL booth was manned by Terry Williams W1UED and Ellen White W1YL.

The computers booth monopolized a great part of the attention, having unusual coverage by the local TV stations. I am afraid I'm hooked for good and my personal budget is going to suffer great loss this year.

One of the parking lots was open to enlarge the swap meet and fortunately we had some of the best weather of the season.

Albert H. Coya WB4SNC
Miami FL

The Miami Bayfront Park Auditorium had wall to wall hams.

THE 10M SOLUTION

Over the past few months, prices of CB radios have been falling like a rock. It seemed like now was as good a time as any to take advantage of some good cheap radios and put them to some practical ham use. WBØMZD and myself looked over several units and decided on one type for conversion. It is here where we would like to pass on a few suggestions. First, a frequency scheme.

We decided on a scheme which would allow use of as much coverage around the frequencies of 28.6, 28.65, and 28.8 MHz as possible. These areas appear to be the most popular on 10 meters at the present. Our channel versus frequency selection is as follows:

Channel #1 28.550
Channel #2 28.560
Channel #3 28.570
Channel #4 28.590
Channel #5 28.600
Channel #6 28.610
Channel #7 28.620
Channel #8 28.640
Channel #9 28.650
Channel #10 28.660
Channel #11 28.670
Channel #12 28.690
Channel #13 28.700
Channel #14 28.710
Channel #15 28.720
Channel #16 28.740
Channel #17 28.750
Channel #18 28.760
Channel #19 28.770
Channel #20 28.790
Channel #21 28.800
Channel #22 28.810
Channel #22B 28.820
Channel #23 28.840

Those who research this scheme will note that the original CB channel spacings have not been tampered with, which leads us to our second suggestion. We modified *only* the injection or offset oscillators and not the synthesizer. First of all, it is the easiest, cheapest, and most electrically sound way. Secondly, if modification of the synthesizer is done, several problems might occur (depending on type of unit and synthesizer scheme) with the offset oscillators or traps used for filtering of synthesizer products. By converting the offset oscillators only, you have several other important things to gain. You might incorporate diode switching of these crystals with two other crystals to extend coverage in other areas, or, how about modifying these with a varicap to slide in between channels? Note: Not to be confused with sliders, delta tuners, or clarifiers.

We are submitting this frequency scheme to as many of our local clubs as possible. It would appear this is the beginning of something big for 10 meters; local interest is very high. Now would be the time for frequency coordination so we do not have gangland wars similar to some in the beginning of 2 meter repeater days.

Present plans are for breadboarding a scanner similar to the types used on public service monitors and a solid state amplifier for mobile use, although most hams would be surprised to find out just what 5 Watts can really do on a clean frequency.

WBØMZD and myself would like to receive any other plans by individuals or clubs. All letters will be answered. Get on ten cheap and have some fun! Remember: use it or lose it!

Tim Haake WAØTSY
128 Lake Point Drive
St. Peters MO 63376
Ken Lowrance WBØMZD
11569 Tivoli Lane
Creve Coeur MO 63141

Well? – Ed.

10-4?

I've been reading your articles since the days of *CQ*. I probably wouldn't like you if I met you since anyone that drives sports cars and endorses no code licensing has got to have long hair too! But you do have a CB, so you're probably just a native Texan who went "astray."

Most important, however, is your ability to create the best ham rag around. Congratulations to you and the staff of *73* for selecting *useful* construction articles and opening a forum for any idea or opinion – independent of advertiser pressure. Those companies who boycott *73* should also be boycotted. May we see the complete list? Moreover, any decent ad man employed by these firms should quit in protest. After all, since when did advertising policy win out over editorial policy? Other magazines in various fields which allowed their advertisers to dictate their editorial policy soon were out of business!

I buy all the ham mags and hope ol' *CQ* does stay in the game. I don't agree with everything the ARRL promotes and – gosh – I wish they'd change some of the construction articles that refer to parts that are no longer available. Also, I wish *Ham Radio* would hire a rewrite man to modify the construction articles to make them more readily understandable.

Lately, *73* has had the best range of construction articles. The Ham-M modification article was super simple and accomplishes the same thing that other published modifications set out to do, only at half the time and 25% of the cost! The TR22/15 amplifier article was great and *even mine* works. And believe me, if I can build it, anyone can! And I mean anyone!

Keep up the good work. And remember, Wayne, I probably wouldn't like you at all, but tell your advertisers I'm reading every single page – ads included. 10-4?

Don Peak WB5OZZ
Spring TX

THE SHEMYA BLUES

I'm writing *73* because I'll never get an answer from the ARRL. I'm currently on a 2 mile by 4 mile rock 1400 miles west of Alaska and country status is not offered to the hams on this island. How can they give country status to a stilt shack on a reef where the operators have to man boats upon leaving the ham shack? I'd like to see some readers ask the ARRL why one group can get country status and not another. By the way, the QTH is Shemya Island, 176° 10′ E, 52° N on the other side of the 180th meridian.

There are many future hams on the island, but because of recent FCC ruling, the only test I can administer is the Novice. Unless someone wants to spend $600 for plane fare to go to Anchorage, it's impossible to upgrade. Quite a price for anyone to take a test to enjoy a hobby. This means that at best all you can get on this island if you want to be a ham is a Novice. That means no OSCAR, no 20 meters, no VHF, no personal 2m FM with hand-helds, and a very small spectrum filled with foreign broadcast and jammers. With little else to do at this satellite tracking station, you would think many people would like to advance into amateur radio as the only outlet off the Black Pearl of the Aleutian. Alas, alas. There is, however, a Novice course – only a Novice course, though.

Larry Macionski WA2AJQ/KL7
Elsworth Warmouth WB9LGG
Frank Yatko KL7HAM
Shemya ARC KL7FBI
Shemya Island

80 CHARACTERS

In your Holiday, 1976, I/O Editorial, page 74, you mentioned visiting Southwest Technical Products in San Antonio where you had heard about a couple of fellows who have worked up an 80 character modification of the SWTPC PR-40 Alphanumeric Printer. I've just purchased the whole SWTPC system, less the GT-61 Graphics Terminal and the Printer, and am now looking for an 80 character printer.

Are you planning to publish their modification and if so, when? If not, do you have the names and addresses of these people? Or should I write to Mr. Dan Meyer at SWTPC for more information?

Richard Gay
South Harpswell ME

I'd love to publish an article on such a modification. – John Craig.

WB6JXB

JAMES BRODSKY
633 POR LA MAR CIRCLE, 111-D
SANTA BARBARA, CALIF. 93103

OUCH!

I thought *73* readers would like to see the latest advance in space conservation. This shack requires no shelf space, no table, and causes no problems with the YL. All you need is a power plug. Try it!

James Brodsky WB6JXB
Santa Barbara CA

MORE WARC

VE3CYC's personal observations on the future of the 420-450 MHz band ("More WARC," page 9, January *73*) are useful if they cause more hams to think seriously about the preparations for the 1979 WARC.

However, I would like to remove any impression readers may have gained from that letter that the Canadian Radio Technical Planning Board has recommended the 420-450 band be radically changed from its present pattern of use in North America. As a matter of fact, the committee (which was referred to in the letter) did not recommend any changes whatsoever in allocation status between 420 and 450 MHz, despite the near-crisis situation in UHF frequency requirements in other services.

It is worthwhile considering how much of the band in question can at present be "called our own."

In Region 2 of ITU, which includes the US and Canada, the primary allocation is to radiolocation, with secondary allocation to amateur. In the US, the domestic allocation is to government and non-government, with secondary allocation to amateur and amateur-satellite. There are US footnotes which impose a power limitation on amateur use in certain areas, and reinforce protection for radiolocation against interference from hams. In the small segment authorized for amateur-satellite, there is a provision that any harmful interference from hams to other services "must be immediately eliminated."

Where is the part we can call our own?

The Canadian Amateur Radio Federation, in its proposals for WARC 79 preparation, has recommended that 420-430 remain as it is, 430-440 be

assigned worldwide exclusively to amateur, and 440-450 stay shared. This would be an improvement over the present situation, and it would be unrealistic to press for more.

I think it is dangerous to use as proof of need the fact that "an amateur TV repeater takes up more than 12 MHz," especially at a time when a commercial lab has released information about a system for transmitting moving TV images using a fraction of the usual 6 MHz. Haven't we always argued that hams are in the forefront of technical advance?

Bob Eldridge VE7BS
Burnaby BC

Yes. – Ed.

THE I/O DEBATE

I wish to add my tuppence worth along with WN2DYU and W5GOS. I feel that there has been too much emphasis on computer articles and also articles which assume the wealth of the amateur reading the article. Yes – yes, I know, not all the articles are like this, but it is still pretty bad.

Computers are fine, and I hope to get into them someday, when I can understand them. But with all the jargon printed in *73*, *Byte*, and in *Kilobaud*, how can a newcomer learn anything?

You say computers are closely related to hamming. Well, so is the automobile, especially for two meters. However, I have yet to see an article on how to tune up a car. After all, cars and mobile work *are* related. How about some wood-working articles for those of us who build antennas and radio benches? And how many hams drink tea or coffee when on the air during contests? Where's the article on brewing that ultimate cup of coffee? They ARE related . . . (Sorry, I seem to be stretching a point . . .)

And finally, what is the constant knocking of *CQ Magazine*? I will grant that in the past it was not very good, but in recent months they have been making what looks to me like a considerable effort to print a good magazine. I have subscribed, and I find the articles both interesting and informative. I am not a contest buff nor do I much care about DXpeditions. However, their articles about such things are well-presented and interesting. Finally, they seem to devote a good deal of space to amateur radio in general. So, before casting stones at *CQ*, Wayne, why not read one of their latest issues. No computers, but you still might get something from it.

If it will serve to identify my position a bit further, I no longer subscribe to *QST*, because it is so rankly dull. I am also too young for the ARRL, being that I am under age 87. So, you can see that I have at least some agreement with my Uncle Wayne. But, if *73* keeps being a rich man's ham mag/computer mag, I will drop my subscription to *73* as well. I know nothing about computers, but would *like* to know. However, NOT ONE publication explains computers without using jargon and buzzwords.

David J. ("Walrus") Mann WA6MHD
Redwood City CA

AFD '77

The members of the 143 Communications Flight (Spt), Rhode Island Air National Guard, plan to be operating on Armed Forces Day, May 21, 1977.

Anyone working our club station, K1FCO, will receive a commemorative certificate from our unit provided an SASE and QSL card are sent to us. Our mailing address is: K1FCO, 143 Communications Flight, Rhode Island Air National Guard, T. F. Green Airport, Warwick RI 02886.

We will be operating on the following frequencies: 21.385 MHz – 1400Z to 1800Z; 14.330 MHz – 1400Z to 1800Z; 7.280 MHz – 1400Z to 1800Z; 50.700 MHz – 1400Z to 1800Z.

TSgt Raymond A. Allard K1MFZ
Warwick RI

NØPPI

In October I organized a special events station, NØPPI, for the 2nd annual worldwide conference of People-to-People International. With fantastic amounts of help from several hams and lots of loaned equipment, we had a very successful demonstration and operation. We made several hundred contacts and requested SASEs for QSLs. As yet, I haven't sent out the QSLs because I'm trying to get them printed for little or nothing – I'm the original cheapskate ham and I hate to ask P-PI or the local ham clubs to foot the bill.

So, if you would please tell your readers who worked NØPPI and sent SASEs to please be patient a little while longer, I will soon have a source (hopefully) and will get that special prefix off to them as soon as possible.

Oh – also enclosed is a 3 yr sub (renewal) to your fine mag. Keep up the good work. Thanks much.

Neil Preston WBØDOW
Kansas City MO

YASME

This is a report on our successful YASME DXpedition operation as PJ8KG, Philipsburg, Dutch Sint Maarten, Netherlands Antilles.

Some 7,500 QSOs were made with amateurs in 121 countries. There is a system to the way calls are issued here that is not well known outside the immediate area. There are two DXCC countries in the group. One consists of Sint Maarten (PJ7), Saba (PJ6), and St. Eustatius (PJ5). For these countries, all *visiting* foreign hams are assigned PJ8 calls (usually of their choice). The other DXCC country consists of all the remaining islands: Curacao (PJ2), Aruba (PJ3), and Bonaire (PJ4). For these countries, all visiting foreign hams are usually assigned PJ9 calls of their choice. It normally takes two months for the processing of an application for an amateur license, which must be made on their official form.

People sometimes ask, "What does the YASME Foundation do?" We had a good example at PJ8KG of how the YASME organization (all officers and directors are avid DXers) can help a YASME DXpedition in the field. Three condensers in our transmitter burned out. We managed to get word of our plight to Frank Campbell W5IGJ, an ex-publicity director for YASME. He got replacement condensers off to us by air mail immediately. Within a few days, the defective condensers were replaced and we were back in operation. There have been a number of similar incidents where YASME officers have helped in the licensing and operation of YASME DXpeditions in the field.

Lloyd Colvin W6KG
Iris Colvin W6QL
Netherlands Antilles

BAUDOT TO ASCII

I am sure that you receive hundreds of letters telling you how good your magazine is. And, it really is spectacular. Let the other magazines try to work their way up to the top, if they can. If *73* is an inspiration, the ham fraternity will gain a lot. Amongst several projects I built from *73* articles, I picked my last one, the keyboard project by K7YZZ, for sending you some photos.

Despite the warning from Mr. Hutton on availability of the 5220 BL/N chip, I chose to build the Baudot to ASCII converter using that ROM, as I saw it advertised by some of the companies in the USA. At this writing, I had not yet received the ROM ordered from Tri Tek more than a month ago. So the ASCII part of the keyboard is not yet working.

To build an electronic project in Brazil can be very frustrating, as you don't easily find (if you can find at all) many of the necessary components. So, some imagination and adaptation is usually necessary. As I had only a small piece of double-sided PC board for the encoder matrix, I chose to locate it on the top of the main board. Under it you can see the UART and the Molex pins that will receive the 5220 BL/N. Since I am a "beginner" in putting projects together, you can see that I had to use some jump wires.

Underneath the main board you can see another small board. That is the parallel ASCII to serial ASCII project from another *73* article: W8LNY's. Some small modifications had to be made on both boards to suit my own needs.

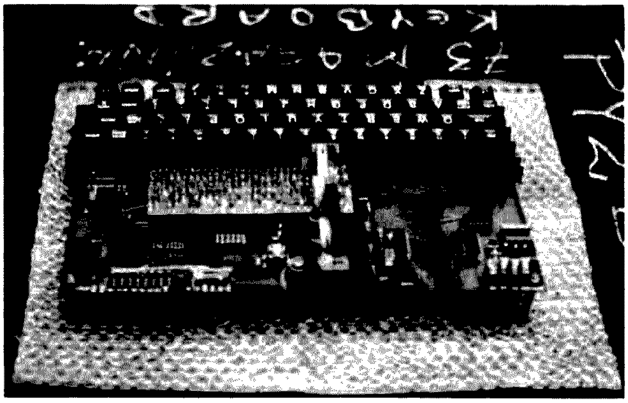
Thank you very much for such an excellent magazine.

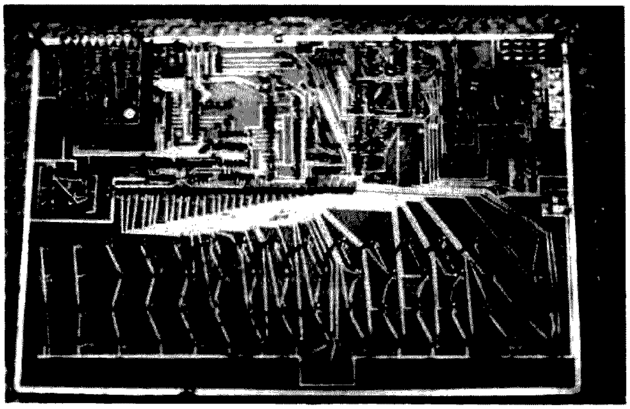
Robério Dias PY2BLA
Sao Paulo, Brazil

HB 1089

We enjoy your magazine and the point you make of speaking out on the issues. I think that if more amateurs would do the same, amateur radio would be (and continue to be) in good shape. Keep up the good work.

In our Oklahoma state legislature at present is HB 1089, "prohibiting the





use of devices to detect radar." I haven't seen a copy of the bill yet, so I don't know what type of microwaves they are talking about, but I assume it's traffic radar.

Some of the amateurs in the area have expressed concern over the principle of state government trying to regulate reception of radio waves, as well as other possible side effects of a bill like this. Here in Tulsa, the amateur and CB community has just had a taste of city government regulations in towers and antennas and is sensitive about the issue.

We would welcome your opinion on the issue. The bill is still in house committee, so there is still time for action.

Charles Frentzel WB5EUK
2704 N. Norwood
Tulsa OK 74115

MA BELL – AGAIN!

The new "Bell bill" in Congress is a threat to phone patches. Each ham should realize the many undesirable consequences including the threat to phone patches in this bill that is now being considered by Congress.

After many years of illegal phone patches, hams can now in various ways legally attach phone patches, telephone answering equipment, tape recorders, computers, and other communication devices to the telephone lines. This may be a short-lived benefit if this new bill is passed.

A very good description of the undesirable effects of the new bill is contained in the January, 1977, issue of *Consumer Reports*. In this article it mentions, "Another section of the Bell bill, as already noted, would strip the FCC of power to regulate terminal equipment; regulation would be turned over to the states. In some states, that shift would wipe away any chance for consumers and businesses to buy and attach equipment without need for the unnecessary and expensive protective module previously required by state regulators at the insistence of phone companies."

It is very important that each ham and all his friends and acquaintances contact their congressman and mobilize influence against the "Bell bill." As in so many cases, we must fight for our rights to have them.

C.W. Tazewell W2GTV
Syracuse NY

BATTING .400

Bravo to Tom Carney WB9RXJ for his letter in Jan., '77, *73*. Nothing is more frustrating for someone new to CW work on the low bands than to establish a QSO and have someone call CQ on top of it. In all the CQs that I have heard, only about 1% even think to ask if the frequency is in use. It should be a requirement for every amateur to memorize chapter 24 of *The Radio Amateur's Handbook*.

As long as I'm on my soapbox: Bull to you die-hards who insist that you aren't a true ham unless you can tap out umpty-ump words per minute CW in order to upgrade. When a baseball player tries out for a team, he doesn't have to hit x number of home runs or strike out x number of batters simply in order to be a left fielder.

I agree with the Advanced theory test and 5 wpm as brought up by WB2BJH. From the way I've heard many Generals and Advanced hams talk on the phone bands, it seems that they spent so much time learning how to tap out the alphabet on a key that they forgot how to speak.

I've heard every ham I know say that in ham radio there's something for everybody. Well, you're wrong, gentlemen. How about certain HF phone privileges for those of us who like to talk rather than tap?

Finally, I am sick and tired of hearing those who knock *QST* and the ARRL. I don't like them either. What's the solution? Mine is: Wayne Green for president in 1980!!

Mark Camp WB6QHZ
Santa Ana CA

THE HUSTLER

OK, Wayne. You are a transparent but crafty hustler. I hereby doff my hat to you.

Here I had tried and failed to get the code mastered, built and tested (and then sold for less than it cost) a complete top-grade station, and let my *73* subscription expire. So just after my oldest son gets assigned to Germany and my buddies start talking about setting up a sked for me to talk to him, you decide to spend a few bucks sending the current tantalizing issue of *73* to selected ex-subscribers. You are a fiend, and I know I am going to learn some new reasons to hate you, because I hereby fall for the bait. Enclosed please find my check for a bunch of code tapes and study guides, and also for another year of *73*.

When I start finding out how dang tough it is to learn the #$%&* code, despite your overtures to the contrary, and start spending money like a drunken sailor to get the ham shack "properly" fitted with gear and the necessary outside wires and sticks, you can expect to start receiving some more hate mail. You will probably deserve it.

Bill Sill
Tunkhannock PA

THE IVORY TOWER

Regarding the letter by Bob Welsh (reprinted from *LERC*), page 13 in the January, 1977, *73*, paragraph three: I think it is a bit unfair to say the ARRL has been duped into helping the FCC clean up the CB mess because of the following considerations. First, the CBers who are potential hams are generally the more serious practitioners of the hobby and also the least likely to participate in the childishness that occurs on 11 meters (especially channel 19). Removing these people from the CB fold is not likely to clean up the mess. CBers interested in amateur radio are usually the more technically minded members of the group and in that regard would be an asset to amateur radio. Finally, amateur radio is also not without its impolite, even childish members – for instance, see the note in January, 1977, *73*, page 208. entitled "Tragedy on Mt. Wilson."

I think it is time for hams to abandon the ivory tower. A first step might be to acknowledge that everyone is human and every group, society, whatever, has its mavericks.

Bruce Ott VE7BOT
Port Coquitlam BC

ON BEING HUMAN

It is great to know there is still at least one organization that has *humans* in it!

I like *73* so much I ordered a subscription for my son WBØVEZ, with instructions that the bill be sent to me. Some time later, I got a second copy of the Holiday issue with a handwritten mailing label on it. Figuring that my instructions had been misunderstood, I wrote, explaining the whole situation. A short time later a friendly note came.

Nowadays, it seems, the usual response to a letter of complaint or inquiry is either (1) a pre-printed form which leaves doubt that the letter was ever read, or (2) a letter which has been dictated, transcribed, and typed on a fancy letterhead (and cost a bunch of money).

I like your way best. It's not very elegant, but it is refreshingly personal, to the point, and very effective. Keep up the good service and personal attention!

Donald Inbody WAØPBQ
Overland Park KS

MORE 10M

Interesting note: While talking on 20m about 10m CBers, a fellow on the east coast said his club submitted a proposal to *QST*. The answer was, "We don't want anything to do with it!!"

The more I think of it, what other answer (from *QST*) would he get?

73 and *Kilobaud* are the best!

Ken Lowrance WRØMZD
Tim Haake WAØTSY
St. Charles MO

We are receiving many proposals for a 10 meter band plan based upon converted CB transceivers. Watch for them. I'm expecting your comments. – Ed.

REASSESSMENT

Today I took and passed my amateur Extra exam, thanks in part to the *73* 20+ wpm code tape. In answer to your question, I figure I spent about 10 hours with the tape. Since I last took a code exam for my General some 20 years ago, I don't know what

my "starting speed" was, but probably around 18, since that is what most hams seem to use.

I have but one suggestion for improving the code tape: put in some longer strings, perhaps 8-12 characters long. The exam I took had words like "disaster" and "shield" which are (a) relatively long, and (b) have an effective speed around 28 wpm for the 8 character burst. (I was afraid I'd have to copy "reassessment," but they didn't put it in – or if they did, I missed it!)

Thanks for a whole bunch of super stuff in general, and the code tapes in particular.

Frank Bates W6IPB
San Jose CA

A REAL WINNER

My son Robert, who is a specialist in microcomputer programming and who works with a local computer firm, just brought home issue #1 of *Kilobaud*. I must say that I am impressed! I have seen *73* grow from a small beginning into the most prestigious ham publication by far, but *Kilobaud* seems to be well up the ladder with its very first issue. I'm too old a canine to understand all of its intricacies (or too lazy to learn?), but my son, who was fortunate to have had a very smart mother, says it's a real winner. I am sure it will enjoy fully as great a success as *73*.

Keith Berens W6CWU
Orange CA

MORE 80M FOLLIES

Thought I'd drop you a line and let you know how much I enjoy your magazine. I wish I had known about it a year ago so I could have saved myself a lot of money and messing around with store purchased antennas. I don't know if any other people have heard some of the garbage I've heard on 80m or not, but I thought I was back on 11m again. I don't know if they were hams or not because no call letters were being used. I would like to let you know of a super amateur radio shop in the midwest – it is Burghardt Amateur Center, Box 73, Watertown SD 57201. Keep up the fine work on the magazine and the articles.

Robert W. Todd WBØTWN
Jamestown ND

Special Report

by Bill Pasternak WA6ITF

The first time I commented on SAROC in Looking West, I stated that this convention was unlike any other, in that it was not the convention but rather the atmosphere of Las Vegas that was the real drawing card. When compared to a convention such as Dayton, it can't compete. It is different from any other convention that I have ever attended, and the only fair way to judge SAROC '77 is against previous years. Based on that criterion, I found myself disappointed this year.

Las Vegas, Nevada, is known worldwide as the "Live Entertainment Capital of the World." Twenty-four hours a day, "Vegas," as its friends call it, is a gold mine of entertainment, with some of the most lavishly staged extravaganzas to be found anywhere. There are few well-known club entertainers who have not played there, because playing "Vegas" means that an entertainer has indeed "made it."

Not that this is the only lure of Las Vegas. Gambling is legal and open to all of legal age twenty-four hours a day. Put these two factors together, and you can see why a trip to Las Vegas has the appeal it does – and why this city has become one of the world's most visited vacation spots.

Sharon and I like to go to Vegas when a good excuse such as SAROC comes up. Therefore, in my opinion, it is Las Vegas that makes this convention. Were there a less exciting environment, I doubt if it would go.

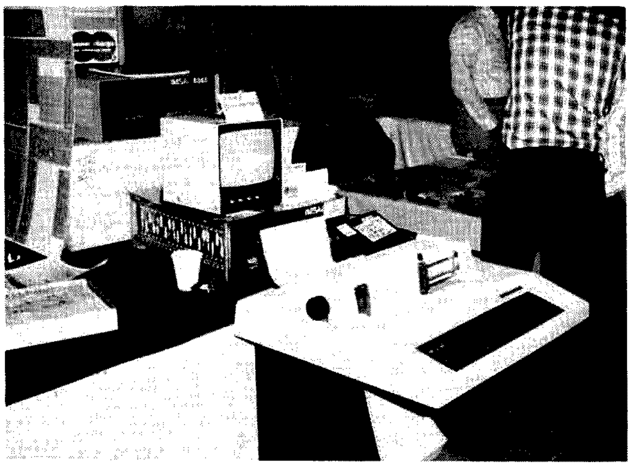
This year, despite a reported record registration, more exhibitors than last year, a record number of portable repeater and remote-base systems, and more hospitality rooms, the overall attitude of the attendees seemed very subdued. While many seemed to be enjoying themselves, there was an "air of apprehension" permeating things. It was definitely a lot quieter than it has been the last two years.

Since I am one person and cannot be everywhere at once, I try to have either a friend, my cassette tape recorder, or both, to help cover things. This year the assistance came not only from my Panasonic RQ-309 and RE-15 microphone, but also from a lot of fellow amateurs. (Thanks.)

Although the overall number of companies exhibiting was up a bit, it was interesting to note that a number of regulars were missing. The most notable change this year was the larger participation by those offering computer-related hardware applicable to amateur radio – and the share of the crowd that they were drawing.

In that department, the most interesting and attention-getting display was the booth operated by HAL Communications (staffed by their highly knowledgeable sales manager Ken Sartain and his associates). If you have been around for any length of time, you realize that HAL (Urbana, Illinois) pioneered the interface of DP hardware to amateur radio. HAL is one of the new breed of companies that has found that keeping an ear open to what amateurs want and need leads to success. Needless to say, their video display units and peripherals attracted a lot of attention.

So did the new Curtis System 4000 Ham Computer, a device that is definitely going to open up a whole new era in amateur operation. Not only does it have the ability to send CW using an integral keyboard, but it also will read and display on a screen received CW at a rate of up to 250 words per minute. It also tells you just how fast the other guy is sending, to boot. If that were not enough, the keyboard also functions as an ASCII terminal, either half or full duplex. Still not satisfied? Well, Curtis intends to have a few software goodies available: storage (for the 4000) for 10 fifty to one hundred character CW messages, complete contest station management, automatic beam direction based on the other guy's callsign, DX forecasting, Oscar and other satellite orbit predictions, and lots more. Computers are an interesting hobby and are applicable to amateur radio . . . hmmmm . . . a note to Curtis Electro Devices at PO Box 4090, Mountain View CA will bring more info.



"More Computers for Hams": IMSAI's interface to amateur radio.

In the basic ham hardware department, the new all solid state Century 21 CW transceiver really attracted my fancy. Maybe it's because, after 15 years as a ham (most of the time spent in the world above 50 MHz), all of a sudden the challenge of low band CW has hit me. The size, price, and features of the Century 21 sure caught my eye. At a first glance it looks like just about any other HF SSB transceiver, and you have to get in really close to realize that there is no mike jack or phone provision. It's a complete 70 Watt, all solid state, 80 through 10 meter CW station – and "complete" means built-in power supply and speaker. Suffice it to say that for $289 the features contained in this box (backed by a company whose guarantee of quality is unsurpassed) are well worth the investment. Write Ten-Tec, Sevierville TN 37862 for more info. This has got to be the perfect setup for a Novice or the Technician who wants to make use of his newfound low band privileges.

In VHF, Midland not only showed its complete line of two and 220 radios, but also drummed up a lot of interest in its new line of VHF marine equipment. If I were to single out one manufacturer that has helped in the overall development of 220, I would have to pick Midland. I'll bet that the majority of 220 repeaters these days are built from the guts of the famed 13-509, and that says a heck of a lot for both the radio and the people selling it. Not that it stops there. How many repeaters have come into being thanks to Midland's RSVP program? How many companies are willing to take part of their profit and donate it directly back to the amateur service with no middle man? That's the kind of manufacturer support that amateur radio needs. Needless to say, their new synthesized radio for "two" captured the eye of many of us. A note to Midland at PO Box 1903, Kansas City MO 64141 will bring a complete catalog and the name of your closest dealer. If you do write, please don't forget to say thanks for the direct support that they are showing us.

How would you like to be able to pump 200 Watts into a window screen in Las Vegas and work Long Island, New York, on 20 meters? This was actually done at SAROC by one of the visitors who passed by the SST Electronics booth and purchased one of their $29.95 Model SST-T-1 random wire antenna tuners. One of these is just a little green box, 3" x 4-1/4" x 2-3/8", that I have found will load my old Globe Scout Deluxe into almost anything. I saw it there, but it was not until a week later that I got one for myself – I now understand why this little unit is becoming so popular. Eleven states on 40 CW in two days is nothing to sneeze at when your antenna is the feedline to a six meter vertical. No wonder SST did such a brisk business at SAROC. For the Tech who wants to make use of his Novice privileges without putting up a new low band antenna, or for the ham who can't put up a really good antenna, the SST-T-1 can be a godsend. It has been to me. SST Electronics is at PO Box 1, Lawndale CA 90260, in case you are interested in more info on this product.

Not all the new goodies were to be found on the exhibit floor, however. In fact, one new radio that I predict you will be hearing a lot more about real soon was not publically shown. However, we were able to get a sneak preview and a few photos. The radio is called the FM-144-DX, and the man behind it is none other than the foremost pioneer of amateur VHF communication, Mr. Ed Clegg W3LOY. Ed, who helped sponsor this year's Mt. Wilson Repeater Association Aloha Hospitality Center, not only brought along his inexpensive crystal-controlled 12 channel two meter radio, the Mark 3 (which was on operational display in the MWRA room), but had the FM-144-DX with him as well.

This little gem is fully synthesized, and has LED readout, concentric knob quick change channel selection, standard plus/minus 600 kHz offset, and provision for other offsets that are switch-selected (not to mention a host of other features that will make it a hard radio to beat). Best of all, Ed tells me he hopes to market it at a price that will make it affordable to most amateurs. Keeping in mind the track record of Ed Clegg, the fact he was building and marketing VHF equipment before most companies thought of going in that direction, the fact that his equipment is usually a bit ahead of the competition, and the knowledge that a fellow amateur stands behind the equipment and its guarantee, I'll be willing to bet that when the FM-144-DX hits the market, it will gain quick and widespread acceptance throughout the amateur community. I know that I plan to buy one to replace a dying T-43-GGV in the '71 Torino, and this decision is based on the few minutes I had to play with it in Ed's room at the Sahara. It's the personal confidence that I have developed over the years in "the man and his radios," starting in the very early '60s when I bought my first '99er – a very personal thing on my part.

The convention peripherals, such as hotel service, rooms, hospitality rooms, and portable repeaters, are what make or break any convention. I heard the usual number of complaints about rooms that had been paid for not being ready, and in some cases not available; about poor service on the part of the hotel; about people being turned away. If this is true, it sure didn't happen to any of our group. Our block of about 30 reservations was not handled through the SAROC convention committee, but rather as a direct group reservation through the Hotel Sahara. Not one person in our group was turned away, and in every case the rooms were available when our contingent arrived. Moral: Sometimes it pays to do one's own legwork. In my case, arrival was at 1 am on Friday morning; we were in our room by 1:20 am. Not bad for

"midnight service." Based on that, I find it rather hard to place the blame for any snafus on the hotel, and I am interested in knowing where the problem really lies. The people running the Hotel Sahara always seem to go out of their way for us when we are in Vegas, and I guess that's one reason we keep going back. If you had a problem, drop me a letter with full details and I will see that it's forwarded to the proper people at the Sahara. I've had the chance to talk with people in management there, and I get the distinct impression that if something is awry, they would like to know about it so that it won't happen again. They have a lot of pride in their place.

There were a few new hospitality rooms this year and a lot more portable repeaters. One even showed up on 220! I would estimate that there were about 25 portable repeaters. Again this year, the best portable repeater award goes to Kirk Nemzer WB6EGR and his crew for their 147.435/146.40 system. It had a coverage of over 70 miles, and turned out to be the most heavily used of all the portable systems. A good number of the portable systems were on 450 and were kept low key.

One of the criteria that you should use to judge the level of fun at SAROC is to listen to 146.94 in the evenings — especially Friday and Saturday nights. There has always seemed to be a direct correlation between .94 activity and the enjoyment level at the convention. Unlike past years, .94 was quiet. Again, the overall temperament of the crowd was down considerably from the past. Many of the people I talked with during my rounds of the various hospitality rooms complained that there was nothing really new here that they couldn't see at their local radio store. And the bargain hunters found no bargains whatsoever.

At SAROC, anything free, such as technical sessions and seminars, is kept to an absolute minimum. Too bad. It would be a great place to really get into VHF/UHF developments, such as the use of circular polarization to minimize path loss, computers for remote control procedures on repeaters and remote bases, etc. SAROC has few technical sessions.

I did enjoy a talk given by Mr. Hartley Postlethwaite WA6CQW, founder and director of the HAPPY FLYERS organization.

Hart spoke on a subject near and dear to every repeater owner's heart these days: direction finding technique as applied to tracking down a device known as an ELT, or Emergency Location Transmitter. ELTs are carried aboard every aircraft. They are designed to trigger on impact and emit a signal so that a downed aircraft can be located. As a pilot, Hart has been involved in ELT location for a few years. The techniques he has developed have appreciably speeded up location of these devices and thereby saved many lives. As he explained, while the hardware and technique were specifically developed to aid in ELT location, the same hardware techniques do find repeater jammers. Drop a note and SASE to the HAPPY FLYERS, 1811 Hillman Avenue, Belmont CA 94002.

Dick Everett, Assistant Chief of Safety and Special Services of the FCC, was on hand to answer questions, such as:

Q. "Would the elimination of the repeater subbands mean that 15 could be repeated to 20?"

A. "Yes."

Q. "How do you rationalize a closed repeater?"

A. "There is nothing in the rules that says that one amateur *has* to provide a repeater for another."

The main speaker at the ARRL Forum was from an organization known as the Personal Communications Foundation. Its Director/President is one of my valley neighbors, Mr. Jon J. Gallo WA6PTM. You will note that the "6s" seem to be taking the bull by the horns, going out and getting things done.

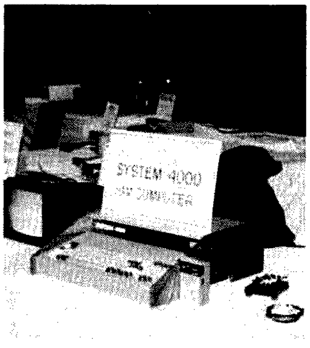
With over 7,000 legal matters involving amateur radio in 1976 alone, and with the average cost per matter being around $3500 (and going up), it is easy to see how even the simplest of such legal proceedings can give instant grey hair to any ham who might become involved.

The concept of PCF is to do the hard job, that of legal background and documentation work, so that an attorney in need of such input can be provided with the data. This will thereby cut the overall cost to the amateur substantially. An estimate given was that a legal action that now would cost $1000 might drop to as low as $300, with PCF aid. PCF, however, states that while it will provide such material, it will not act to represent an amateur in court. Its function is to provide advice and research.

All this does not come cheap. There will be a WATS telephone, and office and secreterial costs, plus what it costs to reproduce the documentation packages and get them mailed. If one out of every three amateurs were to donate a dollar, all costs of the PCF could be met. How about it, readers? Here is your chance to act directly and do your part.

This nonprofit corporation is headed by a 24-member Board of Directors, made up of judges, attorneys and legal professors who also are devoted amateurs like you and me. The least we can do is support their work by kicking in a few bucks. The address is Personal Communications Foundation, c/o Carl Markov K6RLP, 915 Lancaster Boulevard, Lancaster CA 93534.

I mentioned that there were more than the usual number of hospitality rooms this year. Last year, the MWRA's (with Bill Orenstein at the helm) won overall acclaim by having most in attendance. Both MWRA and Bill were back again this year, with a format that not only featured a quiet relaxing spot, but also such added features as an "Amateur Radio Theatre" that showed regular screenings of Dave Bell's "Moving Up To Amateur Radio" and an operational exhibit of some of the Clegg VHF line (with Ed Clegg himself as special guest). It was never jammed, never



The Curtis System 4000 Ham Computer.

noisy, and the most relaxing spot at SAROC this year — just as it was last year. Bill gives a lot of the credit for the success of the room to the staff that runs the Sahara.

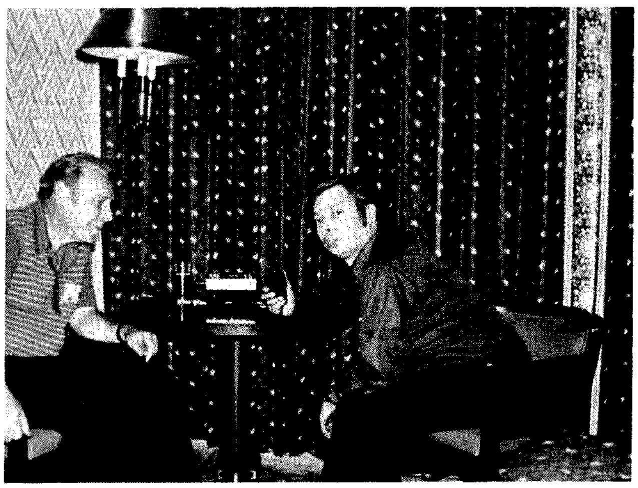
The Palisades Amateur Radio Club (PARC), of Culver City, California, pulled off a big surprise: the PARC hospitality center. This was an after-arrival idea of Wayne Maynard WB6BFN, Shelley Chelsey WB6KED and Don Root WA6HJW. Pooling their collective resources, they came up with a convention get-together spot that was hard to beat. I never noted a moment when it was empty or when anyone was not having a good time.

The Spectronics FM hospitality room is always worth a visit. Spectronics' Art Householder was ill and unable to make the trip. Captain Dick McKay K6VGP, who visited Art recently, said that he is recovering, but still must take it easy for a while. Not that Art wasn't well represented. Well armed with his famed "Drinkie Talkie," "Squeak" Porray K7RBM took the reins this year and put out the kind of hospitality that this room is famed for. It's not uncommon to find people there whom you will see nowhere else at SAROC. True-blue FMers will travel from all over just to spend a few hours in this particular hospitality suite.

I was not alone with my feeling about SAROC. Wherever I went throughout the three days I spent at the convention, amateurs kept coming to me to say that there was "something lacking this year," that "things were just too political," that they had come for a good time and not to have the ARRL preach to them. One guy came to me up in the MWRA suite and told me that he had been to many conventions including Dayton. He said he had always liked SAROC because it was different than the rest, but if it were going to become like another ARRL Division Convention, he would not return. I do feel that the politics should be left to the politicians, so that the majority of attendees can accomplish what they came for: a Las Vegas vacation shared with a lot of their fellow amateurs. While I do not challenge the right of the ARRL to take part in this convention, I do feel that if they had left their "New England Formal" attitudes back home and picked up a bit on "Southwest Casual," they might have accomplished a lot more for the ARRL image and alienated fewer of this area's VHF/UHF-minded amateurs. Excepting shows or formal dinners, Las Vegas is not a formal town. Most of the Southwest isn't. When one is super-formal out here, one stands out like the proverbial sore thumb. A casual friendly approach goes far in winning both friends and support in the Southwest.

Well, there you have it: SAROC '77 in no way matched its own past. Bigger does not always mean better and numbers in attendance are not the real material that makes for an outstanding amateur radio get-together. In my opinion, based upon the three years I have personally attended, I do feel that SAROC needs a bit of changing. It should bury the surface politics. It needs a lot more emphasis placed on technical presentations, so as to interest technically-minded amateurs. Amateurs enjoy exploring new concepts and new ideas. By making sure to have experts and time made available for them to be heard, we can look to the future of communication and explore these new frontiers.

I am not an expert on conventions, but I do know when I am having a good time. In the past, SAROC has offered that to me. This year I was disappointed.



Ed Clegg gives 73 a preview of his FM-144-DX 2m synthesized FM unit.

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

WISCONSIN STATE QSO PARTY

Starts: 0001 UTC Sunday,
April 3, 1977
Ends: 2359 UTC Sunday,
April 3, 1977

Please note that the dates originally submitted (March, *73*) were incorrect.

SIX METER GROUND WAVE CONTEST

Starts: 0300 GMT
Sunday, April 2
Ends: 0700 GMT
Sunday, April 2

The second annual contest is sponsored by Global Research and is open to all amateurs worldwide on all modes: SSB, CW, FM, AM, SSTV, RTTY, and FAX. Any six meter contact is valid. Skip stations do count in the event the band is open, but they only count ½ point each no matter where the station is located.

SCORING:

For scoring purposes, there are four zones defined by the distance between your QTH and the station contacted. Zone definitions and QSO points for contacts with each zone are as follows: Zone 1, stations within 25 miles of your QTH – 1 point/QSO; Zone 2, stations 25 to 50 miles from your QTH – 2 points/QSO; Zone 3, stations 50 to 75 miles from your QTH – 3 points/QSO; Zone 4, stations over 75 miles from your QTH – 4 points/QSO.

LOGS:

Show your name, call, address, ARRL section, and input power. Mobiles and portables must show actual locations. For each station worked, show: call, ARRL section, zone (as defined above), time, and points scored. Show your total score, sign the log, and submit to: Phil Caruso K9DTB, c/o Global Research, Contest Chairman, PO Box 271, Lombard IL 60148. Logs must be postmarked by May 3.

TENNESSEE QSO PARTY

April 2-3

7th annual party sponsored by Tennessee Council of Amateur Radio Clubs.

PERIODS:

Saturday, April 2, 2100Z, to 0500Z, Sunday, April 3.

Sunday, April 3, 1400Z to 2200Z.

Bonus period April 3 from 0500Z to 0600Z for out of state stations only to work Tennessee mobile and portable stations only on 75 meters.

EXCHANGE:

Tenn stations send signal report and county. Out of state stations send signal report and state, province, or country. Work same station different bands or county if mobile or portable.

SCORING:

Separate CW and phone contests (one point each contact). Tennessee stations – QSO points times sum of (different state including Tennessee plus different provinces plus different Tenn counties).

Out of state stations – QSO points times number of different Tenn counties.

Bonus points – 200 extra points to mobiles and portables for each county operated outside home county.

FREQUENCIES:

3550, 7050, 14050, 21050, 28050, 3725, 21125, 28125, 3980, 7280, 14280, 21380, 28580.

LOGS:

Date/time in GMT, station worked, band, mode, exchange, and score. Use separate log sheet for each band over 25 contacts; contestants with 100 contacts or more must submit cross check sheet similar to ARRL operating aid No. 6. Logs must be legible to avoid disqualification.

AWARDS:

Plaques to top phone and CW scores in Tennessee, to winning mobile, to winning portable, and top score out of state. Certificates to every station sending log with 15 contacts. Repeater contacts not allowed. Mobiles compete against mobiles, portables against portables. Minimum 10 contacts each county to earn bonus points.

Tennessee stations on phone call "CQ Tenn QSO Party," on CW "CQ Tenn" or "TEST" – variations to encourage contacts from non-contestants will result in disqualification.

Mailing deadline May 1, 1977. Send self-addressed stamped envelope if eligible for certificate to Dave Goggio W4OGG, 1419 Favell Dr., Memphis, Tenn 38116. Every entry will receive summary along with certificate if eligible.

COMMON MARKET DX CONTEST

CW
0600 GMT to 2400 GMT
Saturday, April 2
Phone
0600 GMT to 2400 GMT
Sunday, April 3

The purpose of this contest is to increase the activity of radio amateurs in the Common Market of Europe and to establish as many contacts as possible during the contest periods between stations of the Common Market of Europe and the rest of the world. All bands 80 to 10 meters may be used on the appropriate mode. Contest call is "CQ CM" or "CQ Common Market." Entries may be in either of the following classes: Single op, all bands; Single op, low bands (80 + 40); Single op, high bands (20-10); Multi-op, single TX, all bands only (also club stations).

EXCHANGE:

RS(T) and QSO number from 001.

SCORING:

Non-Common Market stations: QSO with CM = 5 points; any other EU station = 2 points. Common Market stations: QSO with CM = 1 point; non-CM, EU = 2 points; non-CM outside EU = 5 points; QSO with own country = 0 points but ok for multiplier.

Multipliers: One point for each band. For non-CM, CM countries = Belgium, W. Germany, Italy, Denmark, Great Britain, Luxembourg, Ireland, the Netherlands, and France. For Common Market stations: each country in the world, following DXCC list. Claimed scores is total QSO points times total multiplier as usual.

ENTRIES:

Separate logs for each band; show date/time in GMT, exchange, points, and multipliers. Summary sheet must include signed usually-used declaration that all rules/regulations observed. Mail by April 30th to contest committee: Michel Le Bon ON4GO, Chee de Wavre 1349, B-1160 Brussels, Belgium. Certificates to highest scoring single op in the CM on each mode and to highest scoring single op outside CM on each mode.

ZERO DISTRICT QSO PARTY

Starts: 2000 GMT
Saturday, April 2
Ends: 0200 GMT
Monday, April 4

Organized by the Mississippi Valley Radio Club, this contest covers a lot of territory and should create a lot of activity. Stations outside of Zero district will work Zero district stations only, but Zeros may work both in and out of district stations. The same station may be worked once on each band and each mode.

EXCHANGE:

QSO number, RS(T), and QTH. QTH is county and ARRL section for Zeros, ARRL section only for all others.

SCORING:

For Zeros – total QSOs multiplied by (ARRL sections + Zero counties + DX counties) worked. Others – total QSOs multiplied by (Zero counties + Zero sections).

FREQUENCIES:

3560, 7060, 14060, 21060, 28060,

CALENDAR

Apr 2 - 3	Common Market DX Contest
Apr 2	Six Meter Ground Wave Contest
Apr 2 - 3	Tennessee QSO Party
Apr 2 - 4	Zero District QSO Party
Apr 2 - 4	Annual April QRP QSO Party
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest – CW
Apr 16 - 17	County Hunters SSB Contest
Apr 16 - 17	Florida QSO Party
Apr 16 - 17	Bermuda Contest
Apr 16 - 17	CD Party – CW
Apr 23 - 24	PACC
Apr 23 - 24	H22 Contest
Apr 23 - 24	CD Party – Phone
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest – Phone
Apr 30 - May 2	Connecticut QSO Party
May 7 - 8	Triple Letter QSO Party
May 7 - 9	Georgia QSO Party
May 7 - 9	Vermont QSO Party
May 14 - 15	Kansas QSO Party
May 14 - 15	Massachusetts QSO Party
May 14 - 16	Michigan QSO Party
May 15	World Telecommunications Day – Phone
May 22	World Telecommunications Day – CW
June 11 - 12	ARRL VHF QSO Party
June 18 - 19	West Virginia QSO Party
June 25 - 26	ARRL Field Day
July 2 - 3	QRP – Summer – Contest
July 4	ARRL Straight Key Night
July 9 - 10	Bicentennial Celebration Plus One
July 16 - 17	10-10 Net Summer QSO Party
July 16 - 17	Apollo II 8th Anniversary Contest
Aug 20 - 21	New Jersey QSO Party
Aug 20 - 21	Worldwide SARTG RTTY Contest
Sept 10 - 11	ARRL VHF QSO Party
Oct 1 - 2	Open CO Party – CW
Oct 15 - 16	Open CD Party – Phone
Nov 5 - 6	ARRL Sweepstakes – CW
Nov 19 - 20	ARRL Sweepstakes – Phone
Dec 3 - 4	ARRL 160 Meter Contest
Dec 10 - 11	ARRL 10 Meter Contest

3900, 7270, 14300, 21370, 28570, 3725, 7125, 21125, 28125.

ENTRIES & AWARDS:

Beautiful four color certificates will be presented to the General class section high scorer and to the Novice/Tech class section high scorer. Mailing deadline for entries is May 15th, to: Mississippi Valley RC, 3518 W. Columbia, Davenport, Iowa 52804. Include an SASE for results.

ANNUAL APRIL QRP
QSO PARTY
Starts: 2000 GMT
Saturday, April 2
Ends: 0200 GMT
Monday, April 4

The contest is open to all amateurs and is sponsored by the QRP Amateur Radio Club International, Inc.

Stations may be worked once per band for QSO and multiplier credits. Each member QSO counts 3 points, non-member QSOs 2 points. Stations other than W/VE count as 4 points per QSO. Multipliers are as follows: More than 100 Watts input power — x1; 25 to 100 Watts — x1.5; 5 to 25 Watts — x2.0; 1 to 5 Watts — x3.0; less than 1 Watt power — x5.0.

Final score is QSO points times total number of states/provinces/countries *per band* times power multiplier.

EXCHANGE:

Members — RS(T), state/province/country, QRP number.

Non-Members — RS(T), state/province/country, power.

FREQUENCIES:

CW — 3540, 7040, 14065, 21040, 28040.

SSB — 3855, 7260, 14260, 28600, 21300.

Novice — 3720, 7120, 21120, 28040.

All freq's +/- 5 kHz.

ENTRIES:

Send full log data, including full name, address, and bands used. Indicate equipment, antennas, and power used. Include a #10 SASE for results. Logs must be received by May 30, 1977 to qualify. Send logs to: E. V. Sandy Blaize, W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

Certificates will be awarded to the highest scoring station in each state/province/country. Other places depending on activity. One certificate for the station showing three "skip" contacts using the lowest power.

COUNTY HUNTERS SSB CONTEST
Contest Periods:
0001 GMT Saturday, April 16 to
0800 Saturday, April 16
1200 GMT Saturday, April 16 to
0800 Sunday, April 17
1200 GMT Sunday, April 17 to
2400 GMT Sunday, April 17

Please note two four hour rest periods!

This is the 6th annual contest sponsored by the Mobile Amateur Radio Awards Club, Inc. Mobile stations may be worked each time they change counties or bands, but if worked again from the same county on a different band count for point credit only. Mobile stations contacted on a county line count as one contact but two multipliers. Portable stations that change counties during the contest may be worked for both point and multiplier credit from each new county. Fixed stations may be worked by other fixed stations only once during the contest regardless of bands. Repeat contacts between fixed stations on other bands are not permitted! Fixed stations may be worked by mobile/portable stations each time they change counties or bands. Repeat contacts between mobile/portable stations are permitted provided they are on a different band or county.

EXCHANGE:

Signal report, county, and state (country for DX). Mixed code contacts are permitted provided that one station is on SSB. (Mobiles please keep an ear for CW county hunters calling!)

FREQUENCIES:

3920-3940, 7220-7240, 14275-14295, 21375-21395, 28575-28595.

Please note: This year there will be a "mobile/portable window" of 10 kHz on the following frequencies: 3925-35, 7225-35, 14280-90. Mobiles/portables will be in this 10 kHz segment and fixed stations are asked to refrain from calling "CQ Contest" in this segment. After working mobile/portable stations in the "window," fixed stations are requested to tune and work other mobile/portable stations or QSY to the outer edges of the suggested frequencies to call CQ or work other fixed stations in the contest. This will allow the mobile/portables running lower power a chance to be heard and worked in the contest.

SCORING:

Contact with a fixed US or Canadian station = 1 point. Contact with DX stations (including KL7 & KH6) = 5 points. Contact with mobile/portable stations = 10 points. Portable stations are defined as operating from another temporary location for contest purpose. Multiplier is total number of US counties plus Canadian stations worked; take credit for a county only the 1st time it is worked. A Canadian station counts each time it is worked. Final score is total number of QSO points times total number of different counties and VE stations worked.

ENTRIES:

Logs should show date/time in GMT, station worked, report exchanged, county, state, band, claimed points (1, 5, or 10), and each new multiplier numbered. Official log sheets and summary sheets are free for a #10 SASE or SAE and appropriate IRCs from John Ferguson W0QWS, 3820 Stonewall Ct., Independence MO 64055. Submit all entries to the same address no later than June 1st to be eligible for awards; DX should use air mail.

AWARDS:

Plaques to highest scoring fixed US or VE, DX, mobile, and 2nd mobile certificates to top 10 fixed and mobile stations in US and VE and to the highest scoring DX in each country. Only single operator stations are eligible for these awards, but multi-op certificates may be issued if merited. A station may enter as both fixed and mobile, but separate scores are required.

Continued

RESULTS OF THE 1976 YL
ANNIVERSARY PARTY
(OCT/NOV 1976)

Winners

CW:	
DJ0EK	860 points
I3MQ	817
VE1AMB	646
WA2DMK	585
OK2BBI	580
PHONE:	
YN1KG	12,717 points
HC2YL	12,152
FG7XL	8,910
K6KCI	8,845
W2GLB	8,680
COMBINED:	
HC2YL	12,385.75
DJ0EK	8,510
DJ1TE	6,447.5
VE7DTO	5,648.75
K6DLL	4,955

RESULTS

RESULTS OF 1976 CARTG ANNUAL W/W
RTTY DX SWEEPSTAKES (OCT 1976)

Following is a list of the top 10 places that each received plaques donated by various groups:

I1PYS	1,955,244 points
W3EKT	1,584,380
CT1EQ	1,562,660
W4CQI	988,612
CE3MA	928,988
K8JUG	794,928
KH6AG	794,015
WD8CPU	787,695
W1GKJ	739,344
K0JWX/6	699,900

W3EKT won top US plaque while VE2JR won top Canadian plaque. VK3SG won "Green" RTTY high score for his first time in. Paul Menadier of USA won top SWL printer plaque. W1MX won top multi-op score.

Many other certificates were awarded to the top scores in each USA and Canadian district, and each DX country.

103 logs were received from 49 countries with 25 stations working WAC during the contest period. Looked like a good showing from the USA!

RESULTS

RESULTS OF 1976 DELAWARE QSO PARTY (NOV 1976)

High scoring DEL station — K3YHR with 20,605 points.
High scoring out of state station — AC7UIC with 450 points.

Out of State Scores:

ARIZ	AB7BQN	225
CA	AA6MQS	25
CONN	AA1UAX	175
FLA	K4KMA	200
GA	WA0DGL/4	150
ILL	K9DDA	105
IND	WB9THY	120
IOWA	AC0BQ	200
LA	W5WG	325
NJ	AB2VWW (QRP)	105 — tie
	AA2ZWH (QRP)	105
NY	W2EY	105
OHIO	WB8NTY	90
OREG	AC7UIC	450
TENN	AB4WHE	60
TEXAS	WA5KGW	200
VA	W4ZRJ	5
CANADA	VE3EJK	150

DEL Winners:

New Castle	K3YHR	20,605
Sussex	WA3WIY	5,635

BERMUDA AMATEUR RADIO CONTEST

Starts: 0001 GMT April 16
Ends: 2400 GMT April 17

Sponsored by the Radio Society of Bermuda. Operate no more than 36 hours of the 48 hour contest period. Off periods to be clearly logged and each period to be of not less than 3 consecutive hours. All stations shall be single operator only and must be operated from their own private residence or property. Each station may be worked only once per band regardless of mode. Use all bands 80 to 10 meters, but no cross band or cross mode contacts permitted.

EXCHANGES:

All stations exchange RS(T) and following: UK – county, US – state, VE – province, Bermuda – parish.

US and VE stations must exchange reports with UK and Bermuda stations only. UK stations must exchange reports with US, VE, and Bermuda only.

SCORING:

Each QSO = 5 points. Multiplier for all stations outside Bermuda is the total number of VP9s worked on each band. The same VP9 can be worked on all bands. For Bermuda stations, it is the total number of states, provinces, and counties worked on each band.

AWARDS:

Top scorer in each state, province, and county shall receive a certificate. Trophy to top scorer in VE, US, and UK. Round trip air transportation plus accommodation will be provided to overseas winners to enable them to receive their awards.

ENTRIES:

All dates and times in GMT. All contestants to check for duplicates and to compute their own scores. Sign a statement that all rules and regulations have been observed. Each page must be clearly marked with call, name, and address, and must be received by the contest committee before June 30th. Send entries to: PO Box 275, Hamilton 5, Bermuda.

RESULTS

RESULTS OF THE 1976 DELTA QSO PARTY

Plaque Winners as follows:

High score Delta Div = WA5KOD/5 with 33,592 points.
High score outside Delta Div = WB4OGW with 10,360 points.
High club station = WB5RHX with 21,480 points.
High portable station = K4LTA/4 with 11,340 points.

First place winners in each Delta Div as follows:

ARK	WA5KOD/5	19,698
LA	WB5RHX	21,480
MISS	W5RUB/5	22,248
TENN	AD4PUZ	40,967

First place winners by sections, outside Delta Div, as follows:

CONN	AC1GNR	3,444
EMASS	AC1AQE	2,646
ME	W1UOT	770
VT	AD1ORS	1,056
ENY	W2WSS	414
NLI	W2RPZ	3,430
NNJ	AA2EJZ	234
WNY	W2NCI	1,224
EPA	W3ARK	4,263
MD	AC3RAB	4,002
WPA	W3HDH	967
GA	WB4QGN	6,141
NC	W4OMW	1,519
SFLA	WB4OGW	10,360
VA	AA4SHL	864
NMEX	W5TIL	120
NTEX	K6TE8/5	3,835
OKLA	K5DEC	154
STEX	WA5TPO	2,552
ORG	KØGJD/6	7,182
SV	W6YMH	782
SDGO	AG6JES/6	840
SBAR	W6OUL	567
MONT	W7JYW/7	1,870
ORE	AC7ULC	1,960
MICH	W8WVU	945
OHIO	K8BBH	180
ILL	W9WR	1,248
IND	W9JOO	1,269
IOWA	WØPRY	4,992
MO	ACØQWS	5,355
CANADA:		
MAR	VE1MX	1,258
ONT	VE3EJK	3,675

FLORIDA QSO PARTY

Contest Periods:
1500 to 2000 GMT
Saturday, April 16
0000 to 0500 GMT
Sunday, April 17
1400 to 2400 GMT
Sunday, April 17

This is the 12th annual QSO party sponsored by Florida Skip. Phone and CW are separate contests. The same station may be worked on each band for QSO points. FLA stations may work other FLA stations for QSO points only.

EXCHANGE:

RS(T) and QTH-county for FLA; state, province, or country for others.

FREQUENCIES:

Phone – 3970, 7270, 14317, 21370.

CW – 3570, 7070, 14070, 21070.

SCORING:

FLA stations count 1 point per QSO; multiplier is sum of states (49 max), provinces (12 max), and DX countries (12 max). Maximum multiplier is 73. FLA mobiles and portables on emergency power and running 200 W or less multiply total score by 2. All others count 2 points per FLA portable/mobile station worked; 1 point for fixed FLA QSOs. Multiplier is number of different FLA counties worked (67 max).

AWARDS:

Certificates (phone and CW) to top single operator score in each state, province, and DX country, also each FLA county. Five plaques also to be awarded to high single op in FLA and out-of-state, phone and CW, and to FLA club with highest aggregate score.

ENTRIES:

Stations may be disqualified for various reasons – improper reporting, excessive dupes, errors in multiplier lists, etc. – at discretion of the contest committee. Anyone disqualified this year will be barred from the contest next year. A summary sheet is requested showing scoring and other pertinent information. Also include your name and address in BLOCK LETTERS, and a signed declaration that all rules and regulations have been observed. Include a 13¢ stamp for results. Mailing deadline is May 30th. Mail to: Florida Skip Contest Committee, PO Box 660501, Miami Springs FL 33166.

PACC CONTEST

Starts: 1200 GMT
Saturday, April 23
Ends: 1800 GMT
Sunday, April 24

Sponsored by VERON of Nederland, the contest is open to all amateurs to help obtain their PACC award. Use all bands, 160 to 10 meters, CW or SSB, but no cross mode contacts. Categories: single or multi-operator and SWL.

EXCHANGE:

RS(T) and serial number from 001. PA/PI/PE stations will give province as well. Possible provinces are: GR, FR, DR, OV, GD, UT, YP, NH, ZH, ZL, NB, LB.

FREQUENCIES:

CW – 3525-3585, 7010-7040, 14025-14085, 21040-21100, 28050-28100.

SSB – 3650-3750, 7040-7100, 14150-14300, 21150-21300, 28200-28700.

SCORING:

Each PA/PI/PE QSO counts 1 point. Each station may be worked only once per band regardless of mode. Multiplier is number of provinces per band (max 12 per band x 6 bands = 72). Final score is then sum of QSO points times total multiplier. SWLs score same.

ENTRIES & AWARDS:

Logs must contain code group given by Dutch station and station worked with; usual score calculation is required. Please use a multiplier column and insert multiplier only first time worked. Include a signed statement that contest rules and regulations were observed. Certificates to each country, US and Canadian call district winners. Logs must be sent to: VERON Contest Manager, PAØDIN, Schoutstraat 15 Nymegen 6805, Netherlands, not later than June 15th.

Of last year's several hundred contestants, only 4 were from the US. Winners from stateside were: AC3ARK, AC1OPJ, and WB5IAL. How about a little more participation from the States?

H-22 CONTEST

Starts: 1500 GMT
Saturday, April 23
Ends: 1700 GMT
Sunday, April 24

Use all bands 160 to 10 meters, CW to CW or phone to phone.

EXCHANGE:

RS(T) and 3 digit serial number from 001; Swiss stations send abbreviation of their canton as well. Abbreviations for 22 cantons are: AG, AR, BE, BS, FR, GE, GL, GR, LU, NE, NW, SG, SH, SO, SZ, TG, TI, UR, VD, VS, ZG, ZH.

SCORING:

Each contact with an HB station counts 3 points; each station can be worked once per band regardless of mode. Multiplier is sum of Swiss cantons worked on each band, 22 max per band. Final score is total QSO points times total cantons worked on all bands.

ENTRIES & AWARDS:

Certificates to highest scorer in each country, US and Canadian call areas. Logs must be postmarked not later than 30 days after the contest and sent to: TM USKA, HB9AHA, im Moos, 5707 Seengen, Switzerland.

H-22 Award is available for working all 22 cantons on CW or phone (all one mode). Send QSLs to Walter Blattner HB9ALF, Post Box 450, CH 6601 Locarno, Switzerland.

CONNECTICUT QSO PARTY

Starts: 2100 GMT April 30
Ends: 0200 GMT May 2

Sponsored by the Candlewood Amateur Radio Association, all amateurs are invited to participate. Each station may be worked once on each band and mode. W1QI, the club station, will be operating CW on odd hours and SSB on even hours and counts for 5 QSOs (each band/mode). Novice QSOs count 2 points each.

EXCHANGE:

QSO number, RS(T), and ARRL section for out of state, and Conn county for Conn stations.

SCORING:

Out of state multiply QSO points times number of Conn counties worked (8 max). Conn stations multiply total number of QSO points by number of ARRL sections and provinces; DX stations count only as one additional section total.

FREQUENCIES:

CW — 40 kHz up from bottom of band.

SSB — 3925, 7250, 14300, 21375, 28540.

Novices — 3725, 7125, 21125, 28125.

ENTRIES & AWARDS:

Certificates to top scoring stations in each Conn county and each ARRL section or province. Logs must show category, date/time in GMT, calls, numbers, bands, QSO points, and claimed scores. A Worked All Conn Counties Certificate will be awarded for anyone working all 8 counties. Enclose a large SASE for results. Logs must be postmarked no later than June 1st to: Candlewood ARA, c/o Fred Porter W1VH, 169 Carmen Hill Road Nr. 2, New Milford, Conn. 06776.

THE 18th ALL ASIAN DX CONTEST

The purpose of this contest is to increase the activity of radio amateurs in Asia and to establish as many contacts as possible during the contest periods between Asian and non-Asian stations.

CONTEST PERIOD:

Phone: 30 hours from 1000 GMT June 18, 1977, to 1600 GMT June 19, 1977.

CW: 30 hours from 1000 GMT August 27, 1977, to 1600 GMT August 28, 1977.

BANDS:

The amateur bands to 30 MHz may be used.

ENTRY CLASSIFICATIONS:

Single operator, 19 MHz band (CW only); single operator, 3.5 MHz band; single operator, 7 MHz band; single operator , 14 MHz band; single operator, 21 MHz band; single operator, 28 MHz band; single operator, multi-band; multi-operator, multi-band.

POWER, TYPE OF EMISSION, AND FREQUENCIES:

Within the limits of own station's license.

CONTEST CALL:

For Asian stations: Phone — "CQ contest"; CW — "CQ test."

For non-Asian stations: Phone — "CQ Asia"; CW — "CQ AA."

EXCHANGE:

For OM stations: RS(T) report plus two figures denoting the operator's age.

For YL stations: RS(T) report plus two figures "00 (zero zero)."

RESTRICTIONS IN THE CONTEST:

No contact on cross band.

For the participants of single operator's entry: Never transmit two signals or more at the same time (only one signal may be used).

For the participants of multi-operator's entry: Never transmit two signals or more on each band at the same time (one signal per band may be used).

POINT AND MULTIPLIER:

For Asian stations: Point — A perfect contact with non-Asian station will count one point; Multiplier — The number of different countries in the world worked on each band (according to the DXCC countries list).

For non-Asian stations: Point — A perfect contact with Asian station will count one point; Multiplier — The number of different Asian prefixes worked on each band (according to the WPX rules).

About JD1 stations: JD1 stations on Ogasawara (Bonin and Volcano) Islands belong to Asia; JD1 stations on Minamitori Shima (Marcus) Island belong to Oceania.

Contacts among Asian stations and among non-Asian stations will count neither point nor multiplier.

Contacts with KA stations are not eligible. They are considered not amateur but military.

SCORING:

(The sum of the contact points on each band) X (The sum of the multipliers on each band).

INSTRUCTIONS ON THE SUMMARY AND LOG SHEET:

Use a separate sheet for each band. Please keep all times in GMT. Please fill up the blanks of "multiplier" by the countries or prefixes only the first time on each band.

AWARDS:

Both phone and CW certificates will be awarded to the highest scores of each entry in accordance with the number of the participants of each country:

If the number of participants is under 10, awarded only the first rank.

If the number of participants is 11 to 20, awarded the second rank.

If the number of participants is 21 to 30, awarded the third rank.

If the number of participants is 31 or more, awarded the fifth rank.

The highest scorer in each continent of the single operator, multi-band entry will get a medal and certificate by the Minister for Posts and Telecommunications of Japan.

The highest scorer of the multi-operator, multi-band entry in each continent will get a medal. In addition, certificates will be awarded to the highest scorer of each call area of the United States of America, in the entry of single operator, multi-band.

REPORTING:

The log and summary sheet must arrive together at JARL P.O. Box 377, Tokyo Central, Japan, on or before the following dates: Phone — September 30, 1977; CW — November 30, 1977.

DISQUALIFICATION:

Violation of the contest rules; false statement in the report; taking points from duplicate contacts on the same band in excess of 2% by the total.

ANNOUNCEMENT OF THE RESULT:

Phone — about February, 1978; CW — about April, 1978.

You may have contest results by enclosing one IRC and SAE.

1977 CAPE TOWN FESTIVAL AWARD

This award is available to all licensed amateurs. Contacts must be made during the period starting 2200 GMT April 1st and ending 2200 GMT April 30, 1977. All DX stations (non-ZS) are required to work ZS1CTF or ZS1CTM plus 2 other ZS1 stations. QSL cards are not required for the award. Submit an extract of your log, certified as being correct by either your local awards manager or two licensed amateurs. Any band, mode, or combination may be used. Closing date for applications is July 31, 1977. Certificates will be posted after this date only. The fee is $2.00 (USA). A special endorsement will be available for VHF contacts or may be applied for as an additional award. Applications should be addressed to: Derek Siegel ZS1DP, SARL CT Branch, PO Box 5100, Cape Town 8000, South Africa.

ALL VE/VO ON RTTY

Offered by the CARTG, VE3RTT, contacts must be 2-way RTTY only, any date. Award will be a certificate, numbering from one. There is no charge for the award, but the necessary QSLs are to accompany the request. They will be returned! An official of a RTTY group or society may inspect and send in a signed list of such QSL cards, including all pertinent information (in place of sending the actual QSLs). Send all requests to: The Canadian Amateur Radio Teletype Group VE3RTT, 85 Fifeshire Road, Willowdale, Ontario M2L 2G9, Canada.

Oscar Orbits

Oscar 7 Orbital Information

Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
10866 A	1	0052:45	65.9
10879 B	2	0147:02	79.5
10891 A	3	0046:23	64.3
10904 BQ	4	0140:40	77.9
10916 A	5	0040:00	62.8
10929 BX	6	0134:17	76.3
10941 A	7	0033:38	61.2
10954 B	8	0127:55	74.8
10966 A	9	0027:16	59.6
10979 B	10	0121:33	73.2
10991 A	11	0020:53	58.0
11004 B	12	0115:10	71.6
11016 AX	13	0014:31	56.5
11029 B	14	0108:48	70.0
11041 A	15	0008:08	54.9
11054 B	16	0102:26	68.5
11066 A	17	0001:46	53.3
11079 BQ	18	0056:03	66.9
11092 A	19	0150:21	80.5
11104 BX	20	0049:41	65.3
11117 A	21	0143:58	78.9
11129 B	22	0043:19	63.7
11142 A	23	0137:36	77.3
11154 B	24	0036:56	62.2
11167 A	25	0131:13	75.7
11179 B	26	0030:34	60.6
11192 AX	27	0124:51	74.2
11204 B	28	0024:12	59.0
11217 A	29	0118:29	72.6
11229 B	30	0017:49	57.4

Oscar 6 Orbital Information

	Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
NA	20391 BTN	1	0122:45	80.8
N	20403	2	0022:41	65.8
NA	20416 BTN	3	0117:37	79.5
N	20428	4	0017:33	64.5
NA	20441 BTN	5	0112:28	78.3
NA	20463 BTN	6	0012:24	63.3
N	20466	7	0107:20	77.0
NA	20478 BTN	8	0007:16	62.0
N	20491	9	0102:11	75.8
NA	20503 BTN	10	0002:07	60.8
N	20516	11	0057:03	74.5
NA	20529	12	0151:59	88.3
NA	20541 BTN	13	0051:55	73.3
N	20554	14	0146:50	87.0
NA	20566 BTN	15	0046:46	72.0
N	20579	16	0141:42	85.8
NA	20591 BTN	17	0041:38	70.8
N	20604	18	0136:34	84.5
NA	20616 BTN	19	0036:30	69.5
NA	20629 BTN	20	0131:25	83.3
N	20641	21	0031:21	68.3
NA	20654 BTN	22	0126:17	82.0
N	20666	23	0026:13	67.0
NA	20679 BTN	24	0121:00	
N	20691	25	0021:05	65.8
NA	20704 BTN	26	0116:00	79.5
NA	20716 BTN	27	0015:56	64.6
N	20729	28	0110:52	78.3
NA	20741 BTN	29	0010:48	63.3
N	20754	30	0105:43	77.1

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.

OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.

Mode 8: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

BE MY GUEST

visiting views from around the globe

from page 13

and the word "stroke," for portable and mobile. The English phonetics are widely used. Those who speak English obviously work twenty meters a lot. Europeans work all bands, except 6 meters. That is reserved for commercial and public service use. In Germany and Austria, there is no FCC. All communications are controlled by the Postal Department (heaven forbid it here!). The Postal Department not only monitors the ham bands, but it transmits on them, too. One afternoon in Frankfurt, I gave a call and received no immediate answer. Thirty seconds later, a booming voice came over the repeater saying, "Where are you located, W8WLQ?" He gave no ID. I gave my location in Frankfurt, and he said "Thank you." I heard the Germans buzzing about how the Post and Telegraph Director was on the repeater frequency. I was told by a ham in Vienna that their FCC monitors commercial stations for entertainment and hams for laughs.

Autopatch is forbidden in Germany and Austria. The telephone companies would lose the revenue. In Germany, most communications are run by the government. Ham licenses cost more in Germany and run for only a year. The cost of a visiting license in Germany is about $5.85; it is valid for three months and cannot be renewed. The ARRL will supply all the necessary information for applying for one. I would like to commend the German government, as they are quite helpful and expedient in processing licenses for visiting hams. When you receive your license, you are also supplied with a book of rules and regulations written in English.

If you travel by train in Germany and Austria, you will find them to be very efficient. They are always on time, and speed across the countryside at 50 to 100 miles per hour. They also use overhead wires in the city and suburban areas. If you are "train mobile" like I was, the overhead wires can make it difficult for you to hit the repeaters. The express trains only stop for one minute to load and unload passengers and mail, except at the border. At the border, you have six minutes to get off the train and exchange your currency. This is a must if you expect to use the diner. The currency and menus change in the diner, when you cross the border. First class is the only way to go (by train) in Europe. Only first class can sit in the diner. The compartments are large and air conditioned. The regular class cars are crowded, warm, and the seats are hard. You can work "train mobile" and it is fun. Contacts don't last too long, because of the speed of the train. The repeaters I worked from the train included Nurnburg, Regensburg, Passau, Linz, and Wels. For information purposes, the two crystal pairs I used while in Europe were 145.15 in, 145.75 out and 145.20 in, 145.80 out. One contact on the train that I had was in Austria and the train went right by the other station's house. I never did figure out which house it was, but he saw the train. A ¼ wave whip came in handy, both on the train and in the cities. It gave me a little extra rf when I needed it.

Vienna

Vienna is a beautiful and old city. Its people are friendly and fun-loving. The food and beer are excellent. The streetcar is the KING of transportation, but Mercedes taxis are plentiful and inexpensive. Vienna is my favorite city in Europe. I arrived four days earlier in Vienna than expected and this caused considerable trouble. Hotel rooms are at a premium in July and August and I found that renting a room without reservations would cost me up to $40 a day. This was out of the question with my budget. A taxi driver and a very pleasant lady passenger located a room for me near the inner city. I stayed at the Hotel-Pension Schneider for two days, during which time I was able to extend my previously made reservations for $6 a day.

Should you ever go to Vienna, I would like to recommend tours to the palaces, the inner city tour by horse and buggy, and a visit to the Prater amusement park. In the Prater, you will find, along with the circus atmosphere, outdoor restaurants, beer gardens, and a beautiful park. There is one beer garden in the Prater that holds over a thousand people, gallon glasses of beer, a floor show, and a German band. When the band isn't playing, the lights are turned down, and a waterfall with changing patterns and colored lights is exhibited. A little old lady passes through the crowd hawking white rosette radishes, alpine hats, and colorful flowers. One of the exciting landmarks in Vienna is the Dunube Tower. On top of the spire is a wonderful restaurant which gives a fine choice of gourmet food. While eating, you are overlooking the entire city of Vienna. At night, the lights below look like thousands of stars twinkling away in the distance. For those with a sweet tooth, the pastry shops are utopias.

When I arrived at the banhof, I had already been listening to the Vienna repeater. I didn't contact anyone on it till later. Once in my hotel room, I ordered a cold drink and "kerchunked" the repeater. I received a call from Peter OE1SP. He spoke English and I later found out he had spent two years or so in North Carolina. Peter was very helpful to me while I was in Vienna. Fred OE1BMA was another English-speaking ham with whom I had several contacts.

The repeater in Vienna was a simple one. It was an old taxi radio, with two vertical half wave antennas and no duplexer, which caused periodic trouble. Pigeon deposits have to be cleaned off of the antennas periodically to insure good radiation.

As my trip to Vienna was to attend a magic convention, my ham activities were confined to talking on the repeater. But Peter OE1SP invited me to a Liars Club one evening. The Viennese version of the coffee klatch took place in a beer garden. I believe the name to be The Green Lantern. It started at 1700 and was still going on at 1930, when I left. It was an informal get-together, with about 15 or 16 hams attending. Two or three of the hams spoke English and I tried to speak to the others in my broken German. My Austrian friends were impressed by some of the features on my Wilson HT. In Europe, the Ken and Standard are sold to the amateurs, not the Wilson. The Ken is somewhat smaller and does not have a separate microphone. It also lacks the auxiliary plug on top. Peter OE1SP told me the Wilson is approved for police use in Austria, whereas the Ken is not. I passed out some bicentennial QSL cards, drank a couple cups of espresso coffee, and caught a cab back to the hotel.

The next day I received a call on the repeater from another Viennese ham. I came back to him, and he asked that I only speak English. Sometime later, I learned that our QSO had been recorded and was to be played over an international short wave station. It would be beamed toward English-speaking countries. A very nice gesture on behalf of the Austrian government.

In Austria, there are about 1200 licensed amateurs: YLs get special calls, beginning with OE1Y. You must have a permit to buy radio equipment as well as a license. It is necessary to have a license to own a TV set or a regular radio. These are paid for by the year. I checked a radio shop in the center of Vienna, and found that the TS-520 in the window cost $995. I saw a couple of used pieces of Heath equipment and some two meter rigs. No place to look for bargain prices. Licenses are issued in Austria according to power: Class A – 25 Watts, Class B – 50 Watts, Class C – 100 Watts, and Class D – 250 Watts. Power is based on the plate dissipation of the final tubes. Non-code licenses are issued for 2 meter use. Licenses are issued to visiting amateurs at a cost of a $1 per month. You must have a license for each one of the 5 states in Austria in which you intend to operate your station. In Germany, one license applies for all of Germany. If you hear music being broadcast on ham radio in Austria, don't be alarmed; it's legal. It can be used for testing purposes. Repeater IDs are set at high speeds. This is requested by repeater club members, simply because it interferes with their conversation. There are few timers and they are extra long. This is because, once again, the members resent timers. Repeater dues in Vienna are $15 a year. The Vienna Liars Club meets Tuesday night, and the regular club meeting is Thursday night. Repeater frequencies for two meters are R10 to R19. R10 is 145.00 in and 145.600 out. The inputs start at 145.00 and go up every 25 kHz. Outputs are 600 kHz up. Simplex frequencies are 145.500, 145.525, 145.550, and 145.575. The 145.500 is the most commonly used one. For anyone wanting to apply for licenses for use overseas, or in any foreign country, it is best to write the ARRL. They will supply free all the latest requirements.

With all respect to the Austrians, the Gummi-Wurst (rubber sausage) is better described in the English language as a rubber duck. Hope you enjoyed the trip, and perhaps someday you will operate portable DL, OE, or even UA.

Les Mitchell W8WLQ
Lansing MI

Reprinted from The Scope, *bulletin of the Central Michigan ARC, Lansing MI.*

Micro Future

Purchases of computers and related products for home use will increase at an average 37.2% annual rate for the period 1976-1981, according to a recent study completed by Venture Development Corp., Wellesley MA. The study, "The Home Computer," represents over seven months of effort, during which time VDC queried hundreds of users, manufacturers, retail stores, and hobby groups.

The study reveals that not all computers used in the home are so-called "hobby computers," but that some are industrial single-board prototyping systems adapted to that purpose. This year, for example, 22.5% of the 24,164 computers purchased for home use will be supplied by such established "non-hobby" manufacturers as Intel, National Semiconductor, Texas Instruments, Intersil, and MOS Technology. Conversely, one third of the total computers

Calypso SOS

Sunday morning, January 30, 1977, several radio amateurs throughout the southern U.S. were galvanized into action by a distress message that eventually was found to be false. Before it became clear that the message was a hoax, many amateurs had become involved in relaying related traffic, and the U.S. Coast Guard had initiated an air search.

At about 9:45 am CDT, amateur radio station WB5LTP/MM2, aboard a vessel located about 100 miles south of New Orleans LA, reported he had copied the following message: "The motor vessel *The Calypso* is sinking off the Texas coast between Port O'Connor and Freeport, Texas. Located at about 96 degrees west, vessel is of 332 tons, 138 feet length, twin screw, radio call is FOAE." WB5LTP/MM2, the first radio amateur to retransmit this message on 7229 kHz, relayed its content to other amateurs.

The original message was transmitted by an unknown source on 7254 kHz, a frequency also assigned to the amateur radio service. It was received on the east coast, and also by an amateur operator in Colorado. In very short order the message was relayed to the Eighth Coast Guard Headquarters, New Orleans LA. On instructions from this office, an immediate air search was begun of the area. Advisories were transmitted to marine traffic to keep a sharp lookout for survivors or evidence of the disaster.

As a matter of fact, *The Calypso*, the famous oceanographic ship of Jacques Cousteau, was nowhere in the vicinity; it was safe and sound, thousands of miles away. Cousteau himself, however, was in the Gulf Coast area, diving to study and film underwater life in the vicinity of offshore oil drilling platforms.

Although many amateurs were chagrined at having been duped, Coast Guard reaction was one of satisfaction. Lt. L. H. Smith, Public Affairs Officer, U.S. Coast Guard Air Station, Corpus Christi, Texas, advised that this was the first time in his experience that a hoax distress message had originated on an amateur frequency. Lt. Smith remarked, "Had this situation been a true distress, the hams involved would have been commended for the detailed information passed to the Coast Guard."

Of the several Coast Guard officials contacted during and after this unfortunate incident, none criticized or blamed the radio amateurs involved. In fact, they expressed surprise at the accuracy and consistency of the message input arriving from stations located throughout the southern United States. One Coast Guard officer remarked, "I was so impressed with it all that I may just become an amateur radio operator myself!"

Bill Edwards K5CN
Norval Sommers W5JOK
Corpus Christi TX

Hoodwinked?

"We are aware of no compelling reason why amateurs wishing to operate repeater, auxiliary, control, or remotely controlled stations should be continued to require the obtaining of Commission permission before beginning such operation, as they have in the past. For this reason, we propose to delete those provisions . . . requiring that licensees obtain prior approval of the Commission to operate a remotely controlled station and requiring that repeater stations, control stations, and auxiliary link stations be separately licensed. We would discontinue the issuance of station licenses with 'combined' station privileges: All amateur station licenses would convey authority to operate as repeater, control, auxiliary link, and remotely controlled stations now operate." That's a quote from the Notice of Proposed Rule Making, dated January 6, 1977.

Editorials should be short and to the point . . . so here goes. The radio amateur is proud of his hobby and his ability to regulate himself. Here's hoping the Federal Communications Commission isn't being "hoodwinked" into believing it can shirk some of its own responsibility, that of helping us help ourselves. Repeater councils have been and are doing an excellent job of coordinating. It is still relatively simple to obtain repeater authorization, when and where it is needed. Let us not deregulate what might need more regulation in the future. Instead, let us demonstrate to prospective hams that *we can operate under an existing set of responsible regulations.*

Chris Roberts WB9WXL
Ft. Wayne IN

Reprinted from The State of the 'Arts, *publication of the Allen County Amateur Radio Technical Society, Inc., Fort Wayne IN, February, 1977.*

Rig Service

1. Approach the ailing equipment in a confident manner. This will give the instrument the (often mistaken) idea that you know something. This will also impress anyone who happens to be looking, and if the equipment should suddenly begin working, you will be credited with the repair. If this step fails, proceed to Step 2.

2. Wave the *Handbook* at the instrument. This will make the equipment assume that you are at least somewhat familiar with the sources of knowledge. Should this step fail, proceed to 3.

3. In a forcible manner, recite Ohm's Law to the instrument. (Before taking this step, refer to some reliable handbook and be sure of your knowledge of Ohm's Law.) This will prove to the equipment beyond a shadow of a doubt that you do know something. This is a drastic step and should be attempted only after the first two steps.

4. Jar the equipment slightly. This may require anything from a three to a six foot drop, preferably on a concrete floor. However, you must be careful with this step because, while jarring is an approved method of repair, we must not mar the floor. Again, this is a drastic step, but if it fails, there is nothing to do but to move to step 5.

5. Add a tube, resistor, or capacitor. This will prove to the instrument that you are familiar with instrument design. Also, this step will give the piece of equipment an added load to carry and will thereby increase your advantage. If these five steps fail to work, you must proceed to the most drastic step of all. Seldom needed, it is to be used only as a last resort!

6. THINK.

Reprinted from Squelch Tail, *bulletin of the Arizona Repeater Association.*

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produced this year by MITS, Inc. and IMS Manufacturing Corp., currently the two largest hobby computer suppliers, will be sold for non-home use, although the remaining two-thirds will acount for 40.7% of the home mainframe market.

The VDC study analyzed hobbyists and their applications, finding that less than one-half of all self-described computer hobbyists own computers, and that over 70% of owners use their systems for games. System utilization for this application is currently 32.8%.

VDC's analysis of distribution patterns revealed that 61.6% of home/hobby computer sales in 1977 will be made by computer stores. Over the 1976-1981 period, computer store sales of computers for home use will increase at an average 47.8% annual rate in terms of units, and at an average 46.3% rate in terms of revenues. Purchases by commercial users will account for an increasing percentage of total retail sales over this period.

Revenues from home/hobby computer submarkets (main memory, peripherals, software, miscellaneous products) will increase less rapidly than mainframe revenues between 1976 and 1981, with mainframe revenues showing an average annual increase of 42.5%, and submarket revenues growing at an average 35.1% annual rate. Software will represent the fastest-growing submarket, averaging 81%/year growth through 1981. Among the standard peripherals purchased for use by hobbyists, floppy disks will exhibit fastest growth, rising 63% annually in terms of units.

Venture Development Corp.
One Washington Street
Wellesley MA 02181

Briefs

from page 9

times. A controversy arose early in February after a New Hampshire motorist was ticketed and fined by a Massachusetts State Trooper. A Boston area legislator is mounting a drive to have the bill repealed. Massachusetts is well known for a large number of strange laws that have never been taken off the books. Keeping both hands on the wheel at all times makes it difficult to do things like turning on headlights or even shifting.

High power rf energy at 13.56 MHz is the basis of a new type of cancer therapy that is achieving a high degree of success at several hospitals throughout the United States. The therapy is based on the fact that blood flow through a cancer area is drastically decreased because the explosive growth of a tumor pinches the vessels shut.

Doctors use an rf generator with an output of 1000 Watts at 13.56 MHz, the lowest frequency approved for medical use by the FCC. The rf is transmitted from an amplifier to an impedance matching circuit via coaxial cable that is connected to electrodes in the tumor area.

When the rf is applied to the electrodes, immediate heating of tissue takes place. In normal non-cancerous tissue, the normal flow of blood cools the area so that no damage is done. However, with the constricted blood vessels of a cancer tumor limiting blood flow, that area is heated above the temperature at which the cancer cells are destroyed.

Of 21 patients treated so far, all were cured by the technique. Doctors are encouraged and plan to use the rf treatment mainly in areas where it is difficult or impossible to operate. *Reprinted from the* Journal of the American Medical Association.

What is the status of the two rf interference bills which are pending before Congress? According to Senator Barry Goldwater K7UGA, they may be in trouble. In a letter to an unidentified member of the Arizona Repeater Association, Goldwater writes:

"To put it as bluntly to you as I can, so you can pass it on to your readers, that fabulous affair we call politics has gotten into the matter of the two bills you have written to me about.

"The electronics industry in this country is a very large one and it isn't about to want to spend another dollar or two to make a receiver or a TV set immune to other frequencies. The industry has been working hard on the committees and I can assure you that I will continue to work hard on this. I really think that as the people begin to understand it as organized labor already has, we are going to get this passed either this year or probably next year." *Tnx to* Arizona Squelch Tail.

Attorneys for Offshore Navigation Incorporated, a New Orleans based radionavigation service with a subsidiary in Canada, have informed the Canadian Department of Communications of their disagreement with a WARC proposal by the Canadian Radio Relay League that 420-450 MHz be exclusively allocated to amateur service.

In the letter, the attorneys confirm that up to the present time, radiolocation operations in the band have been minimal. They add that the situation is in the process of change and that they anticipate the band will be heavily used for radiolocation in the near future due to comprehensive development of new equipment for use in this band. The equipment would replace current SHORAN equipment, which is 20-30 years old and of tube design. They point out that development work has been in progress for more than two years, with a prototype system under test for over a year. Delivery of additional systems is planned for the near future.

In conclusion, the letter urges the Department to maintain the provision for radiolocation in the 420-450 MHz band. There was no immediate comment from the Canadian Radio Relay League.

A letter from the Canadian Radio Technical Planning Board to John Van Der Ryd VE3CYC has taken issue with Van Der Ryd's letter on page 9 of the January issue of *73*. In the letter, Van Der Ryd claimed that at a meeting last fall between the Canadian Radio Television Planning Board and the DOC in Ottawa, a discussion to rearrange frequencies between 406 and 960 MHz included a suggestion to take the 440-450 MHz band away from amateurs.

Bud Punchard VE3UD, Chairman of the ad hoc committee on the band, replied that the committee has recommended that amateur bands in that band remain unchanged. Punchard added that the group is working hard to save bands for amateur use.

The Amateur Radio News Service has announced the rules for its 1977 annual contest. The contest is aimed at promoting amateur radio journalism in club publications of various sizes. Club bulletin and newsletter editors are urged to send three different issues of their publications from the year 1976 to the three judges listed below. The deadline is April 15th, according to ARNS spokesman Norm Monro. There are six categories in the compeition: Class A (for publications subsidized in part by outside interests), and Class B (for publications produced solely through the resources of a club or organization), each further broken down into three divisions, depending on circulation, in multiples of 50 or more. Three copies must be mailed to each judge: Norm Monro K4FRY, 215 Brindly St., Gadsden AL 35901; Phil Sager WB4FDT, 3877 N. Abingdon, Arlington VA 22207; and Lee Knirko W9MOL, 222 S. Riverside Plaze #2400, Chicago IL 60606. Each entry must be accompanied by an official class of entry, the name and address of the editor, and the publication's average monthly readership.

According to the *West Coast DX Bulletin*, it appears that Yugoslavia has moved to give their amateurs privileges in the 160 meter band. YU1PCF was worked on the band recently and another Yugoslavian amateur, YU3EY, is also active. First reports are that their 160 band is only 10 kHz wide with activity recently heard on 1830 kHz.

The phenomenal success and growth of the "Sidewinders on Two," a two meter SSB group headquartered in Fort Worth TX, has created a money problem. In the past, an annual $2.00 fee was sufficient to mail club bulletins to all members. The February bulletin of the group, however, lists 366 members, making it necessary to charge for postage. Now a $5.00 fee will cover both membership and a subscription to the bulletin. Those who wish membership only can still join for S2.00.

More information is available from Sidewinders on Two, 1704 Glenn Drive, Fort Worth TX 76131.

Western Airlines Captain Carl Smith WØBWJ earned a "good guy" award from the mayor of Honolulu HI recently after making a perfect two-point landing of his 707 at the Honolulu airport in January. The landing was made necessary after the nose gear of the airplane failed to extend after repeated attempts. In the true tradition of amateur radio operators, Smith handled the situation coolly and professionally and said it was "not an adrenalin situation." He refused an offer of foam being spread on the runway and landed the big jet perfectly on two sets of wheels, taxiing for some distance before dropping the nose. No one was injured.

A-8 Honolulu Star-Bulletin Thursday, January 27, 1977

He Made the Best of an Emergency Situation

Safe Landing Earns Pilot a 'Good Guy' Award

Over the years, the Collins KWM-2 and KWM-2A single sideband transceivers have undergone a number of modifications, some of which were made during the period the unit was used in military service.

Available through Military Affiliated Radio Service (MARS) libraries, and the Government Printing Office, is an Air Force Technical Manual that lists over 50 modifications to the KWM-2/KWM-2A, along with expanded, fold-out diagrams of the circuitry, which are a great improvement over the amateur-style instruction manual.

The title of this technical manual (TO-31 R2-4-183-3) is: *KWM-2A Transceiver*. It also covers changes to the 30L-1 and 30S-1 rf amplifiers.

A second technical manual of interest to KWM-2/KWM-2A owners is TO-31R2-4-183-2, entitled *Technical Manual (Service) KWM-2A Transceiver*. It also covers the previously mentioned amplifiers. This publication provides detailed alignment instructions for the transceiver and linear amplifiers. *Thanks to* Parking Ticket, *bulletin of The Plano Amateur Radio Klub, Inc., PO Box 435, Plano TX.*

Previously unpublished papers on all technical subjects relating to amateur radio are invited to be submitted for the 1977 ARRL Technical Symposium. The event will be held in September in Falls Church VA under the management of the Amateur Radio Research and Development Corporation and is sponsored by the Northern Virginia Amateur Radio Council.

Areas of interest include propagation, antennas, transmitting and receiving equipment, amateur applications of microprocessors, design and construction techniques, station and shop design, HF techniques, VHF/UHF repeaters, ATV, RTTY, space communications, microwave, and any other topic of technical interest to amateurs.

Prospective contributors should forward an informal summary, along with a photo and one page biographical sketch, by July 15. Manuscripts are due by August 15. For more information write Paul Rinaldo W4RI, 1524 Springvale Ave., McLean VA 22101.

While you're about it, how about submitting the article to *73*? That way you can get paid for your effort.

Australia may soon have a CB problem of its own. At present, there is no licensing system for CB radios in that country, but an increasing number being brought in from the United States are beginning to create interference problems "down under." Some estimates put the number of radios currently being used at near the quarter-million mark. Although not illegal at the moment, it is becoming clear to government authorities that they will soon have to develop legislation to regulate the units. They are currently studying alternatives. The Wireless Institute of Australia, the

country's amateur organization, has offered the government help and expressed concern that possible legislation regarding CB will adversely affect the state of amateur radio in Australia.

OSCAR 6 continues to show signs of deterioration. When launched in October, 1972, the amateur satellite had an expected life of one year. It's been going strong until recently when telemetry data showed that one of the 18 cells had failed, and there were strong indications that a second was about to. OSCAR 6 passed through the period of highest temperature at the end of January and beginning of February. During this period, the satellite is in sunlight 100% of the time and temperatures inside rise drastically. AMSAT president Perry Klein told *73* that this high temperature period is detrimental to the batteries. Both OSCAR 6 and OSCAR 7 pass through full sunlight periods twice a year. Klein added that AMSAT expects to shut down OSCAR 6 when the A-O-D satellite is launched later this year. That is, of course, if OSCAR 6 lasts that long.

Meanwhile, OSCAR 7 was continuing to have problems with overcharging of the batteries and was alternating between Mode B and Mode C on all orbits. It was theorized that a bad solar aspect angle with the sun hitting the satellite on the top only might be responsible for the problem.

On the lighter side, the International Repeater Group in New Brunswick can be thanked for the following compilation of a few categories of the infamous "thumpers":

Early Morning Thumpers: The first thing they do each morning is check to make sure the repeater is on. They usually get up between 6:15 and 7:15.

Late Night Thumpers: They give the repeater a little thump before going to bed.

73 and 88 Thumpers: After a QSO, they always have to thump the repeater a few times as a friendly way of saying goodbye.

Repeater Checker Thumpers: On an irregular basis, all repeaters in the area get a thump to find out if they are on the air.

Casual Thumpers: They check to make sure the repeater is still on the air at various times throughout the day.

Rapid Fire Thumpers: Those who like to see how many times they can push their mike button in three seconds.

Guess Who Thumpers: They always return a thump to the Casual Thumper, but don't like to give their call.

If you're looking for another certificate, why not try the Capitol Hill Amateur Radio Society? W3USS runs a kW on SSB and CW from the basement of the Old Senate Office Building in Washington. Antennas range from a vertical to a three element tri-bander up 120 feet. As Pete WA3KSQ put it, "For those in a hurry, it takes only three minutes to travel from our QTH to the Senate floor."

This year's observance of Armed Forces Day, scheduled for Saturday, May 21, marks the 28th anniversary of this annual event.

A featured highlight of the day will be the traditional military to amateur communications tests. The proceedings include operations in CW, SSB, RTTY, and SSTV.

Certificates will be awarded to amateurs who accurately copy the Armed Forces Day message from the Secretary of Defense, Harold Brown. The message will be transmitted in both CW and RTTY.

The military to amateur crossband operations will be conducted from 1300 UCT on May 21 to 0245 UCT on May 22. Military stations NPL, NMH, NAM, NPG, WAR, and AIR will transmit on military frequencies and listen for amateur stations transmitting in portions of the amateur band. The operators at the military stations will specify which portions they are listening to.

73 will publish a complete list of the frequencies in next month's issue.

Want a two letter callsign? April 1 will be the date on which you can apply if you received your Extra ticket between July 1, 1974, and July 1, 1976. If you received the Extra after July 1, 1976, you can apply on July 1, 1977 or later. If you had an Extra before July 1, 1974, you are eligible to apply immediately.

The Dallas TX Amateur Radio Club reports that thefts of two-way radio equipment in the Dallas area declined at the end of 1976. During the month of December, 565 radios were reported stolen to the Dallas Police Department, a low for the year. The total for the year was a staggering 10,635. Several Dallas Police spokesmen expressed the opinion that the trend has gone full circle and thieves might go back to hubcaps and mag wheels. With 40 channel CB rigs and the increasing use of mobile 2 meter equipment, what will happen remains to be seen.

In an effort to improve their signal to the western United States, W1AW in Newington CT has been conducting tests with a variety of antennas. Comparisons were made between a 4 element 20 meter yagi and a rhombic. Reports from Los Angeles favored the rhombic, although stations 20 degrees off heading reported the yagi as superior. Comparisons between the W1AW signal and other amateurs in the Hartford CT area were also made. In some cases, signals were 10 to 12 dB in favor of the other stations.

It was decided to build a new array with stacked 4 element 20 meter beams at 60 and 120 feet, and a 3 element 40 meter beam at 90 feet. The project is funded by a bequest from silent key W8FX, a longtime Michigan S.C.M. The array will bear a plaque in his memory.

As part of a federally funded project, a study team at Cornell University recently spent time monitoring conversations on the CB channels. According to their conclusions, almost 50% of the conversations were discussions about the locations of the parties involved, 20% were discussions of equipment and technical aspects, and less than 5% were requests for information, "smokey reports," and traffic directions.

The study showed that 75% of the communications were directed specifically at another party, although in over 50% of the cases, the operator was unable to find the party that he was seeking.

They found that 50% of the traffic occurred on Fridays and Saturdays, with the peak time between 5 and 6.

In conclusion, the study team called CB a "wireless party line used primarily as a way of making friends and maintaining a community network."

EDITORIAL BY WAYNE GREEN

from page 4

stopping at either 13 or 20 words per, but heading for them thar hills. Some preliminary experiments with high speed code indicate that it may not be much more difficult to master than slow speed code . . . indeed, it may not take much longer than learning slow speed code . . . once instructors are able to get over using the graduated teaching method.

Despite the example of more and more code classes starting students out at 13 words per minute right from the beginning and making the goal in less than half the time required by the old (ARRL) system, all of the code learning systems on the market today (except the *73* tapes) go the same old route . . . and that includes the just released ARRL tapes which teach 5, 7½, 10 and 13 per . . . for those who want to take the time to learn four different code speeds.

The next step is to try starting people out at copying code at 50 words per minute, right from the start. The whole idea of copying code is to train the brain to translate the sound patterns on a subconscious level, thus getting around the slowness of the computer system on the conscious level. The code translation on the conscious level bogs down at around ten words per minute . . . the famed "plateau." It is only after this plateau has been reached in the normal code learning system that the whole business is turned over to the subconscious mind for deciphering.

When you hear di-dah and then say, *"hmmm, that's A," you're looking it* up in memory and the circuits involved are many and relatively slow. When you hear di-dah and your fingers write or type "A" before you can say it, then you're working on a subconscious level and headed for speed.

Let's get some hams who would like to try for 50 per and start them out with the dots and dashes at that speed . . . crank up the keyboard or bug and send individual letters well spaced at first . . . then close up the spacing as you go. You'll quickly be able to tell the difference between even the most similar of letters such as 1 and J. Let me know how you do.

New Products

YAESU FT-221R TWO METER ALL MODE TRANSCEIVER

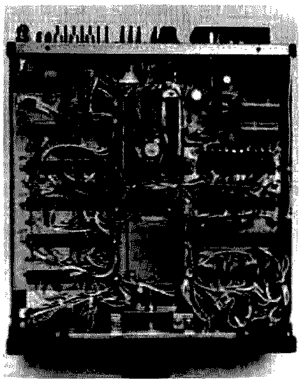
The 2 meter operators who have confined their VHF activities to FM are in for a surprise: The spectrum between 144 and 146 MHz is alive with SSB activity, but without the problems of QRM, jamming, and the general disorders associated with low band sideband operation. In order to join the fun of 2m SSB, a suitable transceiver is required, and the Yaesu people provide a perfect rig – the FT-221R. This all mode transceiver provides every feature required to fully exercise the 2m band.

The transceiver is VFO controlled, and main dial accuracy is maintained by dividing the 4 MHz 2m band into eight 500 kHz segments, with each segment being selected by a rotary switch. Main dial resolution is 1 kHz. If crystal control is desired, the operator has a choice of eleven crystal positions controlled by a front panel switch resulting in 88 crystal channels. The rig also has a standard built-in calibrator that can be used to perfectly set the main dial. This is accomplished by turning on the calibrator and adjusting the main tuning knob while locking the VFO with a button located by the dial. A signal strength meter doubles as a center scale discriminator meter when receiving FM. The meter also reflects relative output power when transmitting. The operator also has control over rf gain, squelch, audio and microphone gain, VOX gain, and repeater control via front panel controls. Standard and reverse repeater offsets are provided, as well as an operator selected offset. The additional offset is generated by an internal crystal, provided by the user. A mode control selects upper or lower sideband operation, as well as FM, AM, and CW. And finally, a clarifier control is provided for the SSB operator. CW sidetone, noise blanker, and repeater tone burst functions are standard features, making the FT-221R a totally versatile package. The radio can operate on either 12 volt dc or ac line. The power transformer is tapped for those who have non-standard line voltage.

Operating the FT-221R is a joy. I spent an entire weekend operating the transceiver in the rf-burdened New York City area, and never experienced any problems relating to overload or intermodulation. I started my day by making a few basic tests on the transceiver.

I checked the FM power output with a Bird 43 wattmeter, and found the transceiver was delivering 22 Watts into the line. Sideband PEP output was about the same, as was CW. The AM output was four Watts. (Yaesu rates the FT-221R at a conservative 14 Watts on FM.) I have often wondered about the accuracy of VFO tuned rigs on VHF. A frequency counter check of the main dial resolved the question, as accuracy was within 100 cycles at all settings. Drift was undetectable. My first operating test consisted of a rag chew on FM simplex with friends. Perfect tuning is accomplished by using the center scale discriminator meter, and no off-frequency problems were encountered. The receiver is superb, and the rf gain control can be used with the squelch function to select the group of stations desired. I live on a hill, and undesired distant FM stations have always been a problem. Not so with the Yaesu; the rf control took care of that situation. I tried the local repeaters next and encountered no tuning or operating problems or peculiarities. The microphone gain control allows considerable latitude in deviation, a necessary feature when using city repeaters with narrow audio bandpass characteristics.

The time was finally right for SSB. Not knowing the two meter calling frequency, I tuned around "below" 146 MHz until the familiar SSB sound was heard. A touch of the clarifier, and perfect audio resulted. SSB tuning is sure and solid, and there is no drift once the signal is tuned. Breaking into the QSO resulted in an hour long round table with four others on SSB, and two of the stations were well outside my normal FM range. Encouraging signal and quality reports were received, so I decided to call CQ (it is acceptable on 2m SSB!) on the national SSB calling frequency of 145.025 MHz. I talked to several other SSB stations on both sidebands, and noted that there is no shift when switching between the upper and lower sideband. The 221R was rock solid throughout the session, and nothing but favorable reports were received. The VOX functioned well, and I found operating 2m SSB was much like a late evening crosstown QSO on 20m when the band is out. No QRM, no problems. It was also obvious that 2m SSB activity is growing, as virtually every CQ resulted in a contact.



Underside of the FT-221R. Most of the circuitry is contained on easily removable cards that slide into the visible edge connectors.

The FT-221R is bound to excite the OSCAR satellite operators. Being VFO controlled, the transceiver can easily be operated in the OSCAR 7 Mode A transmit region, or the Mode B receive segment. One of the editors at *73* is an OSCAR enthusiast, and his first test of the Yaesu was to fire up during the first available OSCAR 6 pass. He was immediately rewarded with a contact from Argentina, with good signal and quality reports. The FT-221R has sufficient power to work the satellites with simple antenna systems. The operator at *73* used a Ringo antenna tuned to the high end of 2 meters with good results on both OSCAR 6 and OSCAR 7.

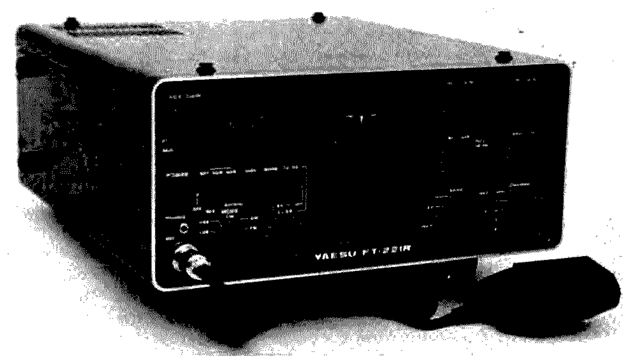
Everything considered, the Yaesu FT-221R is a pleasure to operate. There are enough controls and options to please the most demanding operator, yet one does not get lost when operating. There are no tuning or loading controls. The amplifier delivers full power from band edge to band edge, and there is no obvious evidence of spurious output (immediately detectable in the New York area, as there is a repeater or public service outlet on almost every VHF channel). The receiver does not appear to "peak" anywhere on the band, and is immune to the intermodulation headaches known by all city operators. Single sideband operation, which is the 221R's forte, is superb, and is guaranteed to open a new frontier for those 2m operators who are tired of FM and repeaters. The Yaesu FT-221R is priced at $629. *Yaesu Electronics Corp., 15954 Downey Ave., Box 498, Paramount CA 90723.*

John W. Molnar WB2ZCF
Executive Editor

MONITOR TUNER 160-10 MAT AND SUPER SUPER TUNER

Having moved into a new house just before the first snows of winter set in on New Hampshire, I did not have time to erect all the antennas that I wanted. In fact, the only antenna I could get into the air was one of the more common 75 and 40 meter multiband dipoles which are available commercially. This 66 foot antenna works fine in the 75 meter band (and has a pretty flat swr curve throughout the 40 meter band), but it was completely unsuitable for any of the other bands. This is quite a devastating problem for the avowed DXer, especially during the international DX contests when operation on other bands is definitely desired.

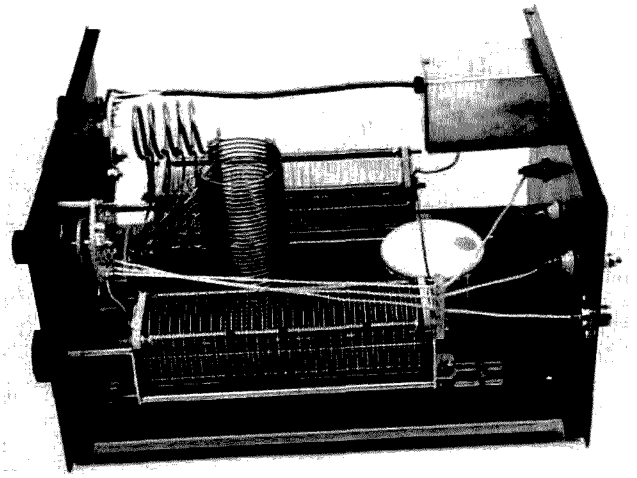
Of course, what I needed was an antenna tuner – and a good one at that. Knowing that eventually I was going to increase my station power from the current 180 Watts PEP to 2,000 Watts PEP, I started looking for a tuner that could handle the legal limit. Having had some prior experience with equipment by the Dentron Radio Co., I chose their Model 160-10 MAT Monitor tuner. Besides being able to handle upwards of 3 kilowatts,



The Yaesu FT-221R. Note double-sided tuning scale and 8 position bandswitch that allow accurate VFO tuning.

The Dentron Radio Monitor Tuner – basically the same unit as the Super Super Tuner, but with an swr/power meter built in.

this tuner has a built-in rf power meter which shows both forward and reflected power at the flick of a switch, making tune-up a snap. It also features an easily accessible front panel switch which permits you to select either the coax, balanced or random wire terminals on the back of the tuner. You therefore can have three antennas or a dummy load connected to the tuner at one time and be able to select any one without the need to disconnect the others. I tried this with a 50 foot wire which ran from my bedroom window to a nearby tree – it loaded perfectly on 15 meters while hooked to the random wire terminal. There was no need to disconnect my multiband from the coax connector while this test was being made. By the way, the multiband worked out fine on all bands through 10 meters, and I even managed to pick up a few new countries on both 15 and 10 during the February DX contest.



Guts view of the Monitor Tuner by Dentron. Round plastic device on the right is a balun.

The Monitor tuner also comes without the rf power meter (in which case it is called the Super Super Tuner). For those of you who are lucky enough to have an accurate separate meter, this is a good deal. The tuner is well named. The bridge and meter unit is also available as a separate unit for $99.50.

The construction of the unit is very sturdy, and the coil and rugged capacitors were chosen to be well within the power range of the unit. The case measures 9" x 13" x 16" and fits nicely on any operating table. The price is also right, with the metered unit costing $299.50 and the unmetered version $229.50. *Dentron Radio Company, Incorporated, 2100 Enterprise Parkway, Twinsburg OH 44087.*

Rich Force WB1ASL
Associate Editor

73 TESTS THE COMMUNICATIONS RECEIVERS

The 1979 WARC conference has many of us thinking about the future of the ham bands. As we reported back in February, and have updated elsewhere in this issue of 73, amateur radio is only one of more than a dozen services vying for spectrum space. And compared to amateur allocations, frequencies set aside for international broadcasting (about 2 MHz not counting the "tropical" SW bands) are much more important to the majority of WARC delegates.

Foreign broadcasting is closely tied to foreign governments, in most cases controlled *by foreign governments. It is a highly political business, employing great numbers of personnel (over 3 thousand in the Voice of America alone). Radio Liberty and Radio Free Europe, until recently, were secretly funded by the CIA. That should be a clue to the political stakes involved.*

US government figures compiled five years ago showed nearly 7 thousand hours of programming per week *from the communist bloc alone! That's enough programming to keep about 45 transmitters going continuously. The western bloc broadcasts about twice as much on the SW bands, over 12,500 hours per week, according to a BBC survey. Russian broadcasters, considered separately, are beaming programming in 84 different languages (by US figures), an expensive proposition at the least. Even the smaller countries are making substantial investments in foreign language transmissions, such as Cuba with 8 languages, and Mongolia with 4.*

Amateurs active on 40 and 80 meters are well aware of the power and bandwidth the SW broadcasters use, and the intensity of their activity. Stations from every corner of the world can be received with simple whip antennas, and many of us found our way into ham radio by listening to them.

Many hams are still SWLing and, by recent reports, it appears the hobby is headed for a revival on the heels of what's been called "the personal communications boom." One report has it that there are so many SWLs active in Japan that some broadcasters are limiting or ending QSL services. One country's SW service was saved from shutdown (an austerity move) by hundreds of complaints from overseas listeners!

Nearly all SW broadcasting is AM, but there are mounting arguments to switch to SSB while retaining the carrier, thus preserving space in the already overcrowded bands. The broadcasters themselves don't like the idea for a variety of reasons (mostly economic), but SSB on SW broadcasts seems to only be a matter of time.

Recognizing the growing interest in SWLing (and scores of letters from 73 readers wondering what's available nowadays in general coverage communications receivers), we begin this month a series of reviews intended to cover the major gear available. Our premise is that many amateurs are now considering a reasonably priced general coverage receiver, not only for SWLing, but as a standby for their station receivers. There are several ways you can use a standby – for spotting on other bands during a contest, for example, or with VHF-UHF converters to keep your HF station separate, and so on. On top of the amateur uses, there is, of course, the benefit of SWLing itself.

SWLing can be much more than listening to foreign broadcast outlets – there are thousands of point-to-point communications to intercept, ranging from aircraft control circuits to foreign embassies communicating with home. A book is even available on "secret" frequencies, called the Confidential Frequency List, *by Robert Grove and published by Gilfer Associates, Park Ridge NJ. Everything from foreign embassies to CIA frequencies (those registered with the ITU) is listed in 34 different sections.*

Microprocessor hobbyists are into SWLing as well, using their uPs for deciphering high speed RTTY broadcasts. (Several articles on the subject are coming up in future issues of 73.)

There is much more, of course, to be said about SWLing, but hopefully we've whet your appetites with this brief introduction. So here's part one of 73's survey of general coverage SW receivers.

THE DRAKE SSR-1 COMMUNICATIONS RECEIVER

My first receiver (save the crystal set I built out of a science lab kit) was a GE nine transistor portable. It covered only 4 to 12 MHz (plus the AM broadcast band) without the benefit of much more than a volume and tuning control. My antenna was a bizarre concoction of wire scraps that eventually wound around the house, up into the attic, and out to a tomato plant stake in my mother's vegetable garden. With each new find of scrap wire, the random antenna grew in length.

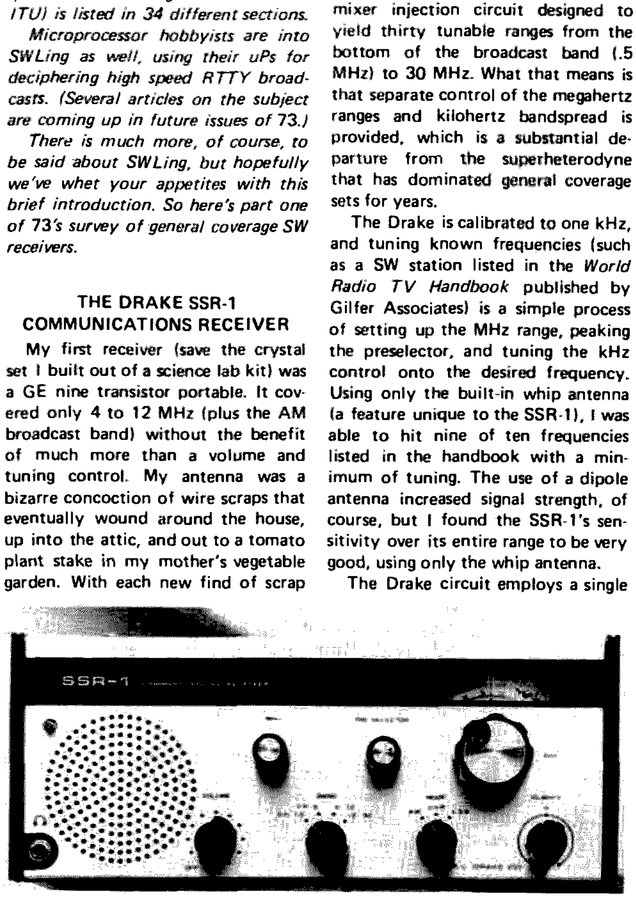
Fifteen years have passed, and a lot has happened with communications receivers. First of all, Dr. T. L. Wadley designed the so-called Wadley loop, first popularized in the British Racal line of receivers. The Wadley loop reached a worldwide audience through the South African manufacture of Barlow-Wadley receivers, and they were dominant among SW enthusiasts for decades.

More recent developments in PLL circuitry and the apparently booming interest in SWLing have brought a series of medium priced general coverage receivers, primarily from Japan. The Drake SSR-1 is imported by Drake from Japan and well represents the new generation in SW sets.

The Drake uses a synthesized first mixer injection circuit designed to yield thirty tunable ranges from the bottom of the broadcast band (.5 MHz) to 30 MHz. What that means is that separate control of the megahertz ranges and kilohertz bandspread is provided, which is a substantial departure from the superheterodyne that has dominated general coverage sets for years.

The Drake is calibrated to one kHz, and tuning known frequencies (such as a SW station listed in the *World Radio TV Handbook* published by Gilfer Associates) is a simple process of setting up the MHz range, peaking the preselector, and tuning the kHz control onto the desired frequency. Using only the built-in whip antenna (a feature unique to the SSR-1), I was able to hit nine of ten frequencies listed in the handbook with a minimum of tuning. The use of a dipole antenna increased signal strength, of course, but I found the SSR-1's sensitivity over its entire range to be very good, using only the whip antenna.

The Drake circuit employs a single



The Drake SSR-1 receiver, with a simple layout and 500 kHz through 30 MHz coverage.

10 MHz crystal oscillator, so unmodulated signals will appear at multiples of 1 MHz. Although this could be eliminated in circuit design, Drake says it would push the cost of the SSR-1 right out of its price class. Another side effect is small birdies, which are easily tuned out with the MHz control. Peaking a signal for maximum strength with the preselector, kilohertz, and megahertz controls will eliminate the birdies completely. They can, in fact, be used as a tuning aid, since eliminating the birdie peaks the receiver on frequency. In a month and a half of operation, I never found the birdies objectionable, and as for the 1 MHz unmodulated signals, they were very helpful as calibration markers. (Tuning WWV at 10 MHz, I found the SSR-1 within 100 Hertz.) One final point on this: Using other synthesized receivers in this price class shows that all of them have their share of birdies and 1 MHz markers. I never found them objectionable and they did not interfere with reception to a degree justifying the 2 or 3 hundred dollars more investment necessary to eliminate them.

The SSR-1 is completely solid state, with a built-in battery pack which requires 8 type D flashlight batteries. The dial lights are disabled when using the dc supply, which automatically switches on if ac is disconnected or interrupted. A push-button switch on the SSR-1's front panel is used to momentarily operate the panel lights when using dc power. Another feature is a 12 V dc power plug on the back apron which, when used with an accessory cable, allows use of the radio in an automobile or boat. Power consumption was measured at just under 100 mA at 12 V dc. The ac supply can be switched between 117 V and 240 V through a tapped transformer.

The Drake receives AM, CW, and SSB signals quite well, with good stability and audio response. The SSR-1 has separate detectors for AM and SSB, another feature unique to the Drake set. On AM it's a diode detector and 5.5 kHz filter, while on SSB-CW Drake uses a product detector and 3 kHz filter. Cross modulation noted on extremely loud signals was easily eliminated by switching in the 20 dB pad. Another feature exclusive in its class with the Drake is a ±3 kHz clarifier. The clarify control makes SSB and CW reception precise, since it acts as a fine tune control. In addition, heterodynes can be reduced in the AM mode with the clarifier.

I would not hesitate to recommend the SSR-1 as a standby receiver for CW and SSB reception in the ham shack. Muting provisions are included through an RCA type connector on the rear apron, and through a signal splitter, the SSR-1 served well as a spotting receiver during a recent DX contest. I've also used it with my standby transmitter for CW work with good results. I did find an audio filter (MFJ type CWF-2BX) very helpful in getting the passband down below the Drake's 3 kHz CW-SSB filter. The front panel 8 Ohm headphone jack came in handy there, plus I found the receiver had more than enough audio output to drive the outboard filter and headphones. (The SSR-1 is equipped with a front panel speaker.)

The Drake is the smallest general coverage receiver in its class — 13" wide by 11" deep by 5½" high. It weighs 14 pounds less the battery pack, and comes with accessory mounting feet to allow installation with the front panel sloped slightly upwards.

Among the accessories Drake offers for the SSR-1 are matching headphones model HS-1, dc power cord, and an antenna kit for the SWL bands. List price on the SSR-1 is $350, but company officials say dealers are discounting them down to the $279-299 price class. (Check with your local Drake dealer for details.)

In conclusion, the Drake SSR-1 is a compact, go-anywhere general coverage receiver with excellent stability, and sensitivity enough to receive signals from the broadcast band through 10 meters using only the supplied telescoping whip antenna. The SSR-1 allows precise tuning, directly from frequency tables, on the SW bands to within a few kHz. It is in an attractive, self-contained package that fits into ham shack, living room, or listening post and at the same time is capable of camping trips and vacations where ac mains are not available. *R. L. Drake Company, 540 Richard St., Miamisburg OH 45342.*

Warren Elly WA1GUD
Associate Editor

HY-GAIN 3806 2 METER HAND-HELD FM TRANSCEIVER

The evolution of "portable" 2 meter equipment over the years has been amazing. Just a few short years ago, commercial surplus "boat anchors" were the rule. If nothing else, they did make for excellent traction by adding fifty pounds to the trunk. Times have changed. Even the diehards who insisted that they would never become involved are seen sporting the ultimate in amateur radio portability, the HT.

There are quite a few HTs on the market with a wide range of features over a wide range of prices. Initially, the arrival of a box here at *73* containing Hy-Gain's contribution to the HT field created little excitement. That changed, however, after a few minutes of using the new 3806 transceiver. The standard-looking blue external case hides an HT that is outstanding.

The 3806 measures 8½" by 3½" by 1¾" and could be a handful for a person with small hands. Its weight is surprising: only 2¼ pounds, complete with battery pack. The weight is kept down by the use of an ABS case that is highly resistant to damage and shock. At first glance, the case looks plain enough, but in the process of disassembling the unit, a few surprising features come to light. Hy-Gain Electronics makes a well-respected line of commercial radio equipment, and it's evident that they've included a few of the heavy-duty features in this part of their amateur line. The two parts of the external case are gasketed to preclude moisture getting inside and fouling up the works. The grill that covers the speaker and microphone is specially baffled to prevent water from getting in. Even the power pack is completely separated from the circuitry. Lifting it off reveals a sealed compartment, with two battery contacts the only evidence of its use. Admittedly, just about no one is going to use an HT under water. But most are exposed to a wide variety of climate, from rain to high humidity to salt spray.

The receiver section of the 3806 is much more than adequate. Hy-Gain claims less than 0.4 uV for 12 dB SINAD. I had no trouble backing up the claims and was able to have a QSO with another HT seven miles away while operating the 3806 inside my Volkswagen, with its horrendous ignition noise. Add to that the fact that hilly New Hampshire terrain and a noisy road were involved, and you have a perfect test for sensitivity. The 3806 came through with flying colors. The double conversion superheterodyne receiver with MOSFETs in the mixer and amplifier stages is superior to anything I've heard in a hand-held unit. The audio output power to the 2 inch speaker is ½ Watt and is more than adequate for just about any situation.

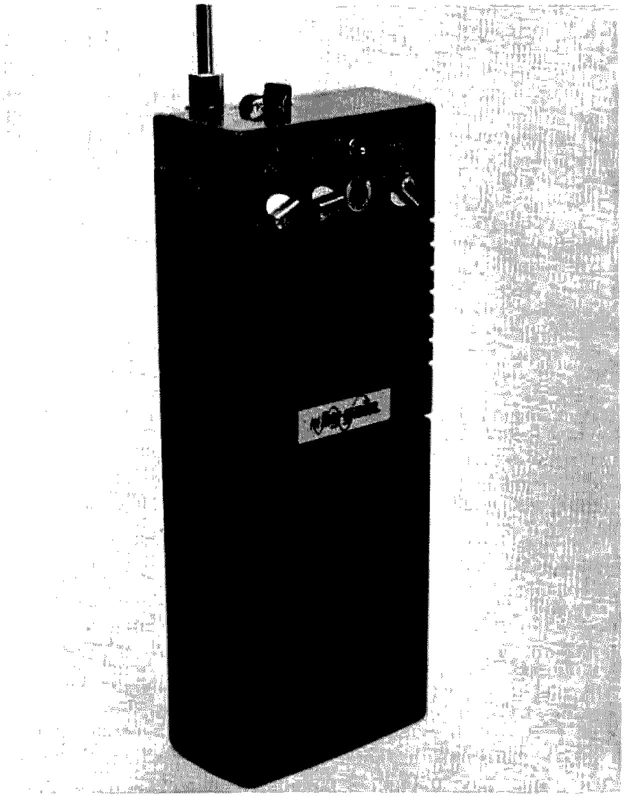
The transmitter section of the 3806 puts out a measured one Watt. Although that might seem low compared to a few other HTs on the market, it's more than enough for HT range. It also keeps the battery drain down. The unit only takes 380 mA on transmit. On squelched receive, drain is 20 mA; with signal, it's 100 mA. The battery pack takes 8 AA penlights or an optional nicad pack. The six channels (52 supplied) use standard 12 MHz crystals.

A few other features of the 3806 will appeal to the avid HT fan. All the controls are right out front. While transmitting, a large red LED stares at you, as an indication that a signal is really getting to the antenna. A meter indicates battery condition on transmit and relative signal strength on receive. A telescoping ¼ wave whip is supplied as standard equipment, although a rubber duckie is available as an optional accessory. More and more amateurs seem to be returning to the ¼ wave. The difference between it and the effective negative gain of a rubber duck is truly amazing.

Jacks for an earphone, external power, and external antenna are also supplied, each covered with a moistureproof plastic cover. The list of available accessories is long and includes a case, earphone, external antenna cable, cigarette lighter adapter, nicad pack, and a plug mount charger. At the time this went to press, Hy-Gain announced a tone pad that will fit flush into the back panel of the unit.

Suggested retail on the 3806 is $189.95, making it a moderately priced transceiver with features and performance that rival much more expensive units. It's built tough for outdoor use and should take the occasional abuse inherent in hand-held use in stride. *Hy-Gain Electronics Corporation, 8601 Northeast Highway Six, Lincoln NE 68505.*

Stan Miastkowski WA1UMV
Associate Editor



The Hy-Gain 3806 hand-held 2 meter transceiver. Note the heavy duty moisture-sealed case and the convenient position of the controls.

HEATH HW-2036 2 METER TRANSCEIVER

In just about every endeavor there seems to be a "people's machine" — be it a Model T, a Volkswagen, a "Benton Harbor lunchbox," or a small portable TV. Utility these days demands a television and for most folks, a car. For hams these days, utility means 2m VHF gear, and the prices are getting lower and lower.

Heathkit got started with, among other things, amateur radio kits. Heath earned its reputation with DX-40s, AT-1s, DX-100s, and the company's famous SB line of tube transmitters and receivers. On the VHF side, Heath started out with the "lunchboxes" for 6 and 2 meters, the "Sixer" and "Twoer" as they were known. With the advent of FM came the HW-202, a crystal-controlled radio known for its high audio quality. Heath's first synthesized 2m rig was introduced in 1975.

The HW-2026, as it was known, sold quickly, but problems developed, and Heath became the only manufacturer on record to stage a full refund recall. Every 2026 customer was offered a full refund, and first crack at the rig's successor. A year later the new radio was ready, and somehow Heath had managed to get the price even lower! Suggested retail for the HW-2036 is $269.95.

The 2036 has gained quick national acceptance, just like its predecessor, and there have been no reports of problems. The 2036 works fine.

When we first got a look at the new radio, it had already been assembled at the Heath factory. Operating impressions were reported in January '77 73, so it only seemed proper to follow up with a construction review.

Upon arrival of the kit, I tore into the box, anxious to begin construction. There is no wasted space in the shipping carton; sub-packs and chassis parts are interlocked with the rest to form a cushion, an effective one since all parts came through FB. Chassis parts were in the bottom of the carton; the microphone was in a separate pack, as were the five circuit boards. The Heath method of subpackaging makes parts sorting an uncomplicated procedure; you can bet it would have been pure joy counting and sorting some 1,241 parts contained in the HW-2036 kit. Heath only packs the hardware you need to build and install each individual circuit board or assembly. Especially fragile parts (like the 2036's signal strength/relative power meter) are packed in styrofoam-lined boxes to insure safe delivery. If you're like me and like to peek ahead a little and see what all the parts look like, you'll also find the 2 final transistors in the power amplifier pack, which supply a minimum output of 10 Watts to the antenna.

The assembly manual is typically Heath — very clear and concise. Each part is clearly identified, and another great help is the scales Heath has printed on the bottom of each page whose steps require a measurement.

Heath does not stop its design work with the production of new gear. Instead, a constant updating process takes place, with owners kept abreast of what's happening. In the case of the 2036, four pages of corrections are sent along, with substitute parts included. The builder merely changes a few values in the assembly instructions, and tapes new pages over the existing ones — then you're all set to begin work.

During assembly, I did not use any special method for parts sorting. Since each board package was opened one at a time, the parts could all be laid out on the work surface. I grouped all the common value capacitors together, the same resistors, and so on (no reason for the traditional cookie tins or pie pans!).

The first step in assembly of the 2036 is the installation of scores of printed circuit board pins (PCB pins) on each lead extending from the wiring harness. This is quite tedious work, especially when the majority of the pins must then be wrapped in heat-shrinkable tubing. Once installed, however, the pins make for simple interconnection of the PC boards during final assembly and testing. Heath supplies a small alligator clip to hold the PCB pins upright, so you can place the wire right into the end of the pin, then apply heat and solder. I found it much easier and faster to make sure the wire to be inserted was tinned first, followed by heating the pin and melting a small amount of solder into it. Using that procedure, it takes a very small time interval to place each wire in a pin, apply a small amount of heat, and make a perfect connection.

By the time the first six hours of assembly time had passed, the chassis was complete and mounted in place, and the front panel meter, switches, and pots were installed. At about this point, with the rig taking shape, the hours of concentration began to pay off. The front face and control knobs complete the first lion's share of construction, and from there on out the work is less mechanical. It's time for the PC boards.

The first circuit board to deal with is the smallest, the voltage controlled oscillator (VCO) board. The VCO's job is to produce signal to the synthesizer for frequency selection. Construction of the VCO assembly is crucial because this stage must be stable enough to keep the synthesizer on frequency. For this reason, the board is installed in a shielded case on the chassis, and is the only board without IC sockets.

Soldering work on the circuit boards must be done carefully. Take your time, and save hours of troubleshooting problems later. After each board is complete, examine your work carefully for solder bridges, cold joints, etc. After a careful visual check of each board (preferably using Heath's X-ray views from the assembly manual), installation is accomplished with lock washers and nuts.

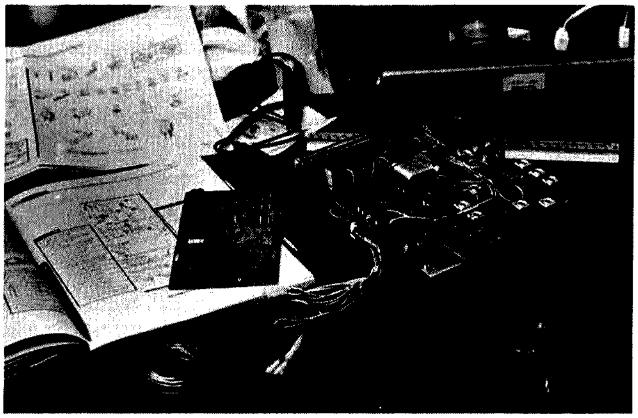
The next step is to plug all those beautiful PCB pins into the posts on each board. You'd never think you'd be glad to see another one of those pins after you finish soldering them all, but they really are fantastic. You should, however, be careful to route all wires from the harness in their correct positions, or you may find yourself taking apart half the radio to fix a minor mistake. Pay special attention to wires going around the speaker assembly and see to it they are routed straight back and *under* the VCO shield. This will make for easier hookup later between the synthesizer and receiver boards. Also be careful when installing the VCO board on its mounting posts. The six 1¼" wires that go to the coupling capacitors on the shield could very easily get pinched. Try to route them on a smooth path out from between the board and shield. One more point on the VCO board: Be sure the insulation of each lead is snug up to the board. Stray wires hanging around could short on the two-sided board.

see page 191

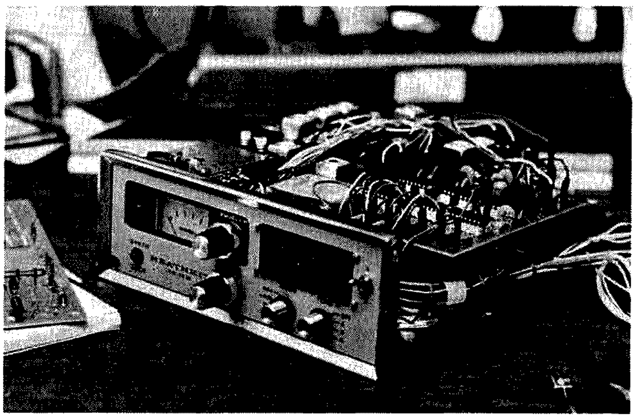
Space is limited in the rear portion of the 2036, where the power amplifier goes. The board is fastened to the back panel with screws, spacers, and the final transistors. Make sure you bend all the capacitors over towards the board when you install them, so when the time comes to put the whole unit together, you won't risk damaging them. Two heat sinks are mounted on the back panel after alignment, allowing for easy access to the PA during alignment.

Alignment requires only a VTVM and a receiver capable of copying WWV. I used a 1 Hz to 120 MHz frequency counter for maximum accuracy in setting the transmit and receiver offsets. All alignment cables, tools, and even a dummy load are included by Heath. The builder is instructed to build the dummy load out of two 100 Ohm 2 Watt resistors in parallel and a phone plug. (This assembly can be put aside after completing the kit to serve as a dummy load for future projects.)

The signal strength/relative power meter is used in alignment of the receiver, and also in peaking the transmitter and power amplifier boards. Later on, the transmitter board is used to provide a low level signal for peaking the receiver. Of course, if you owned a bench full of test equipment, alignment could be done with a signal generator, but Heath keeps the process pure and simple. The 13 pages of alignment took a total of 3 hours, making the total construction time 29 hours and 45 minutes from cracking



Past the halfway point in construction of the HW-2036. Note the Heath assembly manual and fold-outs.



Partial assembly of the HW-2036 from another view, with scores of PCB pins running off the wiring harness.

the box to making the first QSO.

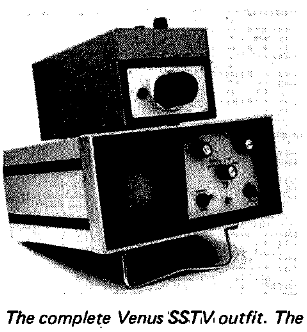
If there's one failing of the Heath 2036, it's the lack of dial lighting on the thumbwheel switches used for frequency selection. One solution would be to drill a mounting hole into the front panel, just over the switches. That may be less attractive than an outboard mount, to minimize damage to the radio, especially if the illumination solution is attempted after construction is complete. With the help of W1ZAW, we came up with an outboard solution requiring no drilling and no circuit modifications.

All you need is a one inch piece of polystyrene (color doesn't matter), a Sylvania type 12ES 12 V bulb, and some Eastman Kodak type 910 cement. If you want to use a 6 V bulb (Sylvania 6ES), we suggest a 47 Ohm ½ Watt resistor.

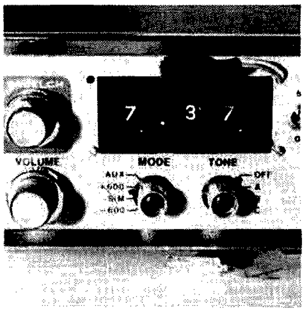
To install the dial light, remove the top and bottom covers per Heath's instructions. Then remove the upper right-hand mounting screw, washer, and bolt from the thumbwheel switch assembly. Using number 20 insulated wire, color keyed for B+ and ground, solder the leads onto the bulb as close to the base as possible. (Be careful to avoid shorts at this point.) Run the leads through the front panel (using the now empty switch assembly screw hole) and dress the wires across the top of the switch assembly case. Solder ground to the lugs on top of the VCO board case, and the B+ lead to the 12 V line running between the synthesizer lock and signal indicator LEDs. This completes the wiring.

To mount the dial light, first glue the polystyrene strip (centered) above the thumb switch assembly on the front panel. Be especially careful not to get any of the type 910 glue onto your fingers or hands – Eastman says surgery has been necessary in cases where people ended up gluing their fingers together! Next, glue the bulb (as shown in the photograph) onto the polystyrene, making sure that the bulb protrudes at least ½ inch beyond the front panel. Finally, tape (with electrical or mystic tape) over the top and front of the bulb to direct the light downwards towards the switches.

Heath did choose very bright markings for the calibrations on the thumbwheels, so it isn't necessary to get a great deal of light on them for illumination. Shoot for the least possible light necessary to prolong the life of the bulb. Another point to watch is that the bulb and its wiring leads are



The complete Venus SSTV outfit. The camera has a built-in slow scan bar generator; the monitor is available either as a kit or factory assembled.



Lighting mod, as described in the text, for the Heath HW-2036.

mounted far enough above the switches so as not to interfere with their operation.

Normally, Keene NH, being the valley it is, is not what you'd call an outstanding VHF location. But with the 2036 and a CushCraft Ringo Ranger antenna up 30 feet, I could work 04-64 in Waltham MA (just outside Boston) regularly. In my judgment, the receiver is quite hot, and certainly consistent with Heath's claim of .5 uV for 12 dB SINAD. A great addition to the rig is a sub-audible tone encoder which can be set up for three different tones for repeater access.

If you run across a problem with the synthesizer not locking when you bring the rig out into the cold car, try tweaking the synthesizer in a colder atmosphere. A fellow on the Maiden MA 19-79 machine suggested the above after his problems with the cold.

Three other stations running HW-2036s were contacted almost immediately after construction was finished. They all raved about the radio and had experienced no major problems in assembly. Performance of the HW-2036 over the last month and a half has been very consistent with what you'd expect on the basis of company specifications. And the fact that any problems down the road won't force me to send the rig back to the factory is a good feeling – since I built my rig, I'm not afraid to tear into it. How many of you can say that?

Paul Hebert WA1VJI
Keene NH

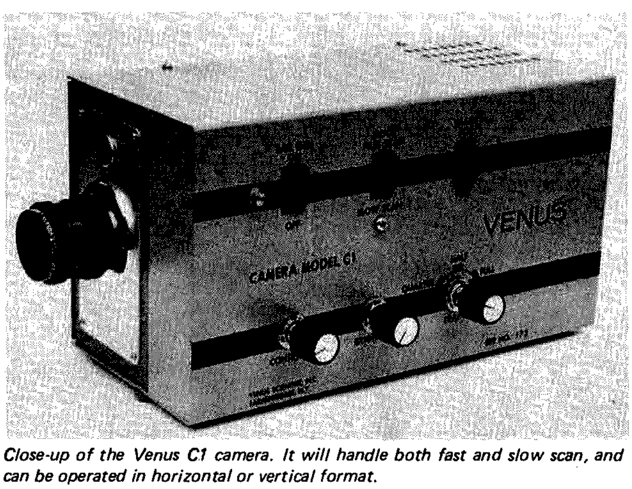
VENUS SCIENTIFIC INC. C1 CAMERA SLOW SCAN/ FAST SCAN AND SS2 SLOW SCAN TV MONITOR

Not being really involved with SSTV, I was hesitant to accept the assignment to test and review Venus Scientific's C1 Slow Scan/Fast Scan Camera and SS2 Slow Scan TV Monitor. In fact, up until that time, I was not very impressed with any of the slow scan systems I had seen.

I reluctantly carried the equipment home into the shack. I opened the boxes with all intentions of spending the remainder of the evening soldering wires and adjusting sync controls. As I opened the first carton, what appeared was a 4-3/4" x 10" x 5½" box with a lens on one end. It was the C1 Camera. Along the top were the slow scan controls (three knobs and three rocker switches). The knobs control the contrast, brightness, and framing. The rocker switches are for the bar generator, mode (fast or slow scan) selection, and positive/negative image. On the rear panel there was a six pin male Jones plug, a focus control, an output socket, a power switch, and an ac power cord. An accessory cable, video cable, and instruction manuals were included in the carton.

The other box contained the SS2 Slow Scan Monitor. The monitor measures 10-3/4" x 12" x 5". The front of the monitor, besides containing the screen, has five controls. These are for brightness, contrast, power off/receiver/tape/camera, accu sync/re-scan, and voice/video. The back panel contains sockets for inputs from a slow scan camera, a receiver, a tape deck, a microphone, and a telephone line. There are outputs for a tape deck, the transmitter microphone input, and 115 V ac. An accessory socket is also provided.

This brought me to the realization that I would not be in for a night of soldering. The accessory cable connects the 6 pin Jones plug on the camera to the accessory socket on the back of the monitor. I did this and plugged the units into my household current. I turned the monitor on first (as was specified in the instructions), and then the camera. I connected a cable from the rf output of the camera to the antenna terminals of my TV set, turned the set to channel 3 (this channel is preset at the factory, but any channel between 2 and 6 can be set), and pressed the button on the camera back which switches from video to rf output. Just like that, there was a blurry picture on the screen of the TV. I adjusted the focus and whammo! There was a fantastic picture. No soldering, no fooling with controls! It was a 15 minute process.



Close-up of the Venus C1 camera. It will handle both fast and slow scan, and can be operated in horizontal or vertical format.

The next step was slow scan, and this I "knew" would take some time. I rotated the camera 90 degrees, as is necessary when changing from fast to slow scan. This puts the slow scan controls on the top of the camera. I made sure the image was focused on fast scan, then I switched the rocker switch to slow scan. I rotated the frame control to full frame. Then came a very impressive procedure which is outlined in the instruction book. I set the mode switch on the monitor to "accu sync" and turned on the bar generator on the camera. I then rotated the contrast control on the camera fully clockwise and adjusted the brightness control so that the display on the monitor clipped equally on the top and bottom. I then adjusted the contrast control until there was little or no clipping. Then I turned the monitor back to operate, touched up the brightness and contrast on the monitor, and there it was! A perfectly adjusted clear slow scan picture forming right before my eyes. A five minute process from fast scan to slow scan!

I just couldn't believe it was that simple. Over the course of the evening, instead of soldering and syncing, I was having fun. I made tapes of various pictures and played them back. I let the kids put on their own TV show with the fast scan. I just couldn't wait for the weekend to try it out on 20 meters.

The weekend finally came and I was set. I had the TV equipment interfaced to my rig and was ready to go. First I just listened and copied signals. Perfect copy on clear signals I recorded and later reviewed. At last it was time for me to try my hand at sending pictures. I listened around 14.230 MHz until I picked up a station in Florida. After a brief explanation that this was my first SSTV QSO, I sent my first picture. The report was excellent and I was on my way. I spent the rest of the afternoon having fun again.

My one regret is that there is not very much ATV activity here in New Hampshire, but I am trying to stimulate some interest so I can use this camera on VHF.

In that one evening, my whole idea of amateur TV, be it slow or fast scan, changed. I learned you do not have to be a video technician to enjoy its rewards and, if you use the right equipment, the results are very impressive. It has made a believer out of me and I hope to enjoy many years at this facet of our hobby.

The Venus camera and monitor would be an excellent choice for anyone interested in amateur TV, be he a newcomer or old-timer. Maybe someday we'll have a QSO and you can copy my pix.

Venus C1 Slow Scan/Fast Scan

Camera $385; Venus SS2 Monitor Kit, $235; wired, $285. *Venus Scientific Inc., 399 Smith Street, Farmingdale NY 11735.*

Rich Force WB1ASL
Associate Editor

HUFCO DIGI-DIAL ADAPTOR

Hufco of Provo, Utah, has come up with a neat little device for hams who have a counter and would like to use it for transceiver direct frequency readout.

Known as the Digi-Dial Adaptor, this unit heterodynes the output from the transceiver variable frequency oscillator (VFO) with a variable crystal oscillator (VXO) frequency generated in the Digi-Dial Adaptor, to produce a 2.0 to 2.5 MHz frequency for the input of a digital frequency counter. The VFO must generate a frequency of 5.0 to 5.5 MHz. The actual readout of the frequency counter will depend upon the number of digital readouts available, but there must be enough to permit 2.000 to 2.500 MHz to appear, in order to be useful. The first digit (2) is ignored, and the reading 000 to 500 represents, directly in kHz, the frequency being received or transmitted for any amateur band, with some over-coverage. For instance, assuming the bandswitch was set for 14.0 MHz, the frequency will be understood as reading from 14.000 to 14.500, but will appear as 2.000 to 2.500.

The circuit of the Digi-Dial Adaptor accommodates either VFOs that compensate for upper and lower sideband shift (such as Heathkit), or those that do not.

Prior to purchasing the Digi-Dial Adaptor, I inquired of Hufco regarding whether or not the unit would operate with my particular transceiver — a Heathkit SB-101. A very prompt personal reply from Jim Huffman WA7SCB assured me that it would, and I placed an order. Within days I received a card telling me that shipment would be made in about a week, and sure enough, it arrived on schedule.

From the very start, I was pleased with the production of this kit. All parts, including the circuit board, were enclosed in one plastic pack, with the individual items of a similar nature grouped so that it was very easy to check.

The board is excellent — with a good commercial etch and outstanding plating characteristics, soldering is a breeze. Drilling is perfect, and the component side is screened for all component identities.

Important connection points are additionally identified on the etched side of the board. On the board I received, two transistors had the same board designation, but this created no problem because both transistors were of the same type.

Parts in the kit are of premium quality. Four similar encapsulated inductances are marked in microhenries in the standard color code, which makes any errors in the installation of these practically impossible.

The instructions accompanying the kit are very extensive and complete, considering the size of the kit. However, this is certainly not a detraction, because every one of the 16 pages is helpful, providing as it does, theory of operation, parts list, assembly instructions, tune-up, many diagrams, etc. One photograph, which has application only to anyone who is using the adaptor with one of Hufco's counters, has not reproduced well. The circuit diagram of the unit includes all information ever needed for servicing, such as exact normal voltages at every component operating point, all values, all designators, and all external connections.

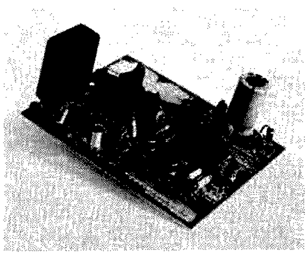
A problem became apparent with my adaptor at turn-on time. Troubleshooting the unit using the excellent schematic voltage references quickly identified an FET as the culprit. It is entirely possible that this was zapped during handling (even though this device is diode-protected), as the humidity at the time was around 10% and static charges easily accumulated, which only emphasizes the need for care in handling these devices.

A note to Hufco brought an immediate replacement in the next mail. Following installation of the new FET, no further problems were encountered, and, after putting the VXO on frequency, installation to the VFO was simple. Installation for each transceiver make is a little different, but the manual clearly describes hook-up for all currently popular transceivers. Power supply circuitry is part of the Digi-Dial board assembly, so that the only external requirements are 6.3 volts ac. Five volts dc may be used directly if desired.

About a month after receiving the kit, I was pleasantly surprised to receive a postcard from Hufco hoping that I had the kit working and offering help if I had any problems. A nice gesture.

For those looking for a unit that will perform as stated, the Hufco Digi-Dial seems to be the answer from all points of view. Priced at $39.95 for the kit, and $49.95 assembled, shipping charges paid, it is available from *Hufco, P. O. Box 357, Provo, Utah 84601.*

A. A. Wicks W6SWZ
Agoura CA



Hufco's Digi-Dial Adaptor.

COMMUNICATIONS ELECTRONICS INTRODUCES THE BEARCAT 210

Communications Electronics has introduced its new 5 band, push-button, programmable, crystal-less super synthesized scanner. Named the Bearcat 210, this unique scanning instrument gives the user push-button access to more than 16,000 different frequencies including 2 meters and the entire 3/4 meter amateur band.

The Communications Electronics Bearcat 210 is literally packed with exclusive space age electronic advancements and features. Completely synthesized circuitry, including Bearcat custom designed integrated circuits, makes possible lower cost and higher reliability.

The user never needs to worry about buying crystals. The synthesizer circuitry permits one to enter or change any ten frequencies in a matter of seconds. The unit will then scan those frequencies at a rate of 20 channels per second. A large digital input and readout display allows the operator to *see* the frequencies he has selected, as well as the frequencies currently being broadcast. Rolling zeros on the large LED display, a Bearcat exclusive, also indicate channels being scanned.

The *search* feature on the Bearcat 210 is fantastic! With this feature, you can locate and identify the frequencies that are currently in use by reading the frequency directly from the seven segment LED readout. This makes this scanner ideal for discovering those "hidden" or nonpublished frequencies.

In addition to an automatic frequency search feature which allows the operator to listen to *selected* segments of the different frequency bands, there is a selectable two second scan delay that permits the listener to hear all the excitement and prevent missing transmissions when "calls" and "answers" are on the same frequency. A push-button lockout feature allows selective skipping of those channels not of current interest. Other features include 117 V ac or 13.8 V dc, a large front speaker with 2 Watts rms output, slope front for easy programming and vehicular use, patented track tuning, tone bypass, and many of the traditional features that have made Bearcat scanners the most sophisticated ones at Communications Electronics. The Bearcat 210 covers 32-50 MHz, 146-174 MHz, and 416-512 MHz, with a sensitivity of 0.6 uV for 12 dB SINAD on low and high bands.

The Communications Electronics Bearcat 210 is mail order priced at $319.95, and CE still offers their unique "guaranteed lowest price" sales policy. You can place a telephone order on their toll free USA 24 hour order line 800-521-4414 and charge it to a BankAmericard or Mastercharge. In Michigan and outside the USA dial 313-994-4441. To order by mail, or for a free catalog including a four page full color brochure describing the Bearcat 210 as well as CE's other electronic products, write: *Communications Electronics, P.O. Box 1002, Dept. RS-3, Ann Arbor, Michigan 48106 USA.*

The Bearcat 210 programmable scanner.

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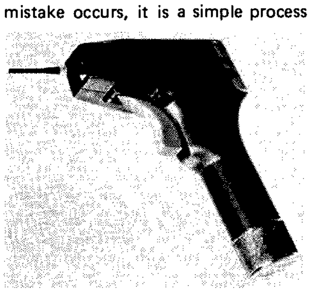
OK MACHINE AND TOOL CORPORATION'S HOBBY-WRAP TOOL

If you have ever built a microprocessor kit, or any other complex digital device, you know soldering is not the ideal way to make hundreds of interconnections. The technique of "wire-wrapping" allows easy circuit construction, and when the inevitable mistake occurs, it is a simple process



The OK Machine and Tool Corporation Hobby-Wrap Tool.

to disconnect and rewire the offending connection. A special wire-wrap tool is required to correctly and securely "attach" the wire to IC sockets. These tools range from simple hand-operated devices that are useful for very small jobs all the way to bulky ac-operated devices with the associated power cord.

The best approach to wire-wrapping is the Hobby-Wrap Tool, manufactured by the OK Machine and Tool Corporation. This wrapping tool is motor driven for ease of use, yet is battery operated, eliminating the trailing power cord. The device is powered by two size "C" cells, and weighs only 11 ounces. The wire bit accepts standard 30 AWG wire for .025 inch square DIP stakes. The bit produces the "modified" wrap, which wraps a two turn layer of insulation around the stake for complete mechanical security. I used the tool to wrap a CPU board and found it a pleasure to use. Each wrap was uniform, and the battery-powered motor allowed complete flexibility when maneuvering into tight corners on the board. The battery lasted for the entire session. The best feature of the rugged Hobby-Wrap Tool, however, is the price. The device is available for $34.95, which puts professional wire-wrapping within the means of every serious hobbyist. *OK Machine and Tool Corporation, 3455 Conner St., Bronx NY 10475.*

John W. Molnar WB2ZCF
Executive Editor

NEW HAMTRONICS CATALOG

A PA/preamp unit for 2 meter walkie-talkies, 6 new test probe kits, and a VHF FM receiver kit model are featured in the new Hamtronics catalog. The 24 page edition contains a wealth of gear, including UHF FM receiver and transmitter kits, scanner adapters, multichannel adapters, and a vast array of ac power supplies. To receive your copy, write Hamtronics, Inc., 182 Belmont Road, Rochester NY 14612. It's yours for an SASE.

SOLDERLESS, CABLE-MOUNTED FEMALE UHF SERIES CONNECTOR

A new "In-Line" SO-239 type connector for both OEM and field application use has been introduced by Gold Line, the nation's largest manufacturer of CB accessories.

A Gold Line spokesman said that the units are available for RG-58/U type cable in both bulk for OEM use and single packaged for the distributors' shelves. The No. 72 series connector eliminates the need for double female splice connectors (PL-258) when additional cable lengths are required. A unique crimping of the center conductor is featured with manual or production ferrules available along with production tools. The model 72-F designates a completely solderless, field-assemblable unit intended for sale through the Gold Line national distributor system. Gold Line designs and produces a complete line of accessories for the CB, ham and marine radio markets. *Gold Line Connector, Inc., P.O. Box 893, East Norwalk CT 06855, (203) 853-1211.*

BRAMMALL BARRELS

Various locking devices are available to prevent the ripping-off of your transceiver, stereo, etc. But as someone has said, "A lock only keeps out an honest man" — and this applies to any of these devices when confronted by a determined thief who has plenty of time.

Now there is a lock available which probably makes the rip-off about as tough as possible for any thief. Designed originally for CB transceivers, it may be used equally as well for any bracket-mounted amateur transceiver, stereo radio, or cartridge/cassette player.

Incidentally, most insurance companies will insure a mobile radio which is *locked* in, without applying the additional premium for "CB/8 track."

Several unique design features have been included in this rather simple locking device, known as the Brammall Barrels. As shown in the photograph, a tapered cylinder fits over the hole for each of two of the mounting screws, which are replaced. After tightening the screws, the barrel lock including key is inserted in each of the cylinders, and, once the key is removed, the lock barrels prevent access to the screws on each side of the mounting bracket.

The purpose of the tapered barrel is to prevent a thief from breaking off the barrels with a pipe — a frequent method of stealing a unit with non-tapered similar locks. The manufacturer claims a unique preventative to another act of thievery whereby the chief inserts a screwdriver in the key slot and works the barrel off. Because Brammall Barrels cylinders spin freely once installed, the barrels cannot be twisted off. Each key is individually keyed to the lock with which it is supplied, thus making the possibility of duplicate keys from the manufacturer almost non-existent.

At $9.95 a set, the Brammall Barrels provide about the least costly form of theft insurance available today. They are available in most CB, amateur, and hi-fi outlets. Manufactured by *Brammall, Inc., Box 208, Angola, Indiana 46703.*

A. A. Wicks W6SWZ
Agoura CA

1977 AMATEUR RADIO EQUIPMENT DIRECTORY

The most complete buyer's guide ever on amateur radio equipment has been published by Kengore Corporation. Over 130 pages and 70 different manufacturer/distributor listings are included, along with one element traditionally missing from product ads — list prices. Recent letters to the editor would indicate some frustration with the lack of prices in manufacturers' ads, and the '77 equipment directory is bound to go a long way towards plugging the information gap. Not only are prices included, but each product is well illustrated with a photograph and the most complete listing of specifications possible. Many of the pages will be familiar to readers of *73*, since the publisher used a large number of ads and manufacturers' brochures that have appeared in the various magazines. In all cases, Kengore has added the prices and, where necessary, additional information that may have been missing from the original. The *1977 Amateur Radio Equipment Directory* sells for $2.95 and will undoubtedly be in demand among hams and would-be hams, whether their interest is horse trading, buying, or just drooling over what gear they'd like to have. (The directory may not be too popular among wives, parents, or others concerned about amateurs spending money.) The directory is available from *Kengore Corp., W2TGH Editor/Publisher, 9 James Avenue, Kendall Park NJ 08824.*

O.K. TOOL'S SPEED-WRAP TOOL

The new G200/R3278 Speed-Wrap Tool is designed to produce solderless wire-wrapped connections by merely squeezing the trigger. The hardened steel working parts ensure long life and troublefree service. It is enclosed in Lexan (Trademark of General Electric Company) housing, enabling the tool to be light in weight, and is designed for production line and field service use in the electronic, telecommunications, and appliance industries. For 22-30 AWG.

Wire-wrapping provides a positive, uniform, "gas-tight" connection. *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

RF TRANSFORMER MATCHES VERTICAL ANTENNAS

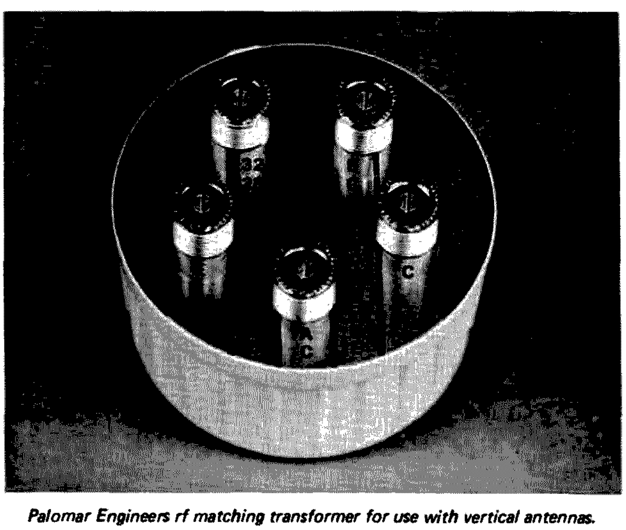
Palomar Engineers has introduced a wideband rf transformer rated at 5 kW PEP (2 kW CW CCS) from 1-30 MHz. Taps are provided to match 50 Ohm coaxial cable to 32, 28, 22, 18, 12, 8, or 5 Ohm antennas. The transformer is unbalanced-to-unbalanced for use with short vertical and whip antennas.

Quarter wave antennas or short verticals that have been resonated with loading coils can be matched to 50 Ohm coaxial cable by selecting the proper tap on the rf transformer. In many cases, the transformer can be used instead of an antenna tuner. It is much smaller than a tuner of equivalent power handling capability, is less expensive, and is more efficient. It has particular application to phased vertical directional array.

The transformer is wound with teflon insulated wire on an rf ferrite toroid core, has UHF (SO-239) connectors, and is epoxy encapsulated in a white PVC case so that it can be used in any climate. Loss through the transformer is less than 0.1 dB. Size is 3½" diameter and 2½" high. Price is $42.50 postpaid in U.S. and Canada. For additional information, write to *Palomar Engineers, P.O. Box 455, Escondido CA 92025.*

Gold Line Model No. 72-F.

Gold Line Model No. 72.



Palomar Engineers rf matching transformer for use with vertical antennas.

Ham Help

This is a plea on behalf of blind hams, at least in this area. I teach ham radio at the local Braille Institute, and the blind hams I know need an audio meter for tuning transmitters. Despite about a dozen contacts on the air with hams who know just what is needed, I have yet to receive further information.

Even though I feel I have little time for building projects, the one article I have been able to find in ham magazines contained junk box parts that no electronic supplier could identify or provide a replacement for. A commercial source is the most desirable; however, a simple schematic composed of obtainable parts certainly would be acceptable.

Any help will be greatly appreciated.

Searle L. Bennett
2656 Riverside Drive
Costa Mesa CA 92627

You have recently published a number of circuits for programming the number 8223 PROM, manufactured by Signetics. Unfortunately, Signetics has discontinued the 8223 and replaced it with the 82S23. If an effort is made to program the 82S23, using the circuits designed for the 8223, nothing will happen. The links just won't blow out.

The *Signetics Bi-Polar Memory Book* gives a schematic for programming the 82S23, but it is an extremely complicated pulse generator, using all kinds of hard-to-get ICs.

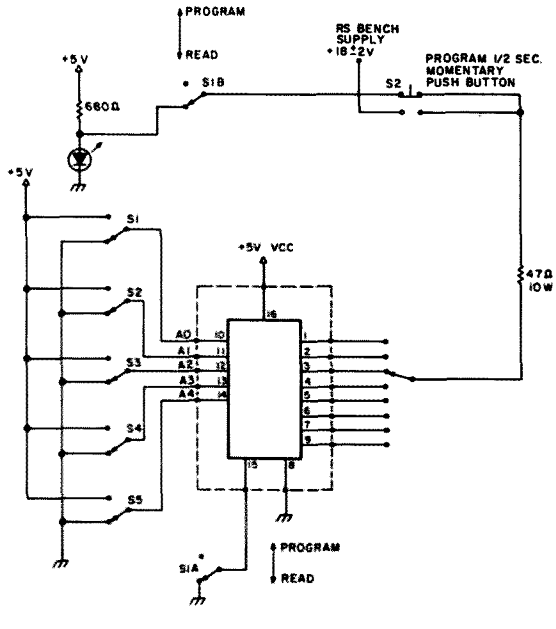
I have experimented, and I have found the simple circuit enclosed to be effective in programming the 82S23. The same circuit — which is based on a design put out by Southwest Technical with some of their kits — can also be used to program the DM8577 and 74188 PROMs. When programming DM8577 PROMs, the circuit will change logic ones to zeroes. When programming 82S23s, the circuit will change zeroes to ones.

There is nothing special about the power supplies. The 18 volts can be derived from a variable bench supply or from three lantern batteries connected in series.

To use the circuit, you set the address switches to the word to be programmed. You then throw SI to the program position and set S3 to the bit to be programmed. Momentarily (less then ½ second) push S2. Then return SI to the "read" position and observe the LED to verify that the bit has been programmed to a one or a zero, as the case may be.

Because this is not a factory-recommended circuit for the 82S23, I can't guarantee that it won't harm the PROM. I can only say that I've tried it on 82S23s and DM8577s and have experienced no difficulties. Nevertheless, users should work slowly to avoid excessive heat buildup, and push S2 only briefly.

Lauren A. Colby
Frederick MO



Do you know where I can obtain conversion information for the R-15 receiver?

Robert Eckard K3PFU
RFD 3 Box 162
Cogan Station PA 17728

I have run into a problem. I now have the Heath SB-301, SB-303, and the Heath SB-401 transmitter. What I would like to do is to use either the SB-303 receiver and the SB-401 transmitter together (transceive) on a Navy MARS frequency, or the Heath SB-301 receiver with the Heath SB-401 transmitter (transceive). As it stands now, the Heath equipment will only go as high as 4.00 MHz. The Navy MARS frequency on which I wish to operate is 4.045 MHz, so I need about 50 kHz outside of the 80 meter ham radio band. What I would like to know is If there have been any articles on using the SB-303 and SB-401 or the SB-301 and SB-401 on Navy MARS frequencies (outside of the amateur bands). If not, can you please give me some idea of how to go about changing the equipment to operate outside of the 80 meter amateur radio bands?

Everett C. Bollin WA3DVO
2543 Perring Manor Road
Baltimore MD 21234

First of all, I want to let you know I think your magazine is great. Just can't wait until the first issue of *Kilobaud* arrives. I already take *Byte*, so with the two magazines, plus the I/O articles in *73*, I should be able to digest enough info on computers. I'm still in the studying phase of computers; my Navy salary won't allow me to purchase one. I'll solve that problem about a year from now.

Also, I want to thank WA9VFG for his article in the Holiday issue. I do a lot of designing using ICs, and his method has really saved me some headaches on my latest project. Wish I had known of It earlier. (While on the subject of ICs, if anyone in the Jacksonville area needs help with digital logic, especially TTL, get in touch with me.)

I'm not a ham yet. I'm working on code now. Will attempt to get my General license in April when the next exams are given in Jacksonville. I already have my first class phone ticket, so I'm not anticipating any problems with the theory section.

Now for my appeal for help. I would like to correspond with anyone who is interested in the 1750 meter band (160-190 kHz). I'm really needing some antenna ideas. The FCC rules and regs on this band are few. Anyone wanting to know them, send me a SASE and I'll be happy to reply. I don't expect to be able to establish a reliable net on this band, but the experimentation should be fun. Any pioneer spirits left out there?

Jim Arner
Box 268
Fleet Electronics
Calibration Lab
U.S. Naval Station
Mayport FL 32228

I would like to get in touch with other amateurs using MTTY (Morse teletype decoders and keyboards) for possible net activity. Thank you.

Mike Stone WBØQCD
1110 East 4th St.
Durant IA 52747

Please inform the writer just how he can learn the Morse code! I have purchased records, tapes, and that cassette that the ARRL puts out with no results. I understand that a 9 year old can learn the code in a couple of weeks, but I'm 60 years old and have been at this for the last four months. I know the code, but I just can't receive it. I've signed up for a radio operating course at one of the colleges here in Milwaukee.

I've never had trouble with the different languages I've learned, so I'm beginning to think there is a gimmick or something ... Any information you may give me would be appreciated. I'm a subscriber to your mag and enjoy it very much!

Robert C. Norton
3162 So. Hanson Ave.
Milwaukee WI 53207

Try the 73 code courses, Bob. Thousands of delirious hams will attest to their value. — Ed.

I need information on the SSR-4 receiver that covers the 50-200 MHz range.

F.G. Senker K4OKD
436 Wallace Drive
Charleston SC 29412

This is the former RAE5/LU2AX, about to make a comeback as a W6 or K6. Coming close to my 74th birthday, the one who was "bitten" by the radio bug back in 1922 must go back to "pound the brass" (even if now the "brass" is a Ten-Tec RK-20A).

I am about to start trying for my American license. So I am thinking definitely in terms of equipment. To begin with I have gotten a Hallicrafters SR-150: yes, one of those "orphans." In reception it is working beautifully on the three indoor half-wave dipoles that I have set in the camera-room of "PHOTOG," my "studio" here in San Jose. BUT ... I haven't been able to secure a copy of the instruction manual for that transceiver.

I wonder if *73* can guide me to obtain one, either original or a photostatic copy. I am a bit lazy to start tracing each and every circuit and prefer to buy a manual.

By the way, here is an idea for a possible addition to your "line" of tapes for radio amateurs: How about a two-tone short one for tuning SSB transmitters?

An "old dog" in this matter of radio publications (I was first Technical Editor for Argentina's "REVISTA TELEGRAFICA"), I most certainly do appreciate your efforts to make *73* one of the best of its kind in the world. It is a real pleasure to see the work of a real "pro" and this last "Holiday 1976" edition is *TOPS*.

May 1977 be good to you and to your magazine. You most truly deserve the reputation already attained in "hamdom"!

Segundo P.I. Acuna
142 Graham Ave. #5
San Jose CA 95110

PS. I hope that your 14 and 21 wpm tapes will "unrust" my code to take me up to an "Extra" sometime soon.

I want some Ham Help on code. I would like to get with some lady, man, or boy who wants practice on code. I have been off the air 26 years — had a Novice, then a Technician license for over 20 years. I had a heart attack a few years ago and the license lapsed. Then in 1976, on April 6, I got another Novice license. Up to date, I have had one contact on 15m —

nobody answers my calls, and I know that my code is no worse than others that I hear call. I am 84 years old. I call every day, but no luck so far. I have been using a vertical antenna, but I am going to a long single wire antenna to see if that will make a difference. I think most hams are on the snobbish side, the way they have acted toward me. If I could get a contact further away from here, it would suit me fine. I'm hoping that you could recommend some ham who is having the same trouble as I have been having. Thanks for the trouble that I am making you. I will say that you have a great magazine.

Glenn N. Crawford WBØSLV
207 5 Ave. N.
Humboldt IA 50548

Last year about this time I bought the *Slow Scan Television Handbook* from the British ATV club. I decided to build the W7ABW/Ø plumbicon camera. After a great deal of trouble getting components and making the focus and scan coils, I did manage to make up all the circuits, make the chassis, and put it all together. However, the camera doesn't work.

I wonder if there are any mistakes in the schematics in the values of the components. As I do not have a thorough grounding in electronics, I wouldn't be able to spot any mistakes. It would also help greatly if I could obtain photos of oscilloscope traces for the alignment procedure, especially 50 MHz.

I would also like to know if the transistors are critical. I made the following substitutions: 2N718 for 2N1711, 2N722 for 2N2907, 2N3117 for 2N930, and 2N697 for 2N1711.

Any help that you could give me in getting this camera to work correctly would be greatly appreciated.

Paul Kaminski GM3PIB
5 Tytler St.
Forres, Murrayshire
England IV 36 ØEL

I've got a problem. I just purchased a 10-80m vertical antenna and I just don't have the room for all the radials needed to make the antenna resonate properly. I have to fit the antenna and all 10 radials (2 for each band) on a 28' x 52' roof.

I can't use any part of my backyard because it is divided up by three sets of overhead power lines and three telephone lines. The yard is only 30' x 30' anyway. My question is this: Can the radials be shortened physically somehow and still be electrically correct? The 80 and 40m radials are the real problems.

I think there are quite a few other city dweller hams who face the same problem I do.

Any help or suggestions from you or your readers would be appreciated by all of us. Thank you.

Ken Gustafson WB9ZPN
5149 W. State Rd.
Burbank IL 60459

I have, for a long while, been trying to get hold of a copy of your article concerning coaxial dipoles, which you published in June, '73, in *73 Magazine*. I have been unsuccessful thus far. I am therefore hereby trying to get it "straight" from the horse's mouth." I intended to build a 40m coaxial dipole and did try one, but I guess the calculations are incorrect, so I would be much obliged if you will help me out.

As far as W2DU's rude comment and article – forget it. I read it and since it is a whole lot of theorizing, I am yet to believe it until proved. Your idea that it works has been proved and therefore bears much merit.

Thanking you and looking forward to your reply.

Dennis P. Sladen VE3DPS
17 Glenshephard Dr.
Scarborough Ontario
Canada M1K4N2

As I am concerned with the increase of radio thefts, I am unsure of the proper, legal way to mark my equipment. The Privacy Act doesn't allow for the tracing of Social Security numbers as I understand. Instead, the idea of using driver's license numbers has been suggested. My driver's license (OKLA) number *is* my Social Security number. Legal advice I have received here overseas is undependable at best. HELP?

Dennis Miller WB5KEA/DA1DM
PSC Box 2858
APO NY 09057

I would appreciate a transistor circuit that would give sharp, strong, ringing pulses. I'm looking for a way to use my audio sine/square wave generator and oscilloscope to test inductances, measure resonant frequencies, and find values of capacitance in tank circuits.

John Peer
7183 Buckthorn Dr.
Orchard Lake MI 48033

I am looking for a design for a burglar alarm system. I would like to interface such a detection system to an automatic dialing unit connected to an ordinary cassette tape recorder.

Your help in advising me of any articles on how to build the above system will be greatly appreciated.

Robert E. Bunn WAØLKE
508 Porter Wagoner Blvd.
West Plains MO 65775

I am looking for information from your readers who have modified an IC-230 with Mu-rata CFS455E 15 pole filters, or equivalent filters.

John F. Meyer WB6OWP
4605 Esther St.
San Diego CA 92115

I have an HQ-110 receiver that is giving me a pain in the neck. Every time I switch the rig from "send" to "receive," it drifts all over the place. I checked all the tubes and replaced two bad ones. It stopped doing it on 160-20 meters, but still does it on 15-6 meters. Any ideas?

Tom Carnket WB9RXJ
605 7th Ave
Sterling IL 61081

Review

AN INTRODUCTION TO MICROCOMPUTERS
Volume II – Some Real Products
by Adam Osborne
and Associates $12.50

This is the second, and by far the largest (865 pages), of Mr. Osborne's four volumes on microcomputers. The first volume dealt with the basic concepts of computing in general and microcomputers in particular. The remaining two volumes are concerned with the application of two specific devices, the 8080 and the 6800, to system logic design.

Each chapter of this volume analyzes one of the currently available microprocessor/microcomputer devices. Virtually all the most popular microcomputers are covered and every type of architecture is discussed. There are 4-bit, 8-bit, and 16-bit machines, chip sets, single chip computers, and chip-slice devices. The 8080A, MC6800, Z80, and MCS6500 are dealt with in the greatest detail, but there is still a wealth of information presented for other systems. Many of the chapters are 60 to 80 pages long and the chapter on the 8080A, which is 176 pages long, would itself make a fair-sized book.

Like all of Mr. Osborne's books, this one is noteworthy for the thoroughness of the presentation and the immense amount of detail. The treatment of the 8080A is especially remarkable. The internal workings of the 8080A and of all the various accessory devices are explored down to the last trailing edge of the last waveform. Some of the information presented is simply a reprint of manufacturers' published literature, but much is original. The total result is a truly comprehensive analysis of 8080A microcomputer hardware and its workings.

Although the treatment of the 8080A is the most extensive, it differs from the other chapters only in degree. A typical discussion covers everything from the pin assignments on the chip to the intricacies of the timing for complex control tasks and data transfers. An instruction list is, of course, provided for each device with a symbolic description of the operation executed by each instruction. Insofar as is possible, this book tells everything about how a machine performs a given operation and the status of all lines, registers, and devices before, during, and after the operation.

However, this is essentially a hardware book and, as such, is not of equal value to every reader. For the professional digital engineer, whether his interest is his personal hobby or his on-the-job assignments, this should be an invaluable reference. For the computer hobbyist who is not a professional, the value of the book is less clear cut.

Mr. Osborne's preceding book, Volume I of the set, was a beginner's book, which assumed that the reader had little or no knowledge of digital technology. The presentation began with the basics of computers in general and worked up to the consideration of microcomputers in particular. Volume II is not really a continuation of Volume I except, perhaps, for the professional engineer looking to master microcomputers for his job. It is a reference book rather than a tutorial text, and it is a reference book for use on hardware design projects.

Many hobbyists are essentially programmers. Their basic machine was an assembled and operational computer when they obtained it. Their hardware involvement is the bare minimum necessary to expand their system with a new device or kit and they have no desire to expand that interest. They want to *use* the machine as it stands. In this case, there is little value to them in the detailed analysis of internal logic and timing.

The final decision naturally rests with the individual. Each reader knows the extent to which he is involved with, or wishes to be involved with, his microcomputer hardware. If there is any considerable involvement and if that hardware is one of the systems treated in this book, then Mr. Osborne's book should prove to be a valuable and frequently used reference. *Adam Osborne and Associates, P.O. Box 2036, Berkeley CA 94702.*

A. H. McDonough
El Segundo CA

MOS AND SPECIAL-PURPOSE BIPOLAR INTEGRATED CIRCUITS AND RF POWER TRANSISTOR CIRCUIT DESIGN
Texas Instruments
Electronics Series,
Published by
McGraw-Hill Book Company,
$16.50

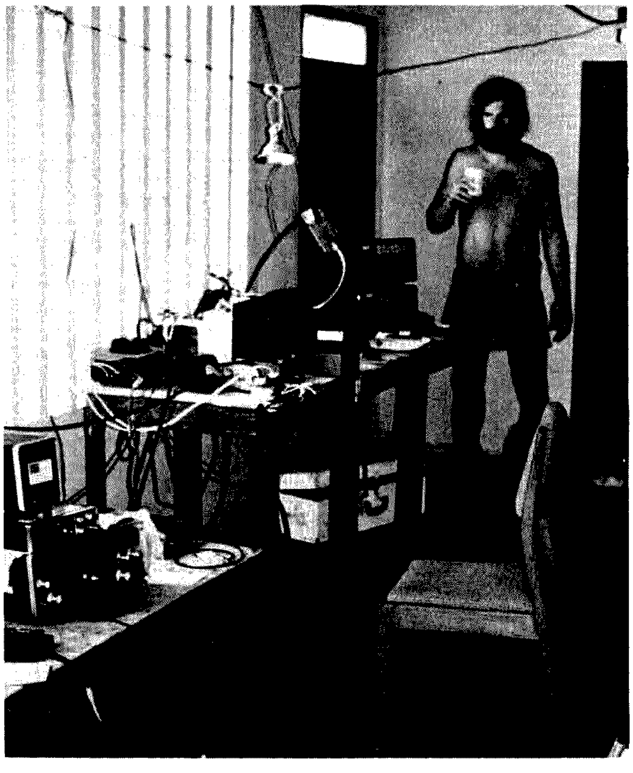
Designed a memory system for your micro lately? If so, you are aware of the timing problems, chip selection, and interfacing involved in such a project. Next time, refer to "MOS and Special-Purpose Bipolar Integrated Circuits and RF Power Transistor Circuit Design," by the Texas Instruments staff. This reference provides design information, examples, and applications using bipolar and MOS memory chips, as well as details relating to the interfacing of memory to the outside world, namely, your computer. Special purpose chips, such as keyboard character generators, are also discussed. The section on rf power may not interest the average home computer experimenter, but the book is nevertheless a useful acquisition.

John Molnar WB2ZCF
73 Magazine Staff

Shoot the Moon!

- - Pack Rat power

Walt Bohlman K3BPP
101 East Street
Doylestown PA 18901



The possibility of going to South America really seemed like a wild dream when toying with the idea in December, 1975. This is about the time this dream turned into a reality. With that reality came a long list of technical problems to solve. This article will describe how most of these problems were solved.

Having had W3CCX/3, the Pack Rat moonbounce station, in operation for about a year, the main technical group (W3HQT, W3HMU, and K3BPP) had a good feel of what a successful 432 moonbounce station required. These requirements are as follows:

Antenna: 26 dBi gain minimum, field repairable, easy to construct, sturdy, easy to rotate (azimuth, elevation, polarization).

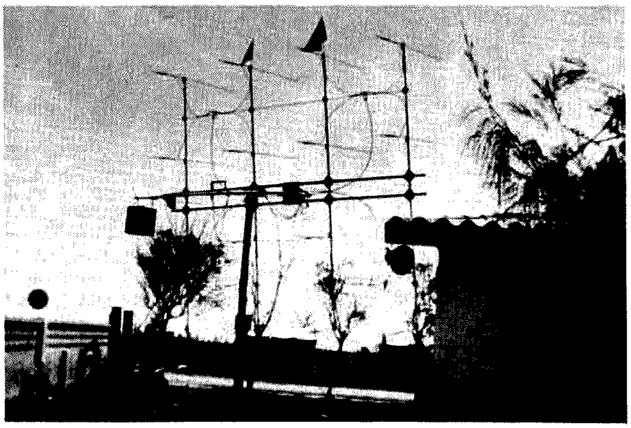
Transmitter: Straightforward design, 1 kW output without straining, stable, rugged.

Receiver: Spares, .5 kHz B.W., 1.3 dB noise figure at antenna, rf filter.

Antenna

After considering many possible approaches, the simplest and most conservative design was used. The antenna consisted of 16 K2RIW yagis fed in phase through adapter power dividers. At the TR relay (Transco-Y), the power divided equally into 4 50Ω outputs. The 4 ports each fed 10' lengths of ½" foam hard line, each of which terminated in a 4 way adapter power divider, each of which fed 4 yagis. Each yagi had an 8' length of RG214 running from its ½λ UT141 balun transformer to the power divider.

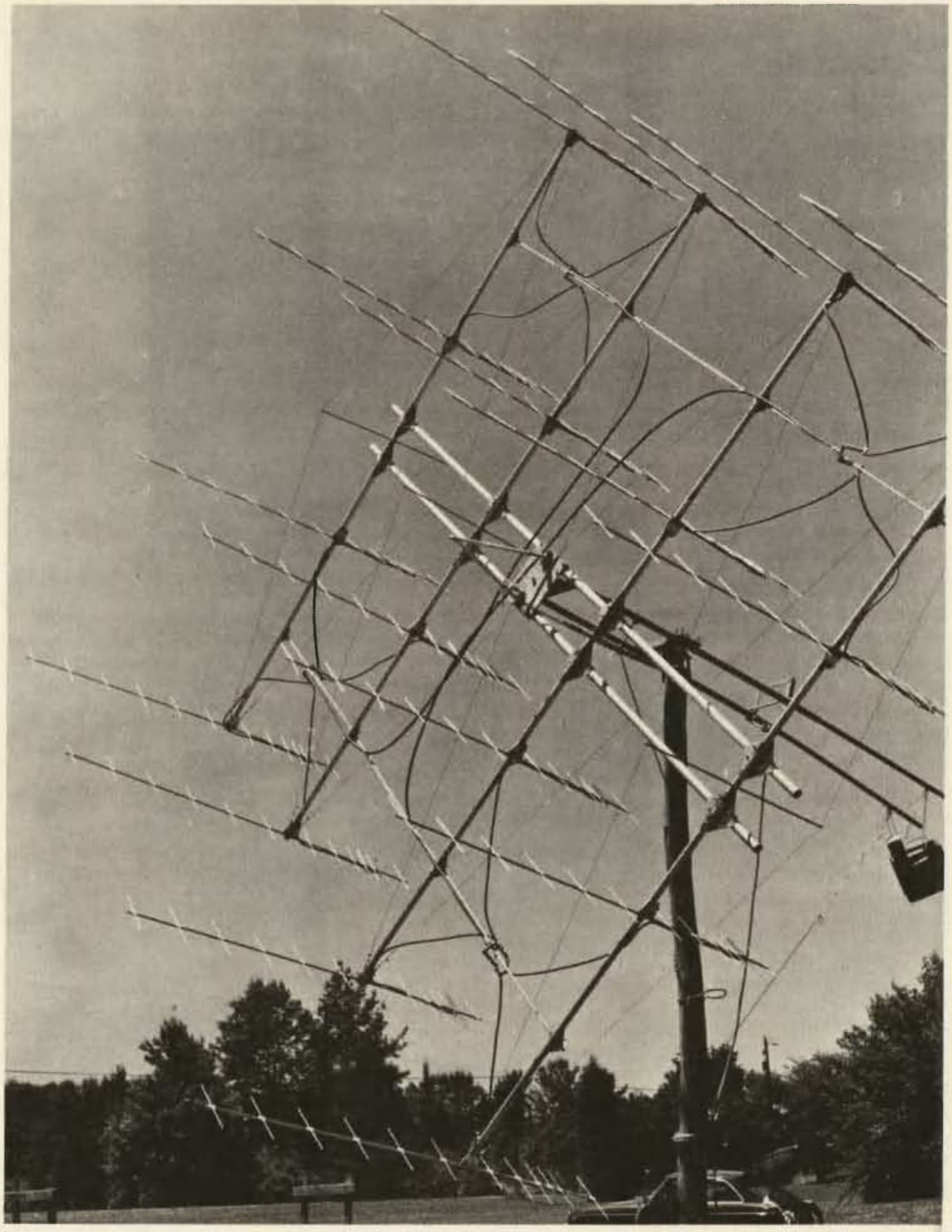
Each antenna boom split in the middle, allowing it to be packed in a small space. The 16 yagis were mounted on a double H frame made of



On location.

lengths no longer than 6'. The very careful design of this frame by W3HMU and W3HQT performed and packed quite well. The antenna spacing was optimized by K3BPP by the use of heuristic reasoning and a computer program to print out the resultant pattern. The ideal spacing worked out to 5' between antennas, thus giving a 15' x 15' array with a theoretical gain of about 29 dBi. Side by side comparison with the 20' dish gives ≈ 2 dB improvement over the dish, putting the realization gain in the proper area.

The mount was mainly the result of the cleverness of W3HQT. Very shortly into the program it was decided the polarization rotation was absolutely necessary. This was accomplished by a bearing plate extended 4' from the azimuth elevation mount. Also, since the moon would be quite high, the antenna had to point straight up (a favored position of dish owners), aligning the axis of the mounting pole with the antenna axis. This complete operation was accomplished with parallel water pipes that straddled the mounting pole in the straight up position. So, in total, the parallel pipes had the polarization bearing at one end, mount back 1/3, and a counterbalance (one of the shipping boxes) at the other end. Though a little difficult to pick the best yagi to use for boresight, the mount and antenna worked just great.



Testing in the U.S. Photo by Richard Boyle K3IGX.

Transmitter

The requirement was set for 1 kW output with no strain. This 1 kW starts to decrease rapidly when things are not just right (line voltage, exciter tuning, weak tubes, etc.). Upon evaluation of a portable transmitter generously loaned by K2UYH, it was decided to construct a new model around an 8938 grounded grid triode. This tube had performed very nicely at W3CCX/3. Having invested many hours trying to optimize the link coupled ¼ wave box cavity of the W3CCX amplifier, a new design was considered. The design was patterned after the successful K2RIW stripline kW. The amplifier was constructed and tested by W3HMU in approximately one month and worked superbly. The design consists of a ½λ triplate line with the tube at one end and a flapper tuning capacitor at the other end. Output coupling is also done with a flapper tuning capacitor at the tuning end of the line. The cathode line is quite similar in construction to the plate line. The amplifier puts out about 1200 Watts with 50 Watts of drive. The power supply is about the size and weight of a DX100. The exciter, also similar in size and weight to the power supply, consists of a conventional 220 MHz 10 Watt 6360 rig with a 4 x 150 doubler to 432. The doubler drives a conventional cylindrical coaxial cavity 4 x 250 amplifier which can put out up to 120 Watts. The exciter was designed so that the 4 x 250 amplifier could be used separately to amplify the Echo 70 for OSCAR 7 use. The exciter was self-contained with power supplies.

Receiver

Though only 40' of ½" foam hard line was used for the feedline, it was still necessary to mount the first preamp at the TR relay on the antenna. The main preamp consisted of an FMT4575 with about 1.3 dB noise fig-

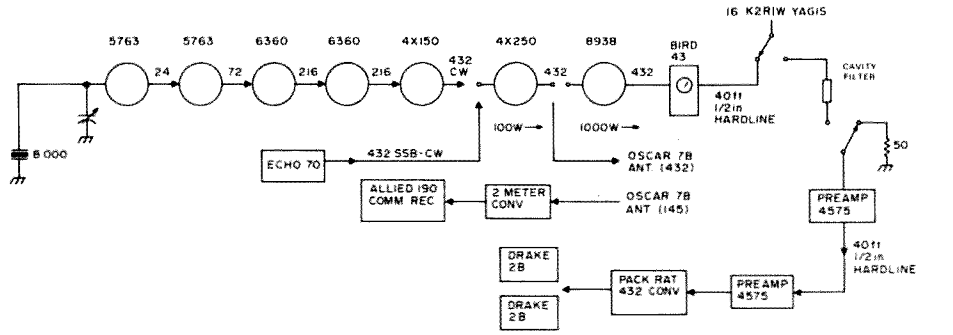


Fig. 1. Pack Rat EME OSCAR portable station, HK1TL.

ure. Between the antenna relay and the preamp, a 3" dia. λ/4 cavity filter was used. The required low loss of the filter necessitates making this a separate item and not a part of the converter.

At the end of the hard line, a 2 dB noise figure preamp was placed to override the loss of the connecting hard line. A Pack Rat converter was used into one of 2 Drake 2B receivers. One of the 2Bs was linearized and used in conjunction with a VOM for sun noise measurements. An audio line from the receiver ran directly to a cassette tape recorder for recording the history-making event. ■

Frustrating the Thieves

-- removable mobile mount

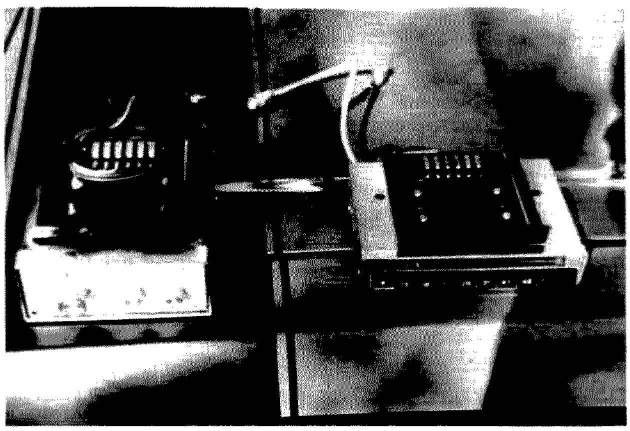
Stephen Wimmer WB0GGT
RFD 1
Lincoln NE 68502

Looking for a really easy way to mount my HR-2A in the car, I hit upon using slide mounts that are normally used for stereo tape players. For me this turned out to be a very good idea, as I am in the Navy and not at home that often. During tours in the Philippines and Italy, this setup has really worked. While I was away, my parents used my car, and since neither is licensed there was no reason to leave the rig in the car. Having had a shortwave converter in the car before I acquired the rig, I decided to make them interchangeable. That way my parents could use the SW converter when I was away.

To put the mount on my HR-2A, I had to remove the speaker. At first I used a speaker box mounted on the hump behind the gear shift lever. I doubled the hot lead and the ground lead to ensure that the rig was getting enough power. The antenna connection was left as a PL-259 since I had to use two of the connectors for the speaker leads. Later I purchased a cassette/radio, placed it in the hole for the old radio, and used the radio speaker in the dash for the rig. Ensuring that the tape player still worked, I moved it to my father's pickup. Since I was going to be driving for him for a while, I put a mount on the tape player and bought a gutter clip mount for an antenna. The mount in the truck is covered by a blank slide when not in use.

Now when I get home, all I have to do is dig the mike out of the attic, slide the rig in the car, and I'm ready to go. ■

The HR-2A in the car.



View showing slide mounts on the rig and SW converter.

Repeater Update

Compiled by Stan Miastkowski WA1UMV

ALABAMA

WR4AZG	Hueytown	147.15	
WR4AUT	Montgomery	146.91	

CALIFORNIA

WR6AAI	Verdugo	147.36	Private
WR6AAH	Disappointment	147.36	Private
WR6ABA	Mt. Baldy	147.81	147.21 IN
WR6ABC	L. A.	224.36	
WR6ABI	Long Beach	147.015	147.615
WR6ABR	L. A.	224.30	
WR6ABU	L. A.	147.06	Private
WR6ABW	L. A.	147.00	147.60 IN
WR6ACA	L. A.	146.70	RTTY
WR6ACD	Johnstone Pk	224.00	
WR6ACK	Santa Monica	224.82	Private
WR6ACT	Barstow	147.15	
WR6ACY	San Diego	147.39	Private
WR6ADO	Orange County	146.895	146.295
WR6AFI	Santa Barbara	223.96	
WR6AFJ	Palos Verdes	224.64	Private
WR6AFX	Barstow	146.76	
WR6AGP	L. A.	147.03	Private
WR6AGV	Mt. Wilson	147.765	147.165
WR6AHA	Palmdale	147.24	
WR6AHR	San Diego	147.675	147.075 IN
WR6AHX	Santa Ana	147.975	147.375 IN
WR6AID	San Diego	224.54	Autopatch
WR6AII	San Diego	146.73	
WR6AJN	Julian	147.195	147.795 IN
WR6AKK	Beverly Hills	147.36	
WR6AKU	Palos Verdes	224.28	
WR6AKX	Mt. Lukins	146.76	
WR6ALC	Johnstone Pk	224.72	
WR6ALH	Rosemead	146.175	146.775 IN
WR6ALZ	Redondo Beach	147.675	Private
WR6ANA	Mt. Palomar	224.92	Private
WR6ANK	Loop Cyn	224.40	Private
WR6ANY	L. A.	147.705	147.105 IN
WR6AOC	Santa Barbara	146.91	
WR6AOF	Hawthorne	146.115	146.715 IN
WR6AOQ	San Diego	146.70	RTTY
WR6AOX	Ventura	146.28	
WR6AOX	Ventura	224.02	
WR6AOY	Monterey Pk	224.44	
WR6APS	Mt. Wilson	224.08	Private
WR6AQE	San Diego	224.12	Private
WR6ASM	San Diego	147.885	147.285
WR6AUG	L. A.	224.84	Private
WR6AUT	South Orange	224.76	
WR6AUG	Malibu	224.32	Private
WR6AWQ	L. A.	224.52	Private
Repeater Testing Channel		224.6	223.00 IN

GEORGIA

WR4ASU	Riverdale	147.48	146.48 IN P

HAWAII

WR6AOD	Ala Moana	147.30	PL

ILLINOIS

WR9AFM	Gurnee	444.35	449.325 IN
WR9AAD	Bald Knob	146.85	
WR9AKB	Springfield	442.05	447.05 IN
WR9AGR	Springfield	146.64	
WR9AKT	Carbondale	146.73	

INDIANA

WR9AKK	Indianapolis	52.60	53.20 IN

IOWA

WRØAOI	Des Moines	146.67	
WRØAJC	Burlington	146.79	Autopatch
WRØAGC	Denison	146.88	

KANSAS

WRØAMW	Hutchinson	146.67	Autopatch

LOUISIANA

WR5ALD	Baton Rouge	146.79	VOX
WR5AOV	De Ridder	146.85	Autopatch
WR5AGO	New Orleans	146.82	
WR5AHT	Slidell	147.27	
WR5AHT	Slidell	224.66	223.06 IN
WR5AKM	Winnsboro	146.70	
WR5AMS	Thibodaux	147.30	
WR5AJO	New Roads	147.03	
WR5AJU	New Orleans	147.06	146.46 IN
WR5AJU	New Orleans	147.09	146.49 IN
WR5AQP	Abbeville	146.67	

MICHIGAN

WR8AJK	Battle Creek	52.64	52.76 IN

MISSOURI

WRØAHR	Kansas City	146.70	RTTY

NEW MEXICO

WR5ABG	Las Cruces	146.64	Autopatch
WR5ANO	Deming	146.82	
WR5ASE	Truth or Consequences	146.76	
WR5AML	Tucumcari	146.88	

NEW YORK

WR2AGS	Amagansett	147.03	TT
WR2AOC	Syracuse	147.90	147.30 IN
WR2ACV	Syracuse	147.93	147.33 IN RACES

NORTH DAKOTA

WRØAGR	Grand Forks	146.94	

OKLAHOMA

WR5ASI	Oklahoma City	146.70	RTTY

PENNSYLVANIA

WR3ACM	Altoona	146.61	
WR3ACE	Pine Grove	146.64	Private
WR3AHZ	Parkesburg	146.985	
WR3AIZ	Blue Knob Mt.	147.15	
WR3AIT	New Castle	147.195	Autopatch

TENNESSEE

WR4AZF	Short Mountain	146.91	

TEXAS

WR5AHA	El Paso	146.79	
WR5AJW	Beaumont	147.12	Autopatch
WR5AJW	Beaumont	52.525	53.12 IN
WR5AOK	Groves	29.60	29.64 IN
WR5AOK	Groves	52.64	53.64 IN
WR5AOK	Groves	146.82	
WR5AOK	Groves	444.0	449.0 IN

VIRGINIA

WR4ACW	Richmond	146.88	Private
WR4APC	Tysons Corner	147.21	Autopatch RTTY
WR4ATJ	Bristol	146.61	Autopatch
WR4APE	South Hill	147.24	

WASHINGTON

WR7AGS	Seattle	444.70	449.70 IN

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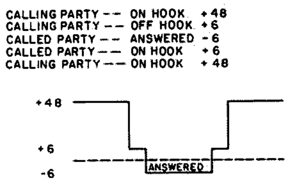

Fig. 1.

Automatic Autopatch Release

-- safer mobile operation for the troops

There's no denying the value of an autopatch on a reliable repeater. Whether it's for the "little" calls or the more important emergency calls, the autopatch is fun to operate.

All autopatches have a defined attach and release procedure. Some of them have a straightforward "easy" attach and release while others may have relatively complex access codes designed to limit use of the autopatch to "qualified" persons. The attach and release can be made as complex as desired. Generally, the release procedure is somewhat simple. If you want to streamline the use of your autopatch, you can make the release fully automatic.

To automate the release, a simple circuit is added that will generate a "disconnect" signal for the patch control logic when the called party hangs up (signaling the end of the telephone call). The circuit is based upon a fairly consistent characteristic of the phone line's polarity. The voltage across the phone line is typically 48 V when the handset is "on hook." When the handset is removed, the voltage drops to around 6 V. When the called party answers, the 6 V reverses polarity for the duration of the call. When the called party hangs up, the polarity returns to the pre-answered condition. This pattern of voltages and polarity transitions can be used to generate a patch release signal. The various levels and polarity conditions are summarized in Fig. 1.

The circuit shown in Fig. 2 is used to provide a contact closure when the called party has answered. This contact closure is then used to provide a path for charging a capacitor that in turn generates a negative pulse when the called party hangs up. Notice that there are two power supplies – a dedicated "floating" power supply for the polarity detector and the +12 V power supply for the system. The separate supply for the detector is an absolute necessity to avoid grounding one side of the phone line! A capacitor is connected across the relay coil to delay the relay pulses that may occur during the answering process. You may need to experiment with the capacitor's value to accommodate local conditions or a different relay than the one used in Fig. 2.

The output stage is simply a transistor switch that is biased on (output = .5 V). The capacitor is charged via the 1000 Ohm resistor during the answered period and then generates a short negative pulse on the base of the transistor when the called party hangs up. The negative pulse momentarily turns off the transistor causing a momentary positive pulse at the output. This pulse can be used to turn off the autopatch by simulating the normal manual turnoff character, pulse, signal, etc.

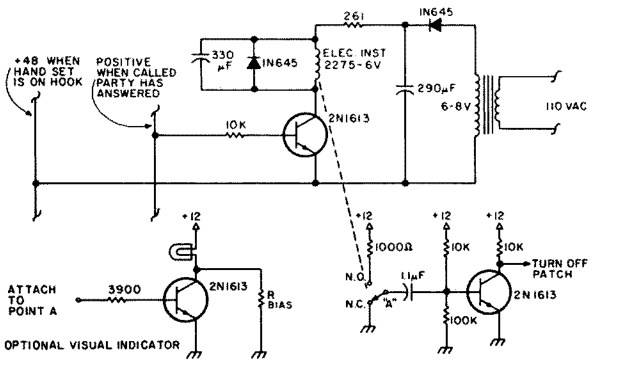

Fig. 2.

The optional visual indicator is simply a lamp driver that can be used to light a panel lamp when the called party has answered. If the repeater is already equipped with a group of status lamps, this additional lamp may be added to provide a little more operational and diagnostic information. Select the bias resistor so that the lamp filament is slightly lighted when the input to the base (Point "A") is grounded. Keeping the lamp warm will prolong the lamp's life and protect the transistor from current surges through the lamp's filament.

The polarity detector should be attached to the phone line on the "repeater side" of the relay that connects the phone line to the patch. This will eliminate any improper interaction with the phone line when the patch is not in use. Fig. 3 shows the appropriate interface. Check the phone line polarity with a voltmeter and attach the detector as illustrated in Fig. 2.

Why not add this little circuit to your autopatch? It makes using the patch a lot more convenient and saves having to reach for and dial a release command at the end of the call. The less you dial while driving, the safer you will be! ■

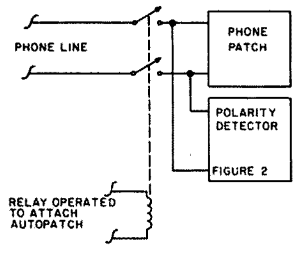

Fig. 3.

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Emergency 911 System

- - help for NYC

It was December 27, 1976, and Christmas gifts were still in sight in the Higgins' living room as Mike WB2EIL and Bill WA2RXQ were hurriedly rewinding a video recording of the evening news. NBC had just aired a three minute and 19 second special entitled "Helping Hams," when over the monitor of WR2ADP came WA2UTV, "Is there any control station on frequency?"

Almost before I could reply, WA2YYZ came on frequency followed by WA2JSJ, KTUAT, WA2VBJ, WA2ECI, WA2FUL, W2DME, WA2KHN, WA2HYT, and a continuous parade of well-wishers. Mike remarked that he had not heard the machine this active since 1975 when we loaned the station to the New York City Police Department for three days, following a five alarm fire in a main switching center of the New York Telephone Company. The station call then was WR2ABK, but it was the same group that was operating WR2ADP now. We reflected on how it all began and how grateful we were to the production crews at NBC, particularly to Stephanie Stern, who had worked so hard to produce the special news documentary about amateur radio.

News Center 4 began the show with Mary Merendini WA2CSM driving down a country road and talking to her harmonic, Lisa, about her day in school, when Lisa, dramatizing, remarked that she saw a burglar breaking into Mr. Jones's home. Mary, determining that the Joneses were away on vacation, proceeded to pull off the road and produce a Wilson HT with TT pad and, as the camera zoomed in over her shoulder, punched the digits 911. In response, a voice returned, "Police Department, where is the emergency?" Mary proceeded to report a burglary in progress. From there, the cameras took us to the repeater site and focused on the repeater cabinet and control circuit that Jim WA2ECP had designed and built. The cameras then took us to police headquarters where calls for emergencies are processed.

I got my chance before the camera and explained that the project implementation was delayed for more than 15 months due primarily to objections and conditions set down by the police department. I explained that it was the desire of the Radio Amateurs Repeater Association of Staten Island to assist the public and government in times of emergency, that while landslides and earthquakes get the most publicity, there are many such catastrophes in individual lives each day on a local level. Assisting with one of them is equally as important as giving aid to a foreign country.

The program ended by showing the awards the repeater group had received in the past: a letter from the FCC, an ARRL Public Service award, and a certificate of appreciation from the New York Police Department. A file film depicting the work we had done during the 1975 telephone company fire was also shown.

Due to the time limitations of television and, I suppose, the desire not to get technical with the viewing public, it was not possible to get into the why and how of our 911 system on television. However, for those of you who live in or visit New York City, here is how it works. The repeater is capable of autopatch and reverse autopatch but, as you already know, the prefix codes to activate dial tone are reserved for active members' use. It seemed to me that to have more than $2,500 worth of equipment idle, when someone had an emergency but could not raise an operator with the autopatch codes, was not good business. My first approach was to request permission from the police department to install amateur equipment at headquarters on 147.911 MHz. The equipment I suggested could be manned by police officers who hold ham tickets. The idea was turned down about four months after my first letter was sent. The police requested that all calls for emergency aid be directed through their 911 telephone system.

It seemed to me that the police did not care or want to cooperate. Some months later, while cleaning up some paperwork, I came upon that same letter. This time the words "directed through their 911 system" had a new meaning for me. I called Jim Passione WA2ECP who had built most of our control circuitry and asked him if he could modify the circuit so that unknown hams and transients could access the 911 police emergency number without knowing the dial tone access code.

The system we came up with is so simple that I am almost embarrassed to tell you how long it took to devise; anyway, here goes. A station comes on frequency (147.915) and signals 911 on a TT pad (no need to bring up dial tone). The decoder receives it and closes a relay which energizes an eight track tape recorder. Track A reports back to the caller, "Please stand by. Your call for emergency assistance is being automatically processed." Track B, simultaneously, is redialing the New York City Police emergency number 911 on an open telephone line and informing the police to stand by: "A call for emergency assistance is being automatically relayed via amateur radio station WR2ADP." Approximately 15 seconds down the line, the caller and the police are patched together. They are permitted 100 seconds of conversation and then are

automatically disconnected. There is a 30 second warning prior to disconnection which states that, "If more time is required, signal 911 again."

The repeater has been programmed to rebroadcast the US weather in order that interested parties may test their equipment: *41 activates weather and *47 disconnects. This function should discourage anonymous operators from embarrassing the amateur fraternity by falsely signaling 911 without reporting a bona fide emergency.

The police department requests that all callers, except those located in Staten Island, state the borough from which they are calling. Since the repeater is using a Staten Island trunk, all calls processed through the repeater appear on the Staten Island dispatcher's desk. They can be routed to other boroughs through the police computer switching system if they are properly identified.

Bill Higgins WA2RXQ, trustee of WR2ADP, demonstrates the "emergency autodial" to officer Andy Merendini WB2EIR. Andy now carries two HTs when on duty.

All hams are welcome and are invited to use the 911 feature in the event they encounter a situation that they believe requires police attention. I sincerely hope that calls for minor disturbances are avoided in order that the network not be overloaded both at the repeater and at an already overworked communications bureau. ■

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The Downspout Vertical

-- a great 15m antenna for soda pop drinkers

Just imagine going from 21.000 to 21.450 and not having to touch the loading controls, after an initial tune-up on about 21.220! I built this one in the middle 50's, right after I received my General Class, so most of this is from memory. My reference was an article in a 1954 *QST*, "Beer Can Vertical," which was for 40 meters.

Description

I used 11 feet of rain gutter downspouting for the vertical element. Since downspouts don't come in such odd lengths, I had to use an extra piece of sheet metal wrapped around the top section to make up the difference. This was attached with sheet metal screws.

The vertical element was insulated from ground by a quart soda pop bottle. This bottle was first placed about halfway into the ground to stabilize it.

The vertical was guyed from the top with nonmetallic clothesline. At the base I used a 6 foot ground rod, and the transmission line was a long length of RG-58. I realize now that two improvements would be: several 12 foot radials and feeding the whole thing with RG-8.

Operation

My rig was a Johnson Adventurer (50 Watts input to an 807) with a wi-i-i-de range pi-network output tank (no tuner needed). This rig loaded up just fine to this vertical. I don't know what the swr was, because I didn't have an swr bridge. In fact, I don't think *anyone* did in those days, except the ARRL's laboratory! With today's "modern" 50 Ohm output transmitters, you probably will have to resort to feedline trimming or use an unbalanced tuner to get a match.

I was able to work "all over" Europe and Africa and into Asia, and I have QSLs to prove it! ■

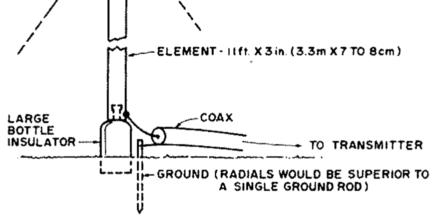

Fig. 1. Ultra-wide bandwidth 15 meter vertical.

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Wallace CA 95254

RTTY? What's That?

- - how to get started with teletype

After doing some years of customary operating, I thought it would be fun to operate with a teleprinter – encouraged by another amateur donating a teleprinter and a lot of advice. Thinking that it would be fun to get involved with something new, I accepted; since then I have learned a lot of good information about how machines operate, how to fix them and the like.

There is a lot of information available about different printer models and basic information on how they work, along with basic operating techniques. Rather than repeat or summarize that information, this article will give a couple practical ideas to the person wanting to get started.

You really only need two things to get started – a printer and a converter (the converter both receives and generates the teleprinter tones). Rather than fussing with one of these "beginner" units, which are really not very satisfactory in operation, I thought I would start the right way the first time. There really is not a great deal of general information readily available, so one must pretty much rely on advice from others. Looking at prices and specifications, I elected to purchase the Hal ST-6 kit. There are several converters available in several price ranges; this one appeared to have the most features at the best price.

The Hal organization is excellent at getting materials out in a hurry. I received an immediate confirmation of my order with the sad information that there would be a slight delay on shipment (it developed that they were out of the power transformer). The merchandise arrived before the expected delivery day by UPS. They were nice enough to send the instruction book right away so I could get acquainted with what to do. It took about a week to put it together – the instruction book was most complete and quite necessary since the circuit boards are not marked, making it necessary to study the pictures and the diagrams to get the components in the proper holes.

Of course, when I got the unit complete it didn't work. (This problem is not confined to Hal – I have had many projects not working the first time around.) After considerable strain and a couple visits to a friend's test bench, it developed that the +12 and -12 voltages were not exactly the same + and -, and one critical place was not balancing. A paralleled resistor got the voltage to balance and everything worked fine.

One must have access to a frequency counter in assembling the Hal unit (or get it already built) since it is necessary to adjust the audio oscillator to the proper frequencies for RTTY operation and necessary to prune the tuned circuits in the receive section to get right on frequency. This takes the better part of an afternoon checking the resonance of the tuned circuits and pulling off turns from the toroids or changing capacitors to get the exact resonant frequency. It's quite necessary to have a little pile of small-value high-precision capacitors in order to get the resonance within 3 Hz of the specified frequencies. The Hal people could make some improvements in their unit by providing support for the circuit boards (they're held in by the edge connectors only) and by supplying several colors of wire instead of the generous supply of one color. It took one day to do the interior interconnecting wiring between the switches and edge connectors; I used different colors, which makes it much easier when tracing and troubleshooting.

Modifying the Heathkit SB-401 transmitter was simple. To transceive on RTTY, two contacts are jumpered to permit the unit to transmit on the RTTY position. The crystals and filter in the equipment, although ideal for 850 Hz shift, work out quite well on the almost universally used 170 Hz shift. With careful work on the carrier suppression, satisfactory operation is easily achieved by feeding the AFSK tones in the microphone jack with resultant FSK (F2) output. There is no problem using a VHF unit since AFSK is used; the signal goes in the mike jack and comes out the speaker connection.

The areas of RTTY concentration are easily found on the bands. Most operation uses 60 wpm operation and 170 Hz shift, although some 850 Hz shift is still occasionally found. A RTTY QSO is little different than an SSB QSO – the same general type of conversation takes place: name, location, equipment listing, weather report, etc. One must remember that it takes longer to say the same thing when typing, so watch that 10 minute timer. Also watch the plate ammeter since you are using a 100% duty cycle – don't exceed the plate dissipation rating of your finals. On VHF, the same information is exchanged that is heard on voice repeaters: "just testing out my new rig" along with a lot of highly technical talk of interest primarily to RTTY and computer specialists. There are RTTY repeaters that have the customary weekly net and check-in. One in this area is complete with swap shop and ARRL bulletins.

With a change of gears, one can use a communications receiver and eavesdrop on commercial transmissions (remember the FCC's secrecy rule), although much of this traffic is ASCII or encrypted.

There is a lot of press activity in Spanish at 67 wpm. Of course it helps to be able to read Spanish . . .

It also helps to be able to type for those intending to engage in 2 way teleprinter contacts. It's surprising that some teleprinter operators are rather poor typists.

At the moment my teleprinter operation is quite small-time in comparison with what many others have. Just a printer (with keyboard) and a converter. Later, when funds permit, I hope to include some tape equipment (puncher and reader) and get set up with a UART to improve the performance. Right now everything is still quite simple and satisfactory. It might be mentioned that the more sophisticated the operation, the more there is to go wrong and the more adjustments there will be.

It's a good idea to start simple and build up the more elaborate installation as your interest and funds permit. At the same time, put in good equipment that will work well, which will, in the long run, reduce your total cash outlay. Don't get a bunch of junk that will take two hours' maintenance to one hour's operating. Don't expend heavy amounts of cash on equipment that is 50 years old and getting obsolete. There is fairly good used equipment generally available; make sure it is working if you are not sure how to do the internal maintenance (or have a friend who knows how). Before starting, check the FCC rules on teleprinter operation which in general is restricted, on the low bands, to the CW portion; identification is done by CW but by your call only (you can use the letters key for dots and the blank for dashes).

You can make new friends and have a lot of fun on the teleprinter, as well as learn a lot of operating and technical savvy. ■

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Do-It-Yourself Photosensitizing

-- practical PCs

Most of the contemporary articles on printed circuit fabrication begin with photosensitized board and take the reader through the various steps of exposure, development, plating, etc. One or two of the articles explain that a spray sensitizer is available, leaving the reader to assume one simply sprays clean board and is then ready to begin fabrication. This is not true. In fact, I found the most difficult part of the whole process was just coating the plain PC board, such that the resist was not floating in streamers in the developer like octopus or squid tentacles. If you've never seen this, you simply cannot sense how frustrating it is. And presensitized board usually costs several times as much as plain board.

After several frustrating times, it became obvious that I was getting the board too clean and too smooth with steel wool and scouring powder ... so clean and smooth that the paint (lacquer base resist) could not stick. A new procedure was devised and success has been mine, unfailingly, since then. I share this with you:

1. Forget the scouring powder and steel wool. Switch to #400 wet-or-dry emery paper. Work in the sink with running water and rub the board in straight, parallel strokes until you have a satin finish on the copper. Keep everything wet to prevent deep scratches. This microscopically rough surface is just what is needed for good bonding of the resist.
2. Dry the boards thoroughly.
3. Immerse them next in clean lacquer thinner. A quart purchased for this cleaning purpose can be split, with half used to remove the resist after etching ... separate containers are a must.
4. Remove the boards from the thinner, point down so they drain well.
5. Place the boards on newspaper, copper side up and dry with warm air from a hair dryer . . . ten or fifteen minutes will ensure complete removal of moisture and a slight warming of the boards.
6. Spray the boards. I do it horizontally, although the instructions on the resist say to do it vertically. I use my son's darkroom, but a yellow bug bulb over the workbench at night will do. After the spray, turn the hair dryer back on and blow warm air on the boards for another fifteen minutes, then let the whole mess dry overnight in the dark. Store in a box or wrap each board in black paper.

That's it . . . from here on, I proceed as usual. I use an ultraviolet bulb about a foot off the surface of the negative. Too much closer than this and the thickness of the negative and parallax will produce non-sharp images on the copper — the light rays will actually shine under each line on the negative and ruin your copy.

Oh yes, I use the General Cement photoresist and developer. Their numbers are 22-231 (resist spray) and 22-234 (developer). No more tentacles. ■

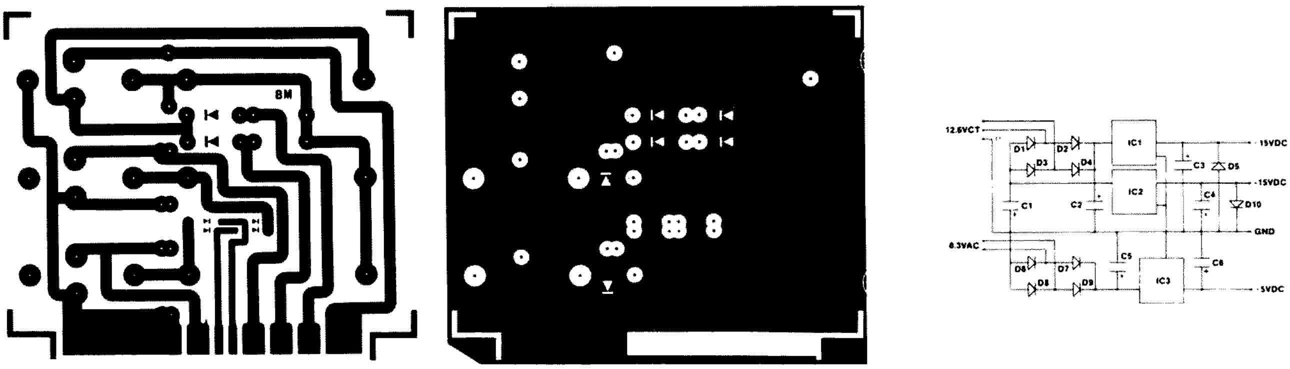

Fig. 1. Artwork and basic schematic diagram for the power supply used for illustration.

Making Your Own PC Boards

- - part II

Charles F. Smith
c/o 73 Magazine

This is the second and concluding part of this article. Last month, you may recall, we discussed all the "paperwork" involved in making a printed circuit board. We concluded with a finished 4 digit clock on a single-sided board. This month we will cover double-sided and multi-layer boards, as well as the manufacturing process.

To begin with, a definition of double-sided and multi-layer is appropriate. Last month a double-sided board was described as a circuit board with printed wiring on both sides. Components are placed on the side with the least amount of wiring. A multi-layer board is a board with many very thin boards laminated together. The multi-layer board described in these pages is not quite as complex as this, but works as well.

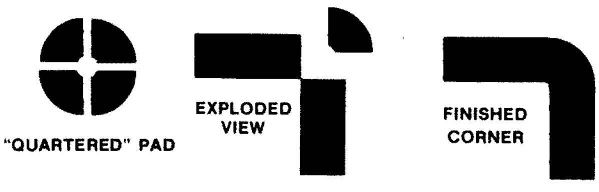

Fig. 2. Rounding the corners using cut pads.

Layout Design

Perhaps the easiest way to lay out a double-sided circuit board is to make it similar to the single-sided board. Use different colored pencils for each side (or layer, for multi-layer). Some people prefer doing each side on a separate piece of graph or tracing paper. Others use one piece of graph paper for everything. The use of two colors on one piece of graph paper will keep the two sides separate, and assure no errors caused by an overabundance of papers to keep track of.

When laying out a double-sided circuit board, it is best to keep a conductor on one side of the board. To elaborate, do not run a conductor to a component lead and then change sides. Shying away from doing this will prevent depending on side to side connections for circuit continuity.

Everything else about a double-sided board layout is basically the same as for a single-sided board.

Artwork Design (Methods)

For taping the artwork for a double-sided board, there are several different methods. The most obvious is to make separate artwork for each side. Another common method uses one sheet only containing pads and other

markings common to both sides. Use separate pieces of clear mylar for the top and bottom sides of the board. On these, place only the conductors for each side and registration marks. When a negative is made, each side or layer is placed separately above the dots. This "set" is shot together, coming out with a combination of the two. This is probably one of the best methods. Side to side registration is going to be excellent, with very little error.

A similar method is to have a print or film positive made of the pads only (one print for each side/layer), and tape directly over the photographic paper or film.

Fig. 1 shows a schematic diagram and board artwork of a power supply you may want to build. This circuit will be used here for explanation purposes.

You will notice that although the conductors are all straight and even like last month's clock, the corners have been rounded. This was done by "quartering" a donut pad twice the size of the tape used. In this case I used a ½" pad with ¼" conductors. Fig. 2 details this process.

A method worth noting was used for the top side of this board, being used as both a heat sink and a ground plane. When the artwork for the bottom side was finished, I placed another piece of mylar over it. At points where no connections between sides were to be made, I placed pads as large or larger than those on the bottom. You can see that this is exactly the opposite of what we want. Using this "overlay," I made a contact print. This gave me artwork on photographic paper for the second side. Fig. 3 should make this clear.

By the way, if you ever have to lay out a ground plane without recesses, and do not wish to use a lot of tape, use red paper. It should be a good grade of paper and be pure red. Rubylith is also a material that can be used. It is manufactured for this purpose. A good drafting supply store should have some. Black paper can also be used with good results. Because of the properties of film, sometimes red appears as a better black than black does. Strange, but true.

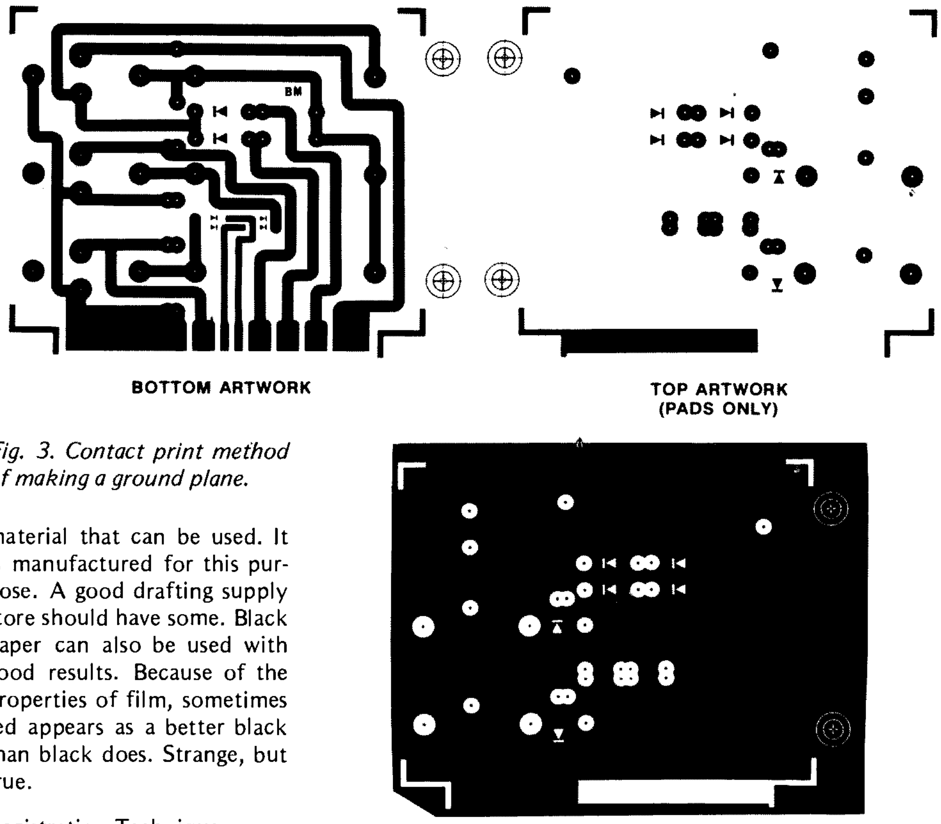

Fig. 3. Contact print method of making a ground plane.

Registration Techniques

There are many registration techniques available. Some are easier than others, but all work well. For the artwork, special preprinted "stick-ons" are available. Fig. 4 illustrates some of these, which are placed on each piece of artwork at three corners. When all layers are laid above each other, these marks should be superimposed to appear as one mark.

Pin registration is a method the graphic arts industry has been using for a long time with great success. This method involves punching a pair of holes in each piece of artwork and using small pins (usually ¼" in diameter) to hold the pieces in register. Fig. 5 shows these two methods of registration.

A relatively new method of registration for double-sided boards has been introduced by Bishop Graphics, Inc. They call it their "Red and Blue System." Instead of using black tape and pads, they suggest using red and blue. Pads and other marks that go on both sides of the board are laid down using black pads and "stick-ons." Conductors for the first side are laid down using red tape. On the same artwork, blue tape is used for conductors on the second side. This method uses only one piece of mylar, and one set of pads. This means that you have only one piece of artwork to keep track of.

When making a negative using the "Red and Blue System," special film (Panchromatic) and filters are used. A red filter is used to drop the red images and hold the blue. A blue filter is used to keep the red and drop the blue. Since there is no filter available to drop the black, mainly because you cannot, such images on the artwork are picked up on both negatives.

This method assures perfect registration every time, as well as the above mentioned benefits.

Manufacturing

Now that you have negatives for the circuit board you want to make, you are ready to do some home manufacturing. You are going to need some blank circuit boards and several types of chemicals. Each of these will be discussed separately.

The type of circuit board you use will depend upon the type of project involved, and

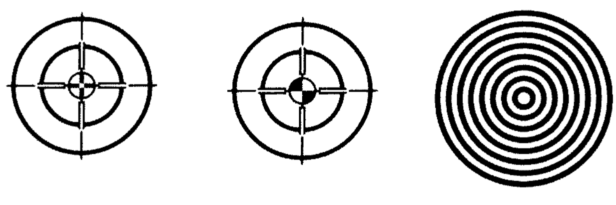

Fig. 4. Typical "stick-ons" used for registering artwork. The concentric circles are used on multi-layer board artwork.

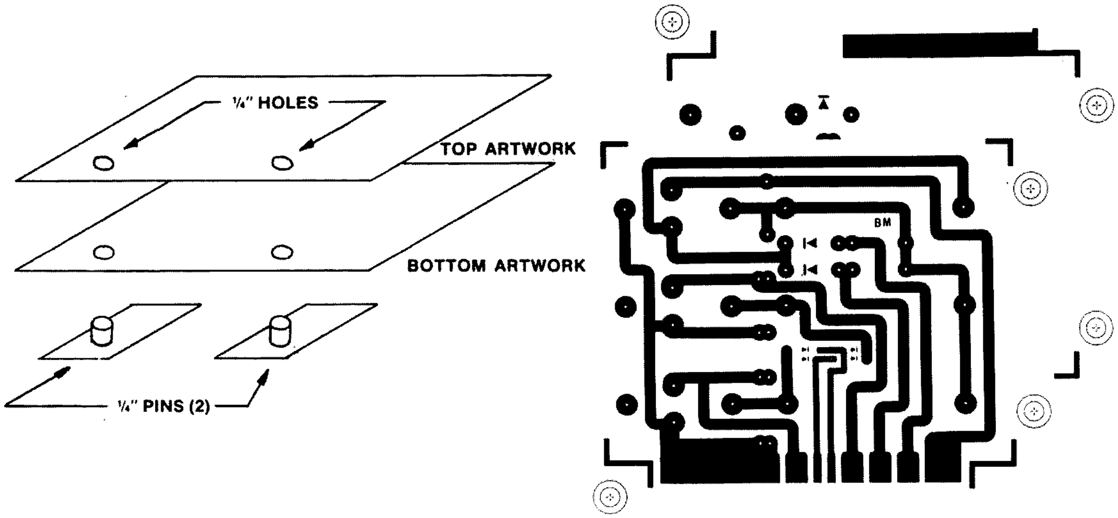

Fig. 5. Methods of artwork registration.

your choice of supply. Obviously, if one type of board is unavailable, you will have to use what is available.

The most popular types of circuit boards are glass epoxy and paper phenolic. Glass epoxy is a good board for everything, but especially for high frequency circuits and critical applications. Its leakage resistance is very high and its stability is good. It is also able to withstand harsh environmental conditions reasonably well. Paper phenolic is satisfactory for most applications, but G-10 glass epoxy is usually better.

Circuit boards come with many different "properties." Thicknesses range from 1/32" to 1/4" and beyond. Most common is 1/16". The copperclad comes in 1 oz., 2 oz., and 3 oz. thicknesses. Here, 2 oz. is most favored.

The Resist

The resist is a chemical placed on the board in places you want a copper pattern. During etching, it resists the acid and protects the foil pattern beneath it.

Resist is available in many forms. Almost any substance that can withstand heat and the etchant may be used. For the purposes of this article we will be using General Cement's "Etch Resist Sensitizer" (cat. nos. 22-230 and 22-233). This is similar to Kodak's KPR photo resist and comes in an aerosol can. KPR can be used with the same results.

The developer for this type of photo resist is either GC's "Developing Solution" (no. 22-234) or Kodak's "Photo Resist Developer."

The Etchant

After the board has been "printed," it must be etched. Etching removes all unwanted copper, leaving only the foil pattern. Different types of etchant include ferric chloride, ammonium persulfate, and cupric chloride. Ferric chloride ($FeCl_3$), available in both powdered and liquid form, will be used here. Radio Shack stocks one pint bottles of pre-mixed ferric chloride (stock no. 276-1535).

Cleaning the Board

Cut a piece of circuit board slightly larger than your finished board will be. Before you make the board, you are going to have to clean it. Unless you have commercial chemical degreasing facilities handy, you are going to have to clean it by hand. I have found two out of many methods to be very good when it is necessary to do this.

Washing a circuit board with dishwashing soap is done like this: Using warm water and a pad of Scotchbrite, lightly scrub the board to remove oils, oxides, and other unwanted residues. Rinse with water. If the board is clean, the water will not stick to the copper. Be careful, though, as water will not stick to an oily board either. Unfortunately, neither will the resist. Do not dry the wet board with a towel or cloth. Let it dry naturally to prevent any oils or foreign matters from sticking to it.

The other method is a little easier. Use fine steel wool and clean the board with this. Be careful not to touch the clean areas of the board with your fingers. As clean and dry as they may seem, your fingers will deposit oil onto the board. This will cause oxidization and prevent the resist from adhering properly.

Resist Application

When the board is completely dry, it is ready to be sprayed with photo resist. Lean the board against a wall with the foil side facing toward you.

Shake up the can of resist to mix the chemicals well. Apply a thin layer to the board by holding the can about ten inches away and spraying horizontally from the bottom to the top of the board. Best results will be obtained by spraying a continuous spray without removing pressure from the nozzle until you are finished.

To sensitize a double-sided board, spray the first side as before. Handling only by the edges, turn the board around and lean it with the coated side facing the wall. Spray the second side and let the board dry in a vertical position.

After the board has been completely coated with an even layer of resist, set it down so it is lying flat. It normally takes at least an hour for resist to dry, but the process may be sped up by

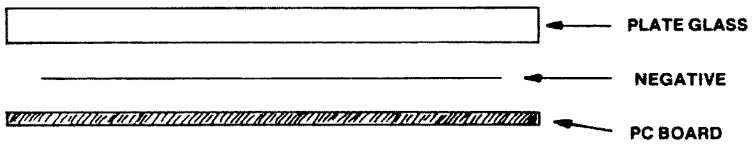

Fig. 6. Simple method of exposing the sensitized board.

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Curing Mobile Noise Miseries

- - particularly on 80 and 160

My car had been away for some time for repair after an accident. When I got it back, I was not surprised to find the suppression was much poorer than it had been before.

I began checking everything: the ignition leads, the distributor suppression, the bonding of the exhaust pipe, etc., and could find no fault.

Then a curious thing happened. I had an 80 meter QSO and complained about a whine which was causing considerable QRM all over the 80 meter band on reception. I could not understand this, drove home and checked the 80 meter band for the whine on the fixed station. No unusual QRM was heard on the fixed station receiver. I had parked the car under the fixed station antenna and went back to the car and switched on the mobile rig. There was the whine all over the 80 meter band again. I ran back to the fixed station. Now I could hear the whine on the fixed station receiver also. After listening for a time, I went to the car and switched off to save the battery and decided to monitor from the fixed station. But, on returning to the fixed station, the whine was gone!

Could it be that the mobile was generating this whine itself even on receive? I switched it on again, and the whine appeared on both fixed and mobile stations.

After repeating this a few times, I was satisfied that the mobile station was definitely generating the whine, which was picked up not only by its own receiver, but radiating enough to be picked up on the fixed station if the two were close enough.

I was really confused, as the whine was not a constant note but seemed to fluctuate rhythmically — somewhat like a jammer.

I rang up a good friend of mine, G8KW (of K W Electronics), who is very knowledgeable and has much experience. He had experienced this phenomenon, but only on 80 and 160 meters.

He suggested that the whine came from the transistor oscillators in the power supply. But why did it fluctuate rhythmically? He suggested it was beating with some other oscillator in the transceiver which caused the fluctuation.

He suggested that either the antenna was not resonant at the operating frequency or else I had a bad connection on the outer braid of the coaxial cable.

I doubted whether it could be the non-resonant antenna, as I had most carefully resonated it and had had good reports when I was transmitting from the mobile on 80 meters. It was only on receive that the trouble arose.

So I took my ohmmeter, which is calibrated down to 1/10 Ohm and on which I can easily interpolate to 1/20 Ohm, and began testing: chassis of the rig to rear bumper, 0.15 Ohm; chassis of rig to engine, 0.15 Ohm; chassis of rig to headlamps, 0.2 Ohm; and so on. Nowhere was the resistance over 0.25 Ohms. Then I broke the connection of the coax from the rig to the antenna base. The center conductor showed a resistance 0.1 Ohm. I reconnected the coax at the rig, but left the coax disconnected at the antenna base, and tested from the outer of the coax cable at the antenna base end to the chassis of the rig – 3 Ohms!

Note that the beautifully low resistance of 0.15 or 0.2 Ohms from the chassis of the rig to the car was through the car, due to good bonding, and that explained the strong signal on transmission. It was not until I had disconnected the coaxial feed line that I found the high resistance.

I discussed this with my friend and we were at first inclined to believe that since it was a big car and a fairly long coaxial feed line, this might be possible. It was hard to believe that the outer braid of the coaxial cable could have a higher resistance than the inner conductor.

So the tests went on . . .

The coaxial cable was broken at various points to insert an swr bridge near the rig and also to insert a loading inductance near the antenna for fine adjustment on 80 meters. These are joined by standard coax connectors.

We found slightly corroded connectors here and there and reduced the resistance from 3 to 2½ Ohms. But the 2½ Ohms resolutely remained.

Then we found one more connector we had overlooked. That really was corroded badly, and the outer conductor was badly corroded too.

We cut out the bad parts, made up brand new connectors, and the resistance – end to end – was 0.15 Ohms including all the connectors.

Now we tested again. The suppression now was superb – as good as it had ever been. The whine on 80 meters was gone.

One cannot overemphasize the vital importance of really low resistances everywhere on a mobile installation. For suppression purposes the feed line, both outer and inner, *must* be really good and very low resistance. For a good radiated signal the car must be really well bonded, and this helps suppression also.

A really low resistance on all leads in the car is vital, and a means of measuring low resistance – by that I mean down to 1/10 Ohm – is essential. ■

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More on HKITL

- - Colombian views

It has been about a year since the Mount Airy VHF Radio Club (the Pack Rats) started planning for the Colombian moonbounce expedition, HK1TL. I was recently reviewing all of the articles written about this successful 432 MHz moonbounce project in South America, when it occurred to me that something was lacking. With all the publicity afforded this project by the radio press, and with the technical and descriptive articles which have been published, still missing was a description of what this project meant to our Colombian hosts. We Pack Rats knew how they felt, but it would not be proper for us to tell their story. So, I asked Dr. Atenogenes Blanco HKIBYM, the project's Colombian coordinator, to write of his impressions. The following article is the result. I think that Ate has conveyed in his article all the emotion that exists. – Elliott T. Weisman K3JJZ.

My first encounter with the South American moonbounce project occurred when I received a letter from Sam Martinez WB3AFY/HK1CWB, a fellow Colombian who now lives in the States at Baltimore, Maryland. Sam informed me about the Mount Airy VHF Radio Club's DXpedition plans and asked if I could coordinate the Colombian end of the project. I didn't know the first thing about moonbounce, but here was a request from a fellow Colombian which had the potential of providing international recognition for my city and country. I had no doubt that my answer would be in the affirmative, since I was told that the planned operation would be the first of its kind on the continent of South America and the request came from a fellow ham and Colombian. However, I did have doubts about the capabilities of the Mount Airy VHF Radio Club (the Pack Rats) and the probability of success of such an ambitious project. It was sure to be a very difficult – if not a crazy – undertaking.

I soon saw that my contribution would be in translating what the North Americans wanted to do into the Colombian way of doing things. Every country's customs and governmental procedures are different, and such an unusual project would no doubt create special problems in licensing, customs, immigration, and so forth. So I responded to Sam that I would do whatever they asked of me to the best of my ability. Here I was discussing a difficult project with a group more than 1000 miles away who were either very capable or very crazy. I really didn't know, but it made no difference – we were going to be a part of the project.

A special meeting of our AREA 2 radio club was held by the president, Juan Navarro HK1JJ. The word "AREA" stands for Association Radio Experimentadores Afficianados, and the 2 for 2 meters (the band in which we are primarily interested). We are a group of a dozen or so hams from the Barranquilla, Colombia, area who like to build and operate 2 meter repeaters and mobile and base stations. Our ambition was to one day combine forces with the Defensa Civil Columbiana (you should say Civil Defense), in order to provide a communications system which could be used in times of emergency. The AREA 2 radio club was responsive to the moonbounce project and volunteered to serve as the sponsoring organization. You see, a DXpedition to Colombia requires both local sponsorship and participation in order to be licensed and approved by the Ministerio de Communicaciones (Colombia FCC).

The problem areas identified for action at that first meeting included licensing, customs, transportation of both people and equipment, and the location for the moonbounce station and lodgings for our expected guests. The most difficult problem would be the customs arrangements.

We began our preparations in February, 1976, for the August operation. I informed Elliott Weisman K3JJZ, the Pack Rat moonbounce project leader, of what documents were necessary for the license and customs. They wrote a beautiful letter to the Ministerio, but when I checked with the head office in Bogota, I found that it had not been received in the correct department. So I flew to Bogota to meet directly with the Ministerio of Communications. Here I was lucky. The counselor to the minister is a young lady lawyer who graduated from the same university at which I studied dentistry. I showed her our official request and some background information reprinted from *73 Magazine* and the Philadelphia *Bulletin*. She issued our special call letters, HKITL, for Tierra-

Luna (earth-moon in English), and gave me an official letter to present to the customs officials. Many letters and documents were necessary for customs in order to bring in such a large amount of complicated radio equipment without having to pay duty. After a mountain of correspondence with the Colombian customs, I was at last beginning to believe that this problem was solved.

The site for the expedition station was selected to be a family beach house on the Caribbean coast about 18 miles from Barranquilla, with a horizon-to-horizon view of the August moon. This is in an isolated area serviced by an experimental power station. I visited the superintendent of the station, a relative, who assured me that there would be adequate electrical power and no problems. I also located some emergency generators for backup. Various ladders, poles and other equipment were located and readied.

Transportation in our country is mostly by bus. Few people own private automobiles, because the cost of even a Renault 6 is about 10,000 American dollars. The AREA 2 members volunteered to drive their cars for our guests' transportation. In addition, I made contact with the chief of the Defensa Civil in our area – which proved to be to our future mutual benefit. He would provide civil defense trucks and civil defense guards for the expedition.

The AREA 2 group was hard at work on our new 2 meter repeater, which we hoped to have ready in time for the expedition. We needed some special parts to complete this project. Our new friends, the Pack Rats, were able to obtain them from VHF Engineering and send them to us. This new repeater is located at 11,000 feet above sea level on a shoulder of Cristobal De Colon Mountain in the Sierra Nevada, about 80 miles from Barranquilla. It operates under an AREA 2 club callsign, HK1EE, on the frequencies 16-76. It covers several thousand square miles from this high location. We used this repeater extensively for liaison during the moonbounce project.

A few days before our guests were to arrive, a problem with their airline tickets came up. Sam's XYL, Rosalba, had arrived in advance with a check to purchase their tickets from Aerocondor Airlines; however, the prices had gone up and the check was thus too small. The group was coming from Philadelphia to Miami on Eastern Airlines, connecting with an Aerocondor flight to Barranquilla. Both airfares had increased. Aerocondor agreed to keep their price as originally quoted. Sheila HK1CWD underwrote the extra cost until the group could arrive and reimburse her. Another problem solved.

Our Pack Rat guests arrived early on the morning of July 26, 1976. There were 9 of them: Elliott K3JJZ and his wife, Lorraine Bolmar WB3AOP/HK1AMW, Sam WB3AFY, Tony W3HMU and his wife Jan, Walt K3BPP, Bill W3HQT, and Danny WA3NFV – along with 1370 pounds of equipment. Even with all the preparations and documents, it still took us two hours to clear the equipment through customs. That doesn't seem too bad, however, when you consider that it usually takes 15 days. We loaded our guests and their equipment into several cars and small trucks. The first stop was for several press conferences. Our guests were prevented from wilting under the hot Colombian sun by several bottles each of our good local beer. Finally, late in the afternoon, we arrived at the beach house QTH.

I must tell you of my impressions of these Pack Rats. These people should be millionaires back in the States, if they work as hard at their occupations as they do at moonbounce. It was very rare when they got more than three hours of sleep a night. If they weren't working radio contacts, they were either repairing something or making preparations for the next day's operation. They were always smiling (except when the power went out) and, even more important, they were always willing to take time to explain, to teach, or to make friends.

The site was not a Shangri-La, but Rosalba did a great job of making it home for our visitors. The AREA 2 gang contributed daily goodies of beer, soda, rum, and homemade cakes. In addition, there is this enormous ocean out front to help moderate the August heat and also provide diversion during power outages. These power problems developed because of the strong afternoon breezes which kept knocking out the electricity. The moonbounce crew located the troublespot. I had three generators which were either too small or too poorly regulated to be of value. The Defensa Civil finally came up with one which would do the job, but by then the problem was cured. However, now we knew where to get one for emergency radio operations. I kept our friends calm by telling them a "proverb" I made up, "The disappointment of a power failure is best soothed by a swim in the ocean." It worked.

We found a combination of English and Spanish and "ham" to work very well. The universal language of amateur radio was equal to all occasions. The success of the expedition has been reported elsewhere. In all, fifteen moonbounce contacts were made with eight countries and 70 QSOs on Oscar 7B were made with five countries. We celebrated at a banquet hosted by the AREA 2 radio club, where we presented our Pack Rat friends with a plaque commemorating the first South American moonbounce contacts. We also elected the Mount Airy VHF Radio Club a brother organization. Afterwards, we found out during an all-night soiree that our North American friends were fully equal to the challenge of a Colombian fiesta.

The benefits of our joint efforts have gone well beyond the moonbounce project. The amateurs and the Defensa Civil have become closer, and are now working on a system of cooperation for times of emergency, when we will provide radio communications through a system of repeaters covering the whole north coast of Colombia. With the AREA 2 club, the radio club of Atlantico, and the Cartegena radio club, HK1BAR and HK1AAH are also working on Oscar systems. Maybe someday soon we will QSO with our friends via the satellite.

A dividend of our project came recently and unexpectedly. A very sick Colombian lady needed a medicine manufactured by the drug company where K3JJZ works. I spoke to Elliott via 20 meters, and he made arrangements for the drug to be flown to Colombia in time to save this lady and her unborn child. This was made possible by the friendship resulting from the project.

Finally, as I wrote this, I flipped through my file of correspondence, looked through the photographs we took, and re-read the newspaper articles that were written. I felt again the excitement of those golden moments we shared together and the warm glow of the friendships we made. The only thing I can say is, "Come back, Pack Rats, we have a Mars bounce waiting for us!" ■

References

1. "Pack Rat Moon Bounce," *73 Magazine*, April, 1974.
2. "Tierra Luna Para Colombia," *QST*, October, 1976.
3. "Colombia Oscar 7B Operation," *QST*, November, 1976.
4. "DXpedition: Memories for a Lifetime," *73 Magazine*, Holiday, 1976.

by Wayne Green W2NSD/1

I/O EDITORIAL

KILOBAUD VS 73

One of the tougher decisions to live with was the one whereby we would not print the same articles in both *73* and *Kilobaud*. Every now and then an article comes in that is a natural for *both* magazines and I have to decide where it will go . . . knowing that I am really shortchanging the readers of the other magazine when I make the decision.

For instance, take a beautifully detailed article on keyboards which thoroughly covers every kind of keyboard that you might run into . . . the debouncing circuits . . . gating circuits . . . coding vagaries. Obviously the computer nuts have to have that data . . . and so do you. It's going in *Kilobaud*, so it comes down to this . . . either you subscribe to both magazines (a move I endorse), you write to me and convince me that some articles should be in both magazines . . . or you just make do without some of the cream.

What do you think?

HOW'S KILOBAUD DOING?

The response has been most gratifying. Apparently there was a gigantic need for a magazine for beginning computer people . . . people who know as little as I do about them. I've made sure that the articles are simple enough so that I'm able to understand them – and this has hit the jackpot.

Kilobaud, like *73*, is *packed* with interesting articles. I'm getting a lot of the same comments on it that I do on *73* . . . particularly that while the readers do get other magazines, it only takes them a short while to read the others and it takes days to read *Kilobaud* because there is so much of interest in it.

The first print run of 25,000 copies of the first issue of *Kilobaud* sold out and we're printing up some more to try to keep up with the demand. If we can keep up the momentum, *Kilobaud* will be the largest circulation magazine in the hobby computer field by its fifth issue . . . all the result of our publishing a massive amount of fantastic and easy-to-understand articles.

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 *or* Kilobaud *in exchange for a spot on your ham or computer club newsletter mailing list. Deal?*

HAMS VS COMPUTERS

Computer exhibits at hamfests and conventions continue to be the most mobbed, as more and more hams discover that a microprocessor is just a newfangled IC with which they are going to have to get familiar. The longer you put off getting into this fascinating part of modern electronics, the more alienated you may find yourself. Try to remember, if you're old enough, how a sizable group of hams tried to ignore solid state, complete with *QST* as their flagship.

The fact that there are about 50,000 people into hobby computing should be an inkling that it is fun. You don't gather up that many fish in a two year period without awfully attractive bait.

One interesting part of this is that while it doesn't hurt to understand how computers work to play with them, it is by no means mandatory. You'll find that only a small percentage of the hobbyists know as much about their systems as you think they do. This is one of the reasons that *Kilobaud* has been such a hit . . . it doesn't assume a lot of knowledge on the part of the reader.

It's quite possible to either buy an assembled computerette or put together a kit and have a ball with it without ever knowing how the blamed thing works. The "appliance operator" rides again. I tend to think in terms of "black box" users . . . and I think that this is going to be the direction of the major growth in microcomputers.

More and more we will be seeing interfaces between these computers and ham gear . . . with television sets . . . with the new video games . . . and all we'll have to be able to do is load programs and have fun. I think most of us will get accustomed to writing our own programs for special jobs we want to do . . . and get so we can read a program in BASIC just as we do a schematic diagram. Kids under ten years old can do it.

Be sure to get to Atlanta in June (18-19) and check out the computer exhibits . . . there will be a lot of them. Those of you who can get to Seattle will have a choice bunch of computer exhibits to see also . . . last weekend in July. I'll be at both . . . be talking on the programs . . . and answer as many questions as I can.

ATLANTA JUNE 18-19

This is the biggest convention in the country outside of Dayton . . . and will be dragging 'em in from all over the South. Chaz Cone (of Navassa Island fame) is the fearless leader on this one and he's rounded up some nice prizes for those who still think there is a free lunch. The biggy is a KDK-144 synthesized rig, a Larsen antenna and a new car to go with the combo . . . talk about thinking *big!*

That's the good part . . . but then nothing is ever perfect, so the fact that I'll be speaking every now and then needn't be held against the effort. If there is any interest, I'll give some details and answer questions on how to get your own business started in your spare time making ham gear (how to become rich). If everyone is so used to being poor . . . or is rich already . . . then I'll give some inspiring words on the WARC debacle . . . a message of cheer to ARRL fanatics . . . how to write articles for *73* and get famous . . . or stuff like that.

It is high time to pencil in that weekend for some fun . . . and Atlanta is a ball! Between Underground Atlanta (I wouldn't miss it!), Stone Mountain (ditto), Aunt Fanny's (wow, what food!), there is so much to do and see around Atlanta that it is worth the trip without any convention.

The convention will have some of the top speaking talent . . . great prizes . . . possibly more exhibits than Dayton . . . including the latest in ham-oriented computer stuff . . . and the friendliest bunch of hams you'll run into anywhere.

HELP!

A glance at any issue of *Kilobaud* will indicate an amazing number of companies providing microcomputer kits, peripherals, and software. The *KB* laboratory is obtaining as much of this hardware as possible, for evaluation purposes as well as for production of software cassettes that you will be seeing at your favorite computer emporium. We have reached the point where our computer specialists could spend their entire day building, testing, and debugging micro systems. Of course, this is not the best situation when there is so much else to do, like getting a chance to do some skiing or snowmobiling every once in awhile. We are looking for a digital technician to help with our microprocessor overload. This individual must be up on digital construction techniques, and familiar with TTL and CMOS. Practical experience with microprocessors is a must considering the nature of the job! Also, feel free to include in your resumé any experience you may have had in interfacing peripherals, such as floppy disks, terminals, or cassettes, to a microprocessor system. The *KB* laboratory has the scopes and test equipment you will need to get our microprocessors going. (Software knowledge sure would help, since hardware expertise gets you exactly half-way in the computer business!) Give it some thought. If you are interested in coming to New Hampshire (no gas shortage here), let us know, addressing the above points as completely as possible. Sell yourself. We plan on reading more than one resumé, so please – no hand-written jobs. After reading every sort of scrawl that gets sent to *KB* for six hours, imagine what sort of reception your hand-written resumé will receive at 4 pm. Please mark your envelope with a bold "RESUME," as our mail sorters also put in a full day's work . . .

An Intelligent RTTY Station

- - the ST-6 TU and 8080 micro

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One of the difficulties encountered when using microcomputers is the problem of finding out exactly

The K7YZZ computerized station.

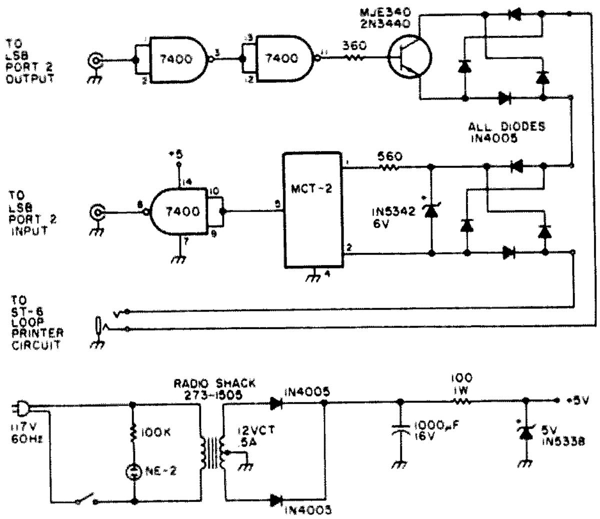


Fig. 1. The RTTY interface unit schematic diagram.

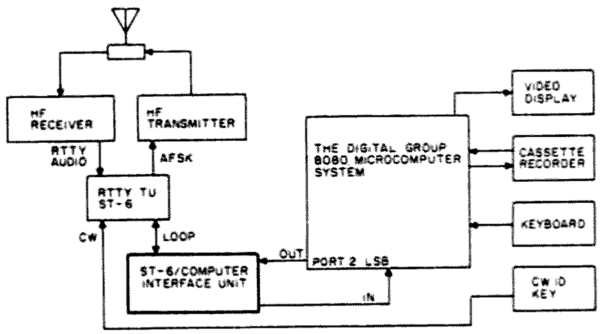
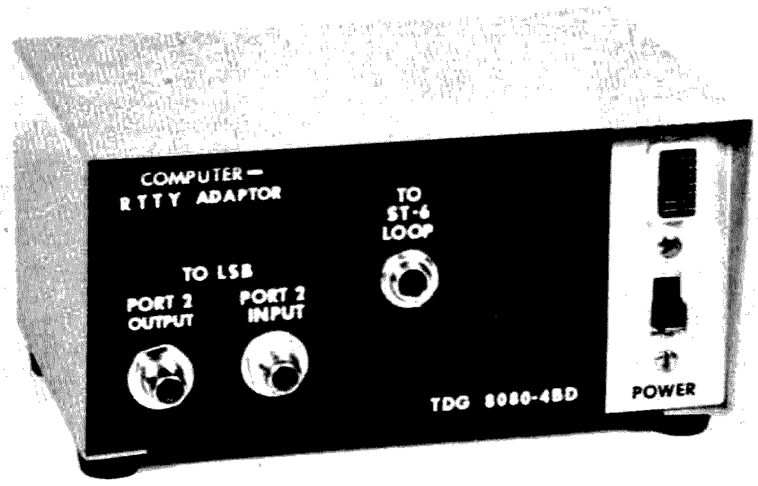


Fig. 2. System block diagram illustrating how adapter is used to interface the ST-6 to computer.

how to use the machine for something other than playing games and doing simple math problems. Since I built my machine[1] with the idea of using it in my ham shack, I decided that after several months of playing and writing games, I would move it from the living room down to the ham shack and see what could be done to get the thing to talk to my transmitter and listen to my receiver on RTTY and CW. This article will describe my efforts in connecting it to my ST-6 RTTY TU and programming the computer to act as a "Model 28 KSR."

I ordered a copy of the HAM-1 audio cassette program for the 8080 system from The Digital Group Software Systems[2], and when it arrived a few days later, I studied the written material that came with the tape recording. The HAM-1 cassette enables the operator to program the computer for operation in two modes, one as a TTY keyboard and video terminal (TTY-TVT), and the other as a CW keyboard with message storage buffers and a CW reader with the characters appearing on the video display (CW-TVT).

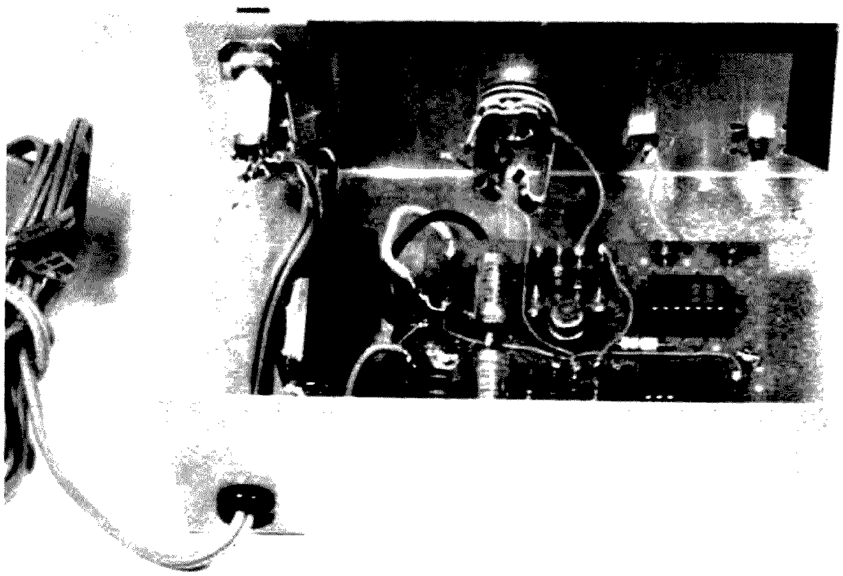
In the instructions, I also found information on how to modify the HAM-1 program to connect the output of the TTY data to port 2 or 3 input and output terminals. I modified the program on my machine to use the least significant bit terminal of port 2 and made a new copy of the program using the "Cassette Write" function. I plan to use the port 3 terminals for a CW system. TTY output signals appearing at these selected ports are in a Baudot coded, serial bit stream, at TTL logic levels. That is, a MARK as plus 5 volts and a SPACE as 0 volts. TTY speeds may be selected from keyboard commands for 60, 66, or 100 wpm. Once the program had been modified as suggested in the HAM-1 data package, the next step was to determine how to connect it to my ST-6 TU to receive and send RTTY.



The completed RTTY adapter.

The ST-6/Microcomputer RTTY Interface Unit

The RTTY interface unit shown in the schematic diagram of Fig. 1 performs two functions. The first is to take


Interior view of RTTY adapter.

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H011 L140   303 320 011
H011 L320   376 240 302 340 011 315 372 000
            076 004 315 242 011 303 135 011
            376 215 302 145 011 026 002 076
            010 315 242 011 025 302 347 011
            076 002 315 242 011 303 135 011
```

Fig. 3.

the incoming TTY signals from the ST-6 TU loop circuit and isolate them from the low voltage TTL logic circuits in the MCT-2. The TTL level Baudot signal from the MCT-2 optical isolator is buffered and inverted in the 7400 and is sent to the least significant bit terminal of port 2 input. This Baudot signal is processed in the microcomputer and displayed on the video monitor.

The second function of the RTTY interface unit is to receive keyboard generated, Baudot encoded, TTL logic level signals from the computer and feed them to the dc loop keyer transistor stage of the RTTY interface unit. The keyer transistor keys the ST-6 loop through the diode bridge. The ST-6 converts the loop signals to AFSK tones for transmission to the radio transmitter audio input. No loop dc supply is required for this unit, as it is supplied by the ST-6. Diode bridges are used to keep from having to worry about loop supply dc polarity damaging the circuit.

Operation

With the RTTY interface unit connected between the ST-6 and port 2 of the computer as shown in the block diagram of Fig. 2, the modified HAM-1 tape is loaded into the computer. A RTTY signal (60 speed, narrow shift) is tuned in on the receiver and ST-6 TU. A 7-1-1 is keyed on the computer keyboard to tell the computer to set the speed at 60 wpm, receive mode, in upper case letters. The resulting decoded Baudot signals should begin appearing on the video monitor beginning in the upper left hand corner of the screen.

To transmit the TTY signal, the RESET key is depressed, and when the monitor program appears an instant later, the 8 key is depressed. This calls up the computer in the TTY keyboard mode. The ST-6 TU is switched to the send mode and the transmitter is keyed. Typing on the computer keyboard will now send AFSK signals to the transmitter.

Modifications to the HAM-1 Program

During the testing of the HAM-1 program, it was determined that there was no method of sending the carriage return (CR) or line feed (LF) functions that are required when you are sending to a station equipped with only a mechanical TTY machine. This problem was brought to the attention of The Digital Group and the modifications shown in Fig. 3 were developed for the HAM-1 tape program. The listing will provide two carriage return and one line feed signal when the RETURN key is depressed on the keyboard.

Conclusions

For those who have an ST-6 or similar type RTTY TU, this little interface unit may be used to connect the microcomputer to the TU for computer generated Baudot RTTY communication. The next article will cover a low cost RTTY TU that is designed for direct connection to the computer and ham station equipment. ■

References

[1] "A Ham's Computer – CW/RTTY the easy way," Louis Hutton, *73 Magazine*, December, 1976.

[2] Digital Group Software Systems, Inc., PO Box 1086, Arvada CO 80001. HAM-1 Cassette, $5.00.

Interrupts Explained!

-- getting a micro's attention

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For most microprocessor owners, the subject of interrupts is avoided like the plague. This should not be so. Interrupts are among some of the most useful options available to the microprocessor owner.

The very nature of interrupts (i.e., their unpredictability) accounts for the fear and mistrust of using them. My *Dictionary of Electronics* defines an interruption as: "In microcomputers: a halting of the main program followed by the starting of an interrupt subroutine, or returning from the subroutine to the main program."

Either way, it does not make much sense until you realize just how useful an interrupt is.

An interrupt is virtually a "Hey you" followed by an "I want this done now . . ." The loudness of the "Hey you" indicates its priority if more than one arrives at once. When an interrupt occurs, you drop whatever you are doing and go to the interrupter to see what he/she/it wants, and when this is completed, you are free to return to what you left.

A more useful analogy when considering interrupts is the telephone. Picture yourself sitting with some friends chatting (main program) when the telephone rings (an interrupt). You excuse yourself and go to answer the telephone (jump to the interrupt location). When you pick up the receiver, the telephone becomes engaged (interrupts are disabled), and you talk to the person calling (execute the interrupt subroutine). When you have finished, you hang up the receiver (enable interrupts) and resume the conversation with your friends (return from interrupt).

Priority and multiple interrupts can also be considered in this fashion, such as the doorbell ringing (high priority), the telephone (low priority, let the XYL answer it), or a call on your ham gear (high priority to you, but low to the XYL). The analogy can be carried much further.

In the following description, I have tried to be as general as possible, because with the wide variety of chips, each with its own unique interrupt system, the details are best left up to the programming manual for that particular chip.

However, the basic rules of interrupts are common to all systems. Interrupts were developed to handle a particular type of situation. This situation is when an external device, at some unpredictable moment, requires that the computer do something immediately.

When an interrupt occurs, the CPU (Central Processing Unit) must literally drop everything, but it must remember where it was before the interrupt occurred. To do this in most systems, all of the contents of the registers are pushed onto the stack (an area of memory or other hardware storage) before the CPU jumps to the interrupt location (the interrupt subroutine). Then the CPU will perform the subroutine at the interrupt location. During this time, the CPU does not want to be interrupted again and, for this reason, most microprocessors have a Disable Interrupts instruction (e.g., DI, hex F3 on the 8080A and SEI, hex 0F on the M6800) which allows the CPU to ignore any "Hey you" no matter how loud, while it performs the current interrupt subroutine.

Systems of interrupts are generally unique to the chip and/or the machine's implementation, but generally there are three main categories:

Single Line Interrupts:

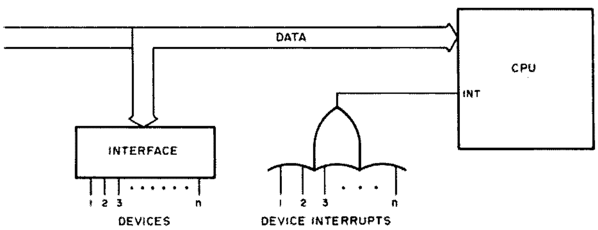

Fig. 1. Single line interrupts.

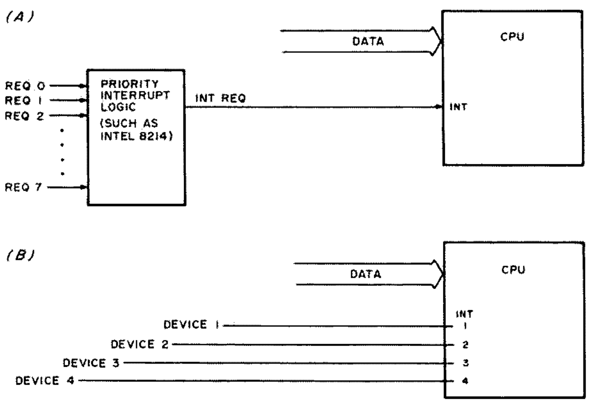

Fig. 2. Multi-level interrupts.

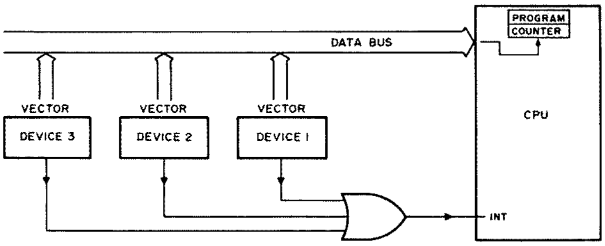

Fig. 3. Vectored interrupts.

Here the processor responds to an interrupt on one line (see Fig. 1). For more than one, the devices are tied to an OR gate and the individual devices must be scanned by the processor to find out which one generated the interrupt (also referred to as "polling"). Because of this, single line interrupts are slow.

Multi-level Interrupts: Here the interrupts could occur on one or several lines going into a priority determination chip or logic (see Fig. 2a). If the number of devices generating interrupts is greater than the number of lines, then some lines must be used as in single line interrupts. The M6800 has two multi-level interrupts within the chip, such as in Fig. 2b.

Vectored Interrupts: In this case, only one line is used, but the interrupting device generates an instruction onto the data bus which causes the CPU to jump ("vector") to a predetermined subroutine. The device priority must be resolved in hardware external to the CPU (the 8080A has a limited form of vectored interrupts). Fig. 3 is a block diagram of a vectored interrupt configuration.

On return from an interrupt, the CPU must be returned to the state it was in before the interrupt occurred. This is often done by a specific instruction, Return from Interrupt (RTI, hex 3B on the M6800). This brings the contents of the registers (especially the Program Counter) back from the stack, so that return to the main program can be accomplished.

With a microprocessor, control lines other than the interrupt lines may be used as specific purpose interrupts, and in most systems they are. The control bus lines, HOLD and WAIT (or their equivalents), are normally used for slowing down or synchronizing the CPU to slow memories. They can also be used as Halts for DMA (Direct Memory Addressing) applications.

The RESET line is a major interrupt line which returns the processor to some initial state to halt the execution of a program. This line could be set by hardware devices any time a major catastrophe occurs (such as a tape drive failure).

Such control lines are normally used to provide versatility for the microprocessor in different machine implementations of the chip and to allow it to be used with a wide variety of devices, e.g., in parallel processing, where several processors are using the same memory (Fig. 4) and switch each other off or on along the HOLD/WAIT lines. Although these lines were designed for interface with slow memories, they are particularly well suited to allow parallel processing and other DMA applications.

An example of the use of DMA would be for slow to fast scan conversions using a microprocessor. The SSTV analog could be digitized (analog to digital conversion) and stored, and the wideband ATV scanned off the same memories by DMA for display on a normal TV set. Think of the graphics facilities this would allow for both SSTV and ATV!

Similar examples of the use of interrupts can be considered by multi-user computers. An example would be to put the microprocessor up near the local repeater and have it accessible to amateurs with RTTY gear. In this case, the use of interrupts would be essential (for timing users, I/O transmission control, etc.).

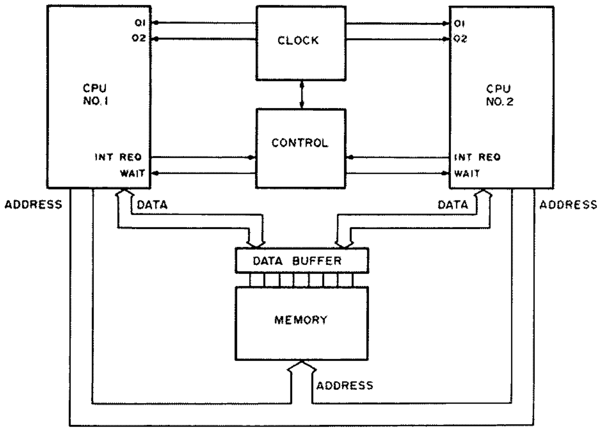

Fig. 4. Parallel processing.

Closer to home, interrupts allow the user to have input and output to several devices occurring simultaneously (or almost) and not wasting time while doing this. As in most computers, the actual processing time is very short in comparison to the input/output time; this means the more time taken for input/output during the processing, the less efficient your programming will be (which may not be a major consideration with home systems today, but will be in the years to come). ■

CW for the 6800

- - it works!

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What? A Morse code reader? And it hasn't been four months since Wayne Green frothed all over his *73* editorial page because another computer mag, in covering computerized Morse code, suggested that 1000 wpm Morse QSOs were possible, and apparently not unlawful. At the moment, anyway.

OK, so I agree with Wayne, at least partially. For one thing, I would probably pay an admission fee just to watch two hams wax extemporaneous at 1000 per. For another, if high speed data transmission is needed, Morse and on-off CW is definitely not the best modulation scheme.

That brings us to this particular Morse reader. It is not designed for high speed, but instead for 5-20 wpm. Its main purpose is to take a subject that a ham has some familiarity with (Morse), and demonstrate what happens as it is processed, decoded, and displayed by that enigmatic box (an SWTP 6800 computer) said ham got for Christmas. If, in the process,

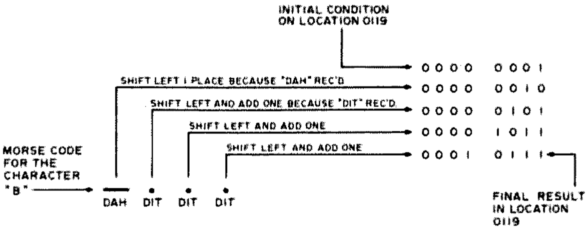

Fig. 1. Example of address generation for decoding table.

Loc.	Data	Remarks
0000	20	Long mark fix
0001	H20	H 20= Space
0002	54	H 54= T
0003	45	H 45= E
0004	4D	H 4D= M
0005	4E	H 4E= N
0006	41	H 41= A
0007	49	H 49= I
0008	4F	H 4F= O
0009	47	H 47= G
000A	4B	H 4B= K
000B	44	H 44= D
000C	57	H 57= W
000D	52	H 52= R
000E	55	H 55= U
000F	53	H 53= S
	•••	
0012	51	H 51= Q
0013	5A	H 5A= Z
0014	59	H 59= Y
0015	43	H 43= C
0016	58	H 58= X
0017	42	H 42= B
0018	4A	H 4A= J
0019	50	H 50= P
	•••	
001B	4C	H 4C= L
	•••	
001D	46	H 46= F
001E	56	H 56= V
001F	48	H 48= H
0020	30	H 30= 0 (Zero)
0021	39	H 39= 9
	•••	
0023	38	H 38= 8
	•••	
0027	37	H 37= 7
	•••	
0029	21	H 21= ! ($\overline{KN}$)
	•••	
002D	2F	H 2F= / (Slant sign)
002E	2D	H 2D= - ($\overline{BT}$)
002F	36	H 36= 6
0030	31	H 31= 1
	•••	
0035	25	H 25= % ($\overline{AR}$)
	•••	
0037	3D	H 3D= = ($\overline{AS}$)
0038	32	H 32= 2
	•••	
003C	33	H 33= 3
	•••	
003E	34	H 34= 4
003F	35	H 35= 5
	•••	
004C	2C	H 2C= , (Comma)
	•••	
006A	2E	H 2E= . (Period)
	•••	
0073	3F	H 3F= ? (Question mark)
	•••	
007A	5D	H 53=] ($\overline{SK}$)
	•••	
00FF	23	H 23= #(Error)

Fig. 2. Decoding table.

said ham discovers that machine language programming agrees with him, and he then goes on to improve and modify this program until it is really good, I shall be happy.

My system consists of an SWTP 6800 with 8K of memory (I plan on a minimum of 16K), CT1024 TVT interface, a surplus full ASCII encoded keyboard which has a lower case lockout key, an AC-30 cassette interface, a 12" Zenith black and white TV converted to a monitor, and one extra general purpose parallel interface board, which is plugged into location 8000.

This is the first programming I have ever tried, so go easy on the criticism; you are definitely not shooting at big game.

I will attempt to answer any questions that my limited technical expertise will allow, and welcome anyone to drop in for a gab session if you happen by my QTH.

The Program

This program will run in as little as 2K of memory, but you do need the extra parallel interface card. Wire the input plug so that I-1 through I-7 are grounded and your hand key (or any make-break keyer) connects between I-0 and gnd.

With the key open, the input line (I-0) floats high like any TTL input. This means the program expects a logic 0 as evidence of activity.

The program does a pretty good job of reading my hand key (very sloppy) or my home brew "accu-keyer"[1] which is reed relay output. It will compensate for speed changes from less than 5 wpm to more than 20 wpm. But, here resides one bug for you to work on. It will not swallow that much of a speed change in one gulp. It must have a couple of letters input at mid-range to bring AV DOT (average dot) closer to agreement with what is actually coming in.

How does it distinguish between a dot or dash? The decoder is based almost entirely on dot length. Why? Did you ever hear an ancient brasspounder on a vibro-plex? A "V" usually comes out sounding like a spooked deer crossing a narrow meadow: three staccato dits and a dah that floats for an impossible time. So, if a single dah lasts for half a day, the decoder will simply call it a "T" and make an adjustment to COUNTER, assuming that the next dit will be of proportionate length.

If the incoming mark is any number less than twice the AV DOT, it is called a dot, added to AV DOT, divided by two, and inserted back in AV DOT as a new average. This is the way it makes speed adjustments. Immediately following a mark, it must decide if the ensuing silence is an element space, a character space, or a word space. We do this by cycling through TIMER, incrementing COUNTER each time, comparing COUNTER to AV DOT each time, and checking for more input each time. If new input occurs before two AV DOTs, it is called an element space, and goes back to process the new input for insertion in TEMP CHAR STORAGE with the last insertion.

If COUNTER gets as high as two AV DOTs, it is a character space, and falls through to the output subroutine, prints the character, then reenters the space routine to determine if a word space is necessary. If it again reaches two AV DOTs without interruption, it again falls through to the print command, but this time a reinitialized TEMP CHAR STORAGE contains only a binary 0000 0001, which, when translated to an LDA-A direct from location hex 0001, loads A with hex 20 (stored there). Hex 20 is an ASCII space, and that's what is printed. At this point, having been through the space decode more than once without interruption, the program jumps back to the beginning, and waits for more input.

Now, how is decoding and storing accomplished? There have been several different methods published. Most involve dual input registers, complementing, adding, and so on. Being somewhat simple to start with, I prefer a simple method. And, if you can call a dit a logic 1, and a dah a logic 0, what could be simpler?

Only one slight hitch: How do you distinguish between an S, M, T, and zero? These would all give an

Fig. 3. Morse code receive program listing.

0105	00		COUNTER	
0106	12		AV DOT	
0107	28		FIXED DELAY	
0108	B6	0106	LDA-A	
010B	F6	0107	LDA-B	
010E	5A		DEC B	
010F	26	FD	BNE	
0111	4A		DEC A	
0112	26	F7	BNE	
0114	7C	0105	INC COUNTER	
0117	39		RTS RETURN	
0118	00		(Not used for anything now.)	
0119	00		RMB TEMP CHAR STORAGE	
011A	86	04	LDA-A	Initialize Interface
011C	B7	8003	STA-A	
011F	86	01	LDA-A	Initialize TEMP CHAR STORAGE
0121	B7	0119	STA-A	
0124	7F	0105	CLR	COUNTER
0127	B6	8002	LDA-A	Get input
012A	81	00	CMP-A	Still high?
012C	26	F9	BNE	Back to 0127 if no input
012E	BD	0108	JSR	To TIMER
0131	B6	0105	LDA-A	Have mark count
0134	81	30	CMP-A	Check for long mark
0136	25	0D	BCS	If not, go to 0145
0138	B6	0000	LDA-A	Get fix
013B	B7	0105	STA-A	Put in COUNTER
013E	B6	8002	LDA-A	Check input
0141	27	FB	BEQ	Recycle if still active
0143	20	25	BRA	Call it a dash
0145	B6	8002	LDA-A	Check input
0148	27	E4	BEQ	Back to 012E while active
014A	B6	0105	LDA-A	New count
014D	44		LSR-A	Div new count by two
014E	B1	0106	CMP-A	To AV DOT
0151	24	17	BCC	To ENTER DASH at 016A

[1] *QST*, August, 1973, J. M. Garrett WB4VVF.

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0153   48          ASL-A   Restore
0154   F6   0106   LDA-B   Get old count
0157   C4   7F     AND-B   Restrict to 7 bits
0159   1B          ABA     Add accumulators
015A   BD   01A2   JSR     See count doesn't get too short
015D   78   0119   ASL     Prepare to enter dot
0160   86   01     LDA-A
0162   B8   0119   ADD     0119 to A
0165   B7   0119   STA-A   ENTER DOT
0168   20   03     BRA     To space decode
016A   78   0119   ASL     ENTER DASH
016D   7F   0105   CLR     Clear counter
0170   BD   0108   JSR     To timer
0173   B6   8002   LDA-A   Check input
0176   27   37     BEQ     If active, was element space, go to 01AF
0178   B6   0106   LDA-A   Get AV DOT
017B   48          ASL-A   Mult by two
017C   B1   0105   CMP-A   Compare to counter
017F   22   EF     BHI     If less than 2 AV DOTS, go to 0170
0181   F6   0119   LDA-B   Get temp char storage
0184   F7   0188   STA-B   Store in OFFSET (0188)
0187   96   00     LDA-A   Direct from loc specified
0189   BD   E1D1   JSR     Now print it!
018C   86   01     LDA-A   Prepare to print a space
018E   B7   0119   STA-A   Store in temp char storage
0191   7C   01A1   INC     Increment space storage
0194   B6   01A1   LDA-A   Get space storage
0197   81   01     CMP-A
0199   23   D2     BLS     If same or less, go to 016D
019B   7F   01A1   CLR     OK, clear it now
019E   7E   011F   JMP     Go wait for new input
01A1   00          RMB     SPACE STORAGE
       **************************
01A2   44          LSR-A   Div by two (from 015A)
01A3   81   08     CMP-A
01A5   23   04     BLS     If same or less, go to 01AB
01A7   B7   0106   STA-A   Store new av dot
01AA   39          RTS     Return
01AB   86   14     LDA-A
01AD   20   F8     BRA     Back to 01A7
       **************************
01AF   7F   01A1   CLR     Clear space storage (from 0176)
01B2   7E   0124   JMP     To 0124; it was element space
```

identically empty register. Or worse, how about N and E? Both would give a binary 0000 0001. There would be other similar mix-ups, and changing to calling a dit 0, and a dah 1, is the same situation viewed from the backside. OK, it looks like we need a "place marker." Bingo! That's it. All we have to do is pick a place for temporary storage (we'll use memory location hex 0119), and initialize the data there to binary 0000 0001. Now, when we have a dah to store, we instruct hex location 0119 to "arithmetic shift left" (ASL). This moves everything left one bit, and puts a zero in the least significant bit (0000 0010). When we have a dit to store, it's just a bit more complicated: We shift location 0119 left (ASL 0119); then we store a 1 in the A accumulator. We then add H0119 to the A accumulator and then store the A accumulator in location 0119. In this case, with a single dit and nothing else entered, 0119 would contain 0000 0011. After keying in a properly spaced B, the data in 0119 would be 0001 0111 (see Fig. 1).

Now that we have numbers we can work with, how do we get them on the screen?

With the SWTP 6800, you can use the existing MIKBUG output routine located at hex E1D1. The literature says that to use this routine, the ASCII equivalent of the character to be printed must be in the A accumulator when the routine is entered. All we need do is convert our binary gibberish to ASCII and store it in the A accumulator, then execute a BD E1D1. The ASCII conversion works like this: We need another temporary storage register to put a completed binary character in. We'll use hex 0188. Now, remember that B (0001 0111 in binary)? Since the computer uses hexadecimal notation, let's see what it is in hex:

$$\underbrace{\underline{0001}}_{1}\ \underbrace{\underline{0111}}_{7} = \text{B in binary} \qquad = \text{hex}$$

We tell the computer to load the information found in hex 0119 into the B accumulator. Then we store the B accumulator contents in hex 0188. At this point, we have a hex 17 in location hex 0188 (still dah di-di-dit). Next, we use base page addressing and say: (refer to the program listing, 0187 & 0188) 96 17. This is an instruction which says load the A accumulator with the information to be found in hex 0017. In this mode of addressing, we can specify hex locations 0000 through 00FF. You guessed it, that's where the decoding table is stored (see Fig. 2). At location 0017, the stored information is hex 42, which is an ASCII B.

At hex location 0001, we have stored hex 20, which is ASCII SPACE, so when the program prints a character, then makes two more TIMER runs through space decode without interruption, it prints the information pointed to by location 0119 (which is 01). Then it goes back to wait for more input.

You will note that blanks occur in the decoding table. These are unassigned in the Morse code. Morse was evidently not assembled from a logical base. I would not recommend assigning and using these blanks over the air. The FCC might take a dim view of that.

However, I do urge you to try to follow the program through a cycle (Fig. 3 is a full listing of the program). Armed with that much familiarity, I'll bet you can make changes that will improve it.

Conclusion

After you load the program, set location A048 to 01, location A049 to 1A, then G. To play with the decoding speed, go back to MIKBUG and change the values located at 0000, 0106, 0107, 01A4, 01AC, and 0135. The numbers located there now are not a result of calculations; they were just selected as something that seems to work.

As a suggestion, perhaps two dit lengths is a bit long for an element space, as Morse is actually sent. How about one and a half, and keep two for a character space?

I have tried the NE567 tone decoders for input from my transceiver and haven't had much luck. The 567 takes a few input cycles to lock on, and if the copy is not crisp, or there is QRM, it will often not drop out at all.

Good luck, and may you become more proficient with machine language programming by trying to understand this. ■

The Super Clock

-- what'll they think of next?

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Here is a really unique digital clock. Using the Cal-Tex CT7001 MOS/LSI integrated circuit gives you a 12 or 24 hour clock, four year calendar, 24 hour alarm, 9 hour 59 minute timer, 50/60 Hz operation, failsafe battery operation, and will drive either common cathode or common anode seven segment LEDs. The basic circuit is built on a PC board only 3.3" by 5" and will fit in Radio Shack's wood grain utility cabinet. By using a larger enclosure, a back-up battery pack may be added, along with a relay to operate external loads with the timer. Construction cost should be around forty dollars with careful shopping.

The schematic shown in Fig. 1 is adapted from both the Cal-Tex and Radio Shack data sheets, plus my own ideas from past (unsuccessful) experience. The alarm circuit shown, Q14, 15, and 16, is quite annoying in the early hours of the morning. (Anyone want to beat my record of 5 seconds hitting the snooze from across the room?) I'm using an earphone element from an old telephone for the speaker, and it's loud. The display drive circuit can be programmed with jumpers for either type of LED. Fig. 2 is the board layout for multiplexed common anode, and Fig. 3 is for common cathode.

The power supply is simple and straightforward. However, use a heavy duty

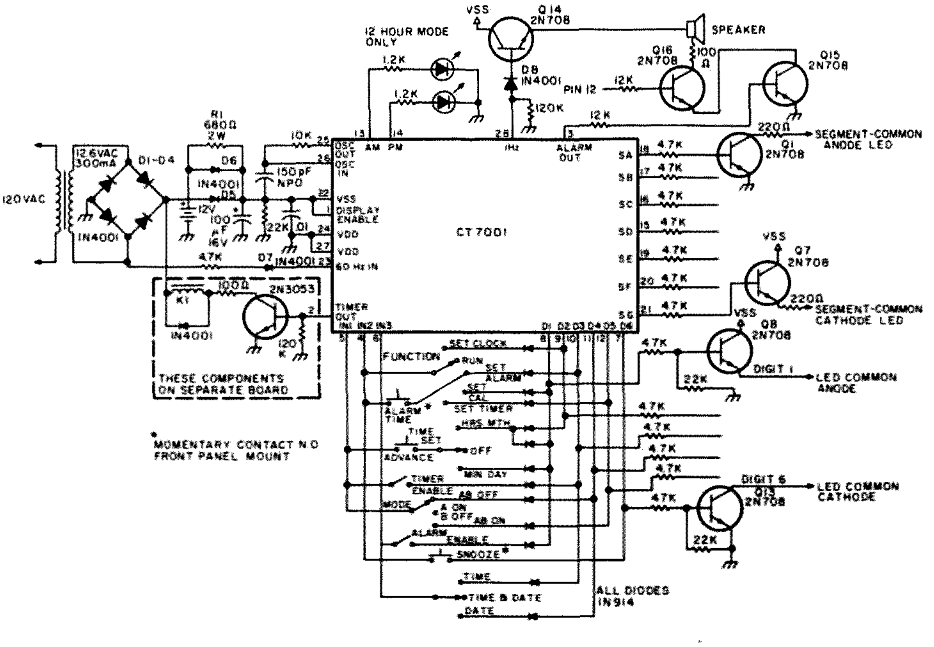
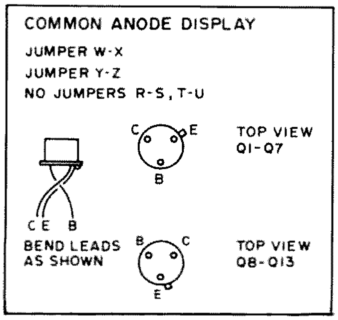
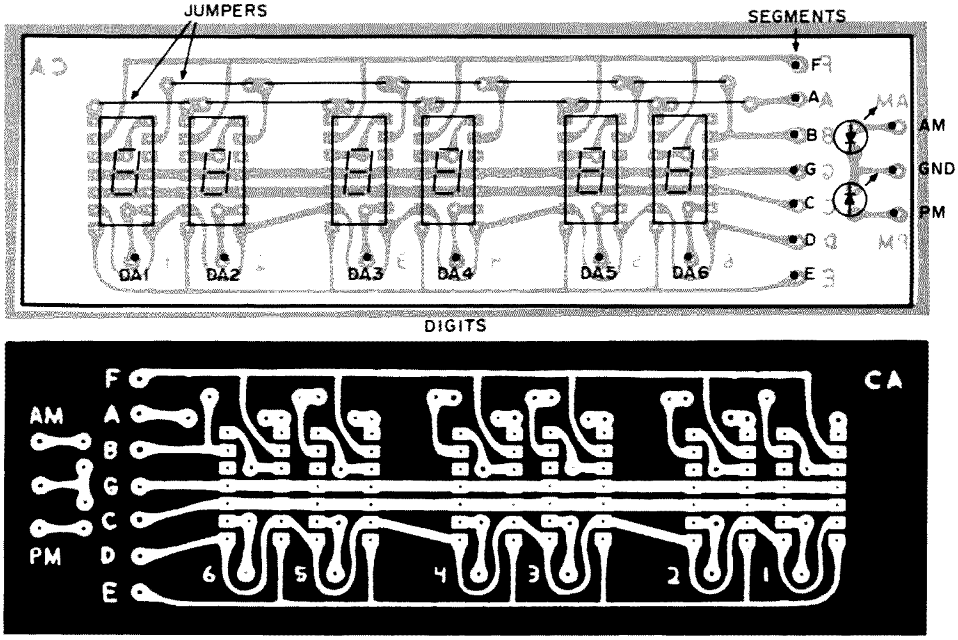


Fig. 1. Select appropriate switching for LED display being used. See Fig. 4.

Fig. 2. PC board and parts layout for common anode LED display. Board is multiplexed for Monsanto LEDs: MAN 1, 1A, MAN 5, 7, 8, MAN 51, 52, 71, 72, 81, 82. Cut pin 6 on LED (decimal point) as it is not used. Board is 1.5" x 5".





nicad battery pack, as the displays are wired to be on all the time. Ac is sampled from one side of the secondary of the transformer through a resistor and diode to drive the chip timers and counters. The power supply also supplies current for the timer relay. Use a low current 12 volt relay with contacts rated at at least 3 Amps for driving external loads.

The am and pm indicators will only operate in the 12 hour mode. They may be omitted if you wire for a 24 hour clock.

Fig. 4 is the parts layout for the main board. Please note that an insulated washer must be used at the mounting hole next to Q13 if you use common anode displays. It is not needed for common cathode.

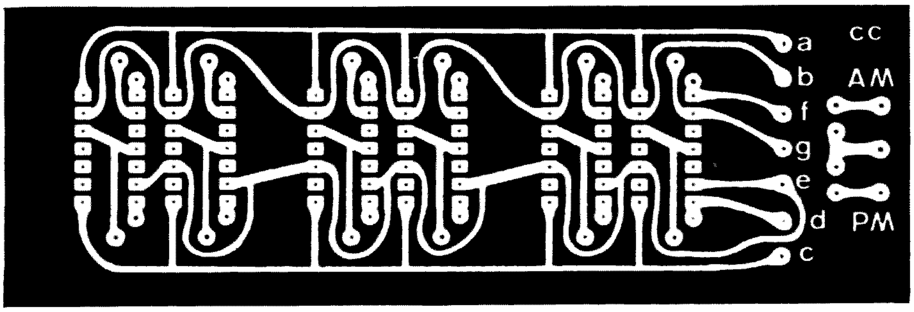
Fig. 5 is a full size negative layout for the main board. Single-sided G-10 is best, but bakelite may be used.

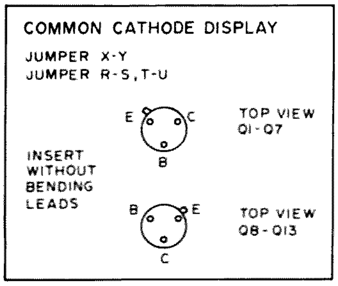
Be very careful with the IC as it can be damaged by static discharges. Once in the circuit it is relatively safe, but can still be destroyed by excessive charges (I found out the hard way).

Fig. 6 is the front and back panel layout for the clock and should be followed if the same cabinet is used; otherwise things just don't fit. The only one that's not critical is the size of the front panel cutout for the display. It may be slightly smaller or larger.

Setting the Clock

First, before installing the IC, check for approximately 15 volts at pins 1 and 22. If you don't get 15 volts, look for a bad diode in the power supply. Disconnect the line cord and carefully plug the IC in the socket. Set the switches on the back as follows: Function-Run, Time Set-Off, Timer Enable-Off,





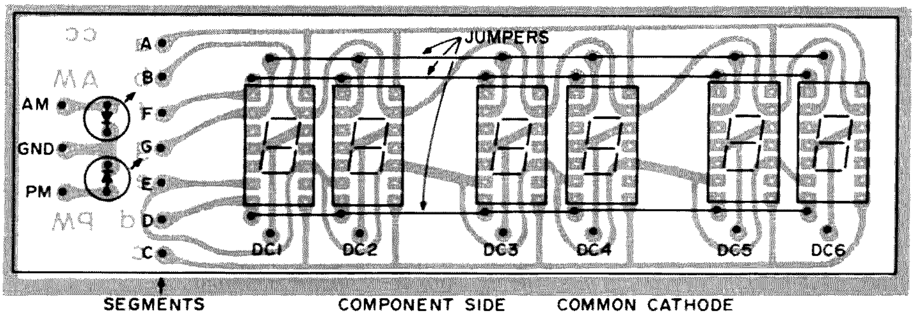
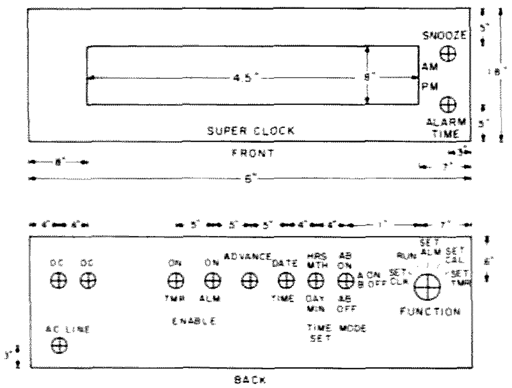


Fig. 3. PC board and parts layout for common cathode LED display. Board is multiplexed for Monsanto LEDs: MAN 54, 74, and 84. Board is 1.5" x 5".

Fig. 6. Front and back panel layout. Snooze and alarm time switches may be mounted on either side of display. Display cutout may be larger or smaller, but should be 4.5" long.



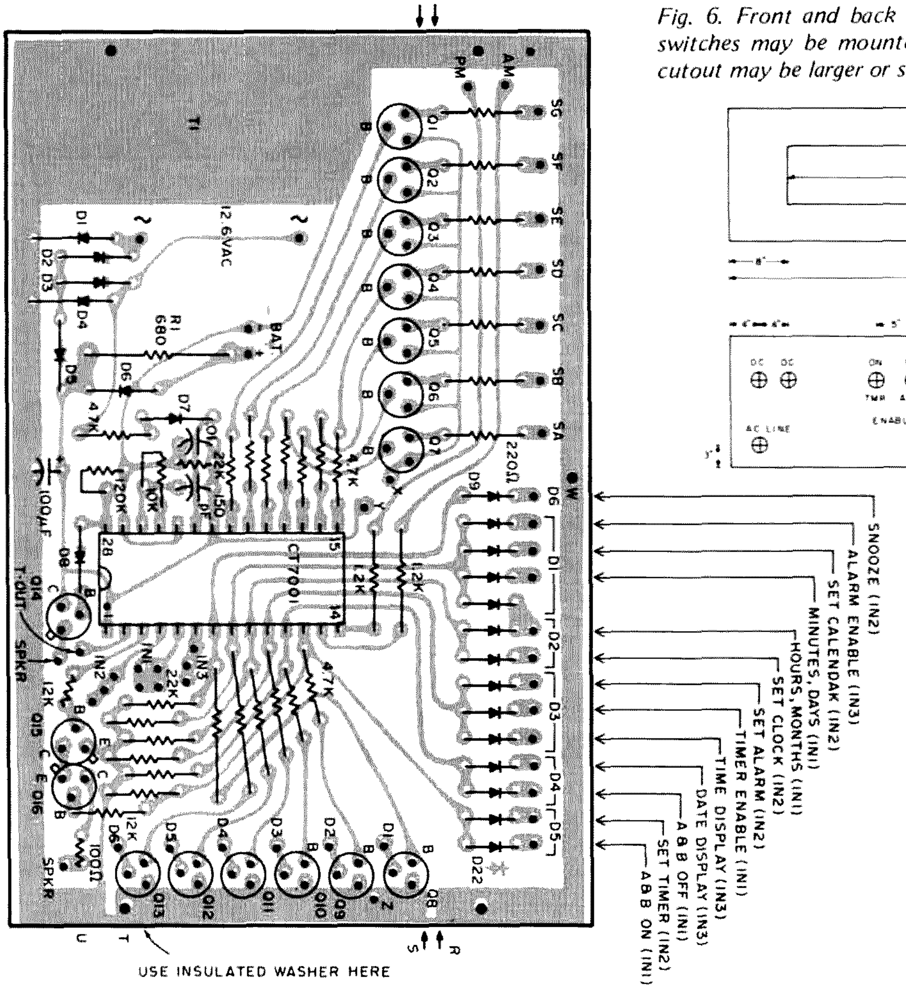


Fig. 4. Main PC board and parts layout. All resistors ¼ W, 10% except R1 — 680Ω 2W. D1-D8 are 50 volt, 1 Amp 1N4001 or similar. D9-D22 are 1N914. Displays are mounted vertically at points marked by arrows, secured to main board with plastic glue, such as Duco cement.

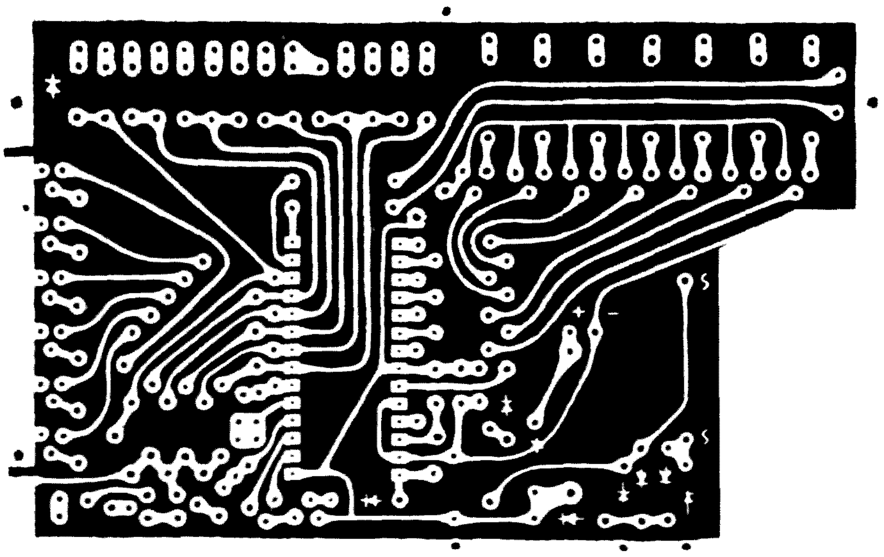


Fig. 5. Full size negative of the main board. When mounting T1 to the board, be sure the base of Q1 does not short.

Alarm Enable-Off, Time/Date-Center position. Plug the line cord in. The display should show all 8s. Set the Function to Clock Set and Time Set to Minutes/Days. Momentarily depress the Advance push-button. The display should change to all 0s. Don't worry if one or more digits are blank. Depress the Advance switch again and the minutes should start counting. Switch to Hours/Months and repeat to set hours. When the time you have set corresponds with the actual time, turn the Function to Run and the clock should start counting. Pay attention to the am and pm indicators when setting the time, as the calendar changes days at midnight. Set the Alarm, Calendar and Timer in the same manner. The Alarm may sound as you rotate the Function switch, but will stop as the times are set.

The Alarm Time push-button is a normally open switch that is wired in parallel with the Function switch so that you can check the time that the Alarm is set for without fumbling around the back. The Snooze switch is the same, and both are front panel mounted for convenience. The Time/Date switch will force the IC to display one or the other. In the center position the time will be displayed for 8

seconds and the date for 2 seconds. The Mode switch controls how the Timer will function. In the A Off, B Off position, pin 3 will be high for the preset time when Timer Enable is closed.

A On, B Off, pin 3 will be high for the preset time and at the Alarm time. A On, B On, pin 3 will be high for the Alarm time. The Timer will only function when Timer Enable is closed. Opening the switch stops the Timer counting, and disables the output.

This IC also has a back-up oscillator to keep time when operating from a battery. If you really want to get it accurate, substitute a 25k pot for the 10k resistor and adjust it as close as you can. Then wire in a fixed precision resistor of the same value.

Parts List — "Super Clock"

1	CT7001 IC	1	5 position non-shorting rotary
16	2N708 NPN	3	SPDT Center off sub-miniature
1	100 Ohm ¼ W	1	SPST sub-miniature
1	680 Ohm 2 W	1	DPDT sub-miniature
2	1.2k ¼ W	3	SP N.O. momentary contact
14	4.7k ¼ W	1	Ac line cord
1	10k ¼ W	1	Cabinet — Radio Shack #270-260
2	12k ¼ W	1	28 pin DIP socket
7	22k ¼ W	6	14 pin DIP sockets
8	1N4001	1	Main PC board
13	1N914	1	Display PC board
2	LED — Discrete		Hardware, wire, plastic window
6	LED Seven segment displays		
1	12.6 V ac 300 mA Transformer		
1	150 pF NPO		
1	.01 uF Disc		
1	100 uF 16 V Electrolytic		

Most of these parts are available at Radio Shack. If you use the above cabinet, get the sub-mini switches, or they won't fit. The seven segment LEDs are from Poly-Paks (common anode).

General Information

Once the clock is working properly and the back-up oscillator is fairly accurate, you may get the idea to use the clock in your car. That is also the reason for two dc inputs on the back: one plugging in a battery to carry it out, and one for operating off the car's electrical system. One word of warning: In some states it is illegal to use red indicators for anything except an emergency condition, so use a different color for the display if you ever plan to use the clock mobile. (All you people with digital tachometers, take note.)

If a larger case is used, the timer relay circuit may be added. With it, you can do a number of different things, such as turn a lamp on and off, turn the rig on at sched time, etc., as long as the relay contacts can handle the load.

If you use a DPDT switch for Alarm Enable, an LED can be wired to indicate when the Alarm is active. This could save you from jumping through the ceiling on Saturday morning.

The only time you'll have to manually set the calendar is Feb. 29th. February is programmed into the IC for 28 days. Oh, well, setting a clock once every four years isn't hard. ■

Add Class to Your Mobile

- - a handset for the rig

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With the popularity of autopatch and other accessories being added to the repeaters, it is little wonder that the touchtone pad is in such demand. While mobile operation is greatly enhanced by a pad in a box on the dash, it is a lot nicer and more convenient to add a complete handset with speaker, mike and touchtone in one handful.

The Trimline™ phone and other similiar designs seem to have been made with mobile operation in mind. With a few modifications they will work with any of the popular transceivers available.

The phone handset has all the goodies necessary for conversion, the base can be discarded along with the cord. You will need a microphone cord with two wires, mike lead and shield. The rigs with electronic switching may need another wire.

To disassemble the handset, pry out the name just above the dial with a screwdriver; this exposes the light and two screws. Remove the light and discard, and remove the two screws and save. Slip the back cover out and down to remove it from the main portion of the handset.

Looking at the cord end with the dial facing down you will observe five prongs. You will also notice where they are attached to the printed circuit. Number them one through five, left to right. Solder the shield from the mike cable to #3, which will be ground (-). Solder a small jumper from #5 to #3 for the dial light return. Solder a 47 Ohm 1/8 Watt resistor from #2 to #4 for lamp power. Solder the mike hot lead to #2.

Now remove the two screws holding the PC board to the earphone element. Carefully pry up the PC foil away from the element. Use the same screws and run a twisted pair of wires from the earpiece terminals down the right side of the handset into the vicinity of the incoming mike cable. Place a layer of black tape over the screws and wires. Now remove the earpiece cover by removing the two screws which hold it in place. With this removed, decide where you will want your push to talk button, and install it appropriately, running the wires down the left side of the handset. Again use a twisted pair of wires.

At the bottom of the handset, join one of the earpiece wires with the "ground" lead from the PTT switch and solder them to #3. The other earpiece wire will go to the black mike cable lead, and the other PTT lead will go to the red mike cable lead. Your handset is now almost finished.

Pull out the earpiece unit carefully and you will notice that it also is the holder for the dial lamp. Install two LEDs of your color choice, one to each side of the lamp clamp. The reason to replace the lamp with LEDs and a series resistor is so you can see the dial in the dark and not have the "short" across your mike lead which the lamp would be if left in. The handset power will come in the hot mike lead.

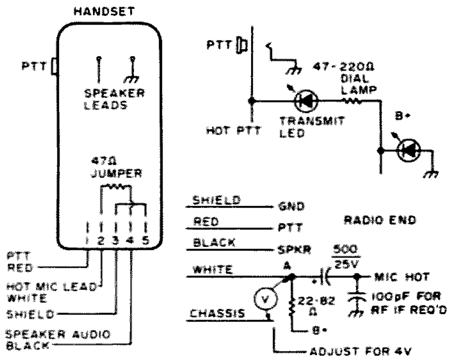
Now observe your transceiver. Either replace the mike connector with one with enough pins for all necessary connections, or throw it away and push your new cable through the hole. It is often more convenient to discard the old mike connector and install a terminal strip nearby, firmly attached to a ground, to hold the end of the new cable. Now it is assumed that your circuit boards have a common ground (not like the Drake ML-2), and one side of your speaker goes to ground.

The shield goes to ground. The hot mike wire goes to its normal place in series with a 500 uF 25 V electrolytic; use short leads. The PTT wire goes to its normal connection, and the hot lead of the speaker goes to the remaining mike cable. Now, find a source of voltage which is greater than 6 volts positive in transmit. Insert a small pot in series with the voltage source and the junction of the capacitor and the new hot mike lead. Adjust the voltage at the junction until you have 4-6 volts. Replace the pot with the closest fixed value *over* the value of the pot reading. This will typically be 22-68 Ohms. A ¼ Watt resistor is sufficient.

Using a Clegg FM-27B, a 56 Ohm resistor was used. No additional adjustment of the deviation was necessary.

The handsets with the integrated circuit produce the best audio and tones when operated from 4-6 volts. Voltage levels above and below this result in low or no audio and distorted, low or no tones from the pad.

For real class, you could use green LEDs for normal dial lights and red LEDs from the PTT to show transmit! Again place a series resistor in the LED lead and run it from the hot side of the PTT switch and the hot side of the



other LEDs, but in reverse so grounding the PTT lead turns on the LEDs. Now that's class.

Also, if you have a Clegg FM-27B, you can improve the receive audio intelligibility and get rid of the annoying speaker rattle by replacing the .1 uF capacitor with a .01 uF capacitor (C-62) and thus roll off the low frequencies.

Now button up the handset, clamping the mike cord so it won't fall out, and put the case back on the radio.

In case you are wondering what to do with the old mike connector: If you have a Clegg, use it to replace the power connector on back for a vibrationless tight connector that won't fall off when you go over the razorback roads. While you're at it, put a couple of miniature (imported) 470 uF electrolytic capacitors across the connector inside the radio. It seems to help if you are having alternator whine on your audio and also smooths out voltage fluctuations.

Happy motoring and QSOing with your new telephone handset. ■

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The Final Feeder

-- driving a high power amplifier

Hey Bunky: Building that new contest amplifier and worried about cooking those grids with excessive drive power?

Tried to find neutralizing capacitors lately?

Don't have enough drive for that pair of 4CX5000s in grounded grid?

Well, this article just might be what you need!

Several months ago I was involved in building up a pair of 4CX350As and wanted, out of sheer laziness, to keep the grid circuit as simple as possible. The thought of operating the tubes in grounded grid came first, but Eimac's maximum grid current rating of 2 mA put the kibosh on that idea fast. The only alternative was to feed the grids, but the thought of tuned circuits and neutralization was enough to make me try to find a better way.

Most SSB amplifiers are operated in class AB1 and theoretically don't need any driving power, just voltage. If you look at Fig. 1 you will see a nice 50 Ohm dummy load to soak up the power from the exciter. The power rating depends on the drive; I have 200 Watts available, so I used 20 1k 11 Watt glass resistors in parallel, sandwiched between two pieces of PC board.

The spec sheet on your tube(s) should now be consulted to find out how much peak grid voltage is needed to drive them to full output. Next, calculate the rf voltage across the dummy load, using:

$$\frac{E^2}{R} = W$$

where W = drive power, E = voltage and R=50. If you have 200 Watts available, for example, your available voltage is about 100 volts rms. R1 and R2 form a resistive divider to adjust the drive voltage to the desired level. 4CX250Bs need about 40 volts rms of drive so R1 and R2 should be 1k. This puts 50 volts on the grid which insures enough drive and lets a bit of grid current flow. The actual values of R1 and R2 aren't all that critical. For example, I replaced one of the 1k resistors in the dummy load with three 330 Ohm 2 W carbon jobs in series which gave me a range of adjustment. You could probably use much higher values, say 4700 Ohm jobs in series, and get a little better match to the high impedance input of a tube which should reduce IM products somewhat. The only important factors are the ratio of resistances, and the wattage rating of same. The entire input network loads the grid circuit down so that the chances of the tube taking off are minimal.

When all is put together, watch the grid current. If you get an occasional flicker on voice peaks, you've got it on the nose. If you have too much current indicated, increase R1 some and try again, Good luck. ■

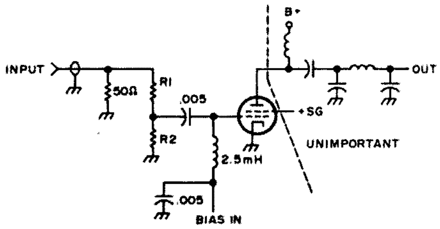

Fig. 1. Power amplifier using resistive grid circuit.

What About Surplus Nicads?

-- how to test and repair them

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If you are the proud owner of a hand-held two meter transceiver, you are aware of the need of a battery pack that is in good condition, particularly when transmitting. Weak or defective cells in the battery will cause the transmitter to lose power rapidly. If your transmitter dies after only 10 or 20 minutes of use after charging, read on. A Motorola HT-220 transmitter will put out 1½ to 2 Watts plus with a fully charged 15 volt battery. When the battery voltage drops to 12 volts, the output of the transmitter will drop to ½ Watt or less. The receiver will continue to operate on 9 or 10 volts with reduced audio output. A good battery should be able to give about one hour of transmitter operation before its voltage drops to 12 volts. In commercial use, the 15 volt 450 mAh Motorola nicad battery is rated at 48 minutes of transmitter operation, 48 minutes of receiving, and 6 hours 24 minutes of standby operation per 8 hour day before recharging. If you purchased a new nicad battery, you should be able to get results similar to these with no problem other than the severe jolt to your pocketbook from the cost of the new battery. They are not inexpensive. You can ease the strain on the pocketbook by going the surplus route and rebuilding used batteries. In addition, you should find it an interesting project to work on.

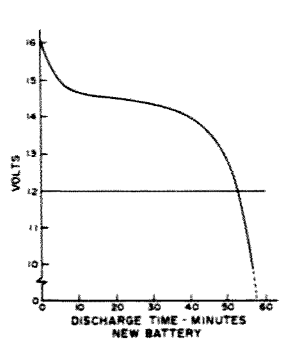

Fig. 1.

To test a nicad battery pack, charge it for 14 to 16 hours at 10% of its mAh rating (i.e., a 450 mAh battery should be charged at a rate of 45 mA, and a 225 mAh thin pack should be charged at 20-25 mA). Rapid charge batteries can also be charged at this slower rate or in a special rapid charger at its recommended time.

After charging, connect a voltmeter across the battery and a load resistor to discharge the battery at the same rate as the transmitter. The load resistor should also match the size of your battery. For a 450 mAh 15 volt Motorola battery, the load resistor should be 32.5 Ohms, and for the 225 mAh Motorola thin pack nicad battery, the proper load resistor is 65 Ohms. Resistors can be connected in series or parallel combinations to get these values and should have a 5 or 10 Watt rating. Take readings of the voltage every minute starting when you begin discharging the battery through the load resistor. After the first 10 minutes, take readings every 5 minutes until the voltage begins rapidly dropping. At this point, take readings every minute again until the voltage drops to about 10 or 11 volts. A nicad battery has reached its fully discharged voltage at about 0.9 volt per cell (i.e., a 12 cell 15 volt battery is fully discharged when it drops to 10.8 volts). To discharge it below this value may damage cells in the battery. Plot a curve on graph paper of the battery voltage vs. discharge time in minutes. New batteries will have discharge curves as shown in Fig. 1. You can see that after the first few minutes of discharge, the battery voltage stays almost constant between 14.7 and 14 volts for quite a period of time. As it nears the end of its discharge, the voltage drops off quite rapidly until it reaches its discharged voltage of 10 to 11 volts. Note that the 12 volt point where the transmitter power has begun to drop drastically is very near the fully discharged voltage as well.

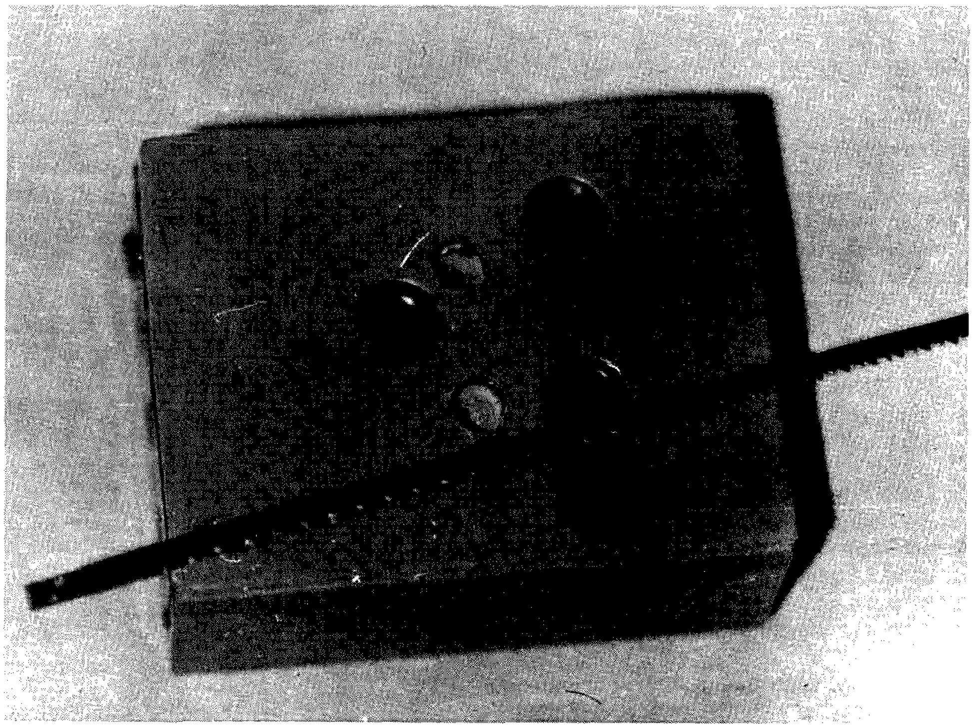

Photo 1. Motorola HT-220 nicad battery with posts drilled out and showing a coping saw blade used to saw around the edges of the top of the case.

What are we likely to find in a surplus nicad battery? Figs. 2 and 3 are typical. The battery in Fig. 2 appeared almost normal for the first 23 minutes of discharge and then dropped abruptly, decreasing rapidly again at 33 minutes. It has two cells that only take a partial charge and become completely discharged at the points of sudden voltage drop. Locating and replacing these cells with good ones will likely result in a battery almost as good as new. You can elect to use it as is if you are satisfied with recharging it after about 20 minutes of transmitter time, since it will deliver almost full power the first 20 minutes. Fig. 3 is more typical of what you will find, however. Here the battery voltage never did come up to full voltage when charged, and it dropped off to below 14 volts rapidly, going below 13 volts after 25 or 30 minutes of use. This lower voltage results in decreased transmitter output almost from the start. The fact that this battery never charged up to 16 volts indicates a shorted cell. Replacing one cell almost brought it up to par, but it still would not last for more than 48 minutes. Locating and replacing the cell that was weak resulted in a battery almost as good as new, as can be seen by the curve just below the new battery reference. You might try Peter A. Stark's (K2OAW) method of "Zapping Dead Nicads to Life" which appeared in January, 1976, *73 Magazine*, to rejuvenate the shorted cell in this last battery. The battery in Fig. 2 does not have shorted cells so would not respond to his suggested treatment.

This method of testing should enable you to identify the type of problem your surplus battery is plagued with: dead cells, weak cells, and cells that accept only a partial charge. Some batteries charge up to normal voltage but lose it overnight or in a few days due to high internal leakage from electrolyte vented from a cell. After opening a battery with this defect, the cells should be washed in running water to dissolve the electrolyte and, after drying, should be charged and load tested to determine the good cells in the battery. I personally have not had much luck rebuilding this type of defect.

The next problem to solve is how to get inside of the plastic case of the battery. I use a thin blade coping saw to just cut through the plastic without sawing into the cells as shown in Photo 1. The two plastic posts near the center of the battery must also be drilled out before the plastic face of the battery can be removed. Most batteries show a dimple where the posts are located. Drill into the center of the dimple with a 1/16" drill. They are hollow and the small drill will feed into the hollow part. Then use a ¼" diameter drill to just drill through the thin plastic. Do not drill too deeply with the large drill because there is danger of drilling into the cells and damaging them. Use the sharp point of a knife to cut through the plastic along the sides where the saw did not cut through completely. It is better to do this than to saw too deeply and damage cells. While this is rather a delicate operation, it can easily be done with a little care and patience. The penalty for sawing into a cell is that you will have to discard it. If you try to saw the battery case apart on the sides along the lines where it was originally cemented together, you will almost surely saw into cells, damaging them.

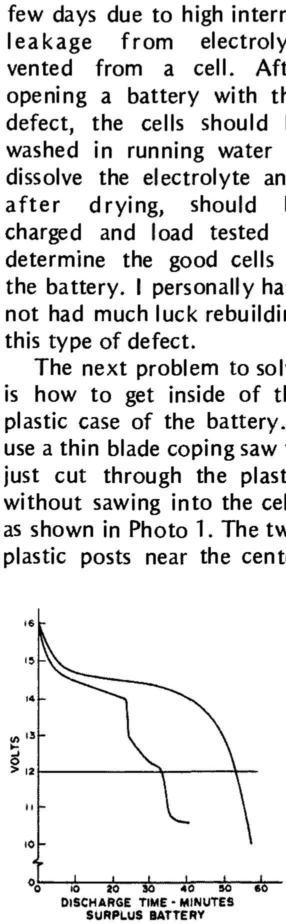

Fig. 2.

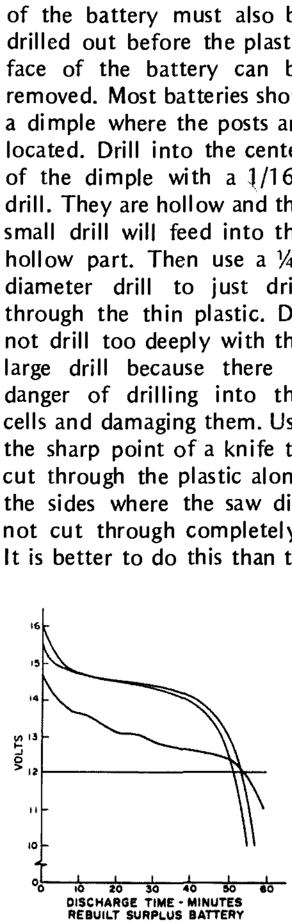

Fig. 3.

Photo 2 shows the inside of the battery after removing the top face. You can pop the cells out of the case by holding the battery upside down over your hand and hitting the palms of your hands together. The cells should come partially out – enough to grasp them with your fingers to pull them out the rest of the way.

Measure the voltage of each individual cell of your discharged battery. To do this you will have to carefully lift the insulating sheet on the terminal connection side of the battery to get at the cells. Any cell that measures less than 0.9 volt on a discharged battery is probably defective.

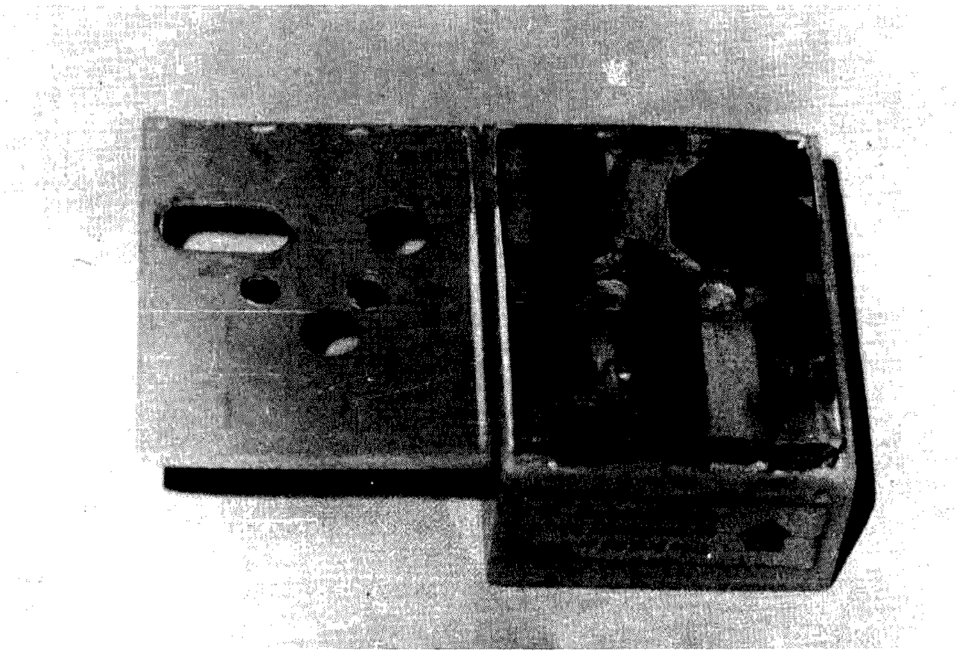

Photo 2. Shows the inside of a Motorola HT-220 nicad battery after separating the top of the case from the rest of the case.

Mark defective cells with a felt tip pen. To make sure that all defective cells have been identified, connect the load resistor across the battery and quickly measure the individual cell voltages. Mark any additional cells that are below 0.9 volt. Using clip leads, connect the battery to your charger and charge it completely. Discharge it with the load resistor and, as it is discharging, measure individual cell voltages to identify which cells discharge first, or are dead.

Repeat this testing procedure on additional used batteries, preferably three batteries. You should have enough good cells to rebuild two of the batteries having the fewest defective cells, and possibly have a few good cells left over for future repairs or for use in some other project.

Remove the defective cells by peeling the connecting straps off the defective cells with a long nose pliers, or better yet, a needlenose pliers. The welds break quite easily. Remove good cells from one of the batteries that you plan to break up, preferably from the same location as the defective cell in the battery you are repairing. If two good cells are adjacent to each other, clip the strap between the two cells, so both can be used. I have used two methods to connect the replacement cells in the battery. I bend the long lead and the shorter clipped lead to form hooks that interlock. When pressed together, they seem to make a satisfactory contact when held by the case after the battery has been assembled. The leads can also be left flat and overlapped slightly and soldered. Put the cells back in the case and give the battery a full charge. Run a discharge test on your rebuilt battery to see how good a job you have done in replacing defective cells with good cells. If you have been successful, you should have a rebuilt battery that meets 80% of the required 60 minutes, or 48 minutes, before it drops to 12 volts. It should also have remained above 14 volts for 35 minutes or more, with a smooth drop-off to 12 volts in 48 to 50 minutes. Starting with three used batteries, you hopefully have been able to rebuild two good batteries and have a few cells left over. In many used batteries you only have to replace one or two defective cells. Use transparent adhesive tape to fasten the cover tightly in place. The pressure from the cover plus the pressure from the battery cover on the hand-held transceiver seem to provide contact between the interlocking straps.

Just a few hints on selecting your surplus nicad batteries: Avoid batteries with distorted, partly melted cases. Most of the cells are usually damaged or in poor condition, probably because the electrolyte has been boiled out of the cells by excessive heat. Select batteries with smooth cases. Many of the pull-outs from commercial service have failed to pass the load test because one or two out of the twelve cells have gone bad. Surplus nicads are available from Spectronics Inc., 1009 Garfield St., Oak Park IL 60304. Surplus Motorola batteries that take a charge and test in the OK zone on a nicad battery tester sell for $10, and those that do not test OK are sold at a bargain 3 for $5. These are the ones I used, so good luck in rebuilding batteries for your transceiver. ■

April - 1977

The History of Ham Radio

- - part II

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Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

1917

During the hostilities of World War I, in which the United States was involved from April, 1917, to November, 1918, there were no amateur activities on the air. After the armistice was declared, amateurs still had to wait almost a year before permission was granted to dust off the old equipment, make repairs, catch up on the many changes to be made due to advancements in the art, and become active again.

It is interesting to follow the trend in activities among amateurs during the lull, due to the war. *QST*, the publication of the Amateur Radio Relay League, continued to appear every month until September, 1917. Then followed increased government restrictions, rather severe. The edict: "No radiation, no ground connections, no capacity or inductance to hook-up!" Amateurs were told, "You may read radio books, think radio thoughts, and learn the Morse code, until the call comes to join up." Many amateurs enlisted in the Signal Corps, the Navy, or found employment with the services.

The transmitter of station "2PM", which produced the first transcontinental signals.

1918

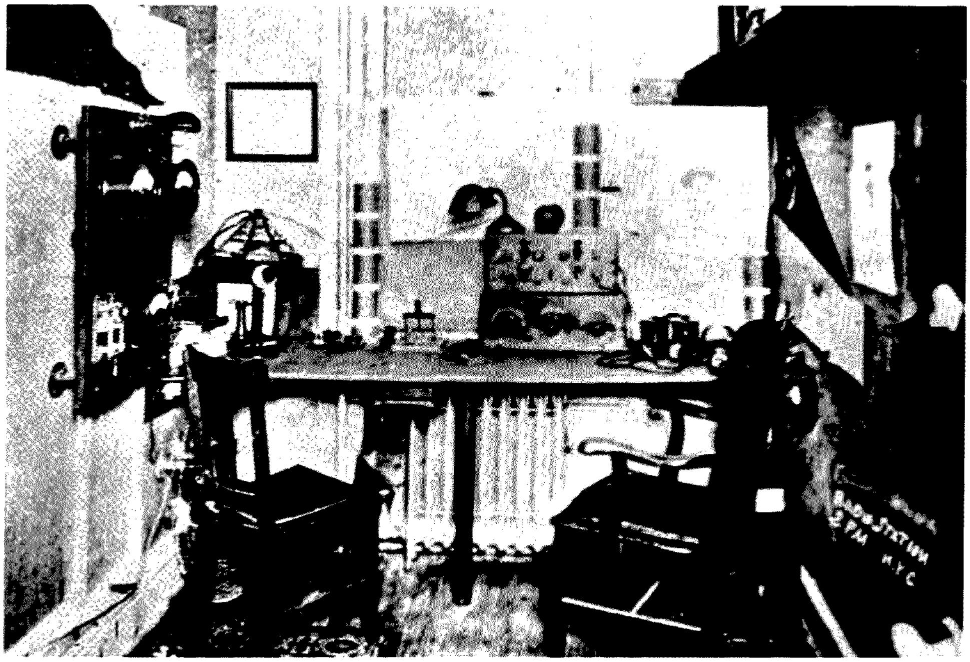
Although the amistice was signed on November 11, 1918, amateurs waited some months before radio publications were again available. The first postwar edition of *QST* appeared in July, 1919, and other periodicals made their appearance, notably *Wireless Age* and *Radio Amateur News*. Restrictions on amateur transmission were removed by the government on October 1, 1919. Here it should be noted that an attempt was made through the introduction of a bill, known as HR 15159, requested by the Secretary of the Navy, to turn over all radio control to the Navy Department. This bill received very strong opposition from the amateur radio fraternity and was defeated.

What were the regulations which now governed the radio amateur? All licenses were cancelled as of April 1, 1917. Rules and regulations had to be followed to go back on the air. Amateurs knew that the Department of Commerce still had complete jurisdiction with William Redfield, Secretary of Commerce, at the time. A publication issued by the Bureau of Navigation, Radio Service, dated August, 1919, entitled "Radio Communication Law of the United States," indicated that no additional radio regulations had been added to those in effect as of the beginning of hostilities. In fact, no changes were made in the radio law during the interim between the introduction of the Act of June 24, 1910, and the ratification of the International Convention of Communications, finalized and signed by Woodrow Wilson, then President of the United States, on July 8, 1913.

1919

Applications for amateur radio operators and station licenses soon had the fraternity by the hundreds back into the swing. The spark coil, the rotary gap, and the old receivers had to be brought up from the basement or down from the attic, unpacked from storage bins, and put back into service. As soon as restrictions were removed, activity started with a vengeance. Radio shops blossomed everywhere. The old wireless bug put everybody to building loose couplers, variometers, honeycomb coils, simple detectors, and a host of new devices.

Along came the newly developed three element vacuum tube. Here was the beginning of the real revolution in reception and transmission of wireless signals. The VT-1 by Western Electric gave the amateurs their first chance to analyze its possibilities. There also were Morehead and Marconi tubes available, but they were very unstable as receiving as well as transmitting units. No two alike would respond equally in a circuit. We were all looking for the advent of larger and more powerful vacuum tubes, and anxious to replace the old spark transmitter. The amateurs knew that it was possible to do away with the noisy spark discharges with their interference problems due to wide bandwidths, and put a new kind of signal into the ether using vacuum tubes.



"2PM" operating position located at 808 West End Avenue in New York City.

At ARRL headquarters in Hartford, Connecticut, where *QST* originated and where our newly appointed secretary and editor, K. B. Warner, took over right after the war, it was decided that the entire body of amateurs be organized into local and regional clubs and associations. The objectives were to foster and promote complete control of all ham activities such as relaying messages, establish relay routes across the country, and keep abreast of all governmental legislation pertaining to amateur radio activities.

K. B. Warner, the new secretary, came from Cairo, Illinois. A very active amateur, he operated under the call 9JT in 1915, using a 1/2 kW fixed gap transmitter.

All amateur radio stations were supposed to be operating on the 200 meter assigned wavelength. Adherence was not too strictly enforced. In fact, some stations were operating well above 200 meters. A few, with special permission, were well into the 375 meter range. So little was known about radio propagation that the erroneous assumption persisted, "the longer the wavelength, the greater the distance waves would travel." August, 1920, *QST* said, "For short wavelengths (below 200 meters) the signal strength is a function of the wavelength, and it may be said that the shorter the wavelength, the weaker the signal." *How strangely the ether waves behaved in those days!*

Everybody was still using interrupted CW, some straight, some quenched, with the only noticeable difference being in the pitch, the whine, and the characteristic interruption of the dots and dashes. Some found satisfaction in a 500 cycle note, if a 500 cycle generator could be found as the prime source of power. Interference created bedlam in many areas, especially before midnight, after which most of the spark coil operators quieted down and went to bed, giving the high-powered boys the ether. The maximum power transformer rating was one kW, usually a Thordarson or Clapp-Estham or equivalent rated at 25,000 volts secondary. The law was specific: "A transmitting wavelength not exceeding 200 meters and a transformer input not exceeding one kilowatt." The ammeter hot wire in the antenna usually was asked to register from 4 to 10 Amperes into an L or T type antenna configuration. It had to be designed and built to a measured length, specifically not over 100 meters, to be within the law. There were plenty of parallel wires, usually at least four, to form a ground network of copper conductors (or buried copper washboilers) for a counterpoise.

The amateurs had a standby pal, "The Old Man," delivering pertinent information to all through articles in *QST*. He kept all in good humor and within the straightjacket of operating procedures. As an example of what could be expected from the OM, here is an excerpt directed to the editor from June, 1919, *QST* under the heading "Rotten Starting":

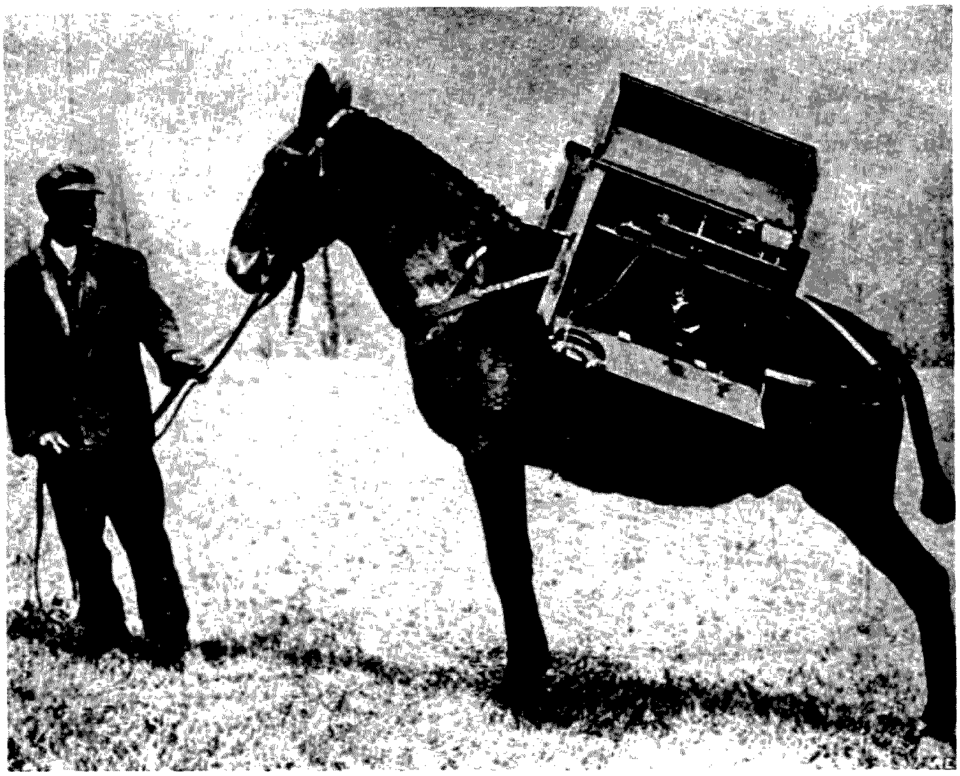
> "I am sending you a specimen of a *Wouff Hong* which came to light out here when we started to get our junk out of cold storage. Keep it in the editorial sanctum where you can lay hands on it quickly in emergency. We will be allowed to transmit soon and then you will need it."

Who does not know the *Wouff Hong*?

What most of the amateurs surmised and expected was just ahead. We read in November, 1919:

> "There will come a day when amateurs will not need to bother their heads about government or commercial stations, but THAT DAY HAS AS YET NOT ARRIVED. The radio millenium has still to come. We mean by this that with our present form of crude apparatus still in vogue, and when we are using quasi makeshifts, we cannot expect that we can tune our transmitters down to within the hundredth fraction of a meter. Usually the amateur wave is so broad that it can be picked up all over the scale. As long as we persist in sending out such waves, we must expect criticism from the big stations with which we interfere."

The junking of the radio spark gap was in the making. To actually let go was an-



"Mule Mobile" was used by the Signal Corps during World War I for carrying the not quite portable transmitting equipment.

other thing. Some of the old-timers in 1920 complained that there was no romance in tube transmission – that it has no individuality or traditional associations like the old spark. There was always a certain stalwart and hearty attraction about the old non-sink rotary, noisy and inefficient as it was. So the *Old Guard* had to finally succumb also to *the little bulbs that had nothing in 'em.*

This is what Dr. Lee DeForest had to say at this time, the man responsible for the development of the three element tube, in November, 1919:

> "The average radio amateur knows enough of the extreme selectivity which the pure undamped wave makes possible, to realize that the problems of interference would largely vanish with the spark gap. Let the amateur urge upon his Congressman or Senator that if the government wishes to further legislate against radio interference, then legislate out of business the damped wave transmitter."

1920

So it became necessary that the amateurs gradually develop the use of the vacuum tube for the various modes of CW transmission, modulating via key and voice, and for better receiving possibilities. With better sensitivity and selectivity built into receivers, our efforts were now directed toward solving the *QSS Bugaboo*! What is QSS? The Q code gives no definition. So – take a look into the May, 1920, issue *QST*, page 25. Well, since you do not have a copy, this "new" abbreviation was added to the list, adopted by ARRL to fill a need. What does it stand for?

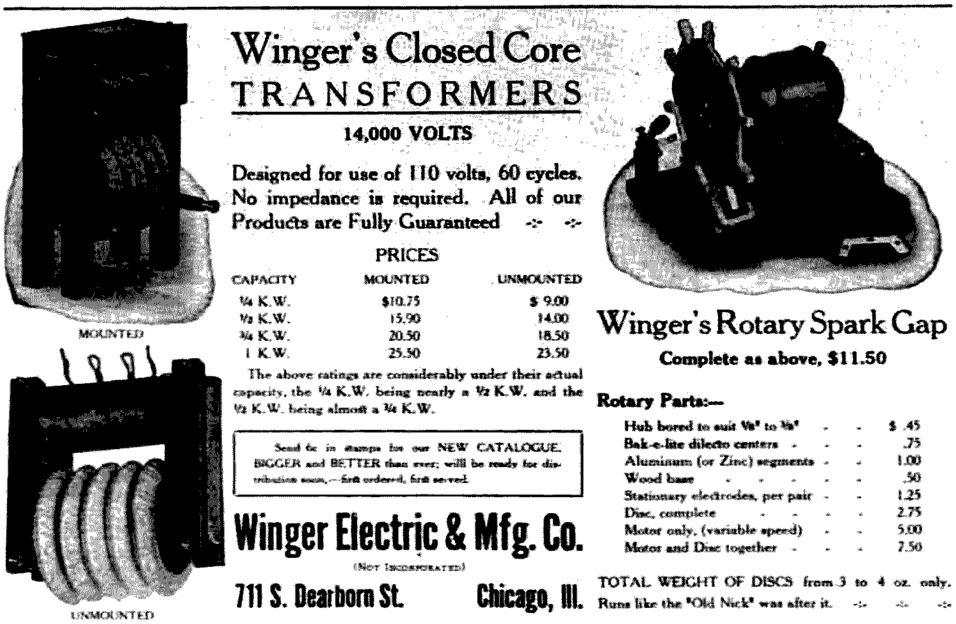
QSS? – Do my signals fade?

QSS – Your signals fade.

Although rarely used, this abbreviation, even in these days, makes sense.

Amateur radio was not out of the woods regarding clear sailing without periodic attempts on the part of the government to curb their activities. The Poindexter Bill, originating as document #165 through a letter from the Secretary of the Navy, was in the hopper. It stood facing the amateurs later on as Poindexter Bill S-4038, and did not bode good news for the amateur.

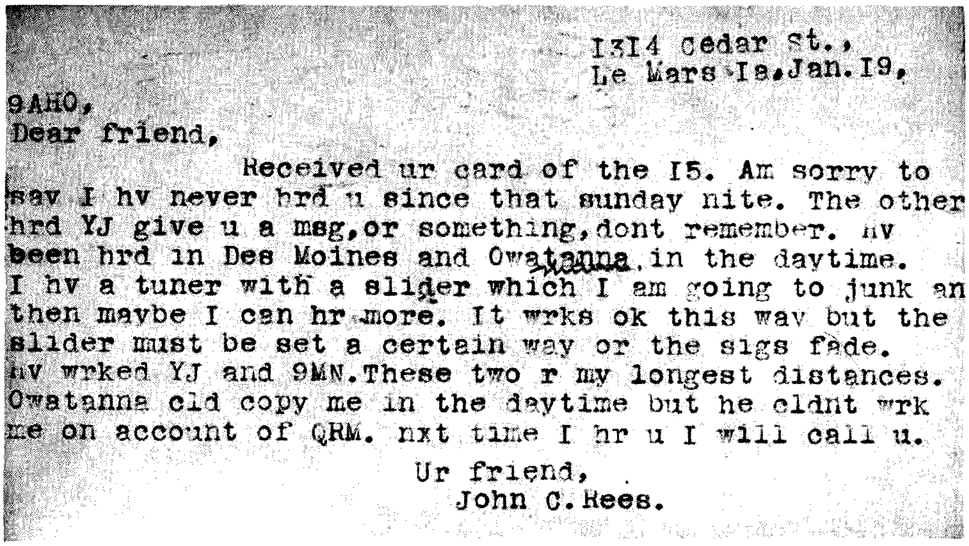
The time loomed on the radio horizon in 1920 to be thinking about international regulatory legislation to bring radio communication the world over under better control. A meeting of the International Communications



The "latest" in ham equipment just before all amateur activity was banned during World War I.

Convention in Berne, Switzerland, was on the agenda. The radio amateurs had to have prominent representation. Intensive efforts were made to protect the rights and privileges belonging to the amateur. Charles H. Steward, member of the ARRL Board, was appointed legal counselor to speak for the amateur in these matters. In order to cement more firmly the ties that bind, amateurs decided that in numbers and in get-togethers there is strength, and much could be accomplished via this route. The thinking centered on having regional conventions, typical gatherings to meet each other personally, to set out program meetings, and to air mutual problems.

One of the early conventions took place in Chicago, sponsored by the Central Division Managers of ARRL. Held September 2 to 4 at the Edgewater Beach Hotel, there were about four hundred in attendance. There had been similar conventions held in Boston and Philadelphia, but this one in Chicago was to be of wider scope in quantity and quality to bring home to all amateurs what we were up against. The report issued from headquarters: "The convention out-conventioned anything yet pulled off in amateur radio."



1314 cedar st.,
Le Mars Ia. Jan. 19,

9AHO,
Dear friend,

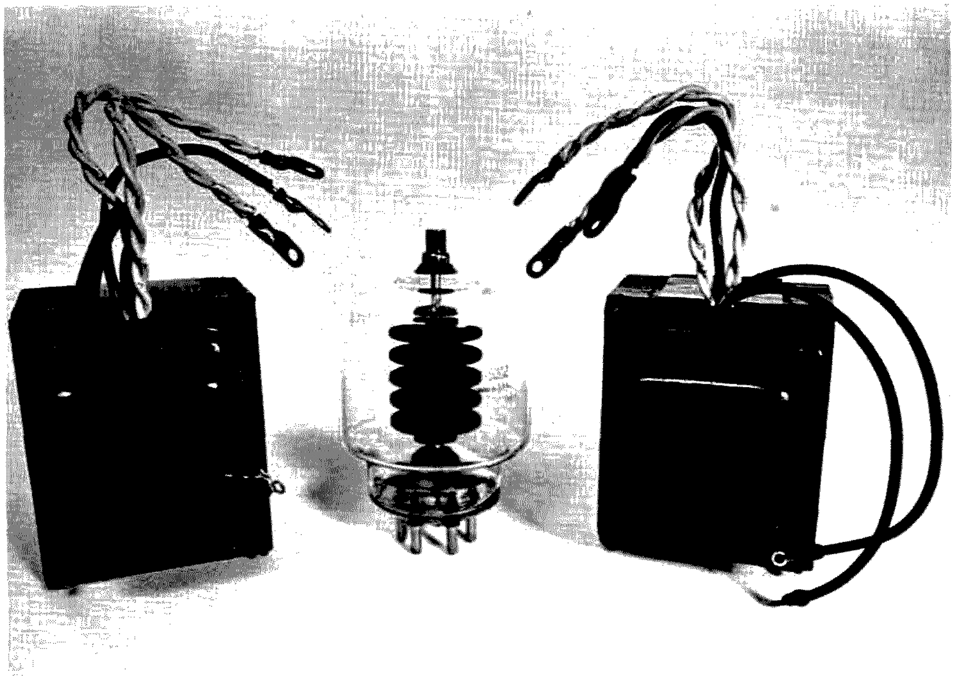
Received ur card of the 15. Am sorry to say I hv never hrd u since that sunday nite. The other hrd YJ give u a msg, or something, dont remember. hv been hrd in Des Moines and Owatanna, in the daytime. I hv a tuner with a slider which I am going to junk an then maybe I can hr more. It wrks ok this way but the slider must be set a certain way or the sigs fade. hv wrked YJ and 9MN. These two r my longest distances. Owatanna cld copy me in the daytime but he cldnt wrk me on account of QRM. nxt time I hr u I will call u.

Ur friend,
John C. Rees.

An early QSL card, sent in 1917.

Not to be outdone, and to top off the year 1920, the Midwest ARRL Division decided that St. Louis would be the next place for a meeting. The time, December 28 to 30, under the sponsorship of the St. Louis Radio Club. Everybody of note in amateur radio circles showed up, from the President Hiram P. Maxin, the Editor K. B. Warner, the Chicago gang, Paul Godley, M. B. West, R. H. G. Mathews, and of course, "The Old Man" himself, who gave a stirring account of the "joyous" and glorious" three days.

To be continued.



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Holly MI 48442

Wind Your Own

-- cheap filament power for that linear

A major expense when it comes to building that linear is the price of the filament transformer. Fortunately, one or two of those obsolete tube power transformers can get you over that expensive hurdle with only a little time and a few cents invested.

First weigh your transformer to determine capability. Refer to Fig. 1, which illustrates the relationship between weight and filament power capability. For example, if the power transformer weighs 4 pounds, it should have a filament power capability of 60 Watts.

Next determine if the transformer is adequate for your application. Let's say you have a transformer with a recycled capability of 60 Watts and you desire a new secondary for a 4CX1000A high power ceramic-metal tetrode. As the 4CX1000A has a maximum filament power requirement of 59.4 Watts (6 volts x 9.9 Amps), you could indeed use this transformer for your filament supply. You could also use two thirty or forty Watt transformers in parallel.

Once you have selected your transformer, disassemble the outer case and note the location of your primary winding in respect to the core of the transformer. The primary leads are usually color coded black. Make sure your transformer has a 110 volt, 60 Hz primary, as some surplus transformers have odd primary voltages that operate at other than 60 Hz. Also, some transformers do have their primary near the outer core and, generally, this type of transformer provides little area for your new secondary. Transformers that have the primary wound tightly around the center core provide the most area and versatility for your new secondary.

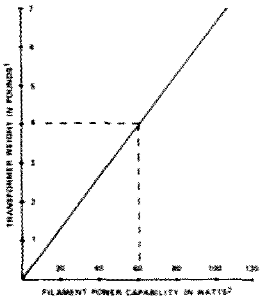

Fig. 1. [1] *Weight excludes mounting fixtures. If case is of heavy steel construction, remove before weighing transformer.* [2] *Data based on an analysis of typical transformers.*

After you have located the primary, cut off and remove with a hacksaw all secondary windings that are wound *around* the primary. Work slowly and take care not to cut or damage your primary winding.

After completion of your cutting, inspect the primary for damage. Next, wrap the primary winding with one layer of plastic tape. Securely attach and insulate the primary leads.

The number of load turns per volt must next be determined. Wind approximately 4 turns of no. 18 insulated wire around the primary as a temporary secondary. Apply the normal primary voltage (110 volts, 60 Hz) to the primary and measure the output voltage of your temporary secondary with an ac voltmeter. The voltmeter reading will determine the turns per volt. For example, if you measure 2 volts, you know it took 4 turns on the secondary to produce this 2

volts; therefore, the turns per volt is 2 turns per 1 volt. Keep in mind this is the no-load turns per volt.

After removing the temporary secondary, wind your permanent secondary. I use two no. 14 wires in parallel for my secondaries, as this is quite easy to wind around the primary. Two no. 14 copper wires will be adequate for secondary current levels up to 10 Amps, 5 Amps per wire. The insulation on the wire should be capable of withstanding at least 10 times your output voltage. Example: If the secondary output is 7 volts, the insulation should provide protection up to at least 70 volts or higher.

Always allow about 50% more wire than your turns per volt indicated, as you will have to increase the number of turns to compensate for the transformer resistance when operated under load.

A filament transformer must have the correct output voltage under load; therefore you must load your secondary and take periodic measurements during its construction.

Let's say for example you require 6 volts at 10 Amps. According to Ohm's Law the load must be .6 Ohms.

$$R = \frac{E}{I} = \frac{6\ \text{volts}}{10\ \text{Amps}} = .6\ \text{Ohms}$$

Therefore you should load the secondary with a .6 Ohm resistor while measuring the output secondary voltage. Ohm's Law requires the power dissipation of the resistor be at least 60 W.

$$P = IE = (10\ \text{Amp})\ (6\ \text{volts}) = 60\ \text{Watts}$$

However, a much smaller wattage resistor may be used if you work rapidly and do not allow the resistor to heat up.

That's it; good luck on that linear. ■

Mitchel Katz W2KPE
147-11 76th Ave.
Flushing NY 11367

Discriminator Output for the HR-2A

-- check deviation and modulation

A very simple addition can be made to the Regency HR-2A and other FM receivers which will provide output for a frequency shift meter, scope, tape recorder or for whatever other purposes a discriminator output is required. A partial diagram of the HR-2A discriminator is shown in Fig. 1. Refer to the schematic diagram of your receiver to locate the equivalent takeoff point.

At test point TP-A, add a 10k resistor and a .01 capacitor to filter out low frequency variations of the discriminator dc output. The other end of this filter connects to an unused terminal on the speaker terminal strip. Fig. 2 shows the circuit of the filter and output wiring. To use the discriminator for meter operation, connect a VTVM to terminals 3 and 4 of the speaker terminal strip and set the meter to the 5 volt dc range. Turn the receiver to a channel that doesn't have a signal coming through and adjust the meter for center scale reference (2.5 volts). You can now switch the receiver to any station that you may wish to check, and see how far they are off zero by the amount of the meter deflection.

In this particular set, the frequency shift is .30 kHz per division of the meter. To calculate how far off zero a station is, merely count the number of divisions above or below the zero center position that the meter indicates and multiply this by .30 kHz. As the frequency shift per division can vary from set to set, it's a good idea to check your own calibration.

Another useful application for the discriminator output is to check the modulation (deviation) of received signals. To do this, connect an ac scope input across terminals 3 and 4. Set the sweep frequency to a low value and observe the modulation peaks on the scope. Set the vertical gain control so that a normal signal deflects the scope to some convenient height. Now, as other stations come through you can tell whether their modulation is excessive or too low. This same hookup can also be used to set the level of a Touchtone pad. Have the operator of the station that you are checking whistle into his microphone, and observe the height of the scope pattern. Now have him press one of the buttons of his pad and adjust the output level control for the same deviation as produced by whistling. Although this may not be the optimum adjustment, it is a good starting point.

When not using the discriminator for any other purpose, it can be left connected to the AUX input of a cassette recorder. Now anytime that you wish to record an incoming signal, merely start up the recorder and adjust the record level control for proper operation. The volume control and tone controls of the receiver will have no effect on the discriminator, so it can be set to please yourself. There are many other uses for the discriminator output on a receiver, but only a few have been mentioned, just to start the mind working. ■

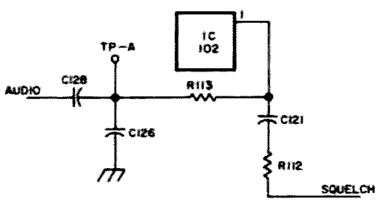

Fig. 1. Discriminator circuit.

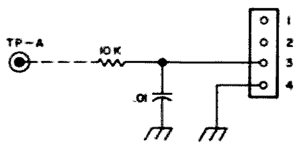

Fig. 2. Terminal connections.

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The Phantom Exposed

-- everything about crosstalk on Ma Bell's lines

By FCC regulations, phone patchers must be careful to avoid high levels when they connect to telephone lines. There seems to be a point where the effects boil over, but a little less makes no trouble at all. Some of us know that it is crosstalk that bothers Ma Bell and the FCC, and this must all come from the conductors in the cable. So why is this effect so abrupt? For that matter, why crosstalk at all? Hasn't Ma Bell heard of twisting wires to eliminate coupling, and of coax?

Yes indeed, she has. In fact, the old girl invented these and a lot else besides. Trouble is, no method *eliminates* crosstalk; at best, it reduces it to a tolerable level. And nowadays, "tolerable" is the best you can afford, the "state of the art."

Fig. 1 shows the classic old farmer's line, the single wire working against ground. It works up to several miles, so long as it is the only circuit on the pole line. Of course, it is a good antenna too, and how many times has it been used as one! It picks up static and power hum on a clear day, and you can hear a storm coming while it is miles off.

Fig. 2 is the classic "full metallic" line. Both conductors are above ground, both literally and electrically. The center tap of the line transformers, or "line coils," may be center tapped with the center tap grounded or not. In any case, there will be lightning arrestors which offer a breakdown path to ground. Even on a clear day, a long insulated line may pick up several hundred volts of static charge. Ask any lineman! The signal is "push-pull" so that the two wires of the pair are always opposite phase.

Static and induction affect both wires in phase, and cancel out in the windings of the terminating transformers. That is, they affect both wires equally if the source of the interfering field is some little distance away, such as a paralleling power line. But string another pair of wires on the same cross-arm, and the coupling between them is both much closer and much less balanced, as is shown in Fig. 3.

Simple Balance Scheme

Fig. 4 shows a simple balancing scheme I have seen used by some radio stations, when they want to run two transmission lines together. The pair numbers are 1-2 and 3-4 and they share a common center point. If you made up two lines with ribbon leads, you would have to split the pairs so that wires 1 and 3 were in one ribbon and 2 and 4 in the other. The spacing would have to be close and critical, so that ribbon lead is not practical. These lines are always open wire ones. But it does work. Notice the bridge symmetry of the capacity couplings.

Transpositions

Untransposed lines are good for a mile or two. After that, you can't tell which line is being talked on — you hear either or both nearly equally well. They are still balanced so far as static and line hum are concerned, but violently unbalanced for the adjacent pair. Only one wire working against ground would be worse.

Fig. 5 is what we do about it. At the middle, you just interchange the wires on one pair, and immediately you're in business! Wire 3 is close to 2 for half its section, and 4 is close for the other half. 3 and 4 are out of phase, so the inductive effect cancels. Of course, 3 and 4 couple to wire 1 also — the coupling is less, but present, and cancels with it in the same way. The net result is, no crosstalk. Swell! Our telephone plant is growing, so let's add another pair, 5-6. Immediately, we're in trouble: If we transpose it, it will crosstalk with 3-4, and if we don't, it will crosstalk with 1-2.

The Transposition Plan

If Fig. 5 worked once, maybe it will again. Let's transpose 5-6 in the middle, so it won't couple to 1-2, and then transpose each half again, to break up the coupling with 3-4, which gives us Fig. 6. Now we're in business — until we add 7-8. If 1-2 has no transpositions, 3-4 has one, and 5-6 has three, it would seem that 7-8 would need seven. And that's exactly right. And by the time you got up to a full forty wire line, the whole scheme would be quite impossible — you'd have to transpose wires in the middle of the span. Oh yes, this has been done, too, but not for this reason.

The Phantom Group

No communication business ever has enough circuits. Ma Bell came up with a good trick generations ago — the phantom circuit, Fig. 8. Just connect an extra pair of line coils to the center taps of the 1-2 and 3-4 coils, and you get a third circuit,

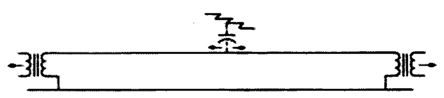


Fig. 1.

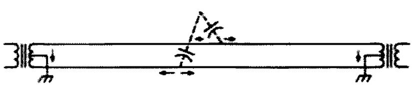


Fig. 2.

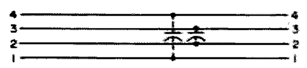


Fig. 3.

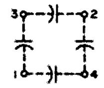


Fig. 4.

practically for free — three circuits on four wires. By means of the center taps, the phantom circuit uses 1-2 (side 1) in parallel as one wire, and 3-4 (side 2) as the other parallel wires. It is called "phantom" because you can't see any wires for the third circuit.

Ghost

The old girl got carried away for a time with the phantom idea. Here was another center tap on the phantom coil — why not go further and make a phantom of the phantom? It actually worked, and the "ghost" was born. Now you could get seven circuits on eight wires. Trouble was, the ghost circuit worked only an alternate Tuesdays — it was always too wet or too warm or too something, and they were the devil to keep balanced. So the ghost was soon kicked out and the standard became a number of phantom groups.

Phantom Group Transpositions

It may have occurred to you that, with two wires of a side circuit used in parallel for one side of the phantom, transpositions in the side would become ineffective so far as other phantoms were concerned. And that is exactly right. Fig. 9 was developed to cope with this effect — you just swapped the pair position bodily with its mate, which transposed the phantom just as a side would be transposed. But the solution worked for more than just the phantom group. By transposing the whole business in this way, the whole transposition plan was greatly simplified. Remember that it began to look as if the highest-numbered pair would turn out to be a continuous spiral, with hundreds or even thousands of transpositions in it? Every time you added a pair, it had to have nearly double the number of transpositions in it. Now you can divide your pole line into phantom groups and just transpose them. This is one case where the solution overshadowed the problem!

So far, we have four main types of transpositions. These are: Type 1 which turns over the low numbered side; Type 2, for the high numbered side; Type 3, which transposes the phantom; and Type 4, which transposes both sides *and* the phantom at the same point (Fig. 10).

Mules

Pole lines are installed by construction gangs, a group of non-sissies under the leadership of a gang foreman, who is no sissy himself. Remember that these men haul poles around and string wires on them over rough country, which takes rough men. The wires themselves are more like hard-drawn copper rods; the smallest is 1/10 inch in diameter and the largest is about 1/6 inch. The linemen delight in getting some engineering type to try cutting the wire with pliers. The men cut the wire snip-snip-snip like cutting toenails, and the indoors type can't even nick it. It teaches him who he is dealing with and saves trouble all around.

Such wire is very heavy and, in most cases, four reels of wire were hitched to a mule, who was as tough as any of the men. He pulled the

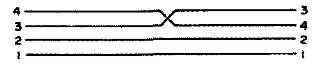


Fig. 5.

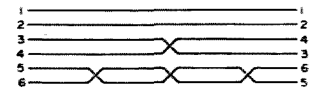


Fig. 6.

wire off the reels while the men kept it from tangling and got it up on the cross-arms and later tied it to the insulators. They had to "cut" the transpositions at certain pole numbers, according to plan, as shown on a big blueprint. Mules are far from stupid, and they soon caught on to what was going on. Entering into the spirit of the thing, the mule would cock his eye at the pole and recognize it as a Type 4 transposition point. Then he would lie down, roll over, and get up, thus cutting his own Type 4 without human help. Many linemen have told me this, with perfectly serious faces, and who in his right mind would doubt the probity of a man who can hike a pole faster than you can climb stairs, with a hundred pounds, more or less, of tools hung on his belt! Not me!

Foremen

In fact, back at the hotel or boarding house, there were frequent arguments about who was smarter, the mule or the foreman. Surprisingly, the foreman had his champions, too. Maybe out of sheer loyalty, maybe just to keep the argument going — what else is there to do in a strange, small town at night?

Carrier

Up to this point, we have ignored Fig. 7, but now the story has caught up to it. When you run out of circuits, the obvious thing is to build another pole line. This calls for another right-of-way and many times this is impractical or impossible. Just after WW I, Carrier Telephony was invented by Major General Squires of the Signal Corps. Or at least one variety of it was. He liked the high frequencies and one wire, while Ma Bell used two and frequencies between 7 kHz and 20 kHz or thereabouts, for her A, B, and the good old C-type carriers. The C lasted for a couple of generations — about as long as open wire lasted — and was an excellent system. On a phantom group that already carried three voice circuits, you could get an additional six with two C systems. This effectively doubled the capacity of the lines, at minimal costs.

Trouble

This unsolved the transposition problem, however. Fig. 7 shows why: The sine wave is an interfering carrier signal. It does not affect the lower side circuit 1-2 because as the phase reverses, it induces alternate plus and minus charges which cancel. But at the same time, it induces a plus charge on 3 and a minus on 4, because the line transposed at the same point the sine wave went through zero, and the charges induced *added in phase* instead of canceling. There was

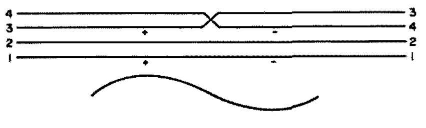


Fig. 7.

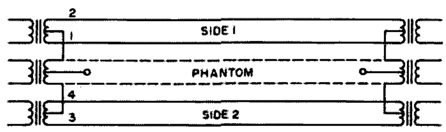
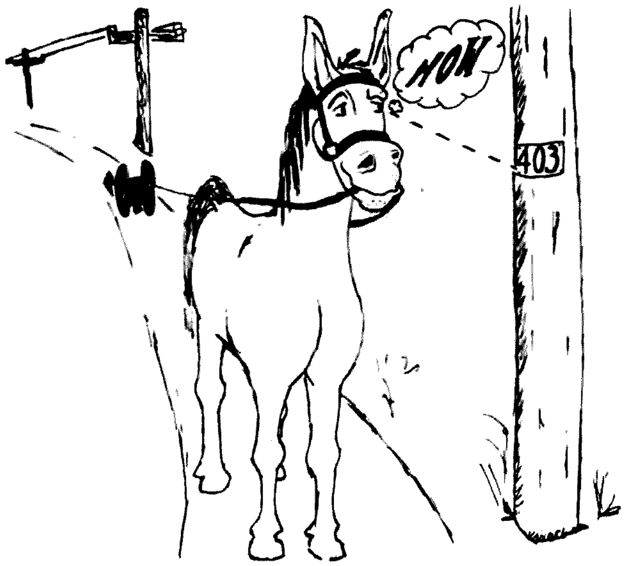


Fig. 8.



nothing for it but to retranspose the whole blooming shooting-match, which was costly and a lot of trouble, but the only way out. Carrier transpositions are just like the others, but are many times as often. The idea is to get several transpositions along just one of the highest carrier wavelengths. This means every pole or two.

Beacon Mountain

Across the river from Newburgh, New York, lies Beacon Mountain. At the bottom of the mountain, everyone puts his TV antenna on the highest mast he can afford, because it is a fringe area, and the fringe is marginal at that. Halfway up the mountain, however, the antennas are mounted directly on the roof, or even in the side yard, which must be an eye-hazard when mowing the lawn. Up near the top you don't see any antennas at all. Maybe they bury them to take advantage of the ground wave. It wouldn't surprise me any.

But under the crest, where there is still some mountain left, but the ground is nearly level, the TV set owners have to harvest all the obstacle gain they can, because the mountain seems to shadow more at this point. I remember one installation – house backed up to the mountain, long front yard extending, nearly level, away from it. Out near the road, a couple of hundred feet from the house, I saw a grubby old conical antenna mounted on a wooden platform which had sled runners on it. Obviously, the owner had hauled it around the lawn until he picked up a "commercial" signal. He used an ordinary ribbon line, supported on what looked like clothes-poles.

Now suppose his brother-in-law had moved in, complete with TV? He'd get the oscillator from the other TV into his own as sure as sin.

Me, I'd leave the original line alone and make him twist his at the rate of a turn in two feet or so – anything shorter than the shortest half wave would do. Instead of threatening him with mayhem, I'd just mention that the spiraling effect made the signals auger their way into the TV set, making a better picture. No argument would be necessary.

Cable

Open wire illustrates the crosstalk problem and its solution as nothing else could, but cable is the facility today. All you have to do is twist the pairs like old-fashioned lamp cord and you can forget about transpositions, isn't that right? Isn't it?

No. Cable pairs come in phantom groups also, but here they are called "quads." If you lay two twisted wires together, they nestle like spoons and you wind up with a swell case of crosstalk. So you have to use different twists for different wires; you have to twist the pairs around each other, you have to interleave the quads, you have to even swap layers in the cable. A cable is one devil of a complex thing! And always, no matter what, there is a little crosstalk that gets in.

If the average level of the circuits at that point is, say, minus 10 dBm and the crosstalk is minus 50, you can forget it. The conversation will drown it out handily. But if the crosstalk comes from a pair with a minus 7 instead of minus 10 level on it, three dB high, the crosstalk will also be three dB higher and you can hear it – just. In fact, the residual noise you hear is mostly the babble from many circuits. But another three dB and it begins to be serious.

Hello

The English word "hello" can be recognized when no other word in the language can. Telephone men can let a hello go by, but any other crosstalk that can be understood requires that the crosstalking circuit be disabled. This is Telco rules and FCC rules, to protect privacy. I have even cut broadcast lines when I heard understandable crosstalk on them, and got away with it. Ma Bell wasn't happy about it, but it had to be done. So if YOUR line crosstalks into others, it will be cut too, as soon as Telco can find it. You won't be reconnected until you fix the level.

Coax

Why not go to coax and get the improved shielding? Simply because coax is a high frequency line. The shielding works at frequencies where skin effect is important. You have cable with a single outer braid where flexibility is important and crosstalk permits. For more severe conditions, you have double braid cable. Next is solid tubing, and if that doesn't work, move it somewhere else.

Shielded Pair

You don't see much of it, but Telco uses a lot of 135 Ohm shielded pair, which is operated balanced just like cable pairs are. It is especially effective at lower frequencies. The shield is grounded at one end, usually, but maybe at both and sometimes in between. You have to insulate the shield, then ground it at a point where ground potentials are least, since ground currents goeth where they listeth and no man knoweth where that ith. Sometimes you're better off letting the shield float; you just have to stay loose and see what works best.

Some preamps have to be laid out with the output next to the input, usually to match other equipment or to pick up the connector, or for some engineering but non-theory reason. Here you have to use a solid tube, with either a coax wire or even a balanced pair in it, to take the output back to the connector. Just like anything else, you just do the best you can with what you have. But isn't that where it's at? ■

Fig. 9.

Fig. 10.

Retire to a Ham Heaven

-- how to go on a permanent DXpedition

George Brumley KØWTM/OA6CV
Apartado 825
Arequipa, Peru

Most of my rag chewing is done with hams in the States and the most common subject is, "What do you do when you retire and where do you do it?" We usually get started when the stateside fellow says, "Uh, you sound like an American; I mean like you're from the States. What are you doing down there? Maybe in the copper mines or in the oil business? Or a missionary?"

"I'm retired, old man; I came down here to live over four years ago, in July of 1972." That usually brings on some other questions: "Well, say now, that's interesting. Do you have friends down there? What made you pick Peru?" Now that I know the man is interested and not just making conversation, I give him the details.

My wife and I went to Africa, to Ethiopia, in 1952, and I built a 31 meter broadcast studio for Haile Selassie. I had the privilege of being on the air as ET3GB most of the seven years we were there. We loved Addis Ababa, high up in the mountains and with all the tropical fruit you could eat in the greatest variety. Living was cheap there in those days. We always said that if we could afford it when I retired, we'd go back. But when the time came, our three children (all born in Addis Ababa, by the way) were getting old enough to think about getting married and we hated to go so far from the States. (The girl is married; the boys are still thinking.) So, we decided to go to South America, even if it meant learning another language. I was 53 and the XYL 54. We had friends in Quito, Ecuador and Arequipa, Peru. We wrote several letters to both places and finally chose Arequipa.

Does that mean that we "just went down there"? Yes, it does. And no, I did not fly down first or visit first and find out about Arequipa. I trusted my friends and read everything I could find in the library in Wichita, Kansas. Then we had a garage sale, sold off everything we could, and gave away the rest. What we couldn't part with we put in six (six!) big crates and shipped them down by sea; we got on a plane and flew to Arequipa. Admittedly, that is not the way I would recommend to someone who has never lived in a foreign country. But we had lived in Ethiopia for seven years and we *knew* there is only one United States of America. Those who expect to go to a foreign country and find conditions just like those in their own neighborhood are in for a shock. But the surprises can be nice pleasant tingling sensations, too.

"How's the weather down there?" Well, friend, we have the weather that California and Florida brag about; sun every day. It hovers around 65 degrees day in and day out and doesn't vary more than about 10 degrees from the hottest to the coolest of the day. Arequipa is about 8,000 feet up in the mountains in the desert part of the Andes. A lot of people have loved this place; the city is about 450 years old and has one of the oldest universities in this part of the world. The sun gets a little hot during the day, but just walk over to the shady side of the street; a bit of breeze will be blowing and you'll almost feel as though you had walked into an air-conditioned store. Most of the natives carry or wear a light sweater. Use it if you have to stay in the shade and take it off if you're in the sun. The poncho is very popular, of course.

With the population explosion, housing can be a problem, but we do very well. A friend owns a huge house here but is living and working in the States. We have six bedrooms, a small fruit orchard, and a private swimming pool. The roof is a huge place, and that's where I have my beam, of course. It's easy to let down and play with. It's on a telescoping mast. The rent? Please don't cry . . . it's less than $100 and I can't tell you how much less but I don't mean what the advertising people do ($99.95)! And no . . . we didn't know about this house deal until we got down here.

Those who have had diplomatic or military assignments overseas and are used to eating out of the commissary should be careful about going to a foreign country to live on their own. It ain't the same! And those housewives whose main kitchen tool is a can opener will soon find themselves asking for a bigger food budget. Canned food is high and there are no TV dinners. But those who like to cook from scratch will find plenty of "scratch." Most foreign housewives go to

The author with more than 100 QSLs. About 150 countries are confirmed, but some of the rare ones insist on sending odd size cards that won't fit the plastic holders.

The XYL, Lucille, likes living in a foreign country, too. She likes all the pretty stamps I get on DX QSLs.

market every day and bring home fresh fruits and vegetables to cook. This is what the French cooks emphasize and they are supposed to be the best in the world. We have everything to eat the North American has, besides all the delicious fruits of the tropics such as papaya, mango, guava and delicious bananas ripened on the tree. You wouldn't believe these after eating those picked green and allowed to ripen while on their way north.

Although there is TV in all the world, we have been weaned because all the programs are, naturally, presented in Spanish. So when the band folds, we read or play cards or develop pictures or generally enjoy ourselves as in the old-fashioned pre-TV days. However, many of the TV serials from the States are presented here with Spanish dubbed in. It's a way to learn Spanish if you're a real TV fan. My youngest son is a TV fan and now speaks such good Spanish and did after only a couple of years that his young Peruvian friends sometimes ask him, "What part of Arequipa were you born in that I haven't met you before?" Or, "Your mother's Peruvian, isn't she?" Well, "Then your father is from Peru?" No, he was 14 when he came down here and he speaks Spanish in a perfect Peruvian way, absolutely idiomatically. But if there isn't an unusually interesting program on and we are tired of cards and reading, we go to a movie. It seems that at least half of the movies are from the States and in English. And the most expensive ones are less than a dollar and the cheapest a fourth of that.

As you may know, the US has reciprocal amateur radio agreements with dozens of countries and Peru is one of them. There probably will be more in the future since the obtaining of a license in the States by foreigners has been simplified and made more liberal. To get a license down here (and in most foreign countries, that is), you should have your own original license from the States and about a dozen photocopies. The process may take three months, but the speed with which most Americans get their ticket from the FCC leaves us little room to grumble. You'll also need a passport and usually some other papers which you can only obtain after you get there – a police certificate, for example, showing that you actually reside at a certain address. You need all of this if you plan to stay in South America for any length of time and operate. If you're just flying down, the best thing to do is write to the radio club in the capital of the country you plan to visit and ask them to help you get a temporary license. Write at least three months before you plan to leave and send along some IRCs. You'll get some forms back in a language you won't understand, but then how many of us can understand the forms Uncle Sam spews out at us every week? Don't we usually have to take them to some office and get official help? So when you get the forms back from the foreign radio club, take them to your friendly high school language teacher and let her put her ability in the language to a real test. Fill out the forms with the help of the teacher or someone else qualified to understand the language and send them off with the required fee. This means an international money order, not your personal check.

Sometimes you get a nice surprise. I did everything outlined in the previous paragraph but didn't get a reply before I planned to leave, so . . . I just said "Get on board, li'l children" and we flew down anyway. When I got to Lima I managed to find the man who was handling the amateur licensing and he personally typed out a temporary license for KØWTM/OA6. So, I could get on the air immediately. Only one little problem: I couldn't get my gear out of customs and didn't get it out until the temporary had expired some 90 days later. But there is an arrangement now to prevent such tragedies. You write to CARNET BUREAU, United States Council of the International Chamber of Commerce, 1212 Avenue of the Americas, New York NY 10036. The CARNET (pronounced kar-nay) is a little paper like a passport or vaccination certificate for your ham gear. So when you get to the foreign port of entry, the customs man takes a look at

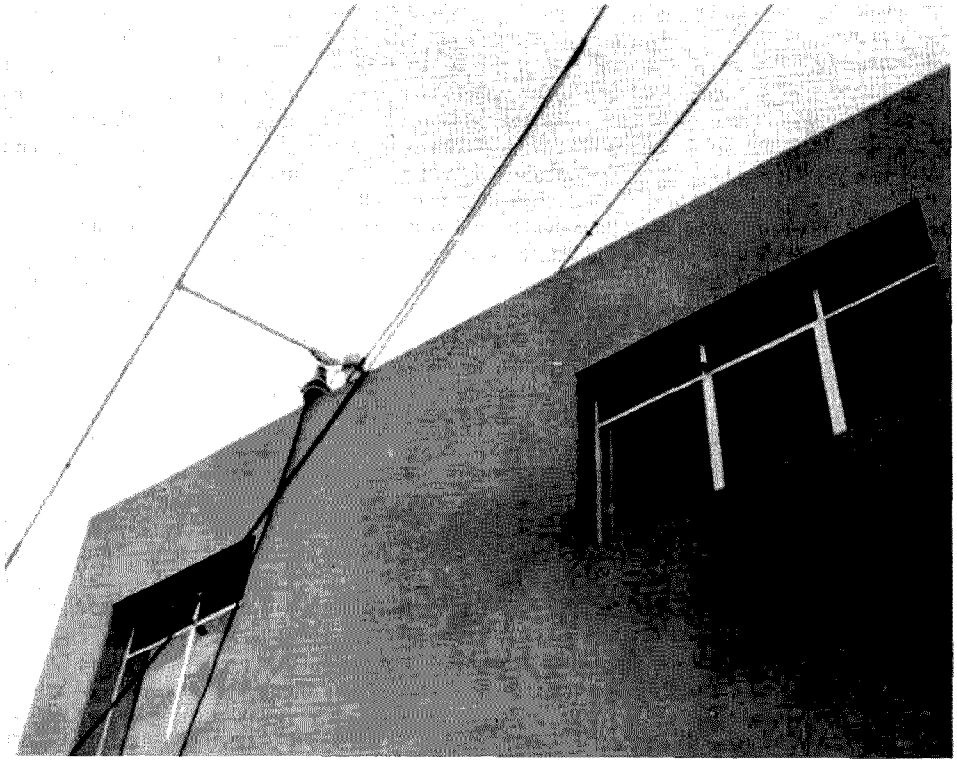
Cleaning up the dishes after a cookout on the patio is no trouble at all if you have a "dishwasher." Our maid costs less than the automatic model you use.

your little CARNET and looks at your equipment and you walk right on in. At least that's the way it's supposed to work. The CARNET is good in 30 countries and with it you aren't suppose to pay customs or post a bond to take your equipment into a country temporarily.

What kind of equipment you take to your foreign hideaway retirement place will depend on a lot of factors, like money and what do you have now. When I knew I was coming to Arequipa, I sold a perfectly good Swan 500 so I could get a Heathkit SB-102. Not that one is better than the other, but I wanted to know as much as possible about the rig I was going to depend on for my hamming. If a rig develops a problem, it is very probable that you are going to be the one to fix it. Sending it out of the country to have it repaired will drive you to drinking . . . the customs hassles are unbelievable. And forget that "send in the card that's bad" bit, too. If everything goes well and a friend hand-carries the card to the States and another friend hand-carries it back, you still might be off the air a couple of months. So *know* as much as you can about the rig you're going to be using. While we're talking about it, remember such simple things as voltages and line current frequencies. The rig should be able to work on 220 as well as 117 and on 50 as well as 60 Hertz. And that "220" may well be as low as 190 or as high as 250, so keep that in mind, too. You need a rig that's not fussy about what it feeds on.

A linear is nice but most people in the world don't use one . . . as a matter of fact, most hams are limited to less power. You won't find it a big disadvantage if you don't have one or can't afford to bring one along. But you will need a good antenna. In South America, in many countries, the houses have flat roofs. I can't resist trying out beams when they are so easy to get to. I built a homemade 3 element, 3 band quad and put it up on two 10 foot sections of TV antenna tubing I bought locally. For a motor I have a big heavy Ham M. But though there is a little breeze most of the time in Arequipa, strong winds are a rarity and I never had a bit of trouble with it. And what a joy to put the swr meter at the right end of the coax or use the grid dip meter where you should use it . . . right at the antenna. Yes, I brought those two simple instruments and an old Simpson along. The grid dip meter is the first of that kind of instrument that Heath brought out years ago. The tube in it has never been changed though I've shocked the daylights out of it a time or two. It's made for use on 117 volts, but twice I've plugged into 220 and was intently measuring away when I realized what I had done.

You'd better bring along your own coax. You can get wire and insulators and you can find someone who can weld together TV antenna tubing for a boom and mast for a quad, if that's your taste, but as for a balun and coax – better bring your own. If you have a 12AVQ, you might enjoy that. I brought a 14AVQ, but the 40 meter band in South America is shared by myriads of shortwave broadcast stations and it takes a lot of courage and



I'm currently using a 2 element triband yagi. What looks like a middle element is the coax from my 80-40 doublet.

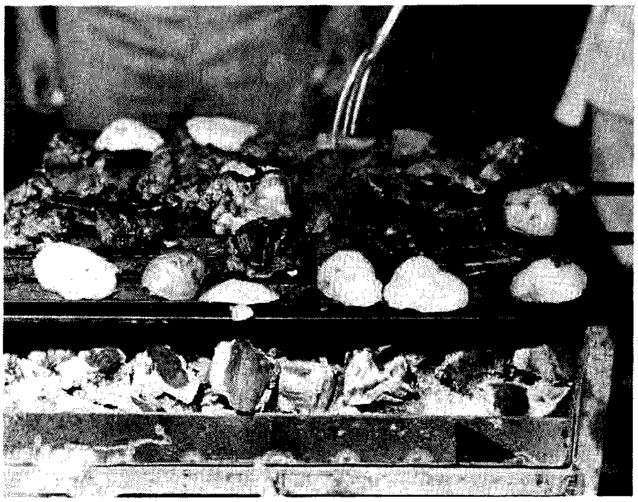
peculiar ears to separate the hams from all the crud on top of them. The old vertical works pretty well on 15 and 20 and I've had some use out of it on 10. The 75 meter band down here has a high noise level . . . as far as I'm concerned. The S-meter needle is usually right up there at S-9. However, I have a 75 meter dipole up and I tune across the band from time to time. Once in a while, fantastic things happen. I worked Iceland and South Africa within 15 minutes of each other one night. I often hear stateside signals, but you'd be surprised at how few people are interested in listening for a weak DX signal on 75 or 40. A linear on those bands is a real help.

But on 15 and 20 you can find lots of DX and have all the fun a retired ham's heart can stand. Assuming that, as an American, English is your native language, you'll find that is a big advantage. Most of the DX stations will be speaking English and if you'll learn to speak slowly and very distinctly . . . even exaggerate the pronunciation of the syllables . . . you'll find that you'll work lots of DX. (This will make up for that lost feeling the first few months when you go shopping and find that people look at you uncomprehendingly when you try some of those carefully rehearsed phrases on them.) And working the DX is just the first part, of course. You won't have to beg for cards; you'll find that people will be sending *you* cards with IRCs and begging *you* to send them a QSL.

And you'll learn some other things about QSLing. Some guys will send you a card via the "burro" and will include some IRCs. The card will finally get to you some six months later but it won't be in the envelope. The "burro" will have opened the envelope, taken out the IRCs, stamped "Courtesy such and such 'burro'" on the QSL and sent it along with a lot of

A cookout given for a group of commercial radio operators. Many are showing interest in getting on the air for fun as hams.

others. Perhaps you'll never know the card was sent airmail or that the other fellow sent you some IRCs unless he mentions it on the card he sent you. But he expects to get your card back within a month or so. It doesn't work that way. He's probably swearing at you when he thinks of how that DX station (*you*) just kept his IRCs and didn't send a card back. So, one of the things you can truly enjoy when hamming from a more civilized DX location (rather than some uninhabited rock) is sending back QSL cards. I always say that I need at least *one* IRC to send a card back airmail. If you're retired and do much hamming, you'll go broke if you try to pay for all the cards. Even sea mail mounts up. So give the other fellow your mailing address (get a PO box as soon as possible) and tell him for quick results, send you some IRCs.



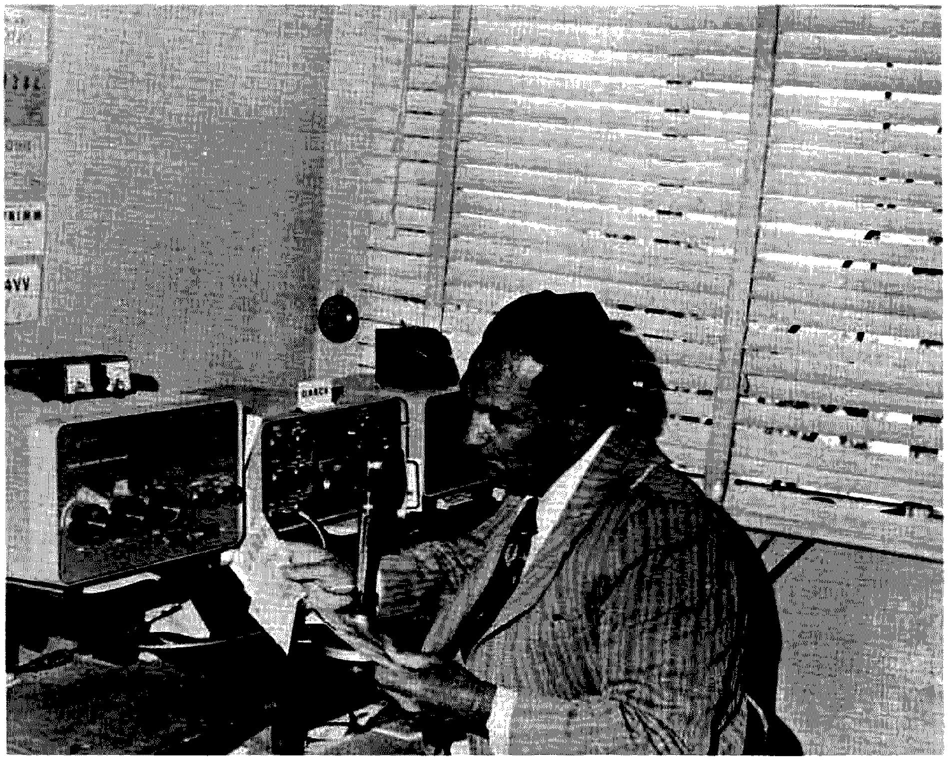
You're looking at young lamb and pork bought from the Indians out in the hills. The grill is homemade — welded in a friend's shop from scrap he gave me. Won't you come down and have a meal with us?

Since most XYLs are not hams, what will the wife be doing while you're having a ball with all this hamming? First of all, let me say that many, many countries in South America have third party agreements with the US and you'll be rather surprised at the interest your wife will begin to show in hamming after you get her in touch with all the kids and perhaps some relatives or friends she hasn't seen or written or talked to on the phone for years. I've been a ham since 1938 and my wife and I have been married for almost 35 years. Hamming has always been something she could definitely leave alone. But now she often says to me, "Why don't you see if the band is open to the States?" Or, if she hears me talking to someone in or near a city

where friends live, she says, "Ask the man if he has a phone patch." The way most people correspond today is not by letter . . . they'd rather pay a five dollar phone bill and talk to you personally than to take thirty minutes or more to write you a letter and then wait a month for you to get around to answering and have it get to you. So, your wife is going to be much more interested in hamming.

But what else can she do? Why should she let you drag her off to Timbuktu? If she has an ounce of "do good" in her, it can grow to full bloom. A nurse or a nurse's aide is really welcome in most of the so-called "underdeveloped" countries. She would be welcome in most any hospital, and though there aren't many orphanages, she would be welcome there, too. There's nearly always an American "Instituto Cultural" run by the US State Department and teaching English is a big thing with them. She won't need a teacher's certificate or even a high school education. They'll be so glad to have a "native speaker" that they'll show her just what to do and put her to doing it quickly.

But besides what she can do for them (it really is more fun to give than to receive, but some people never find that out), there are things the South Americans can do for *her*. There are usually several shops in any given city where guitars are hand made. They won't look as shiny and finished as a Gibson or Fender or what have you, but you'll be surprised at the beautiful sound they can produce. Haven't you always wanted to play the guitar? Well, you'll have a chance for lessons two or three times a week for what it would cost for one lesson in the States. You won't learn "cowboy" style nor "Beatle" style but remember, it was the Spanish who invented the guitar. You can have private lessons or join a class. You'll be practicing your Spanish and having a lesson at the same time.



OA6CV admiring some new QSLs just in. One IRC gets you an airmail QSL in the States. Turn-around is usually 24 hours.

Buying dresses off a rack is not so popular as in the States. If your XYL likes to sew, she'll find plenty of material, though she'd better bring her own sewing machine. Or she will find plenty of people who can just take a picture of the latest style and turn out an exact copy of a "Paris fashion" from it. The beauty shop bill will drop to next to nothing . . . or maybe it won't. She'll get over saying, "I wish I could afford to get my hair fixed more often."

You thought I was going to leave out your aches and pains, didn't you? Well, if you're truly infirm, you'd better stay home. But you can get good medical treatment in any large city in South America today. And you'll find that in most of them there is a doctor who speaks English and has had some training in the States. Your Blue Cross and Blue Shield won't mean a thing down here, and probably none of the other health insurance schemes will either. (Check, if it's a point with you.) But on the other hand, medical service is so cheap in contrast to that in the States that what you've been paying in premiums will probably take care of about anything you need. You might even be surprised at what you have left over from the money you set aside for medical bills. But if you need a special diet or special foods or a chiropractor, better stay home. On the other hand, if you're a reasonably healthy man for your age and have no unusual problems, don't miss out on all the fun worrying about what you're going to do when you need a doctor. Have a good checkup and ask your doctor what he thinks about your leaving the States.

What about education, if you still have some children in school? My daughter had graduated, but my two sons were still in high school when I took them out and brought them down here. What is education, anyway? Isn't it supposed to fit you for life? While we were uneasy about it at the time, my two boys now are very happy I brought them down here. They have learned to look at the basics of life and have participated in life at an early age. They now know two cultures. They speak Spanish far, far better than the usual high school or even college teacher of it. They read and do some studying on their own and when they went back for a vacation to the States, they took the GED examination and now have the equivalent of a high school diploma. If they want to go to college, I feel they will do better than if they had continued on in high school rather than come down here. It's an opinion, of course.

Part of the fun of working DX is thinking about where the ham you're talking to lives and how it would be to visit or live there yourself. But I can't answer all the questions or discuss all the angles even if Wayne Green invited me to expand this into a "Handbook For The Retired Ham Who Wants to Go THERE And Enjoy the Next Sunspot Cycle." But if

you'll send me your questions and doubts and a check for a couple of bucks to pay for the stamps and a cold beer while I'm typing out my comments, I'll be glad to help if I can. To travel you'll need a valid passport and getting an International Health Certificate is a good idea, too. They don't ask for them all the time any more, but you don't want to be in quarantine even a few days. So get it. And you might want to drive, so get your local auto club to get you an International Driving License. They'll do it even if you aren't a member. And for heaven's sake, get that CARNET for your equipment. You do want to ham, don't you?

Just because you've been told these are the "golden" years, it doesn't mean that you can hoard them. The days go by just as they always have and what matters is what you do with these years. If you've always wanted to ham from some exotic place I'd be glad to help you realize your dream. But if you don't . . . I don't want to talk you into something you'll regret. I've never wanted to run a hotel, but if it would help you decide, I'll be glad to have you and your wife come down and stay with me for a week. I'll charge you a hundred dollars and you'll have to eat Brumley home-style meals and generally entertain yourselves. You can use the rig. Your bedroom will be simple and you'll have to look after yourselves . . . you'll have a private bath. But don't just come down; write beforehand. There just might be two couples that want to come down and I'd rather have only one at a time. I only have one rig and I want to use it myself, too. Or, send me a letter with your questions. Come on, OLD MAN, don't just sit there and dream and wish. You can do it if you want to. Wake up and live the rest of your life! ■

Andrew Funk WA2UDS
Delta Tau Delta Fraternity
1077 Morewood Avenue
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Hamming the Buggy Sweepstakes

-- ham public service rides again

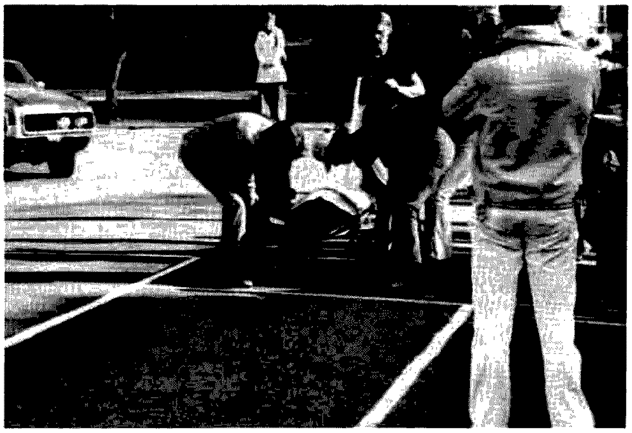
Photos by Glenn Meader

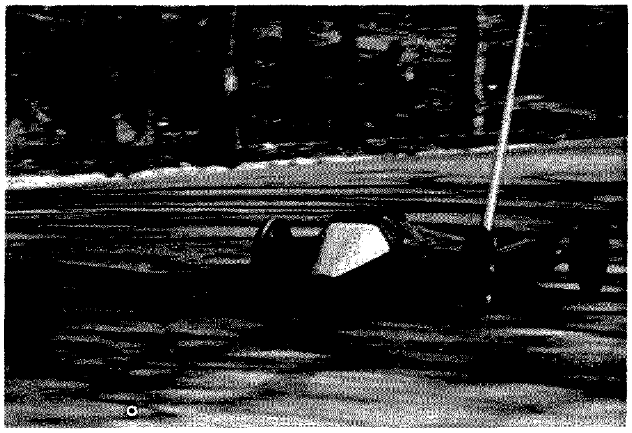
"And the *Streak's* ahead, followed by the *Delta Queen,* and the *Flying Buttress* is a close third. Around the turn of the chute, it's . . ." No, it's not a car race; it's the annual running of the Buggy Sweepstakes at Carnegie-Mellon University, and amateur radio was there.

Sweepstakes is the descendant of the 1920 interfraternity push-mobile race held on the Carnegie Tech Campus. Things have changed since those ponderous contraptions (one a bathtub on wheels!) rolled; today's buggy is computer-designed, costs upwards of $1500 and incorporates modern features. The buggies of Delta Tau Delta, for example, sport fiberglass monocoque shells, torsion bar suspension and pneumatic tires. This isn't for naught, as the best-designed buggies (engineering, appearance, safety, and special features) receive trophies and generally run better in the race, too.


Sol WB9IHC, "Course Closed!"

Andy WA2UDS, "Course Closed!"


The starting line — "Ready, Set, BANG!!"


Free-roll.

The Course

The race is run on Pittsburgh city streets. The buggies are pushed up a 5.9% grade from the starting line to the free-roll, 2400 feet of downhill, curving road. Turning the hazardous "chute" at speeds upwards of 45 mph, they again travel uphill, being pushed to the finish line. The entire course is 0.84 miles, and the record time (set by Pi Kappa Alpha in 1975) is 2:19.3.

Naturally we wouldn't want cars on the course while the buggies are running — imagine what a 2 ton car would do to a 175 pound (maximum, with driver) buggy! Up until last year a car with a signal flag would circuit the course prior to each heat, indicating to the "flaggers" stationed at each intersection that the course should be closed to traffic. This system had many problems, one of which was that there was no way to inform those in authority if a car ran a barricade, nor was there any way except sheer guesswork for the flaggers to know when to open the course.

Enter Amateur Radio

These problems disappeared when the Carnegie Tech Radio Club (W3VC) began providing communications for the practice sessions held at 6:00 am Sunday mornings. Two meter FM units operating on 52 simplex were stationed around the course with the flaggers, and a command post was established within easy earshot of the sweepstakes chairperson. Three minutes prior to each heat the "close course" was radioed to the flaggers, and each unit would respond by confirming "course closed" status. While buggies ran the course, their position was constantly relayed to the sweepstakes chairperson, and once they cleared the course, she authorized course opening.

Accident!

Buggy accidents can result in serious injury, so the CMU Security Van-Ambulance is kept at the chute at all practices and race days. During the practice last April 1st, a buggy's steering malfunctioned, sending the buggy careening into a tree. A quick radio call brought the ambulance to the scene, and an autopatch call over WR3AGJ alerted the hospital of the incoming patient. The driver was not seriously injured, but doctors at the hospital felt that if he had not arrived as quickly as he did, there may have been serious complications.

Race Day(s)!

April 9 and 10 marked the climax of the combined efforts of the many organizations racing — SWEEPSTAKES! Our setup was the same as that used at the practices, with the addition of a motorcycle unit (WB3AWT) and judges/backup communications provided by the CMU Ranger Company. Ever compare a HT to a PRC-77?

The timers on the judges' truck (HQ) required the starter's countdown and gunshot, so this was broadcast by the unit at the starting line. The Security Van, at the chute, was equipped with a PA system which was used to amplify the starting count for the benefit of the spectators there. Race times and other data were also announced in this manner.

Conclusion

The entire Sweepstakes ran smoothly, and for the first time in years, there were no accidents at all. Much of this has been attributed to the fine communications


The long hard push to the finish line.

The crew (l to r) – John WB3AWT, Karl WA3GSB, Andy WA2UDS, John WA2ZUL, Reed WA3JBQ, Connie W3HTL, Sol WB9IHC.

provided by W3VC.

Club members John Rose WA2ZUL, Sol Marcus WB9IHC, Karl Sieber WA3GSB, Don Gregg WA3KGT, Connie Hilpert W3HTL, Steve Salgaller WA3ZGT, Glenn Meader, Andy Funk WA2UDS, and Pittsburgh amateurs Reed Krenn WA3JBQ and John WB3AWT devoted their time and energy to the project, making it a success. A special thanks to Jerry DiGennaro and the members of the CMU Ranger Company for their participation.

This year the Carnegie Tech Radio Club will provide communications for Sweepstakes 1977, and everyone is invited to come down and watch the races or help out.■

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Taming the Wild Beta

-- how to make transistors behave

Transistors, like the ladies, are rather variable, and while the variability of the tender gender may be the spice of life, with transistors this can be just another electronic pain in the epizootic.

Getting sound through the average low powered stone, such as is used in mike stages or other moderate level use, can be a problem when you realize that transistors of the same type number by the same or different manufacturers may have a current gain variance of about 150% or more.

This means initial design problems or troubles when you go to replace a transistor in an already functioning piece of gear and find either too much or too little gain is being produced by the new unit.

A basic approach around this problem is to tackle it from the idea that the circuitry associated with the transistor might be rolled in such a manner that it could ignore the wide differences in transistors plugged into it.

Fig. 1 shows a unique transistor manufactured by the "Anybody's Transistor and Pool Table Mfg. Co., Ltd." It is NPN, will stand up to a 25 volt supply, and is rated at a few hundred milliwatts dissipation. Its beta or current gain is "tightly held" to a tolerance of between 40 and 200.

One key to the circuit is the lack of an emitter bypass capacitor which produces current feedback. Now for some basic rules of thumb that are not exactly gospel, but have enough latitude to make them work in a practical way.

1. Keep your supply voltage between 9 and 20 volts.
2. Make your emitter resistor at least 470 Ohms.
3. R2 should be about ten to no larger than 20 times the value of your emitter resistor.
4. You should have about 1.0 volt across the emitter resistor to ground. (One way of doing this is to utilize RX shown dotted in between the supply and the emitter resistor. Adjust the value of this resistor so that you do get about one volt from emitter to ground, which will solve your problem.)
5. You select your stage voltage gain simply by multiplying your selected emitter resistor by the wanted gain and using that product as the value of your collector load. Example: Emitter resistor=470 Ohms. Stage gain of ten wanted. 470 times 10 = 4700. So collector load = 4700 Ohms.
6. You can select the value of the R1 top leg of the base bias divider by making it a value that will give about one half the supply volts from collector to ground.
7. You should try to keep the base divider current in the 0.1 to 0.2 mil range. The lower values will tend to give lower circuit noise.
8. On a practical basis, try to keep R2 to 15k or less.
9. On a practical basis, the collector load should run between 4700 and 15k, the higher values for use with higher supply voltages.
10. You can assume that your undistorted output voltage (distortion 1% or less) will be about 20% of your supply voltage.
11. You can assume, on a practical basis, that your input impedance will be the value of the resistor from

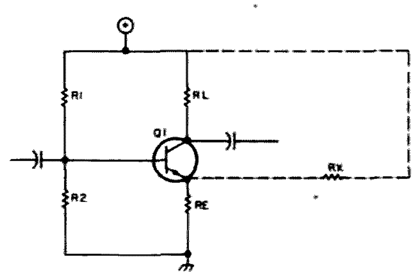

Fig. 1. If your circuit dc conditions are all OK but the emitter to ground voltage is too low, insert a value of RX, as shown, that will bring the emitter voltage closer to the desired one volt target value.

base to ground.

12. You can assume that your output impedance will be the collector load in parallel with the input impedance of the following stage.

13. If your final design does not show a measured three volts or better measured between collector and emitter, fudge your values until you do get close to the minimum three volt figure.

If we follow this series of approximations, what do we wind up with? We should have a circuit that will accept almost any transistor with reasonable approximations of the selected type and give stable gain and stable operation for the range of temperatures that a piece of ham gear might experience in a car.

This would run from freezing in the winter to perhaps 150 degrees in a closed car in the summer sun.

We have two types of stability we are really considering. One is circuit gain or ac stability, and the second is changes in circuit operation with changes in dc conditions in the circuit. This last item is particularly important to you fans of the nine volt battery. These circuit guesstimations should let this type of stage operate down to a six volt throwaway point, or well below the point where any associated power stages would have called for a new battery.

The basic factors for ac stability are the existence of the emitter feedback resistor and the ratio of the emitter resistor to the base to ground resistor. The basic dc stabilizing factors are the effect the bias divider has on swamping out changing base current and, again, the dc effect of the emitter resistor in keeping the base to emitter voltage reasonably constant with changes in collector current. ■

A Combiner for Your 2m Whip

-- BC reception on your 2m antenna

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The article "The Secret 2m Mobile Antenna" on page 44 of the May issue of *73 Magazine* brings to mind a similar unit that I have been using for some time. My requirement was the opposite of that of the article – in my case, to use the one 2m antenna for the 2m transceiver and simultaneously for the AM car radio.

The 2m antenna is a five eighths whip with a loading coil at the base. Fig. 1 shows this coil as L1.

Installation and operation of the splitter unit is a piece of cake. The coax lead from the antenna to the 2m transceiver is broken at some convenient point and the components C1 and L2 inserted in series with center conductor. C1 is adjusted for maximum signal on the transceiver S-meter. No change in the 2m transceiver performance will be noticed.

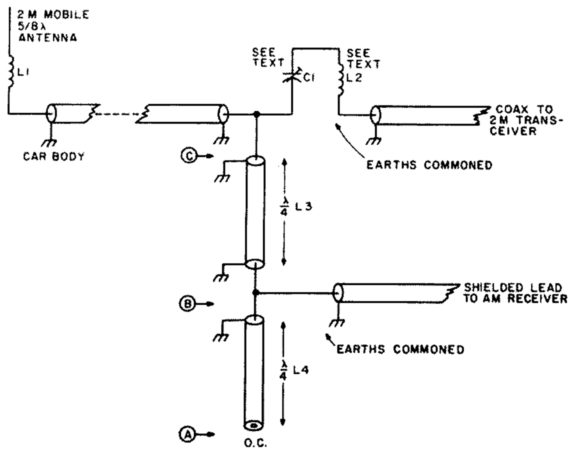

Fig. 1. Diagram of combiner unit for operating AM receiver simultaneously with a 2m transceiver off a 2m antenna.

The AM antenna lead is taken off via a quarter wave stub arrangement. The stub L3 is connected to the antenna side of the C1/L2 assembly. An additional stub L4 is connected to the free end of L3. The AM receiver lead is connected to the junction of L3 and L4. The free end of L4 is left floating with the inner and outer on open circuit.

The operation of the 2m quarter wave stubs is such that the open circuit at A puts an effective short circuit (for the 2m signal) at B. This short circuit at B puts an open circuit at point C. So the 2m signal from the antenna arrives at C and sees an open circuit when "looking down" L3. It sees a low impedance path looking towards the 2m transceiver because C1 and L2 form a series-tuned circuit at resonance. The result is complete isolation of the two operations on the one antenna – 2m mobile with AM music in the background if required.

The five eighths wavelength antenna must be of the variety with a series loading coil at its base (i.e., not the type with a grounded parallel-tuned circuit with a tapped feed). Note that there is a dc path from the AM receiver right through to the antenna.

The coax lengths L3 and L4 depend on the type of coax used. Either 75 or 50 Ohm is suitable. I used solid dielectric type with a velocity factor of 0.66, so the lengths L3 and L4 are each 12.5 inches. C1 is a 27 pF trimmer. L2 is 3½T, ¼ inch diameter, ½ inch long, #18 wire. Both these components should be mounted in a small box to effect good screening.

This combiner has been very effective and certainly improves the appearance of the car (from the XYL's viewpoint, anyway) by reducing the antenna complement by one! This also means that the original AM radio antenna can be replaced with something more useful – such as a collinear for 432!! ■

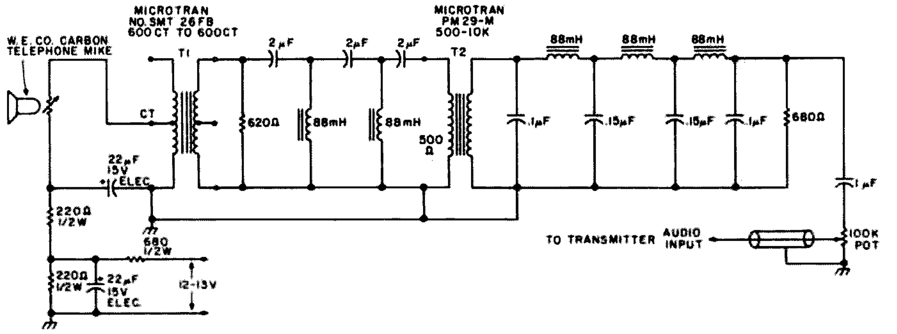

Fig. 1. Unless otherwise specified, all capacitors are non-polarized, preferably Aerovox type V146R aerofilm mylar caps.

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The Carbon Marvel

-- best mobile mike yet?

A carbon microphone is one of the most reliable forms of a voice transducer. The carbon microphone can be made to sound natural and, in most cases, the listener will not know one is being used. Listen to a YL on an autopatch; the voice sounds very natural and it is fed into the transmitter via a telephone. Ma Bell has to accommodate many services and, therefore, has given much attention to the carbon mike — in particular to the manner in which it is incorporated into telephone circuits and to the acoustical response of the device.

Carbon microphones can take a fair amount of mechanical punishment. Great excursions in temperature do not degrade their operation and, best of all, they are cheap. They are found in abundance on the surplus market. They make excellent mobile microphones.

This type of mike requires a small exciting voltage. It is a variable resistor which varies the exciting voltage at an audio rate. The audio response is determined by the mounting of the carbon button to its acoustic resonator. This is the diaphragm and cavity in which it is mounted.

The output of the carbon mike can then be directed into a filter which enhances a useful response range, 300 to 2800 Hz. The name of this game, however, is to match the mike to the filter in a manner which prevents or reduces the variation of impedance caused by the change in microphone resistance.

Let's look at the circuit in use at W1SNN. The carbon mike output is directed into an audio transformer. The excitation voltage applied to the microphone is reduced from 12 volts, usually supplied from a car battery.

A hash filter is incorporated with a voltage divider, which serves to keep the alternator whine from my Maverick out of the audio system and to reduce the battery voltage to 3½ volts. It is important to try to maintain the exciting voltage in the 3 to 3½ volt region, since increasing it above the high limit will allow the characteristic "frying" sound produced by the carbon granules to become objectionable. When transformer coupling is used, a current limiting resistor is required to insure that the current flow will not bias the transformer core too badly and destroy its frequency response. The 220 Ohm resistor in series with the divider/hash filter will keep both of these effects to a tolerable level.

The secondary of the microphone transformer is terminated in a fixed resistor, allowing the two section high pass filter to "see" a constant termination regardless of impedance reflections given by the microphone. The high pass filter output feeds into an impedance matching transformer, which is followed by a three section low pass filter.

The overall response of the combined filters depends upon the fact that load impedances must be constant, so the output of the last filter is terminated in a resistor. A potentiometer ac coupled to the output acts as an audio volume control. This control may be eliminated if one exists in the transmitter. However, remember the output of this microphone filter combination is in excess of .250 mV and is far more than required for most microphone input circuits. At W1SNN this microphone is used to generate direct FM by feeding it into a processed audio system incorporated in a frequency synthesizer. Very little audio is required and hence the pot. The response of the microphone and filter combination is such that it cuts out the low frequency rumbling produced by mechanical sounds of my vehicle in motion and the higher pitched undesirable traffic noise.

Since the audio level is kept quite low, the mike must be held close to the operator's mouth. The reduction of speech slurring from breath sounds and the overall improvement in the sound of the rig make the addition of all this circuitry worthwhile. ■

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The Minicom Receiver

- - finally, a QRP allbander

Does 5 bands, noise blanker, S-meter, tunable CW filter, internal speaker, and ac/dc operation in a receiver small enough for suitcase or attache' case turn you on? If so, then the MK IV may be what you've been waiting for.

Background

The Minicom MK IV is a miniaturized solid state communications receiver, and it should be apparent from the title that there have been 3 predecessors. I guess the earliest version was one I included for illustrative purposes in my article on the LM-373.[1] The real MK I, however, did not appear until 1974 when it was published as a construction project.[2] The MK II was devised during the time the MK I was awaiting publication and, since it was very similar, no

The MK IV makes an attractive package.

attempt to publish details was undertaken. Instead, all readers who inquired about the MK I were advised of the later version. The MK III appeared in print together with a collection of circuit ideas for receivers.[3] It was different from the others in that a triple varactor was used to replace the 3-gang tuning capacitor in the rf section. As with all previous Minicoms, single band operation on 80 meters was standard.

At various times I attempted to design a converter that could be mated with the Minicom assembly to produce a multiband receiver of diminutive proportions. The converter usually ended up being larger than the receiver and success eluded me for a very long time. By using 3 separate PC boards and constructing the converter around and between the wafers of a surplus rotary switch, a suitable converter was finally evolved which led to several copies of multiband Minicoms in the same size cabinet as the single band MK I. Construction of this converter, however, was far too tricky and the rotary switch too hard to come by to make publication of details practical.

The MK IV

Over a period of many months, I investigated the offerings of several switch manufacturers to see if a converter design could be developed that would be suitable for publication. The Stackpole Series 80 subminiature rotary switch offered the most promise, so I ordered some samples fabricated to my specs. The switch has printed circuit pins so that the 2 boards used for the converter mount right to the switch. Pins from various sections are brought out on opposite sides so that the 2 boards form a sandwich with the switch in the middle.

The converter together with 2 other PC assemblies make up the bulk of the receiver circuitry. A third board constituting an ac power supply completes the lineup. Everything is housed in a Radio Shack #270-254 cabinet whose dimensions are 6 ¼" x 2 ¾" x 7 ¼".

The main PC assembly contains the tunable i-f which covers 3.5 to 4.0 MHz, a noise blanker with threshold control, and 2 amplifier stages. Selectivity is provided by 2 transformers and 2 dual ceramic filters at 455 kHz. The companion board houses the detector, AGC circuits, S-meter amplifier, BFO, tunable CW filter, and audio power amplifier. Both of these boards are 2.4" x 5.5".

Power required is a positive 12 volt source capable of supplying 120 to 150 mA during audio peaks. No-signal drain is about 80 mA for SSB/CW operation. The internal regulated supply meets these requirements and is automatically switched off when the receiver is switched to an external dc source.

There are 8 operating controls and 3 switches on the front panel as well as an S-meter and phone jack. The controls are main tuning, rf peaking, AGC time constant, rf gain, af gain, blanker threshold, CW filter tuning, and BFO tuning. Switch controls consist of the bandswitch, AM-SSB/CW selector, and CW filter mode switch. The ac/dc power selector switch, antenna connector, ac power cord connector, and

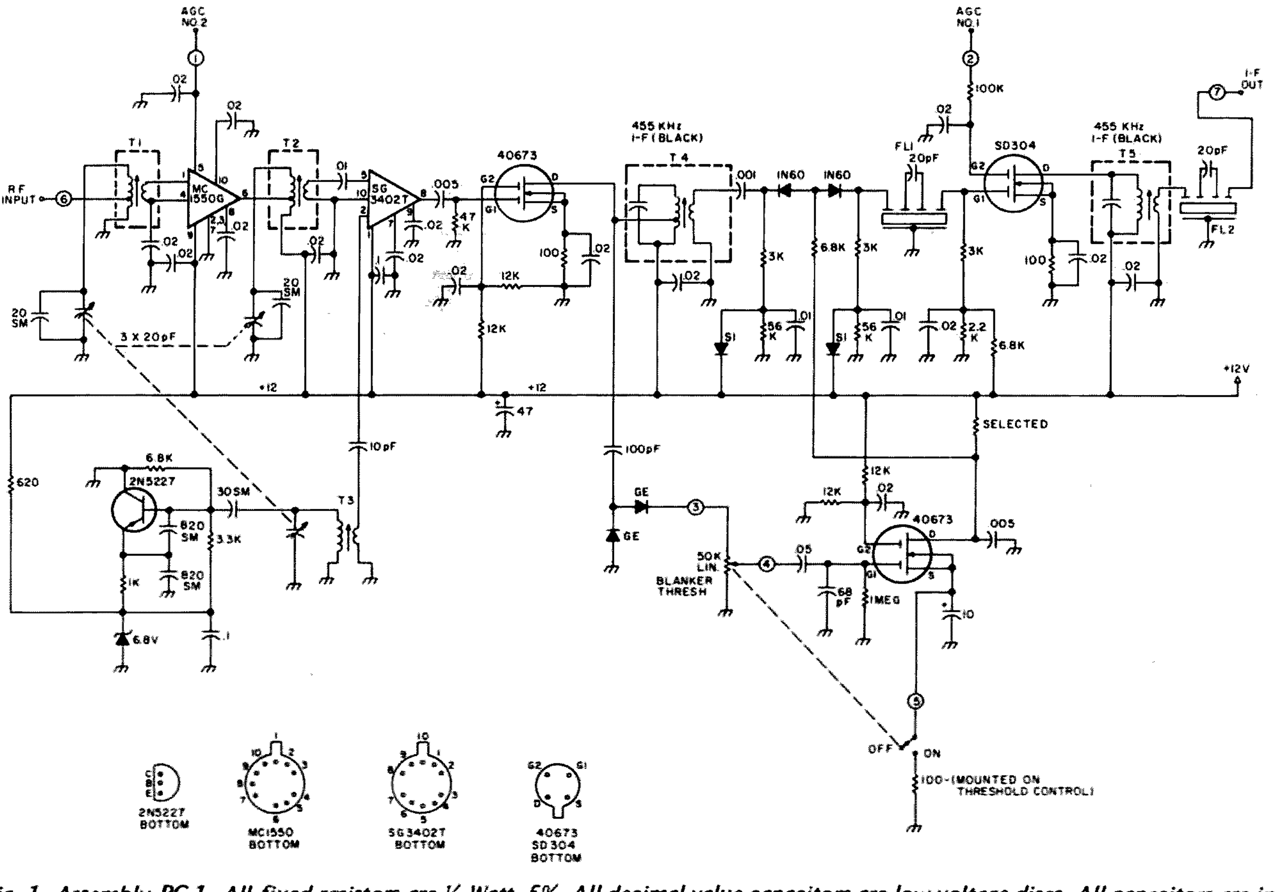


Fig. 1. Assembly PC-1. All fixed resistors are ¼ Watt, 5%. All decimal value capacitors are low voltage discs. All capacitors are in uF except as noted on schematic. Capacitors with polarity marked are electrolytics of at least 15 volt rating. All SM (silver mica) capacitors are in pF. The circled numbers denote pads on the PC board which connect to external points or controls. The artwork layout in Fig. 5 shows the physical location of each of these points.

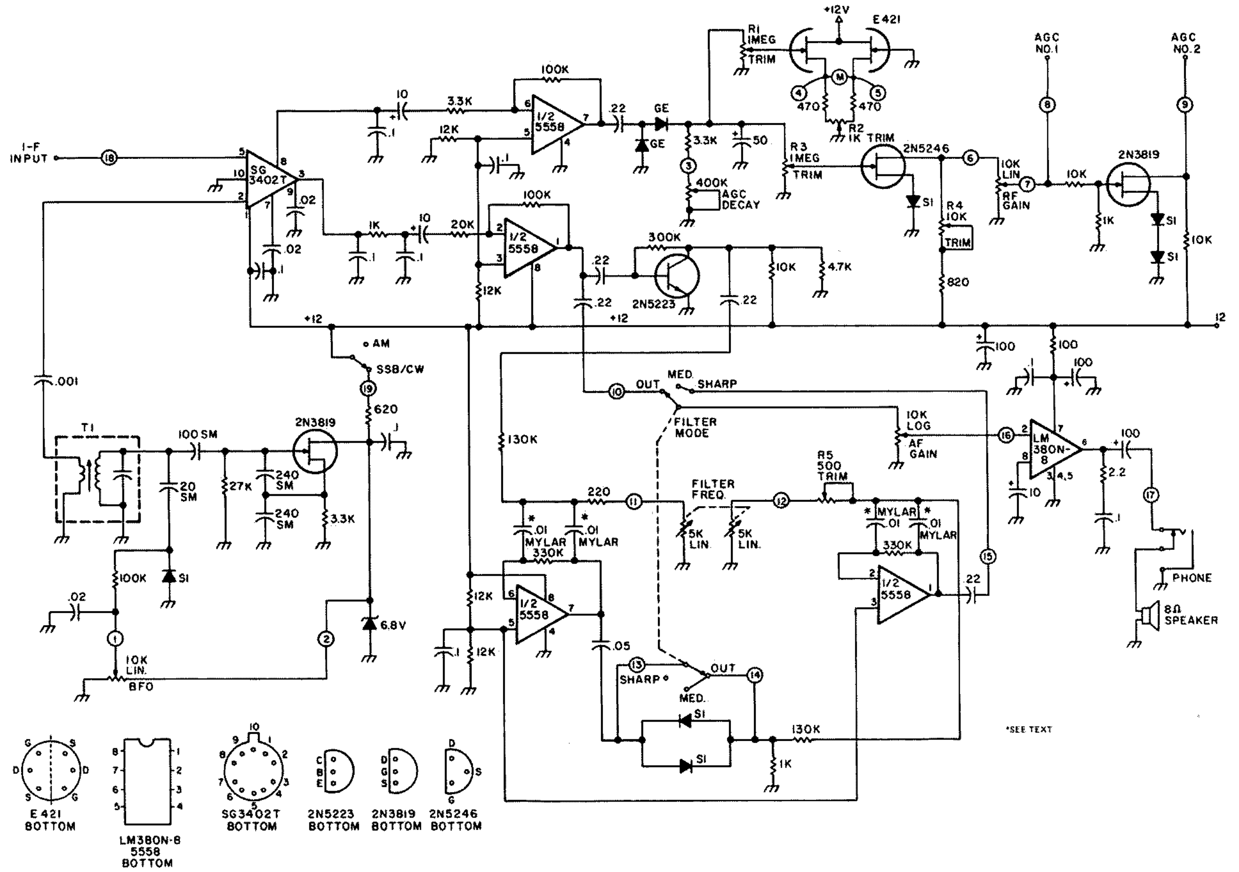


Fig. 2. Assembly PC-2. All fixed resistors are ¼ Watt, 5%. All decimal value capacitors are low voltage discs and values are in uF. All capacitors with polarity marked are electrolytics of at least 15 volt rating. Capacitors marked SM (silver mica) are in pF. The circled numbers denote pads on the PC board which connect with external points or controls. The artwork layout in Fig. 6 shows the physical location of each of these pads.

external power input jacks are mounted on the rear apron. The ac fuse is mounted on the power supply PC board.

The small internal speaker is epoxied to the top of the cabinet for want of any other available space. A larger speaker or phones may be plugged into the front panel jack which cuts out the internal speaker.

That should give you the overall basic picture of what the Minicom MK IV is and the rest to follow will take up the circuitry and construction of each of the sections individually.

Tunable I-f Assembly

For purposes of identification this assembly will be called out as PC-1. Fig. 1 is the schematic for this board.

Recent receivers in this series used MOSFET rf amplifiers which often were plagued with problems of oscillation and instability. For this version, I decided to go back to the old MC1550G IC in the rf stage. The receiver pictured here has been working fine and not shown any tendency towards instability whatsoever. The mixer which follows is also an IC and one which I've used since the MK II. The SG3402T is a proprietary product of Silicon General. It provides good conversion gain with very light oscillator loading, thus eliminating the need for buffers. The VFO tank coils on previous Minicoms were wound on stripped down 455 kHz i-f transformers, as were the antenna and mixer transformers in the rf section. I later found that in some cases this tank coil caused excessive drift in the VFO and the scheme was abandoned. Since no harm comes to the rf and mixer circuits, however, this construction is still employed here. The new VFO tank coil consists of a pie-type winding of litz wire on a standard slug-tuned coil form.

Output from the mixer is fed unfiltered to an amplifier stage whose main purpose is to build up the noise spikes to a level the blanker can do a job on. The blanker itself consists of a diode gate using 1N60 diodes and a pulse amplifier fed from an envelope detector which controls the gate. The pulse amplifier is capacity coupled to the output of the first i-f amplifier and the gate is transformer coupled. Output from the gate terminates in the first of 2 dual ceramic filters used for selectivity in the i-f strip. The 1N60 diodes are normally forward biased and do not impede transmission of the i-f signal. When a noise pulse appears at the input to the pulse amplifier, its drain voltage drops towards ground and momentarily reverse biases the gate diodes, preventing transmission of the noise pulse through the gate. The circuit is quite effective for impulse type noise but is of little value against fluorescent lights, power leaks, etc.

Following the blanker is a stage of i-f amplification using a SD304 dual gate MOSFET. These devices by Signetics operate with all positive bias, making AGC requirements simple. These transistors are run with a small fixed positive bias on gate 1 and an AGC controlled positive bias on gate 2. As gate 2 bias approaches zero, gain drops rapidly and can affect changes as great as 40 dB. Output from this stage is

	L3 (molded choke)	Y1 (HC18/U or HC25/U holder)
40m	4.7 uH	11 MHz
20m	2.2 uH	18 MHz
15m	1.5 uH	25 MHz
10m	(same tank circuit as 15m)	

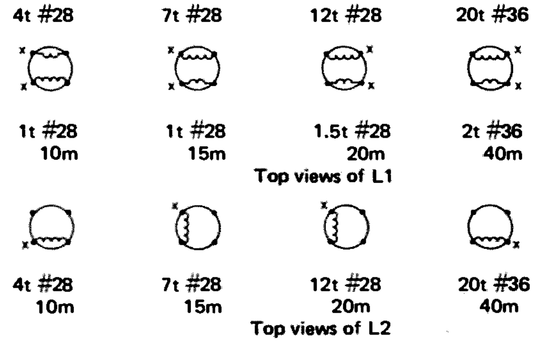


Table 1. All coils wound on Gowanda Series 7 coil forms. Forms are .209" diameter x .625" long with Carbonyl E cores. "X" indicates cold or ground end of winding.

transformer coupled to the second ceramic filter, which completes the circuitry assigned to this board.

Detector and Audio Section

This assembly is PC-2 and the schematic for it is Fig. 2.

A second SG3402T IC is used as detector for both AM and SSB/CW, it being necessary only to disable the BFO for AM reception. The SG3402T has 2 outputs via pins 3 and 8. In this case, pin 3 is used as the main audio source and is fed to the preamp which uses half of a dual op amp. Output from the preamp connects to either the audio gain control or is left open if the CW filter is in use. In order to maintain a fairly constant input to the CW filter, audio from the preamp is fed to a saturating amplifier circuit and from there to the filter. The filter itself consists of 2 identical active bandpass filters joined by a threshold detector.[4] Both sections are tuned simultaneously by a dual 5k pot. A 3 position switch allows the filter to be cut out of the circuit, operated with the threshold detector shorted out for medium selectivity, or with the threshold detector intact for sharp response. It will not always be practical to use the Sharp position, since weak signals or QSB may cause the signal level to fall below the barrier potential of the diodes and cut out altogether. In such cases, the Medium position will still provide a good deal of selectivity. The frequency range covered by the filter is approximately 400 to 1600 Hz.

An LM380N-8 is used in the audio power amplifier stage. This IC is rated at 600 mW output and requires few external components.

The BFO is diode tuned and uses a standard 455 kHz transistor i-f transformer for the tank circuit. Before installing the transformer, the secondary is modified to 4 turns so as to supply proper injection level to the detector. Operating voltage for the oscillator and bias for the tuning diode are zener regulated.

Audio output from the detector is used as the source for generating AGC voltage and is taken from pin 8. The second half of the dual op amp is used to amplify the audio about 30 times before rectification. The resulting positive voltage is stored in an electrolytic capacitor and bled off at a rate determined by the setting of the T/C control. The latter is a front panel control giving the operator a choice of AGC decay time over a continuous range of milliseconds to seconds.

The FET which follows amplifies and inverts the dc voltage appearing across the electrolytic capacitor so that as signal increases, the level at the top of the rf gain control decreases. This is the proper action for control of the SD304, and when I used this transistor in all gain-controlled stages, no further circuitry was needed. Now, however, a reverse effect is required for the MC1550G used in the tuner rf stage. The SD304 operates at full gain when the AGC level is 5 to 6 V. The MC1550G doesn't start to lose again until the AGC starts to rise above this level, making a second inversion necessary. This is accomplished with an additional FET. The rf gain control does the same thing as the AGC when manual control is desired.

It may be worth noting that an early version of the MK IV used separate sources for AGC control. As might be expected, output from the i-f amplifier was used during AM reception in place of the audio source. Since AM is seldom used, this extra circuitry and additional switching were eliminated to save space. Though perhaps not ideal for AM, the audio AGC works well enough to make AM reception practical whenever it is needed.

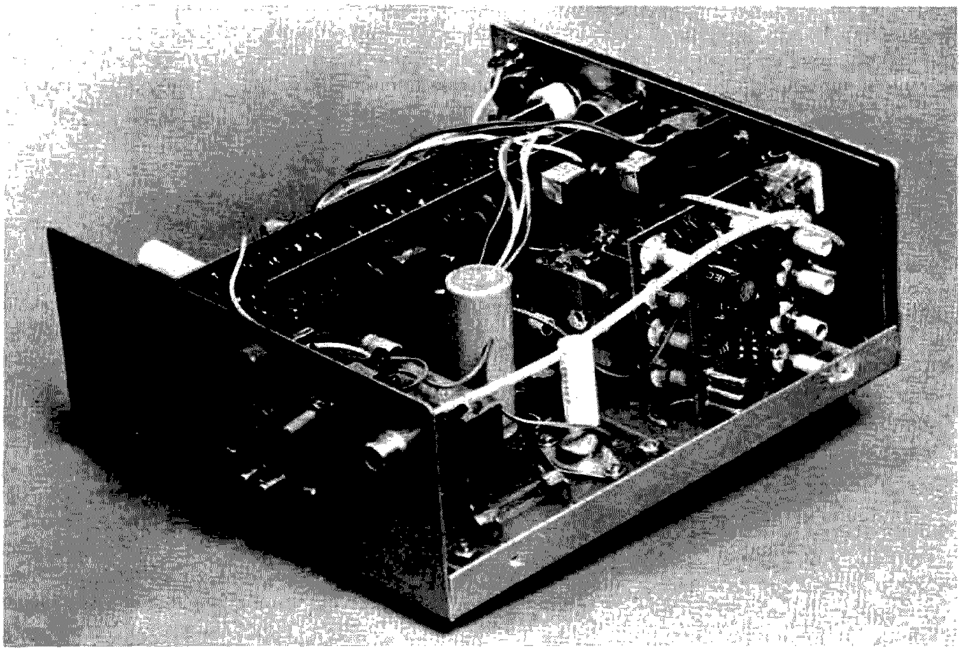
The S-meter amplifier is the final item included in this assembly. Control voltage for this stage is taken directly from the storage capacitor. Trimmer R1 controls meter sensitivity by setting the amount of AGC voltage applied to the meter amplifier. R2 is used to balance the circuit for zero deflection under no-signal conditions.

There are 3 other trimmers on this board intended for various purposes. R3 is the AGC threshold adjustment and sets the point at which AGC starts to affect gain relative to signal strength. R4 is used to set the static AGC level of 5 to 6 volts mentioned above. The last trimmer, R5, is a tracking adjustment for the 2 sections of the dual pot used to tune the audio filter.

The heart of the converter is the Stackpole Series 80 subminiature rotary switch. It is rectangular in shape and measures 13/16" x 9/16". Each section is a totally enclosed module and up to 10 of these decks may be combined in various configurations to make up the desired switching pattern. In the case of our converter, 5 sections of 1 pole, 5 positions are required. All the contacts emerge along one side of the module and are spaced on one-tenth inch centers along both axes. To conform with the design of the converter, 2 sections have their contacts brought out one side of the switch and 3 sections on the opposite side. The 2 PC boards are both 2" square and mount directly to the switch on opposite sides. One board had to be made 2-sided to accommodate all the circuitry, but a single-sided board was sufficient for the other. The double-sided board contains the rf amplifier with its 4 antenna coils and the 3 crystals for the oscillator. The second board houses the mixer with its 4 coils and the remainder of the local oscillator circuitry. Overall thickness is 1-5/8".

Fig. 3 is the schematic for the converter whose circuit consists of a cascode rf stage using a pair of JFETs followed by a dual gate mixer. A second JFET functions as crystal oscillator. The switching is arranged so that the antenna feeds right through on 80 meters.

A 25 MHz crystal is used for coverage of both 15 meters and the low end (28.5 to 29.0 MHz) of 10 meters, thus economizing on both cost and precious space. If coverage of some 500 kHz segment other than those used here is desired, suitable crystals and tank coils may be substituted. Also note that with this design 40, 20, and 15 meters tune backwards.



Internal layout showing vertical mounting of all assemblies except power supply in center foreground.

The 10 meter band will tune normally from low to high with CW rotation of the tuning capacitor since the crystal is on the low side. As built, the converter covers 7.0 to 7.5 MHz, 21.0 to 21.5 MHz, 14.0 to 14.5 MHz, and 28.5 to 29.0 MHz. The tunable i-f covers the 80 meter band from 3.5 to 4.0 MHz.

Power Supply

A simple basic regulator circuit is used in the power supply and requires no particular comment. It is entirely self-contained, including transformer, on a board 2.3" x 3.1". Output is 12 volts at 150 mA. A schematic for the power supply appears in Fig. 4.

That just about covers everything that's in the receiver, so now we can get on with the actual building. I hope you're a real honest-to-goodness do-it-yourselfer and will be making your own boards, too. That's half the fun and not nearly as difficult as so many readers seem to think, judging from the mail I get.

The only real problem area regarding fabrication of the printed circuits used in the MK IV is the double-sided board used in the converter. I generally cut out a cardboard frame for all my boards so that the board fits snugly in the cutout and can't move during handling. The film is cut slightly larger than the opening and once lined up is fastened with tape around the edge. To expose 2-sided boards, I line up the second film on the backside and fasten only one edge with tape. This film is then merely hinged and can be lifted to insert the 2-sided board. Each side is then exposed in turn and the board processed as usual.

Assembling PC-1

All the holes will have to be drilled before any components can be mounted, and it would be well to go ahead and drill all the boards at one time. I generally don't bother with anything smaller than a #65 drill, but you may if you wish a real snug fit on semiconductors or other components with fine leads. Most holes can be drilled with either a #60 or #65 drill. Use a #50 drill for the 2 mounting lugs on the 455 kHz i-f cans and a #30 drill for the 2 screws holding the 3-gang variable capacitor. The #30 drill can also be used for the 2 power transformer mounting lugs and the tuning slug access holes on the single-sided converter board. The power supply regulator transistor can be mounted with either #2 or #4 screws, so drill the 2 holes to suit. The 4 corner mounting holes on this board can be drilled for #4 screws. About the only other odd holes are those for the vertical trimmer resistors on PC-2 which require a #54 drill.

As with assembly of all the boards making up this project, a few basic rules to follow will make the job easier. In line with this, I generally mount the shallowest components first since the board is usually turned on its back during soldering and direct contact of the component with the top of the bench prevents it from falling out. This means all resistors and diodes go in first. The smallest discs, silver micas, semiconductors, and ICs would follow, with the larger discs, electrolytics and transformers going last. In most cases, you can tell what order to follow by laying out all the components in proper sequence by height. Try to keep heating of germanium diodes to a minimum since they are the most temperature sensitive parts you'll be installing. A small iron is essential, but not one with inadequate heating capacity. The rest of the DOs and DON'Ts I'll skip, since you've heard them all before and if you are tackling this project, you must be a big boy now.

The rf transformers and VFO tank coil will have to be wound before proceeding with the assembly operation. All the winding information is contained in Table 2. T1 and T2 are wound on stripped down 455 kHz transistor i-f transformers of the 3/8" square variety. Wire salvaged from the transformers is used to wind the new coils. If you read reference 2, you'll get a few tips on how to go about this operation.

Winding T3 is a little more of a problem if you don't have a coil winding machine. I use one of those that's been advertised in many of the mail order catalogs since the year 1 and sold under the name of MoReCo the last I looked. When I bought mine,

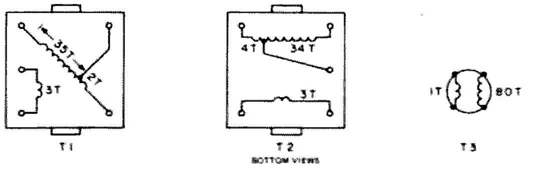


Table 2. T1 and T2 are wound on stripped 455 kHz transistor i-f transformers using salvaged wire. T3 is pie-wound with 7/44 litz wire on a Gowanda Series 7 coil form with Carbonyl E (red) core. The 1 turn link is wound over the top of the pie.

it was a Morris coil winder. A ¼" cam is used and the winding located as close to the bottom of the form as practical. Impregnate the winding with a generous dose of coil wax when done. Use standard 455 kHz i-f transformers for T4 and T5.

Don't forget that unlike other ICs in T0-5 cans, the MC1550G has pin 1 located adjacent to the tab and not pin 10. Also, before installing the SG3402T you'll have to cut off pin 6 since there is no hole for this lead in the board.

The 20 pF padding capacitors across the rf and mixer gangs of the tuning capacitor are mounted right on the capacitor before installation. One end of each padder is soldered to the frame and the other end to the stator connection on each of the first 2 gangs. Before mounting the variable capacitor, you should grind the shaft to desired length and also clip the 3 stator solder lugs to 1/8".

The drain resistor for the noise blanker pulse amplifier is selected during test and a 1k resistor should be temporarily installed. The 100 Ohm source resistor is mounted externally. See Fig. 9.

The SFD-455D filters have small circles molded into the top of the case at one end. Mount these parts with the circle towards the 20 pF coupling capacitor associated with each filter.

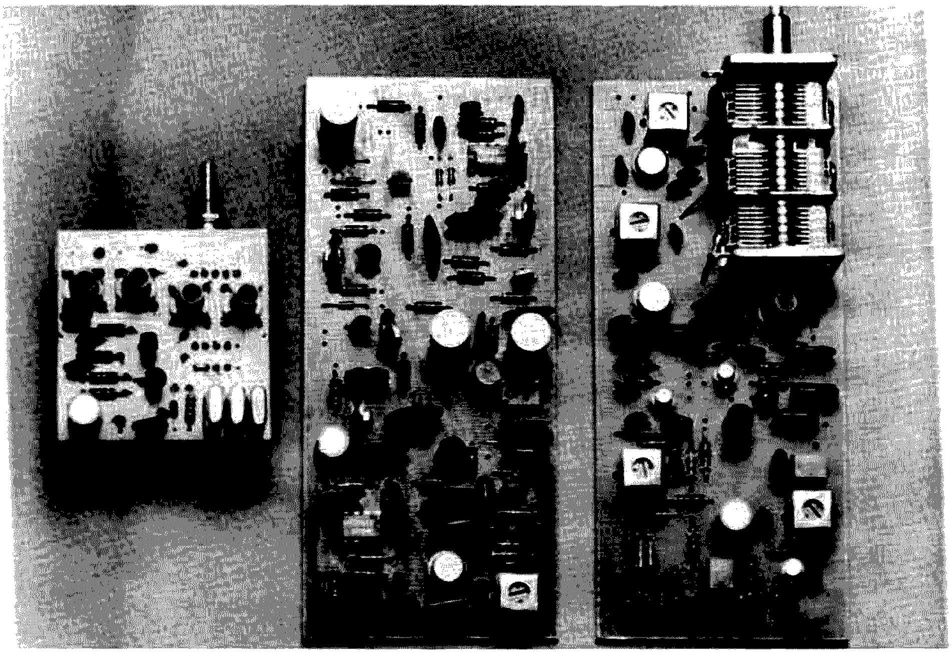
The 3-gang tuning capacitor will be the last item installed. Use #4-40 screws with internal tooth lock washers under the head and insert from the copper side of the board. Use 2 flat washers between the board and the frame of the variable capacitor at each screw in order to clear the rivets and prevent distortion of the board when the screws are tightened. Long pigtails cut from resistors during assembly can be used to connect each gang to its respective pad. These leads should be soldered to the capacitor stator lugs before mounting, since little room is left after mounting. The free end of each lead can be guided into the proper hole as the capacitor is mated with the board.

PC-1 and PC-2 both have several pads available for the +12 supply and are so marked right on the board. You will also find a number of empty holes around the copper border which are there for ground returns if needed. The remaining pads with empty holes amid the copper circuitry are for connections to external controls or to other boards and can be left alone for the present.

Assembling PC-2

Proceed with this board just as with PC-1. There are no coils to wind, but there is a modification to perform on the BFO transformer (T1) before it can be installed. Using a standard i-f transformer, remove the assembly from the can and break off the secondary leads right at the point where they enter the bobbin. A pair of fine tweezers is ideal for this operation. Unsolder the remaining wire from each of the pins and clean off any excess solder. Using a piece of salvaged wire from the rf transformers, wind a new secondary of 4 turns right over the existing windings and solder the ends to the secondary pins.

Clip pin 6 on the SG3402T as before and you are ready to start mounting parts. Assembly is quite straightforward and when the board is complete, set it aside with PC-1 until everything is ready for testing.



Top view of converter, PC-2 and PC-1 fully assembled.

Assembling the Converter

I've taken a lot of liberties with construction of the converter and you may not agree with some of the techniques employed, but it did allow me to squeeze 10 pounds into a 5 pound bag. If anyone comes up with any good ideas on improving this beast without increasing the size, I'd like to hear from you.

As I mentioned earlier, one of the 2 converter boards is 2-sided. One side contains all the circuitry while the other is a ground plane. All the components for this board are mounted on the wiring side, which becomes the top of the converter. This means that all leads will have to be soldered to their pads right at the point of entry except for those connecting to ground on the other side. You can tell which leads get grounded by whether or not the copper has been etched from around the hole on the backside.

There are 4 locations where it is impossible to solder the leads because the pads are covered by the component when it is inserted into the board. These 4 points include one end of each crystal and the positive terminal of the electrolytic filter capacitor. Since I don't have plating-through capability in my rather simple printed circuit facility, I solved this problem by inserting a tiny eyelet through the top of the board and soldering the head to the pad. The component lead is then soldered to the barrel of the eyelet on the other side.

The coils are wound as shown in Table 1. Make certain you get the right orientation when inserting the coil into the board. The crystals may be in either HC18/U or HC25/U holders to fit the layout. I personally prefer the latter since the pins seem to take solder better than the wire leads.

The bottom board is assembled in the normal manner, with components

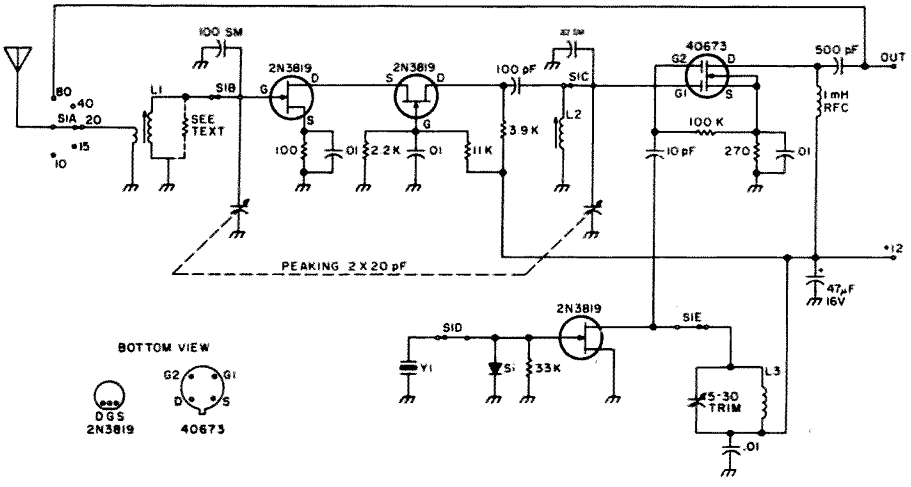


Fig. 3. Converter schematic. Coil winding information appears in Table 1. All resistors are ¼ Watt, 5%. All decimal value capacitors are low voltage discs with values in uF. The capacitors marked SM (silver mica) are in pF.

mounted on the clear side. The ground plane for this board, as with all previous sections, is the copper border around the outside edge. Eventually all printed circuit grounds will be made common with each other and the metal cabinet.

When mounting the 3 subminiature trimmer capacitors used to tune the oscillator tank circuits, try and connect the rotor side to ground. If you look at the top of the trimmer, you'll see a tiny slit at one end where the lug comes up and connects to the stator plate. This end should go to the choke (tank coil) and the other end to ground. The chokes used for the tank coils are mounted vertically in hairpin fashion, with the bottom of each choke seated in the hole closest to the middle of the board. The top leads are bent a full 180° and inserted into the proper mating hole.

There are 5 jumpers and 1 component wired between the 2 boards when the sandwich is complete. The component is the 500 pF disc capacitor connected between the mixer drain and converter output. Cut one end to about ½" lead length and solder this end to its pad on the bottom (single-sided) board. Next you can mount the bandswitch to this board, being careful not to damage any of the pins. Once the 2 switch decks are fully seated, solder all the connections. Now mate the top board with the 3 remaining switch decks topside. Insert the free end of the 500 pF disc into its pad and clip off any excess lead after soldering. As soon as everything is seated properly and the 2 boards appear to be parallel, solder all switch connections.

The remaining jumpers are mostly straight through and here again you can use pigtail clippings. Use sleeving if you wish to insulate these leads, although it is not necessary. There are 2 jumpers joining the ground planes on each board, and you'll find these holes halfway up each side right at the edge of the board. The next 2 jumpers are at the rear of the assembly. One of these joins the 12 volt bus on each board. Use the innermost of the 2 12 volt pads on the top board and the pad between the 40 and 20 meter coils directly below. There is a slight offset to this pair of holes. The other pair joins the 100 pF coupling capacitor from the rf amplifier to the mixer gate. These 2 line up exactly and fall between the 20 and 15 meter coils below. The final jumper is up front and joins the gate of the crystal oscillator transistor with the switch deck that selects crystals. There is about ½" of offset between these 2 holes. On the top board, use the second hole from the right, and the hole directly in front of the oscillator transistor on the bottom board.

Putting it All Together

The receiver was assembled on a sub-base and sub-panel constructed of regular G10 printed circuit material. The panel and base were cut to fit snugly inside the cabinet and were joined by soldering to form an "L" shaped sub-chassis. The pots, switches, S-meter, and phone jack were all fastened directly to the sub-panel. All assemblies but the power supply were mounted vertically to the sub-base with PC-1 in the center. Short lengths of brass angle were soldered along the bottom edge of PC-1 and PC-2 and then drilled to take #4 screws which fastened the boards to the bottom of the cabinet. PC-1 was mounted with the tuning capacitor at the bottom and PC-2 with the BFO transformer up front and facing the outside. This puts these 2 assemblies back to back. From front to rear, PC-1 is positioned so that the end of the large outer shaft on the tuning capacitor is flush with the outside panel. PC-2 has to be positioned farther back in order to clear the front panel controls.

The converter is mounted by fastening the bandswitch to the sub-panel with the switch towards the bottom. A jumper is soldered from the ground plane on each board to the sub-base since there is no other means by which the converter gets grounded. A very small 2-gang variable capacitor from an FM transistor radio was found to fit between the converter boards and is used to peak the rf circuits.

The power supply was mounted parallel to the base behind the converter and is partly visible in the photo. Small standoffs are used in each corner to keep the printed wiring from shorting against the base.

The holes in the front panel were made just large enough for the 1/8" shafts to clear. Since very small knobs must be used to accommodate all the controls in the limited space, a large hole would be unsightly if the knob couldn't cover it. The knobs I used are only 5/16" in diameter and are not really knobs, but were made by someone unknown from unknown material whose origin is lost in antiquity. I had only 6 when I built the MK IV, so I had to keep the number of controls to that number. The remaining controls will take real knobs and you can select those that suit your fancy.

The 2 toggle switches in the bottom row were fastened to the sub-panel but allowed to extend all the way through the front panel where a second nut was used to hold everything together. The phone jack barrel was too short to take a nut so I epoxied a flat washer around the opening to dress it up.

The S-meter is one of those very common subminiature edgewise types with nothing but a 3-color scale and no calibration. Movement sensitivity is 500 uA. A small strip of tape and

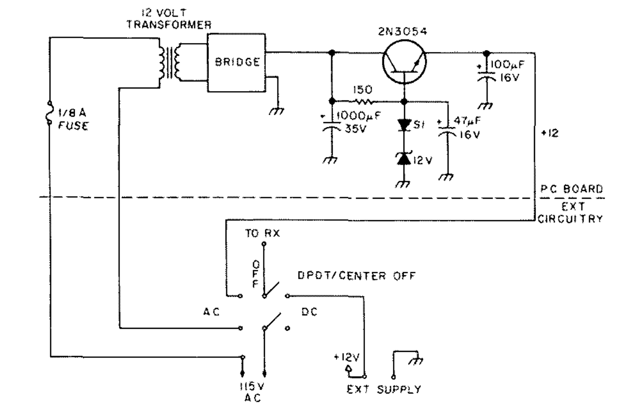


Fig. 4. Ac power supply schematic. The external circuitry was mounted on the rear panel of the cabinet. The bridge rectifier is a TO-5 size molded unit of at least 50 volt rating. The power transformer is a surplus item and is mounted right on the board.

some transfer lettering transformed it into a neat little S-meter. There was only enough room for 3, 5, 9, and a + sign to indicate signals over S9.

The remaining panel hardware consists of a phono jack for antenna input, a DPDT power switch with center-off position, a pair of banana jacks for external power input, and a connector for the ac power cord. All of these mount on the rear panel. If you wish to have reverse polarity protection when operating from external sources, connect a suitable diode between the +12 jack and the power switch in place of a piece of wire.

A full size panel layout is shown in Fig. 10 for use with the Radio Shack #270-254 cabinet. If you go with this setup you'll have to come up with some small knobs. Also, if you find a suitable variable capacitor for the peaking control, you'll have to make a shaft for it, as these little solid dielectric variables don't come with a shaft. This component is not vital, however, and can be left out. If it is, delete the title from the artwork.

The dial portion of the panel artwork has 2 blank scales. One of these can be calibrated to read from .5 to 1.0 in the clockwise direction and the other from 0 to .5 in the reverse direction. When using the 3.5 or 28.5 MHz bands, you will use the first scale, and when switched to 7.0, 14.0 or 21.0 MHz, you use the other scale. As you can see, I calibrated every 100 kHz, but some intermediate steps could be included. Only one set of calibration marks is needed since the scales are exact reciprocals.

Everything You Wanted To Know About Parts

At this point you may be thinking it's a nice project but not worth risking one's sanity trying to find all the parts. I must admit that you would have a lot of trouble obtaining some of the items, so I've been slowly amassing a shoe box full of spares to help out. If you write for a price list or anything else, please enclose an SASE or you won't get a reply.

Some parts can be substituted and the obvious ones we'll skip. The dual JFET S-meter amplifier is one possibility. I had an E421 on hand but some unmarked types in my junk box worked as well. I specified diodes as either germanium or silicon because I found no noticeable difference in performance with any particular type. Some very worthwhile bargains in first line diodes can be found in many ads in *73*, so take advantage of them. The 1N60 did work slightly better in the blanker gate so was the one diode I spelled out. The 1N60 is a germanium type if you wish to experiment. For the silicon units there are plenty of 1N914s and 1N4148s around at bargain prices.

There are only a couple of bipolar transistors in the entire receiver and these are not critical. Just don't try to use a PNP for an NPN. The

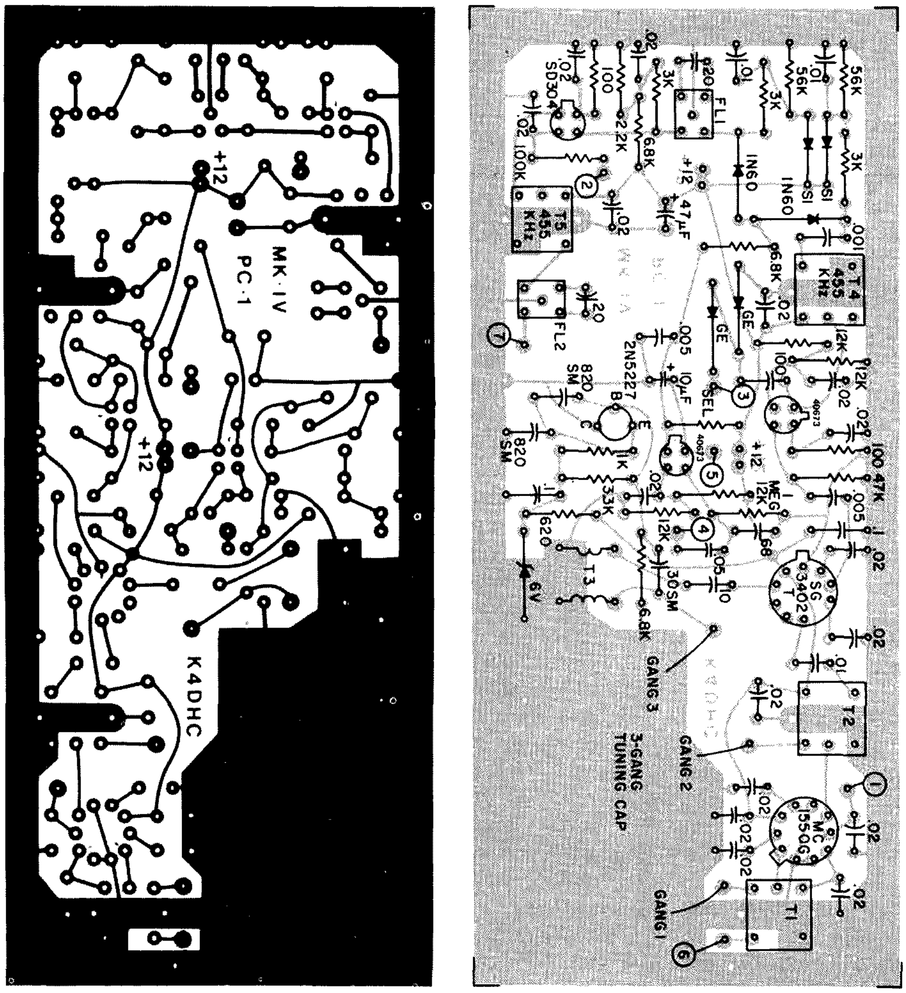
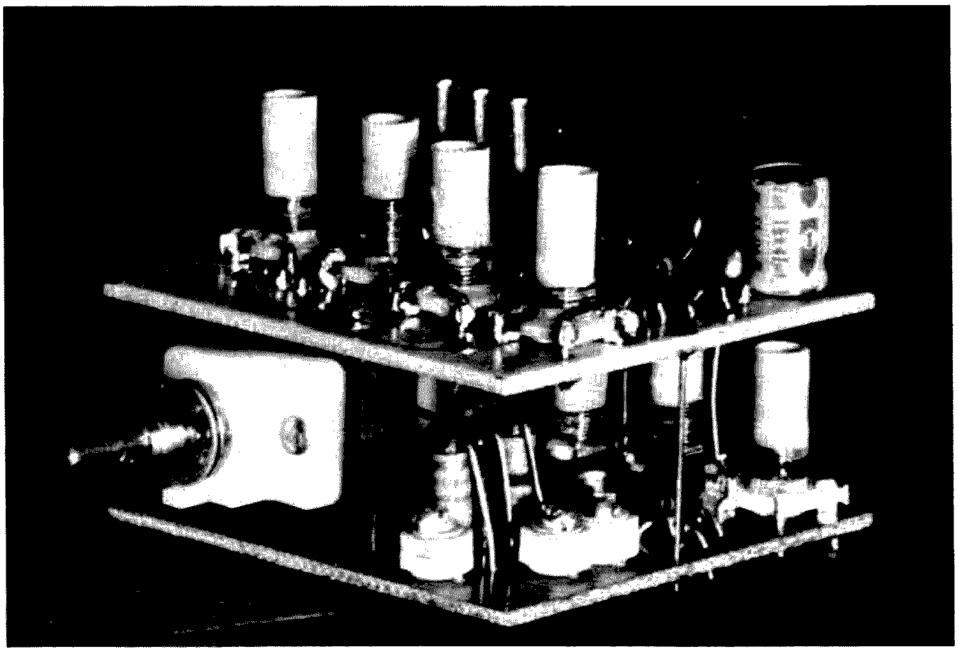


Fig. 5. Assembly PC-1 board and component layout.



This view of the converter shows additional details of the sandwich construction.

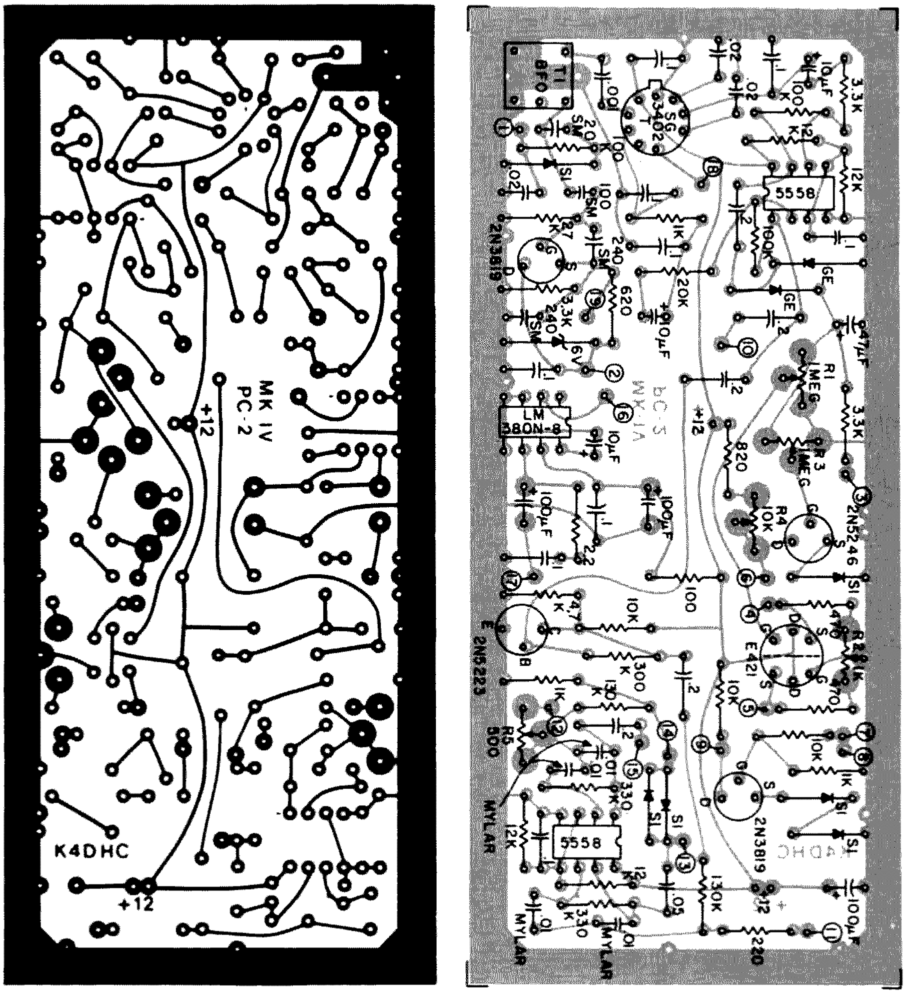


Fig. 6. Assembly PC-2 board and component layout.

40673 dual gate MOSFET has possibilities, such as the 40841, but don't try to substitute for the SD304 which is best left alone.

The tuning capacitor is the same one I've used for all the Minicom receivers except the MK III. It is equivalent to the old J. W. Miller #1460 but has a built-in 7:1 reduction. A pointer will have to be made for it from a piece of clear plastic. You can scratch a hairline in the plastic with a sharp instrument and fill it in with a red ballpoint pen. A nylon screw insulator with a ¼" hole makes a good hub for the pointer and will slip right over the outer shaft of the variable capacitor. If it's a little loose, a single layer of masking tape on the shaft will snug it up.

As I mentioned before, knobs are the big problem, and if any reader has a solution or the facilities to produce some 5/16" knobs for 1/8" shafts, please let me know.

The controls themselves will have to be the ½" or 5/8" diameter types to fit the space available. There are a lot of these around, so keep your eyes peeled when you read the ads. A dual 5k pot in this category is another story and it's not likely you'll find one. By the time this is published, I hope to have some of the little Clarostat ½" square Series 388 pots in a dual 5k version in my shoe box. There is one in the receiver pictured but it is not visible.

The 3 position toggle switch I used for the CW filter mode selector is an Alco MST 205PA. This switch makes some circuits in the center position, so don't try to use a regular DPDT with a center-off position.

Before concluding this section, I should point out that there is no reason why the receiver couldn't be made slightly larger and some of the problems thereby cured. The receiver as it stands is not the most convenient instrument to use from the human engineering standpoint. I cer-

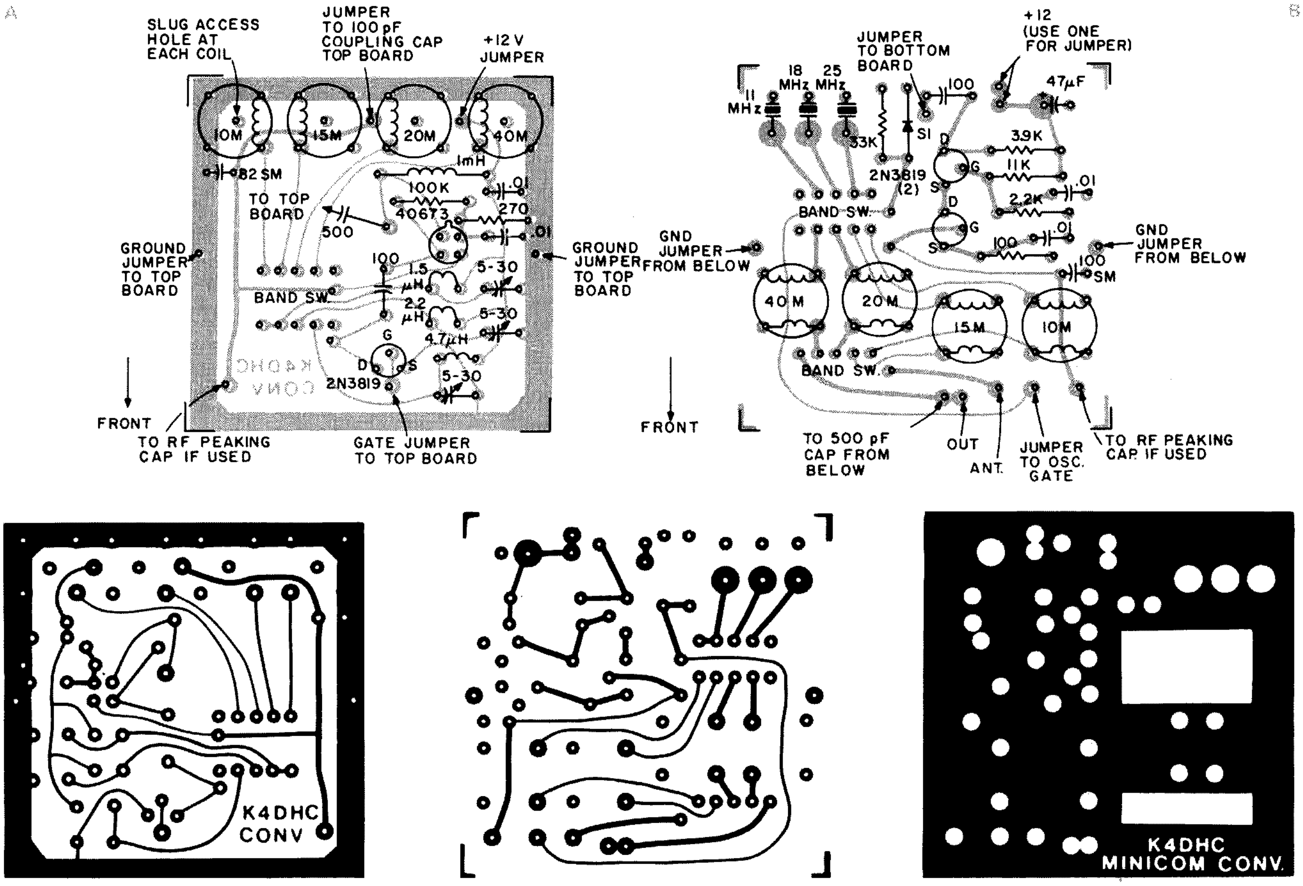


Fig. 7. Converter bottom board PC and component layout (a) and top board (b). Jumpers are explained in the text.

tainly wouldn't recommend it as a station receiver unless you had very small hands and very thin fingers. On a short term basis, however, such as business trips, vacations, or during an emergency, its many extra features would make it acceptable.

Getting It To Work

The best way to tackle initial alignment is to get the 80m section working first. This means that PC-1 and PC-2 will have to be wired up with their controls and interconnections. I've found that the easiest way is to just lay it out on the bench with nothing actually mounted. The leads going to the controls can be cut to about the right length for cabinet mounting and should require minimal trimming later. Besides the controls and switches, you'll need the following wiring:

1. A lead to pad #6 on PC-1 for the antenna or input.

2. A lead from pad #1 on PC-1 to pad #9 on PC-2.

3. A lead from pad #2 on PC-1 to pad #8 on PC-2.

4. A lead from pad #7 on PC-1 to pad #18 on PC-2.

5. A lead from +12 on PC-1 to +12 on PC-2.

6. A lead from +12 on PC-1 to the power supply.

7. A lead from pad #17 on PC-2 to the speaker. Later the lead will go to the phone jack.

Pad #4 on PC-2 is the positive connection for the S-meter if you wish to connect it up at this time. The initial settings prior to firing up are:

1. Set all trimmer resistors on PC-2 to mid position.
2. Set tuning capacitor to full mesh and turn the 2 compression trimmers up snug but not tight.
3. Switch blanker OFF, rf gain to maximum, CW filter OFF, detector to SSB/CW, BFO at mid position, and audio gain to suit.
4. Tie all grounds together with short clip leads.
5. Fire up.

If no smoke is seen, the first thing to do is get the BFO on frequency. If you slowly run the slug in the BFO transformer out towards the top, you should hear some noise when you hit 455 kHz. Adjust the slug for zero beat, which will be the dead zone between noise peaks as you pass through the i-f frequency. The BFO control should then vary the BFO frequency as indicated by noise buildup on either side of zero. The action won't be linear, but don't worry about it.

The next thing is to get the VFO running at about 3 MHz. I use a scope, but if you don't have one, use a counter, a general coverage receiver, or brute force. This latter means feeding a hefty signal in at 3.5 MHz and adjusting the slug in the VFO tank until a signal is heard. Once the VFO has been set by one of these means for the low end of the band, feed in a barely detectable signal at 3.5 MHz and peak T1 and T2 on PC-1. At this time you know the receiver is working and the AGC should be set.

Leave the rf gain at maximum and remove the signal generator. Turn R3 all the way towards ground. With a

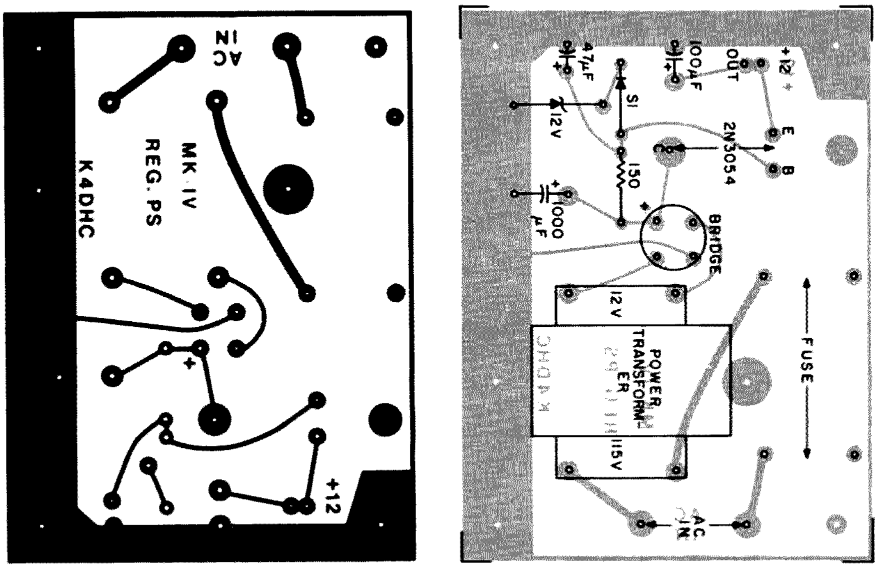


Fig. 8. Power supply PC board and component layout.

scope or high impedance meter connected to the top end of the rf gain control, adjust R4 till a reading of 5 volts dc or slightly less is indicated. Advance R3 about one third of its total travel and you should be in business. R3 sets the AGC threshold and can be advanced or retarded to suit your idea of how tight you'd like the action to be.

Now you can go back to aligning the front end. T1 and T2 should be peaked at the low end and the 2 compression trimmers used to peak the high end at 4.0 MHz. Several trips up and back will be required before everything tracks properly. A final adjustment of the VFO frequency should also be made to center up the band within the full swing of the tuning capacitor.

The 2 i-f transformers on PC-1 tune rather broadly, but you can run the cores through their travel once to get the best setting.

The remaining trimmers on PC-2 can be adjusted next. Turn the rf gain to minimum and set R2 for zero S-meter reading. Later on when you're listening to some strong signals, you can adjust the meter sensitivity with R1. R5 is most easily adjusted by using a steady signal from a signal generator. Adjust for a note falling just inside the high end of the CW filter tuning range and with the filter in circuit, peak the response with the dual tuning pot and then repeak with R5. Repeat a few times to make sure you're as close as possible.

The last thing to check out is the voltage level at the drain of the pulse amplifier in the noise blanker circuit. With the blanker ON, the level should be about 5 volts for best action. The 1k temporary resistor may or may not be the right value. Lowering the resistance raises the voltage and vice versa. When you've arrived at the proper value you can make a permanent installation.

Now you're ready to tie in the converter. Switch the input lead to PC-1 over to the converter output, and the antenna to the converter input. Run a lead from the +12 pad on top of the converter to a +12 pad on PC-1. Clip the converter ground to the rest of the grounds.

With the bandswitch in the 80m position, make sure everything is still working. If so, the next step is to get all the crystal oscillator circuits started. I usually use a scope to observe the crystal oscillator output, but a hit and miss technique will work, too. If a band is dead at a time when there should be signals present, turn the trimmer for that oscillator tank a bit at a time until you start hearing signals. For dead bands you'll have to rely on a signal generator. L1 and L2 for each band can be stagger-tuned for best overall response across a given band, or a small 2-gang variable can be used for continuous peaking. There is a pad on each converter board for connecting to the capacitor. Don't forget to ground the common rotor connection.

There is a possibility of oscillation occurring in the rf amplifier stage of the converter. The receiver shown in the photos had this problem on 40m and required the addition of a 12k resistor across the secondary of L1 on that band. The resistor was soldered directly to the pins on the base of the coil form. If similar problems come up in your receiver, apply the same remedy using the largest value of resistor that cures the trouble. Make no evaluation, however, until every-

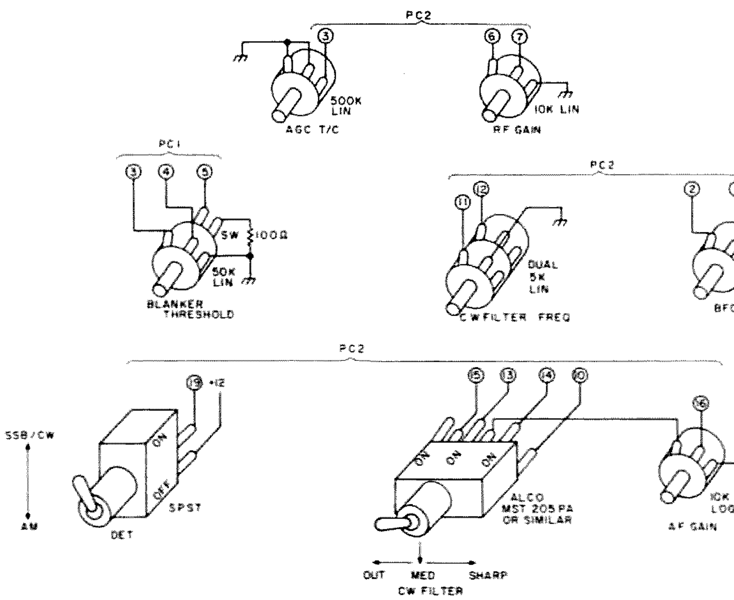


Fig. 9. Pictorial wiring diagram of front panel controls.

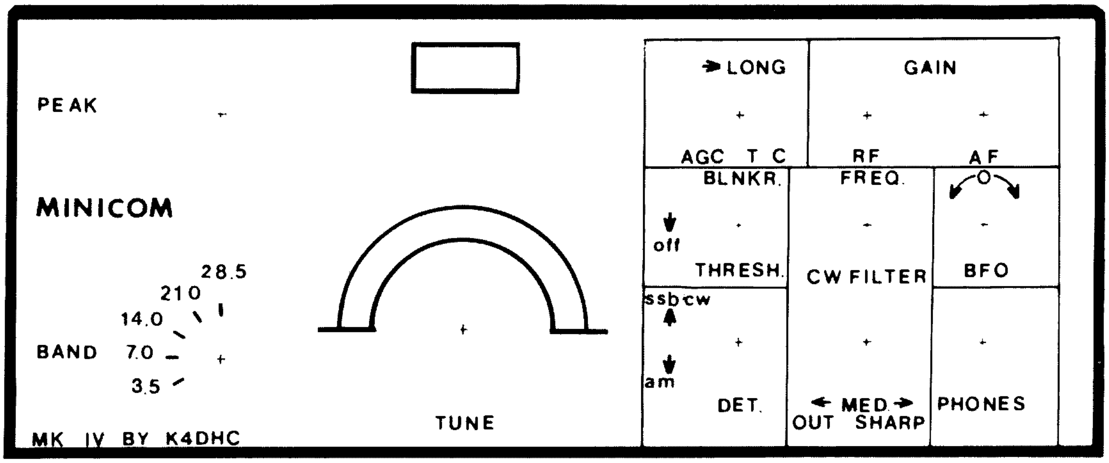


Fig. 10. Front panel layout for the Radio Shack cabinet.

thing is mounted and wired in its final form.

Conclusion

The MK IV was fun to build and operate. The biggest improvement to me was the CW filter. It really peaks up a signal buried in a pile of 2 or 3 others. Incidentally, the 4 mylar capacitors used in this circuit should be matched as closely as possible so that the 2 sections track fairly well.

The noise blanker has also proven to be a big blessing at times. On many occasions it has made unreadable signals perfect copy.

One final point before concluding might be worth mentioning. As I noted earlier, the BFO tuning is not linear due to diode characteristics, so you may want to shift the zero beat point down towards the low resistance end of the pot. The knob can be offset so that the pointer is straight up at zero beat.

Using a generator with crystal checkpoints or some other accurate signal source, mark the calibration points on the dial scale and fill in the numbers with transfer lettering. Voila! It is done. ■

References

1. Ray Megirian K4DHC, "Using the LM-373," *73*, April, 1972, page 37.
2. Ray Megirian K4DHC, "Miniaturized Communications Receiver," *Ham Radio*, September, 1974, page 24.
3. Ray Megirian K4DHC, "Solid State Communications Receivers," *Ham Radio*, April, 1976, page 18.
4. Charles B. Andes WB2VXR, "Threshold Detectors in a CW Audio Filter," *QST*, December, 1971, page 20.

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Those Illegal CB Channels

-- and the tens of thousands using them

Yes, believe it or not, there *are* some significant differences between the CB sidebanders and the AMers. Such as local on-the-air conduct. On CB AM it is common to hear something like: "Howaboutcha, Ratchet-jaw? We're a-lookin' fer that Ratchet-jaw, one more time!" The CB sidebanders usually talk in ham-type monologues. During round table (net) discussions, the monologing per person is shorter. But not always! Sound familiar? They talk about technical radio subjects, if not about their own rigs. Sound familiar? When the skip is in, a lot of them "let their hair down" and get a bit excited, and their conduct deteriorates, depending upon the individual. Sort of like our weekend contests!

Fancy handles such as "Jailbird," "Sneaky-Snake," and "Buckeye-Badboy" are not condoned. Any newcomers to sideband who bring fancy handles along with them are soon told about it, either politely — or in no uncertain terms! The sidebanders give their first names or nicknames, such as "John," "Mike," "Carol," and "Dave." There is also a tendency to refrain from excessive tens-code use. Personally, "10-4" and "Roger" sound no more weird than our use of "fine business."

Some of our "ham codes" are used the same way, some differently. They use QSO, QTH, and XYL, for example, verbally the same. However, QRX and QRT are used together: "We'll pass along our 73 to you fellows; we're going to QRX and QRT." Yes, the sidebanders usually "73" instead of "seventy-thirds" or "Threes to ya, Guy!"

The term "CQ" isn't generally used, except a little by a few during skip conditions. Those who use it, use it as we do or some use it in place of the term "break," to catch the attention of skip QSOs already in progress. The latter does sound weird from a ham's point of view. Try to imagine suddenly hearing "CQ-CQ-CQ" from a third party in between transmissions!

Illegalities

Yes, CQing in any matter on the Citizens Band is an FCC no-no. So is working skip. Not to mention general "ragchewing." That's just the beginning!

Ever hear of a Siltronix 1011? Well, for about 650 bucks, this transceiver (that bears a remarkable likeness to Swan's* rigs) will vfo you, not only on all legal 23 class D channels, but also in between, below and well above them! And it will do all this with 100 to 150 Watts output, depending on how hard the finals are blasted! Not bad, 'eh?

Do these rigs sound familiar: Kenwood TS-520, Heath HW-101, Tempo One, Drake's T4X and TR4, and Yaesu FT-101? All of these are very popular with the CB sidebanders. Often these rigs are featured as first prizes at CB gatherings, such as jamborees! These rigs are easily modified to cover eleven meters (the ones without 11 meter bandswitch position). The "10 A" crystal, or its equivalent, is replaced with one suitable to tune "all around" the CB channels.

Maybe we hams are missing out on something here. Do we need more elbow room on 20 phone? Is "75" getting a bit too crowded now, with the foreign broadcasters moving in? Forty meters? And, just think, we can all use that new proposed 10 MHz band *right now!!!* OK fellows — I was only kidding. Besides, it would only mess up our QSL system, because we would have to resort to phony callsigns (usually assigned by a regional club) and central P.O. boxes.

Many CB sidebanders start out with regulation FCC, DOC type accepted radios. However, the "urge-to-slide (vfo)" becomes irresistable. Perhaps the chief reason is to escape from the AM crowd. Channel 16 is the unofficial "sideband-only" slot, but things get kind of crowded here, and the other twenty-two channels in the metropolitan areas are smothered with AMers. Often "16" gets AMed also. So where do they go? And, how do they do it?

Well, one way is those ham or equivalent type rigs I mentioned earlier. However, using existing gear is sometimes more expedient. The owners of older Hy-Gain CB sets merely purchase the accessory, type-accepted, *receiving* vfo, and plug it into the vfo socket on the rear panel. Then, by snipping "that famous yellow wire" inside the vfo, a relay is disabled and your set can slide around from a little below channel one clear up to 27.430 MHz, on both receive and transmit! See Fig. 1. Many "friendly dealers" would kindly snip that wire for you. Other brands of CB sets that use a 38 MHz output synthesizer are easily adapted to the Hy-Gain vfo. I quote from part of Hy-Gain's vfo ad: ". . . and tune in ALL the action!"

Another way to "tune in all the action" is to install one of the other commercial vfos made by such companies as Siltronix (remember them?) and PAL. They have outputs comparable to one of the crystal oscillators in the synthesizer. All you have to do is pull out one of the crystals and run in the vfo line. The AMers do all of this vfo stuff also, but the sidebanders seem to do as much or more of it, percentagewise.

A popular method is to slightly modify one of the synthesizer oscillators by installing a slug-tuned coil, such as a Miller 4204 in series with the crystal switch and transistor base lead. Tuning the slug will easily get you 10 kHz lower in channel frequency. 27.145 is very popular on sideband. See Fig. 1.

Some Surprises

Would you believe that the vast majority of all those ham rigs I mentioned are *not* illegally used on our own bands?

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*I am *not* implying that Swan®, of Swan Electronics, Oceanside, California, is producing illegally-used, non type-accepted CB rigs, being marketed under a different name. *(Siltronix and Swan are both part of Cubic Corp. — Ed. note)*

Most of the CB operators have only an eleven meter beam. (Many of these are 60 to 100 feet high! Legal height for beam-type antennas is 20 feet, and 60 feet for omnidirectional.)

Quite a few CB sidebanders: A) are considering, B) are studying, or C) have taken the amateur exams. This is almost nil with the AMers.

You may find this hard to believe, but it seems that those who become hams will operate legally in the amateur bands. I guess our own peer group won't put up with too much illegal operation.

It's interesting to note that many CB AMers who have listened to two meter FM liked it. However, many CB sidebanders didn't care for it because (quote), "It sounded a little like AM CB!" *Darn* little, I might add!

More Surprises

There are a lot of licensed amateur radio operators using CB sideband. Many use it as personal communications to "home base" and such, complete with FCC callsigns and legal rigs. A few find it fun to "join the crowd" – if you know what I mean! Hm-m-m. Did "2" or "75" get boring?

CB sideband has many regional and state-wide clubs. Their original intent was and for the most part still is (quote), "To keep (CB) sideband from becoming another mess like (CB) AM!" It's too bad that most of them didn't also try to uphold entirely legal operation in terms of using FCC callsigns, unmodified type-accepted radios, and limited ragchewing, because I believe that as unified groups they had the potential power to speed up the pending extra "sideband-only" channels legislation, etc. As it now stands, I think they would only get the cold-shoulder treatment, due to the illegal operations by their members.

... And More Opinions

From my own observations and very rough headcount, I will venture to say that less than one percent of the AM CBers use or have possession of illegal, high power gear. The CB sidebanders, however, I suspect are up to 40 percent with high power equipment, mostly from base stations.

While looking at the ham gear ads (by *dealers*, not the manufacturers) in the Citizens Band publications and club newsletters, and listening to all of those same rigs in use "all over" eleven meters, I get the distinct impression that we hams comprise only about 50 percent of total amateur radio type gear sales here in North America!

As it stands, I believe that there is absolutely no need for a code-free Communicator Class amateur radio license. Because it's already here on eleven meters – clear up to 28 MHz! In fact, it's here in two stages: 1) Basic Communicator, starting with AM CB, and essentially cheaper radios; 2) Advanced Communicator, or sideband CB, for those who get tired of infantile type of operations, and can afford the higher priced gear. As I stated earlier, it's mostly the sideband CBers who move up to an amateur radio license. ■

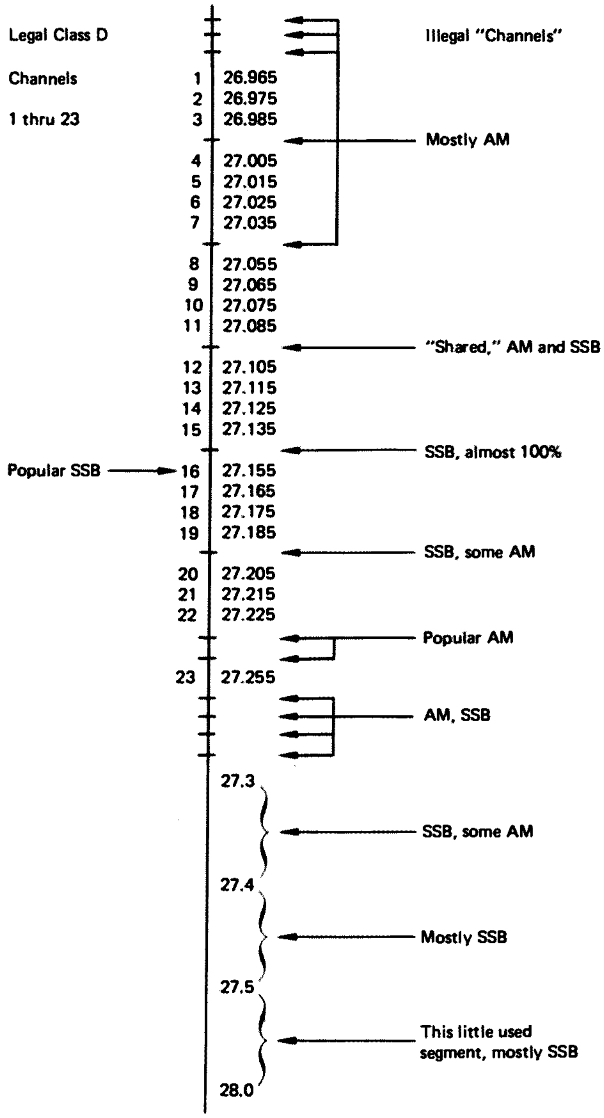


Fig. 1. Actual composite Citizens Band.

Leading Zero Suppression

W. R. Kappele W6AVL
3030 Oceanside Blvd. #7
Oceanside CA 92054

From the articles on counter construction I have seen, it appears that a feature of the 7446, 7447 and 7448 decoders has been overlooked.

These little gems, along with their uncanny ability to make numbers out of pulses, have the added capacity to automatically suppress leading zeros.

Pin 5 on one of these items, when grounded, suppresses the zero. Pin 4, normally high, becomes low when the zero is present and suppressed. Therefore, in order to suppress all leading zeros, one grounds pin 5 on the highest decade, connects pin 4 to pin 5 of the next decade and so on, leaving the last decade open.

Now, when a zero is presented to the highest decade, it is blanked. Pin 4 goes low, arming the second highest decade, whose pin 5 goes blank when a zero is presented there.

When any number but zero is presented on any decade, the zero suppression on all lower decades is automatically lifted. Since about the only thing we are allowed to suppress any more is zeros, let's get up to date and do it. ■

Social Events

GRAND RAPIDS MI
APR 2

The Third Annual Swap and Shop will be held at the Northeast Jr. High School, 1400 Fuller Ave., N.E., Grand Rapids, Michigan, on Saturday, April 2 from 9 am to 5 pm in the cafeteria. Featured will be: CBs, monitors, ham equipment and electronic parts. For further information contact Grand Rapids React at the above address.

FRAMINGHAM MA
APRIL 2

The Framingham Radio Club will be holding an Electronic Flea Market on April 2, 1977 at the Framingham Civic League building, 2 miles south of Rt. 9 on Rt. 126. The doors will be open from 8:30 until 12:30 with a $1 admission fee. For advance indoor table reservation send $5 to W. R. Armstrong, 386 Howard Street, Northboro MA 01532.

COLUMBUS GA
APR 2-3

The Columbus, Georgia Hamfest will be held April 2 and 3, Palm Sunday weekend, at the Fine Arts Building at Fairgrounds, 9 am to 4 pm daily. Flea market, ham auction, prize drawing at 1:30 pm Sunday, talk-in 28/88, 3975 kHz, buffet dinner Sat. at 8 pm. For more information write K4JNL. Advance tickets: K3MTY/4, Rt 5, Box 750, Phenix City AL 36867.

TOWSON MD
APR 3

The Greater Baltimore Hamboree will be held Sunday, April 3rd at 9 am at Calvert Hall College, Goucher Blvd. and La Salle Rd., Towson MD 21204 (1 mile south of Exit 28, Beltway-Interstate 695). Food service, prizes, giant flea market. Admission charge S2. 225 tables inside gym. Over 1700 attended last year. Information and table reservation: Contact Bro. Gerald Malseed W3WVC at school address or call 301-825-4266.

ST. CLAIR SHORES MI
APR 3

The South Eastern Michigan Amateur Radio Association is holding its Nineteenth Annual Hamfest on April 3, 1977 from 8 am EST to 3 pm EST. It will be held at the South Lake High School in St. Clair Shores, Michigan, 21900 Nine Mile Road and Mack Avenue. For further information contact Dorothy Spilski WB8PRJ, Secretary S.E.M.A.R.A., 11906 Riad Avenue, Detroit, Michigan 48224, 313-521-6646.

CANBERRA
AUSTRALIA
APR 8-11

The ACT Division of the WIA would like to announce that the Canberra Easter Convention will be held April 8-11 in Canberra, Australia. There will be plenty of time for sightseeing embassies, the lake, the Captain Cook Memorial Water Jet, etc. For more information contact: Canberra Easter Convention, Post Office Box E338, Canberra, ACT, 2600.

RALEIGH NC
APR 16-17

The fifth annual Raleigh Amateur Radio Society Hamfest will be held April 16-17 at the Crabtree Valley Shopping Center, lower level rear, on highway 70W. FCC exams will start at 12:30 pm, Saturday sharp, by appointment only through the Norfolk FCC district office. There will be an eyeball social and doorprizes Saturday night between 7 pm and 12 pm. An expanded covered fleamarket, meetings, ladies program, and over 100 prize awards on Sunday from 9 am to 3 pm. For additional info contact: RARS Hamfest, P.O. Box 17124, Raleigh, NC 27609.

MOBILE AL
APR 16-17

The Mobile Amateur Radio Club will hold its annual Ham Fest and Computer Fest on April 16 and 17th — all the newest equipment on display, computers too. Swap & Shop all day Saturday from 9 to 5, banquet at 7 pm, doors open Sunday at 9 am, prizes, drawing at 1 pm. Activities for the ladies and children, campsites available, over 1500 people expected, the biggest Fest on the Gulf Coast. For more information contact Marvin Uphaus K4BVG, 512 Tuttle Avenue, Mobile AL 36604.

LIBERTY MO
APR 23-24

The P.H.D. Amateur Radio Assn., Inc., of Liberty MO (Kansas City area) will sponsor the Eighth Annual Northwest Missouri Hamfest on Saturday and Sunday, April 23 and 24, 1977 at the Kansas City Trade Mart, Exhibit Hall 2 (Municipal Airport terminal building). There will be a complete program of forums both days, a large number of commercial exhibits, swap tables, YL-XYL program. Doors open from noon to 6 pm on Saturday, April 23; and from 9 am to 5 pm on Sunday, April 24. Setup time for commercial and swappers will be from 10 am to noon on Saturday. There will be a Saturday night banquet at the world famous Gold Buffet, with ARRL president Harry Dannals W2HD, as guest speaker. Pre-registration is S2, admission at the door will be $2.50. Pre-registration including banquet is S8. Talk-in on 146.34/.94 and 3.925 MHz. For information and pre-registration write to: PHD Amateur Radio Assn., PO Box 11, Liberty MO 64068.

GREENVILLE SC
APRIL 24

The Blue Ridge Radio Society of Greenville SC announces its annual hamfest for 1977. The event will take place April 24th at the Thunderbird Motel on Highway 291 in Greenville. A flea market and dealer's display area will be featured at the motel. Doors open at 8 am.

SULLIVAN IL
APR 24

The Moultrie Amateur Radio Klub will have its 16th Annual Hamfest Sunday, April 24th at Wyman Park, Sullivan, Illinois. Heated indoor area and large outdoor parking area. No charge to vendors. For information write: MARK Radio Klub, PO Box 327, Mattoon IL 61938. Talk-in 146.94.

AMBOY IL
APR 24

The Rock River Radio Club Hamfest will be held April 24, 1977 at Amboy, Illinois (Lee County), at the 4H Center, Routes 30 and 52. Same place as last year. Tickets S1.00 advance. $2.00 at gate. Camper parking available at a nominal fee. Write: Carl Karlson W9ECF, Nachusa IL 61057. Indoor and outdoor facilities.

LAS CRUCES NM
APR 24

The Mesilla Valley Radio Club sponsors Whitey's Bean Feed and Swap-Fest Sunday, April 24th, at 10 am. Located near Las Cruces, New Mexico at La Mesa with talk-ins on 16-76, 04-64 and 3940 kHz. Fun for all the family with big prizes, plenty of food and the usual beverage truck. All included for $5.00 for adults, S1.75 for kids. Eat, drink and win a prize with Whitey K5ECQ as host. Free overnight parking at grounds so come for a spell. All correspondence should be made to: Thomas B. Rapkock Jr., 640 W. Las Cruces Avenue, Las Cruces NM 88001.

DAYTON OH
APR 29

The 8th Annual FM B*A*S*H will be held on the Friday night of Dayton Hamvention, April 29, 1977, at the Dayton Biltmore Towers (hotel), Main at First Streets, from 8 pm til midnight. Admission is free to all hams and their friends. Sandwiches, beverages, snacks and C.O.D. bar will be available. A live floor show will be presented by TV personality Rob Reider WA8GFF and his group. It will be followed at 11 pm by a fabulous prize drawing featuring an Icom IC-245 and many others. See you where the action is!

BROWNFIELD TX
MAY 1

The Brownfield Amateur Radio Club will hold a Swapfest on Sunday, May 1, 1977, in Brownfield, Texas.

WEST TRENTON NJ
MAY 1

The annual Delaware Valley Radio Association (W2ZQ/WR2ADE) flea market and auction will be held on Sunday, May 1, 1977, 9 am rain or shine at the Villa Victoria Academy in West Trenton, New Jersey (the school is located adjacent to Rt. 29 near the junction of Rt. 29 and I-95). Talk-in on 07/67 and 146.52. Refreshments are available. Advance registration $1.00; $1.50 at gate. For additional information or tickets write: DVRA, PO Box 7024, West Trenton NJ 08628, SASE please.

FRESNO CA
MAY 6-8

The Annual Fresno Amateur Radio Club Hamfest will be held this year at the Airport Holiday Inn on May 6 and 8, 1977. For more information write Fresno Amateur Radio Club, Inc., 4788 N. Safford, Fresno CA 93704.

MEADVILLE PA
MAY 7

The Third Annual Northwestern Pennsylvania Hamfest will be held May 7 at Crawford County Fairgrounds, Meadville PA. Free admission. Flea market begins at 10 am. $2 to display — hourly door prizes — refreshments — commercial displays welcome. Indoors if rain. Talk-in 146.04/64 and 146.52. Details C.A.R.S., PO Box 653, Meadville PA 16335.

SUPERIOR WI
MAY 7

The Twin Ports Two Meter Club will hold its Second Annual Swapfest on Saturday, May 7, 1977, in the hall of the Duluth First Methodist Church from 11 am to 3 pm. Pre-registration and door prizes will be awarded. Admission is S1.00 in advance and S1.25 at the door. Selling space is S1.50 additional — $1.00 with your own table. Food available on the premises. Plenty of parking. Talk-in on 34/94. For flyers and/or tickets, contact Twin Ports Two Meter Club, c/o Libby Welsh WB9MLN, 525 Homecroft Court, Superior, Wisconsin 54880.

BINGHAMTON NY
MAY 7

The 18th Annual STARC Hamfest will be held Saturday, May 7, 1977 at Binghamton, New York. Take exit 71N from NY-17, go 3.8 miles north on Stella-Ireland Road. Flea market, tech talks, hourly door prizes. General admission S2.00/person. Banquet by pre-reservation at S6.00/person. Indoor exhibit space by pre-registration at S5.00 per table. Outdoor exhibit flea market space free. Talk-in 146.22/82 and 94/94. For details and reservations, contact STARC, PO Box 11, Endicott NY 13760.

HERNDON VA
MAY 7

The Potomac Area VHF Society will hold its sixth annual hamfest on Saturday, May 7, 1977, from 8 am to 5 pm at Frying Pan Park on West Ox Road in Herndon, Virginia, which is approximately 15 miles west of Washington DC. Registration of $3 includes flea market or tail gate sales. Professional food and beverage catering and unlimited parking will be available. Talk-in on 146.52 and 31-.91. repeater. This is the hamfest formerly held in Westminster MD, but moved to Virginia because of the recently en-

acted Maryland traders law. For further information contact K3DUA or WA3NZL.

BIRMINGHAM AL
MAY 7-8

The Birminghamfest Amateur Radio Convention will be held May 7 and 8, 1977 at the Alabama State Fairgrounds, Birmingham and Rodeway Inn, Oxmoor at I-65 and Oxmoor Road. One of the country's largest flea markets, technical and operating forums, huge prize drawing, manufacturers' and distributors' displays, ladies' and children's activities. Booth display area will be offered free of charge to bona fide distributors, manufacturers, publishers, etc., on a first-come, first-served basis. Others may rent space in inside or outside flea market areas at a small charge. No admission charge. Prize ticket donations — $1. Talk-in 34/94, 3965 kHz. For booth display space, information, and reservations, write: Birminghamfest, PO Box 603, Birmingham AL 35201.

WARMINSTER PA
MAY 15

The Warminster Amateur Radio Club's "HAMMART," Flea Market and Auction will be held Sunday, May 15 from 9 to 4 at William Tennent Intermediate High School, Street Road (Route 132), 2 miles East of York Road (Route 263), Warminster, Bucks County, Pa. Registration $1, tailgating $2 additional. Talk-in on 147.69-09; 146.16-76 and 146.52. For further information write to Horace Carter K3ZAC, 38 Hickory Lane, Doylestown PA 18901.

SANTA BARBARA CA
MAY 13-15

The 22nd annual West Coast VHF Conference will be held on May 13-15, 1977 at the Miramar Hotel on the beach in Santa Barbara CA. The event opens with registration at 6 pm Friday (May 13), followed by a full day of technical presentations starting at 9 am, Saturday. Pre-registration fee is $2 until April 30. After that and at the door, $3. Registration forms, hotel information, and further details may be secured by writing Dr. Overbeck at the Communication Division, Pepperdine University, Malibu CA 90265.

VANCOUVER WA
MAY 21-22

The Fort Vancouver Hamfair will be held Saturday and Sunday, May 21 and 22 at the Clark County Fairgrounds, 7 miles north of Vancouver on I-5. Sponsored by W7AIA, Clark County Amateur Radio Club, in cooperation with W7KYC, Portland Amateur Radio Club. Camping, contests, swap & shop, prizes, displays, and many other activities. Registration donation $3. Send registrations to Dorman Stafford W7ZDR, Registration Chairman, Fort Vancouver Hamfair, 3509 E 21st St., Vancouver WA 98661. Make checks payable to Fort Vancouver Hamfair. Talk-in on 2 and 75 meters.

An FM Gadget

-- timer for the long-winded -- plus!

Bruce Fette WA7NMO
2310 W. Del Campo
Mesa AZ 85202

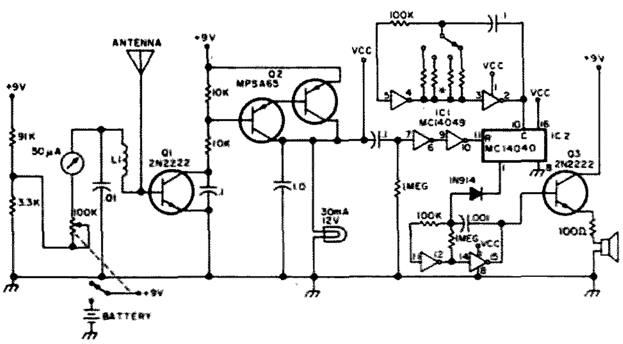


*Fig. 1. L1 = 3 turns #20 on 5/16" form. *Timing resistors:*

R	*Time-Min*	*Freq. Osc. Hz*
47k	*.5*	*82*
100k	*1.0*	*37*
220k	*2.0*	*18.6*
390k	*3.0*	*12*
510k	*5.0*	*7.3*

A field strength meter is a universal instrument in any ham radio shack. It tells you when your final transistor goes soft due to high swr, when your push-to-talk switch goes bad or the connector gets flaky, and the most insidious of all, when the swr shuts you off. But how many hams use their field strength meters?

This design promises to be a more useful ham shack toy than most. In addition to being an FSM, it is a timer to let you know when you have talked too much. This function is particularly useful to several Phoenix hams.

The front panel indicates relative field strength with a sensitivity adjustment, has a switch for time out ranging from .5 to 5 minutes, and displays an on-the-air light. At the end of the selected time-out interval (cleverly chosen to be equal to your neighborhood repeater), an internal loudspeaker signals a tone indicating "time out." So let up on the mike.

Circuit Operation

The antenna drives the base of Q1, which rectifies the signal and provides meter current. The sensitivity is adjusted by the 100k pot. The presence of base current turns on Q1, discharging the .1 uF capacitor in its collector and providing base current for Q2. The .1 uF capacitor could be as large as 100 uF, forcing you to let up on the mike button for one second before it would reset the timer.

When Q2 turns on, it provides current to the "on-the-air" lamp, a lamp carefully selected to draw 30 mA at 9 V so that it doesn't drain the battery. It also provides current to the CMOS integrated circuitry to begin timing the transmission. The timer consists of a hex inverter (MC14049) and a 12 bit ripple counter (MC14040). The combined current drain of these circuits is 1 mA consumed in the timebase oscillator. When Q2 turns on, an 8 V jump in voltage is coupled through the .1 uF capacitor to pin 7 of IC1, but slowly discharges to ground in .1 sec through the 1M resistor. The two inverters (7-6, 9-10 of IC1) square this pulse to reset all stages of the IC2 counter. An oscillator consisting of two inverters (5-4, 3-2 of IC1) runs at the frequency shown in Table 1. IC2 counts the cycles of this oscillator. On the 2049th count, Q12 of this counter will go high, and no longer will disable the audio oscillator (500 Hz, 11-12, 14-15 of IC1).

When this oscillator runs, a square wave is produced at pin 15 of IC1 which is buffered by Q3 to drive the loudspeaker. A resistor is used to limit the current to the loudspeaker, but lower values (or a transformer) would be required for adequate audio in mobile operation.

This unit was built into a Radio Shack minibox (1-5/8" x 2-5/8" x 5-1/8"), but that is a tight fit. The majority of the circuitry was built on one PC card. All ¼ Watt resistors and chip capacitors were used to keep down the size, as well as the smallest loudspeaker I could find. A 9 V alkaline battery is used for long life. The ICs should be kept wrapped in aluminum foil until ready to be soldered in (after all other parts have been soldered in). Pin 6 of IC2 must be cut off the IC, or bent away from the hole before it is inserted and soldered in. Solder pin 8 of the ICs first, thus grounding the static protection devices inside. Grid dip the tuned circuit to put it on the appropriate band or use values shown for 2m. The capacitor in this tuned circuit should be retweaked for maximum sensitivity with an on-the-air signal. On 2 meters the base emitter capacitance of Q1 is almost enough to tune L; however, adjustment of the antenna from ¼λ will optimize the sensitivity. ■

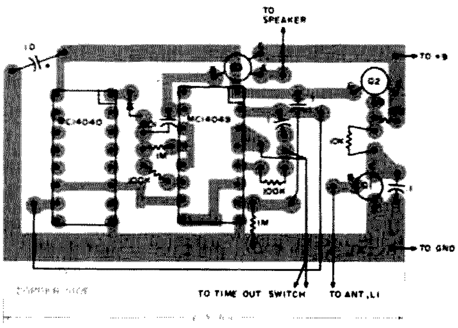


Fig. 2. PC board.

The Real Truth About SWR

- - if the transmitter loads okay, forget it

H. A. Ray WB5IAM
1406 San Rafael
Dallas TX 75218

Everyone writing on swr states some truths but invariably adds more mystery and confusion to the subject in the process. There is no question about whether energy or power flows in both directions on a transmission line. The existence of standing waves on the line is a summation of the forward and reverse waves and can be predicted with mathematical accuracy.

The confusion is in what the swr meter is saying to us. It is saying that "potential" energy is passing the meter in both directions and *if* this line were terminated at both ends in its characteristic impedance, that energy would be dissipated at a certain rate (which is called power). Note the *if*.

Let us take a few examples. If we have an infinitely long line with no loss and we turn a transmitter on for one second, a block of energy 186,000 miles long would propagate down the line and keep going long after the transmitter was shut off. The forward swr meter would read the transmitter power for one second as the block passes it. The meter simply says that *if* the far end of this line is terminated in its characteristic resistance, there would be the transmitter power in Watts dissipated in this resistor for one second when this energy block reaches it. It is perfectly respectable to call this energy flow, but it must be called "potential" energy and, at a certain time rate, "potential" power.

The forward swr meter doesn't know whether power was extracted at the far end or not. If the far end of the line is open or short circuited, then all of this potential energy will reflect and flow as a block in the reverse direction on the line. Now, suppose we turn the transmitter on for one more second. We now have two blocks of energy flowing toward each other. When they meet they will cause a standing wave on the line for one second where they overlap.

Now, let's turn the transmitter on a third time just as the first block of energy reaches its terminals. Depending upon the transmitter matching conditions, the first block of energy will reverse and combine with the transmitter power. We now have a new block of energy which will be read by the forward swr meter as greater than the transmitter power. This is not surprising, as we know part of it came from the transmitter and the rest of it was the reverse power, reversing again when it hit the transmitter.

This is not just a fictitious example. Time domain reflectometers show us pictures of the forward and reverse energy flow on lines. In fact, all calculations of impedance and standing waves on lines are derived from the forward and reverse energy flow on transmission lines.

Standing wave meters are just what they say they are. They show the magnitude of the forward and reverse waves which are propagating on the line and they convert this to the power that could be absorbed *if* the line were terminated in its characteristic impedance.

The above example illustrates that on a good line with large conductors or on a lossless line, there is no power loss due to large swr or reflected power. The power delivered to the line simply flows back and forth until it is dissipated in the antenna or load. Large standing waves produce points of high current on the line. The current squared times the resistance of the copper wire at this point is the loss in Watts. It is usually insignificant on amateur transmission lines. If the transmitter will load up to power, forget the swr. ■

Improving the Dipole

- - omnidirectionalization modification

73 Magazine *Staff*

Any dipole antenna, when it is reasonably well elevated, exhibits very definite directional properties. Maximum radiation occurs broadside (or at right angles) to the line of the antenna and minimum radiation occurs in-line or off of the ends of the antenna. Some amateurs put up a dipole antenna to take advantage of the directional properties of this type of antenna. But most amateurs really only put up a dipole antenna because it fits into the space available for putting up a simple antenna. The directional properties are simply a disadvantage of the antenna which have to be accepted. Most amateurs with restricted space available would probably prefer a good omnidirectional antenna for general purpose work on any one band. The vertical antenna is one solution, of course, but it requires a good ground system to be effective and should also be constructed in an area which is reasonably free of obstructions. Obstructions around the ground end, or high current and hence high radiation portion, of a vertical antenna are particularly destructive of its real efficiency. Vertical antennas are also not the least conspicuous of antennas, in situations where that is a consideration, as compared to a wire-type dipole antenna. So, what to do about making a simple dipole antenna have a better general-purpose omnidirectional radiation pattern? One possibility is to construct the dipole antenna in an inverted V fashion with the center point at the most elevated position and the sides having about a 90 degree angle to each other. A fairly omnidirectional pattern will result but with reduced radiation, as compared to a regular dipole, both broadside to and off the ends of the dipole. An alternative solution is the form of extended dipole antenna presented in this article. It offers broadside radiation efficiency equal to that of a regular dipole, radiation in the "off of the ends" direction only 3 dB down from the broadside radiation, and is extremely easy to construct or add to an existing dipole.

Some old-timers will remember when horizontal polarization was the accepted practice on VHF. Many antenna forms were developed for mobile use to achieve horizontal polarization and yet obtain a reasonably uniform omnidirectional radiation pattern. Most such antenna forms have long since faded into obscurity, but two of them still retain some degree of significance. By far, the most remembered form is the turnstile or crossed dipole configuration (Fig. 1). By properly current phasing two dipole (or folded dipole) antennas erected horizontally and at right angles to each other, one could obtain an almost omnidirectional pattern with the gain in any direction almost equal to that of an individual dipole. The design is still used for some omnidirectional type FM antennas. The second, and usually most forgotten, type of omnidirectional type of horizontally polarized dipole antenna is shown in Fig. 2. It lends itself particularly well to adaptation to HF wire type dipole antennas, although it seems to have practically disappeared from the VHF scene once the latter went "vertical" for most amateur radio usage.

The antenna form is simply that of a regular half wave dipole flat-top with quarter wave extension legs added vertically at each end of the basic dipole. The extension legs should be at right angles to the flat-top to achieve the best omnidirectional pattern, although if they are displaced by about 30 degrees or less no great harm will result. Preferably, the bottom ends of the extension legs should be themselves about a quarter wave above ground if the radiation off the ends of the antenna is to remain also horizontally polarized. If this distance is less, there still will be significant radiation off the ends of the antenna but its polarization will be a combination of horizontal and vertical components.

Changing the overall length of a dipole antenna will, of course, change the feed point impedance seen at the center of the antenna.

Any of the various matching methods described in antenna handbooks can be used to re-match the coaxial feedline normally used with an unmodified dipole to the modified dipole. One of the simpler methods which has worked out well in practice, however, is the use of a quarter wave matching section made from 300 Ohm

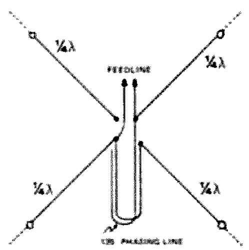


Fig. 1. Turnstile is an excellent form of omnidirectional dipole but obviously difficult to support since four elevated support points are needed.

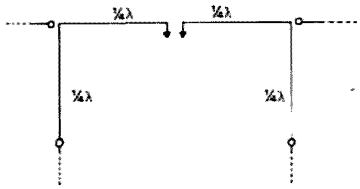
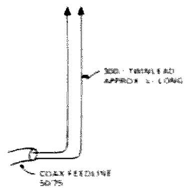


Fig. 2. Two vertical quarter wave sections are added to regular half wave horizontal dipole. Change in dipole feedpoint impedance must be compensated for.

twinlead between the antenna and coaxial line as shown in Fig. 3. One should be prepared to do a bit of pruning of the 300 Ohm matching section. Start with a full quarter wave section and cut it back a bit at a time until an swr meter placed in the coaxial line shows the lowest reading. A balun transformer can be used between the coaxial line and the 300 Ohm twinlead for balance purposes if desired. Be sure to use a 1:1 ratio balun. The idea is not to use a 4:1 setup balun to match the coaxial line to the 300 Ohm section, as this would prevent the latter from acting itself as an impedance transformation device between the coaxial feedline and antenna.

When adding the extension legs to an existing dipole, they can be simply secured to the ground using a length of heavy duty plastic clothesline to keep them in position. Such line has enough give to it to act as a spring and thus keep moderate tension on the extension wires. Clothesline with a nylon core and not that with a metal core should be used.

Fig. 3. Needed matching line for dipole in Fig. 2. Twinlead length should be trimmed for lowest swr.



This dipole modification is not new. It has been used with success over a number of years in different installations. Although no comparison was made with a dipole oriented at right angles to a modified dipole, stations could be worked off the ends of the modified dipole which could not be worked before modification. ■

Anthony Sperduti WB2MPZ
4740 Newton Road
Hamburg NY 14075

The 60 WPM Conversion

- - using 100 TTY on 60 wpm circuits

By now you have more than likely been hearing about the UART. This is, in long form, Universal Asynchronous Receiver Transmitter. This chip can receive, serially, signals with start and stop pulses of any 5, 6, 7 or 8 level data. The Baudot code used on amateur RTTY is (5) five level. Which it will work on is determined by putting a jumper on the chip or leaving it off.

The receiver's input recognizes serial input and converts it to parallel. This output is available on pins 26, 27, 28, 29, 30, 31, 32 and 33. The speed at which the receiver will operate is set by the frequency of pulses that one applies to pin 27. This is determined by multiplying 16 times the baud rate of the speed you wish to operate. To calculate this, use 7.5 as your unit per character of (5) five level code. For example, if you want 60 wpm, that is one word per second. One word in RTTY is five characters plus one character for space that must be printed, or six characters per second. Six x 7.5 equals 45 baud; 45 x 16 = 727 Hz.

The transmitter's input is parallel on pins 5, 6, 7, 8, 9, 10, 11 and 12. Its output is serial, with start and stop pulses on pin 25. The speed at which the transmitter operates is set by the frequency of pulses applied to pin 40. This tool is 16 times the baud rate of the speed you wish to operate. For example, if you wish to run 100 wpm, that is six characters per word, equaling 600, which divided by 60 seconds gives you 10 characters per second, which times 7.5 equals 75 baud. Multiply this by 26 and it gives you 1200 Hz. To make life easier, use the formula:

$$\text{FREQ} = \frac{\text{OPM} \times 16 \times 7.5}{60}$$

Remember, FREQ is the clock frequency you want in Hertz and OPM is the operation per minute you wish to run. For example, six characters per word, 100 words per minute, is 600 OPM. Six characters per word at 60 wpm is 360 OPM.

Now that we have all this, what are we going to do with it? The easiest thing would be to connect the parallel output of the receiver to the input of the transmitter. If we clock both at the same speed we have just made ourselves a regenerative repeater. This does not excite many hams at first, but let's go over it a bit.

Irv Hoff W6FFC and Howard Nurse W6LLO, as well as Paul Satterlee, Jr. WA5IAT, have written two very good articles on the UART in the *RTTY Journal*, April and May, 1974, issues. They say "most companies claim that signals within plus-minus 47-48 percent bias can be handled with perfect output timing being generated in the transmit section." In marginal copy, there should be a significantly fewer number of errors printed. By clocking the receiver and transmitter at different frequencies, we can build a digital speed converter to either go up or down in speed.

The schematics in this article should enable you to build a digital speed converter. You will note that I have added a FR15202E FIFO (First In First Out). This is only a 40 character 9 bit storage chip. As you load each 8 bit character into the input, it just drops through until it hits the output. Or, if there is memory in it, it will load up to that point.

Just think of it as a long hollow tube that you drop ping pong balls into. They will fall to the bottom if there are no other balls in the

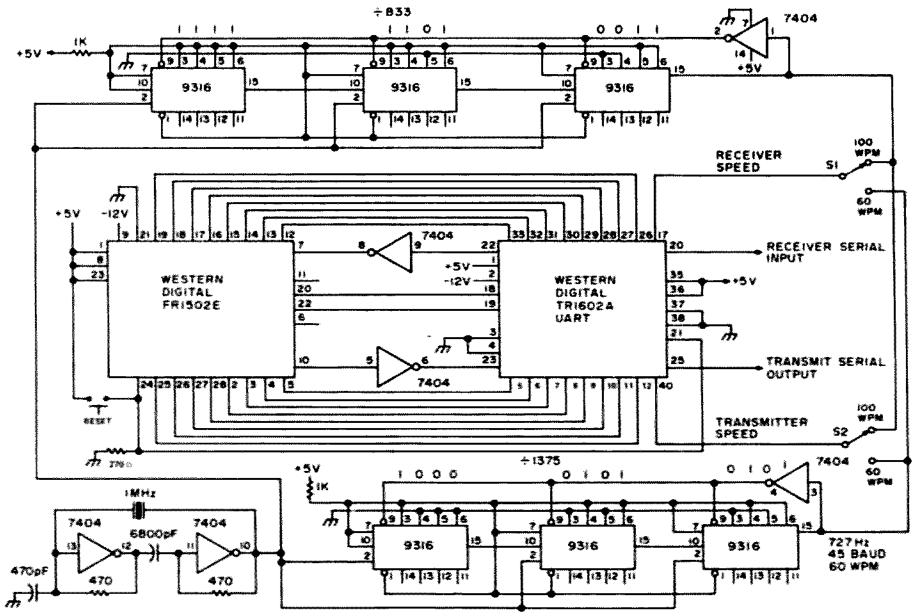


Fig. 1. Speed changer.

way. The UART will release the balls one at a time as it wants them, via pins 22 and 23. The purpose of this is that when you are keying at 100 wpm and sending at 60 you will have a 40 character storage. The whole idea of this circuit is to run your machine at 100 wpm. Now you can copy 60 wpm or 100 wpm by changing the clock frequency of the receiver, and be able to leave the transmitter output at 100 wpm. You can also connect up your 100 wpm keyboard to the receiver and transmit either 100 wpm or 60 wpm by changing the clock frequency of the transmitter and be able to leave the receiver at 100 wpm.

The only problem you might run into is if you run a TD at 100 wpm and transmit at 60 wpm. You can see that if you did that you would soon fill up the FIFO. You could build up a circuit that would recignize a filled up FIFO and stop the TD for a preset time. If you are typing on the keyboard, you will have to take a break once in a while if you type faster than 60 wpm for more than 100 characters at a time. I don't seem to have any trouble there, but I think a fast typist might have to slow down. The reset is used when you first turn the unit on, as you don't know what will be loaded in the FIFO.

Both frequencies are divided down from the 1 MHz clock. Any clock frequency you want can be used as long as you divide it down to the ones we discussed. If you don't like the clock I am using, there is a very good one by Irv Hoff W6FFC called the Mainline XB-6 UART Clock in the May, 1974, issue of the *RTTY Journal*. The 9316s are programmable dividers by Fairchild. For those who don't know how to program these dividers, let's look into them a bit.

The idea is to program dividers up so that when they reach the number you want, the output of the last device goes high. You use this output to feed back or reset the dividers back to the programmed number. Since the input is a crystal clock, you can see now that the output should be as stable as the input but divided by the preset number entered into the divider.

To calculate how to program the divider, you first convert the divisor to binary. Then take the 2's complement of this number and load it into the dividers. Each divider is a divide by 16, so you must load 4 binary codes into each one. The program inputs to each chip are pins 3, 4, 5 and 6. Pin 3 is the least significant number and pin 6 is the most significant number. A 1 is loaded as +5 and a 0 is connected to ground. Let's go over one to be sure you understand it.

To get 1200 Hz for the 100 wpm clock, we first divide this into our clock frequency of 1 MHz. This comes out to 833. Now this means we must program our divider to give us an output at every 833rd count of the clock. If you look at the circuit, you will see that this will also give us the feedback for the reset pulse. The easiest way I know of to convert 833 to binary is to just keep dividing by 2. If 2 divides into it evenly it is 0; if you have a remainder it is 1.

For example:

```
        1 - - - 1   MSN
      2 |3 - - - 0
      2 |6 - - - 1
     2 |13 - - - 0
     2 |26 - - - 0
     2 |52 - - - 0
    2 |104 - - - 0
    2 |208 - - - 0
    2 |416 - - - 1   LSN
    2 |833

ADD
0001 - 0100 - 0001
1110 - 1011 - 1110
                +1
------------------
1110 - 1011 - 1111  2's Complement
     REVERSE
1111 - 1101 - 0111  LOAD
```

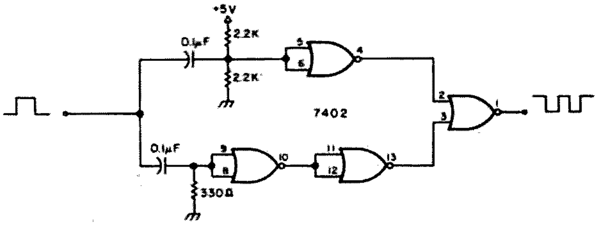
Note that the answer came out to only 9 places. You must add the three 0s to make it come out to 12, as each chip has 4 inputs and they must all be set. If the answer had come out to 8 places, we would have had to only use 2 chips. Now to get the 2's complement we invert all the digits — that is, make every 0 a 1 and every 1 a 0. We then add 1 to the least bit and we now have what we want. There's only one problem: They are in reverse. If you look at the circuit, you will note the LSB is pin 3 of the 1st chip and the MSB is pin 6 of the 3rd chip. What we have to do now is just reverse all the digits end for end or tip the sheet of paper upside down. If you want to get fancy, you could put a series of switches on the program inputs and then be able to pick out any frequency of pulses wanted.

There are many ways to interface the UART to the Mainline TT/L or ST-6. Several are in the May, 1974, issue of the *RTTY Journal*. Remember that the input and output are TTL compatible and you can operate the UART with any circuit that will work with TTL logic. Input is +5 volts and is pulled to ground to operate. The output is +5 volts when not being pulsed and goes to ground internally when operating. I am going to operate my unit in a separate cabinet with its own loop supply and optoisolator so it will be independent of my ST-6. Think I could use it better this way. Most people might like to put it into their ST-6, as you already have the 12 V. Coming up with +5 should be no problem. To operate the circuit you will need about 30 mA of 12 V dc and 50 mA of +5 V dc. This should be well-filtered and well-regulated.

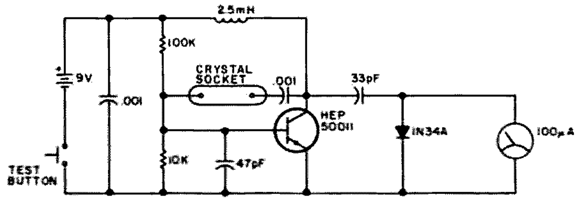
I would like to thank Bob Davis W6HUL for all the help he gave me on this article. Without his knowledge, it would not have been possible. ■

Circuits²

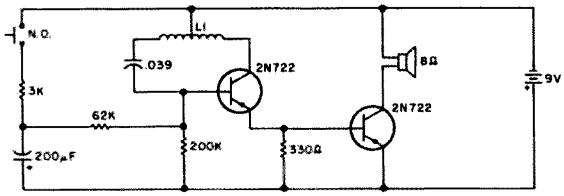
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice.



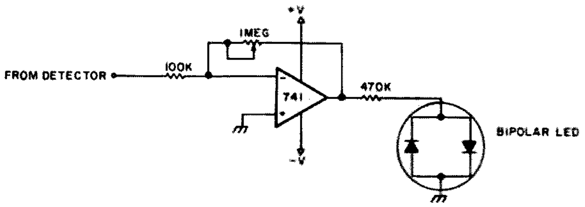
Here's a circuit developed for doubling the frequency of a TTL square wave. It locks onto the rise and fall of the input square wave. If high frequency operation is desired, the capacitors may be lowered in value. Thanks to Howard Gerber WB5YWS.



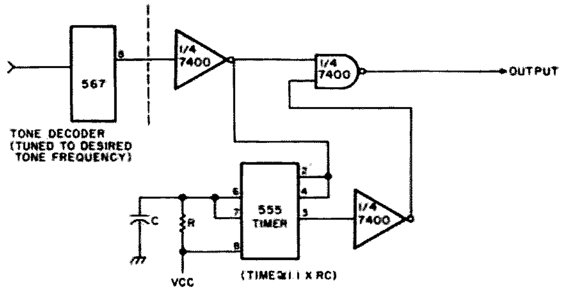
A crystal checker suitable for checking used crystals at hamfests, etc. If the crystal is good, the meter will show a steady indication. A good crystal will cause the circuit to oscillate when the "test" button is pushed, with a half scale reading on the meter. Thanks to John Mairs, Springfield VA.



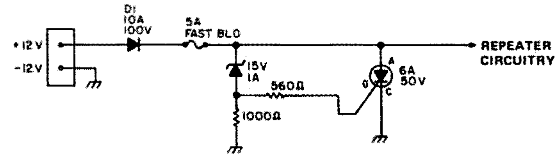
A siren oscillator that sounds just like an air mechanical device. L1 is one half an audio transformer with a 10k center tap. Thanks to Gary Capek K8NSA/5.



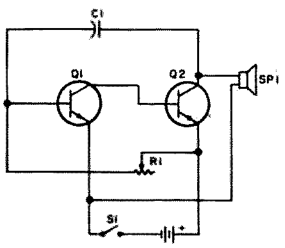
A zero center indicator for FM receivers. To adjust, tune in a station and adjust the 1 megohm pot for a null. Then ask the station to modulate and fine adjust so modulation peaks don't light the LEDs. Stations are properly tuned when neither LED is lit. Thanks to Michael Black VE2BVW.



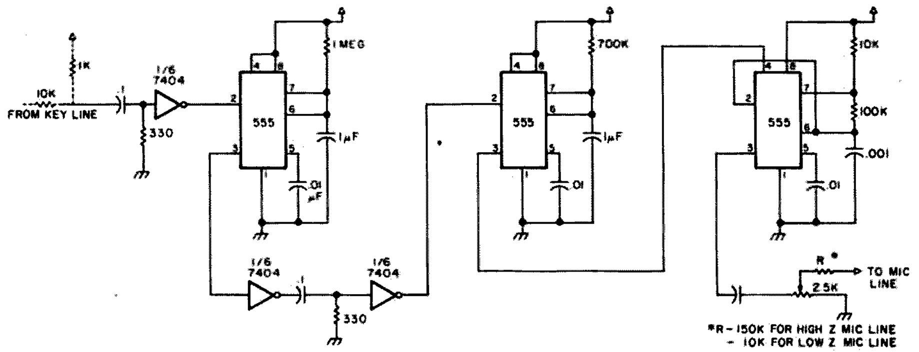
A continuous tone detector using 567, 555, and 7400 ICs. The output goes low only when the tone has been continuous and exceeds the timer pulse. Without a tone, the high at the 567 output is inverted, keeping the timer reset. When the tone comes in, the timer output goes high and, after being inverted, blocks the gate. If continuous tone is used, the gate is opened at the end of the timer pulse. If not continuous tone or shorter in duration than the timer pulse, the output of the gate remains high. The circuit could also be used to reset an alarm system or detect any TTL logic that required a specific length of time. Thanks to Raymond Thompson KH6IEL.



The best way yet to safeguard portable, emergency power repeaters from reverse or excessive voltage. D1 prevents incorrect polarity damage, and zener voltage determines the maximum voltage that will reach the rest of the circuitry. Use fast blowing fuse rated greater than the SCR current rating. Thanks to Paul Hurm WB8CLF.



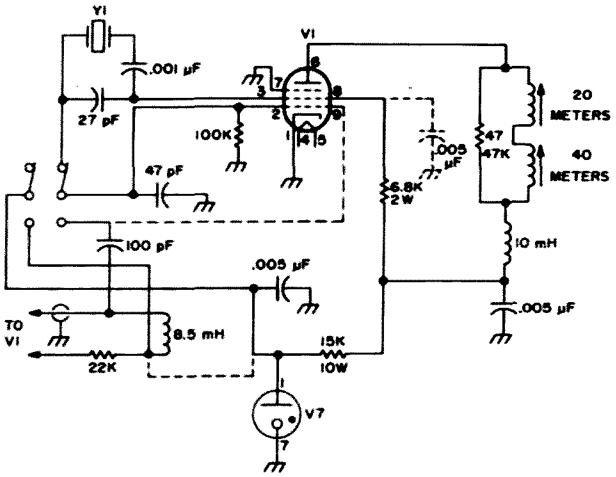
Your basic code practice oscillator, which works with 2 to 12 V dc (but 9 to 12 volts gives best volume and clean keying). R1 can be replaced with a 500k pot and the circuit will sweep the entire audio frequency range. Thanks to Rod Hallen, Tombstone AZ.



The "Key Up Beeper," designed for use on the Jacksonville FL 16/76. The circuit gives a .75 second tone burst 1 second after the COR is de-energized. Time delay may be changed by substituting another value for the 1 megohm resistor. Tone burst duration is varied by changing the value of the 700k resistor, and the frequency of the tone is changed by varying the resistor-capacitor ratio of the third 555 IC. The circuit is set up for 5 V dc, but can be used for 12 V dc applications by adding the components in dashed lines. Thanks to Jim Arner, Jacksonville FL.

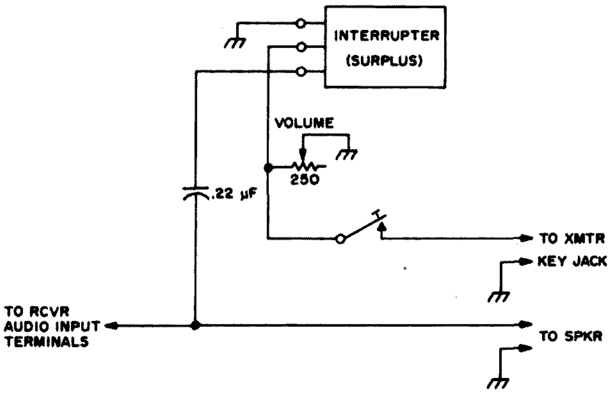
Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.



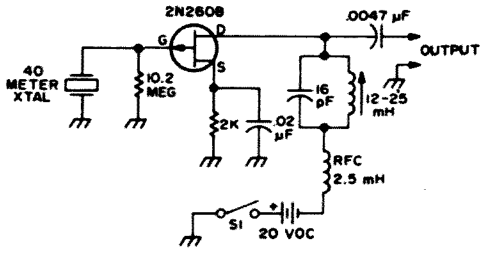
Q. For operation on MARS, CAP, etc., what modifications will allow crystal-controlled as well as vfo operation?

A. This typical-circuit modification (see the figure) will permit crystal-controlled operation and requires only a few small parts for a very worthwhile addition. And, original calibration of the set's vfo is undisturbed.



Q. Is there a diagram for constructing a simple keying monitor?

A. The interrupters in several pieces of surplus equipment, such as telegraph set TG-5, can be converted easily to an excellent keying monitor used with the station receiver and transmitter, as shown in the figure.



Q. Is there a crystal oscillator circuit that will operate at 7 MHz using a Siliconix 2N2608 field effect transistor (FET)?

A. The oscillator circuit in the figure will work very well. Leads must be kept short. The coil can be air-wound or a permeability-tuned unit. If desired, the tuning capacitor can be a variable unit and the value of the coil fixed. The amount of rf output will depend on the crystal (activity) and the voltages used.

Q. What is an integrated circuit?

A. An integrated circuit (IC) is a small piece of a specially treated mineral that has the ability to reproduce entire circuits that might ordinarily require dozens of transistors, resistors, and other components. There is at least one IC that is the size of a transistor that actually replaces a thousand transistors; some replace even more. Being very small, they are perfect for miniaturized construction projects or for simplifying larger projects. Usually they have fourteen or sixteen connections.

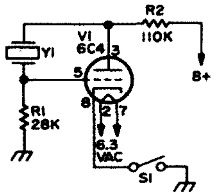
Q. How can a surplus frequency meter rf output be reduced?

A. Simple. To recap, however, the problem occurs when the instrument is tuned to a weak signal. What happens is that a heterodyning effect is produced — and quite an annoying one.

To remedy, a 2 megohm potentiometer should be placed in series with the original screen dropping resistor in the frequency meter. To null or reduce output, merely adjust the newly-installed potentiometer.

Q. If any, what are the advantages of SSB compared to FM?

A. First of all, FM requires more frequency space and more bandwidth. Second, performance of SSB on weak signals is better than FM. Lastly, FM cannot be received properly on an ordinary AM-CW receiver — SSB can, by using the bfo to inject carrier.



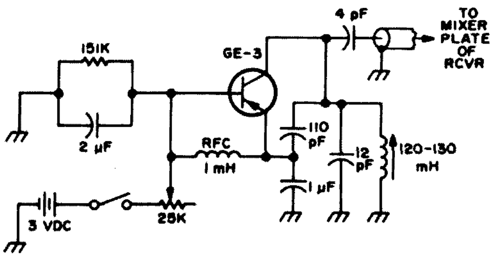
Q. How can you set the main tuning dial to the right spot so that the calibration of the bandspread dial will be accurate?

A. A crystal-controlled marker oscillator (see the figure) is about the best way to do this. The circuit shown can be built right into most receivers and turned on or off at will with a toggle switch mounted on the front panel.

A 3.5 MHz crystal will work nicely. The fundamental and harmonics of the 3.5 MHz oscillator make it usable as a band edge marker for all bands through 28 MHz.

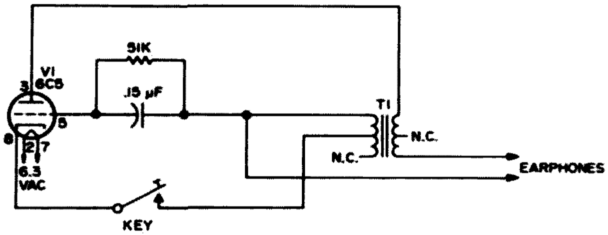
Q. Is the problem of key clicking, experienced with CW keying, also experienced in FSK work in teleprinter operation?

A. Yes, shifting frequency too quickly will result in sharp-edged waveforms. In order to achieve rounded characters, the keying transition must be smooth and slow. Abrupt changes in any keying signal will produce excessive bandwidth, and result in thumps or clicks, even though the affected receivers are tuned to a frequency some distance from the offending station's frequency.



Q. Is there a circuit diagram for a transistorized Q-multiplier that can be used with i-fs in the 1400 kHz region?

A. The lead from the Q-multiplier (see figure) to the plate of the mixer stage in the receiver should be shielded. The coil used should have a high Q and, for 1400 to 1450 kHz, should be an iron-core unit having a value of 120 to 130 uH. The resistor tied to the 25k pot will have a resistance of from 3k to 40 kΩ, depending on the transistor used; the value must be obtained experimentally. Try a 5k unit with the HE-3 transistor. Before changing resistors, try various low-voltage dc values. If a 2N1742 transistor is on hand, it will work extremely well in this circuit.



Q. Is there a circuit diagram available for building a code practice oscillator?

A. The code practice oscillator circuit in the figure can be built for approximately $6. This circuit does not require a plate or B-plus supply. It is essential, however, that high impedance headphones be used with the circuit for maximum performance.

Digital Autopatch

- - with touchtone dialer

E.E. Buffington W4VGZ
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Photos by Danny Turner WB6TUG/4

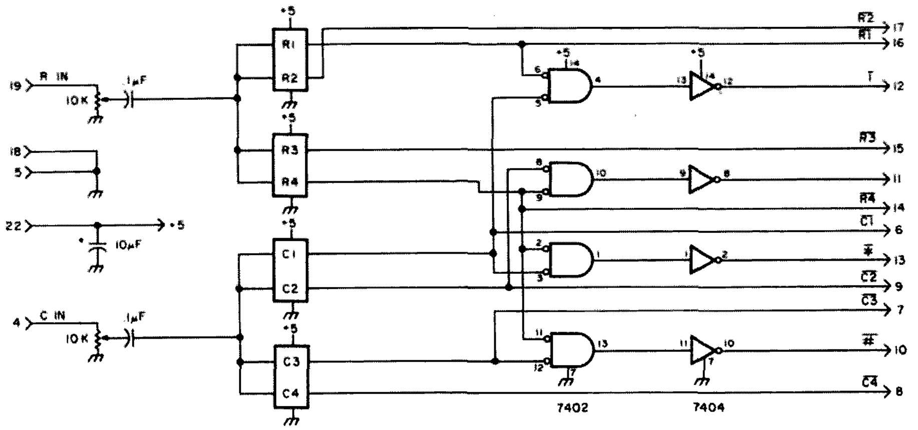


*Fig. 1. Decoder board with NAND gating to supply all rows, all columns, *, #, 1, and 0.*

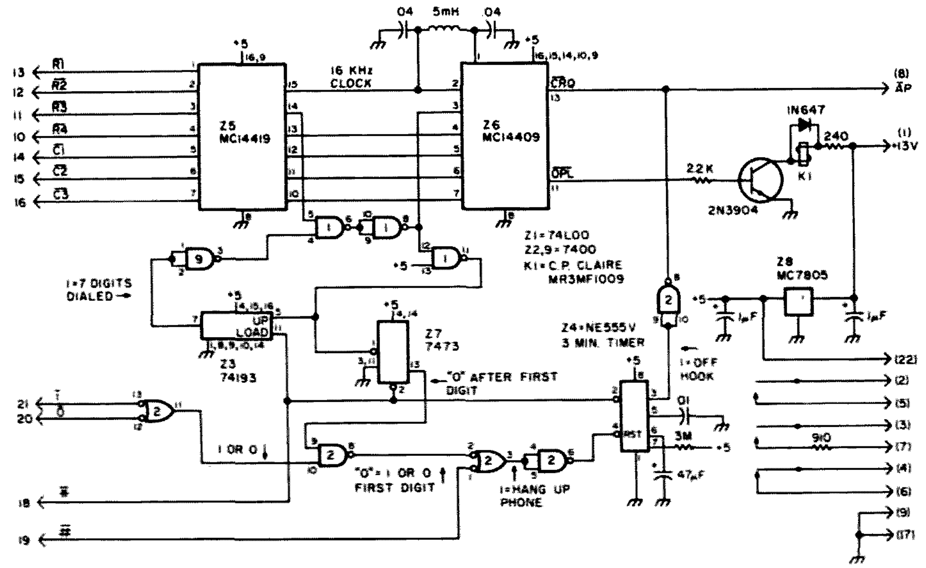


Fig 4. The dialer accepts logic signals from the decoder and dials the phone.

The recent introduction of two new IC chips by Motorola has really opened the door for a practical autopatch for the repeater that does not have access to a touchtone signaled phone line. This article describes all the circuits you need for phone patching.

The MC14419 and MC14409 are the good news items that we have been waiting for. The MC14419 is a 2 of 8 to binary decoder which takes a row-column input, does debouncing, and converts to a 4-bit binary number. The debouncing consists of furnishing a strobe pulse to the MC14409 only after the row-column information has settled. The MC14409 stores this data and dials it out at the proper pulse rate. The storage capacity is 16 numbers and can be read and outpulsed over and over again by using the redial feature. The autopatch described here is in operation on two repeaters presently and is performing just fine.

The Decoder

I designed the decoder around the EXAR XR2567 IC chip because it is a dual decoder and costs only slightly more than a single 567 decoder. The decoder board uses four of these chips to decode the four rows and four columns of the standard 16 button pad. (See Figs. 1 and 2.) There is some "AND" gating done to get (*), (#), (1) and (Ø). These four, plus all rows and columns, are

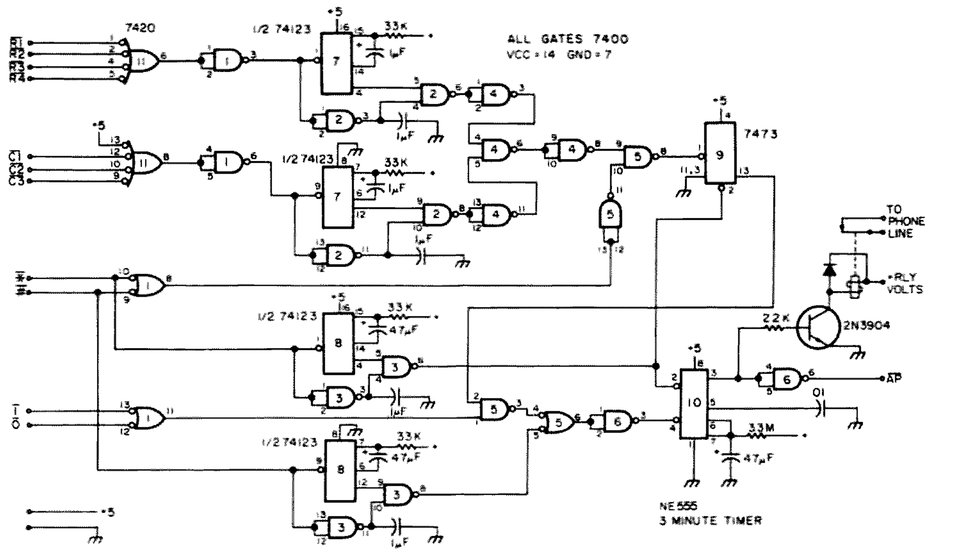


Fig. 7. Control circuit for touchtone signaled phone line.

(Ø) is the first digit, the phone will disconnect."

It was found in the model that some voices would cause a row-column match and keep dialing the phone after the connection was made. This was overcome by limiting the number of digits to 7. The 75192 loads a "1" with (*) and counts to 8, thereafter inhibiting strobe pulses.

The three minute timer will terminate the call after 3 minutes. The call will also terminate with (#) or with (1) or (Ø) as the first digit. The $\overline{AP}$ line is used to turn on the transmitter and the logging tape recorder (third party traffic, you know!).

A fix was also needed to keep voices from "talking up" a dial tone in normal repeater operation. A retriggerable multivibrator (74123) was used to insure that $\overline{*}$ or $\overline{\#}$ must be held low continuously for one second before the output goes low. I don't have a circuit board layout on this feature yet, but the schematic is shown in Fig. 5.

Touchtone Signaled Line Control Circuit

Fig. 7 is the logic for a control system that will initiate the call, start the timer, and provide lockout for (1) or (Ø) as the first digit. The operation of the circuit is pretty straightforward, except for the debounce feature. Begin with (*) going low for one second. This sets the J-K flip-flop ($\overline{Q}$ output goes high) and starts the three minute timer. The output of the timer is inverted and is furnished as a signal to start the tape recorder, make the phone line connection, and keep the transmitter on. If the next digit is a (1) or (Ø), the timer will reset and the phone connection will be broken. The first digit dialed will clear the J-K flip-flop so the next or any subsequent digit can be any digit including (1) and (Ø). A (*) or (#) is not recognized as a digit. The retriggerable multivibrator 74123 is used as a debouncer. The any-row or any-column debouncer is set at 20 milliseconds; the (*) and (#) debouncer is set for 1 second. A logic low must be present for the full time in order to get an output after that time. Any glitching or contact bouncing that takes

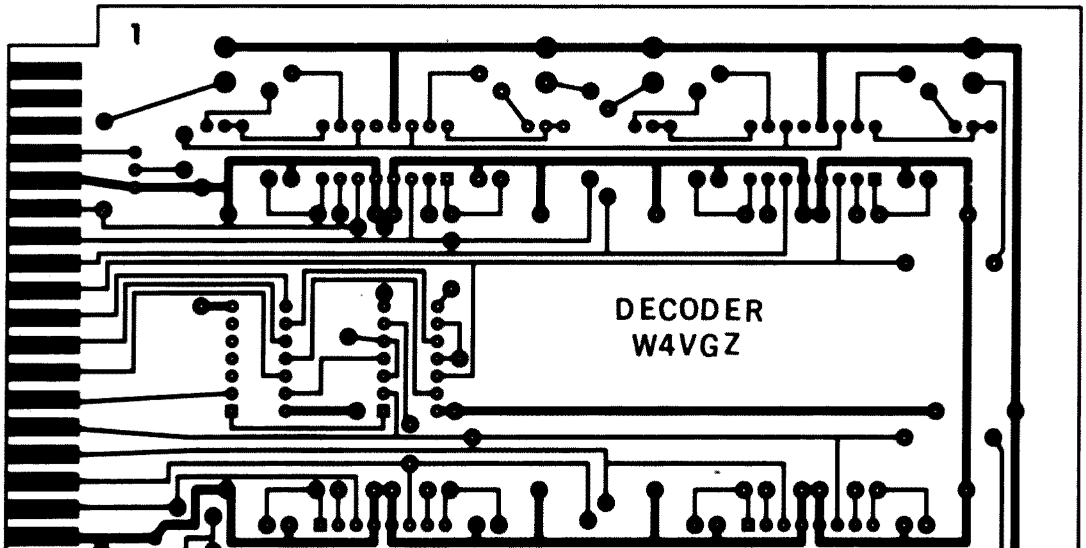


Fig. 8(a). Decoder board.

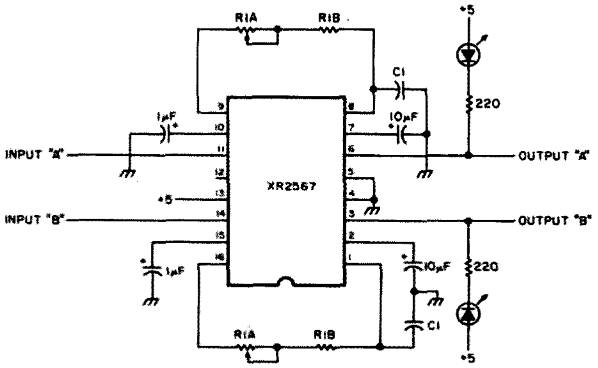


Fig. 2. Dual tone decoder. Four of these decoders with R1 and C1 values from Fig. 3 are used for the complete decoder (Fig. 1).

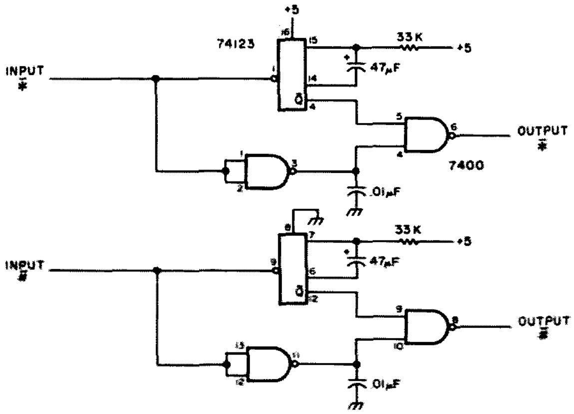


Fig. 5. Dual contact bounce eliminator.

	Freq.	C1	R1 (Nominal)
Row 1	697 Hz	0.1 mF	14.3k
Row 2	770 Hz	0.1 mF	13.0k
Row 3	852 Hz	0.1 mF	11.7k
Row 4	941 Hz	0.1 mF	10.6k
Column 1	1209 Hz	.047 mF	17.6k
Column 2	1336 Hz	.047 mF	16.0k
Column 3	1477 Hz	.047 mF	14.5k
Column 4	1633 Hz	.047 mF	13.0k

Fig. 3. Decoder frequencies and timing resistor and capacitor values.

provided as outputs. The decoders are trimmed to frequency by monitoring pin 9 or 16 of the XR2567 and adjusting the pot for a free-running frequency equal to the desired lock frequency. This is done, by the way, without an input signal. The nominal value of R1 is shown in Fig. 3. The fourth column is not used for autopatching; however, you may find it useful for control of some repeater functions.

The Dialer (Fig. 4)

I decided that I didn't want to pay for someone else's toll calls, so I put in a "fix." This fix makes the logic statement: "If a (1) or

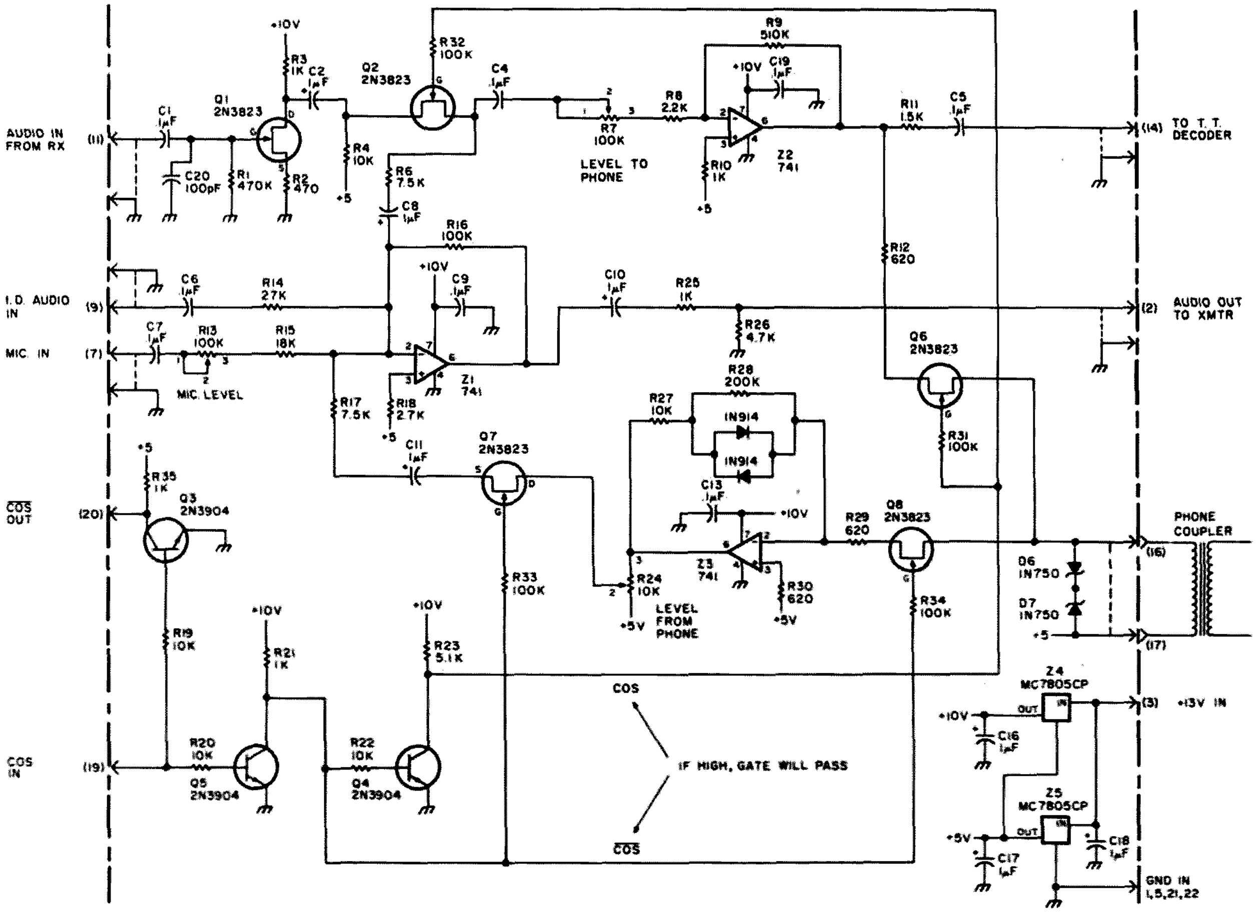


Fig. 6. Audio interface board. R5, Q3 not used. Highest R = 31; highest C = 20.

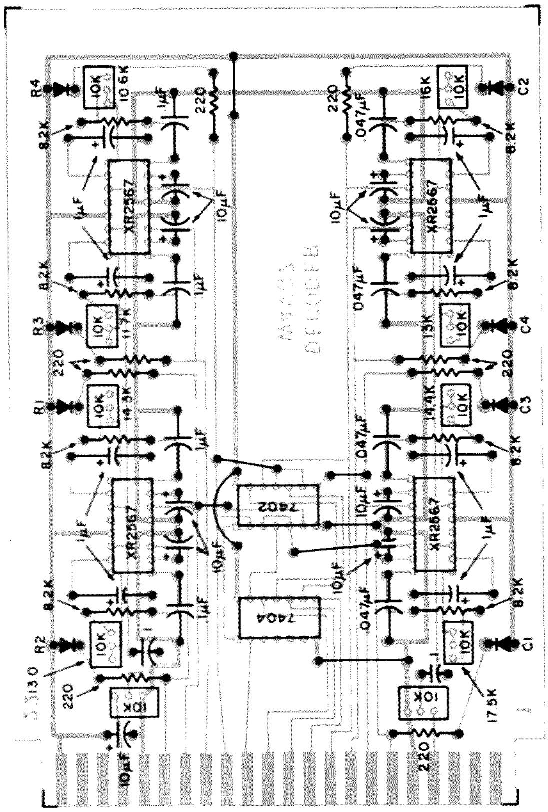
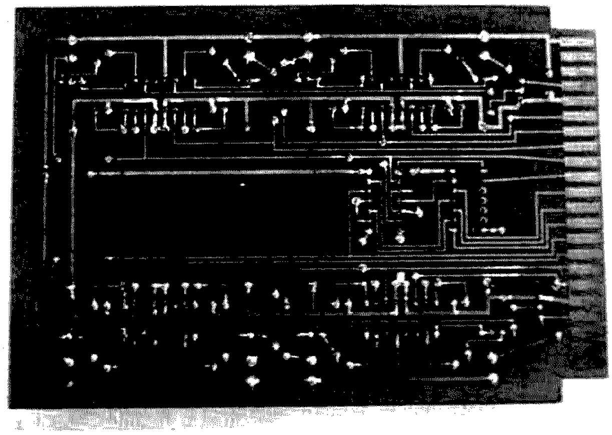
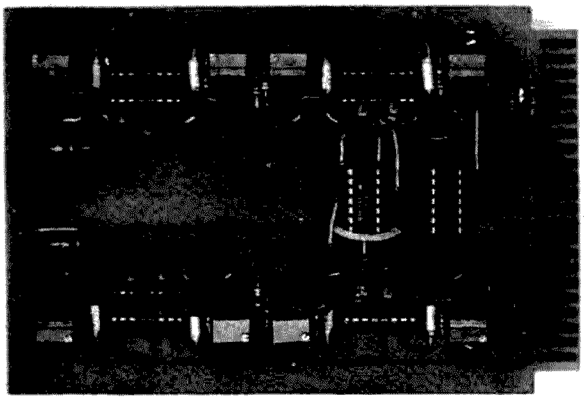


Fig. 8(b). Decoder board component layout.


Decoder board, foil side view.


Decoder board, component side view.

place before this time is over will retrigger the single shot and extend the time by the single shot period.

Audio Interface

The audio board (Fig. 6) connects the receiver output to the transmitter, phone

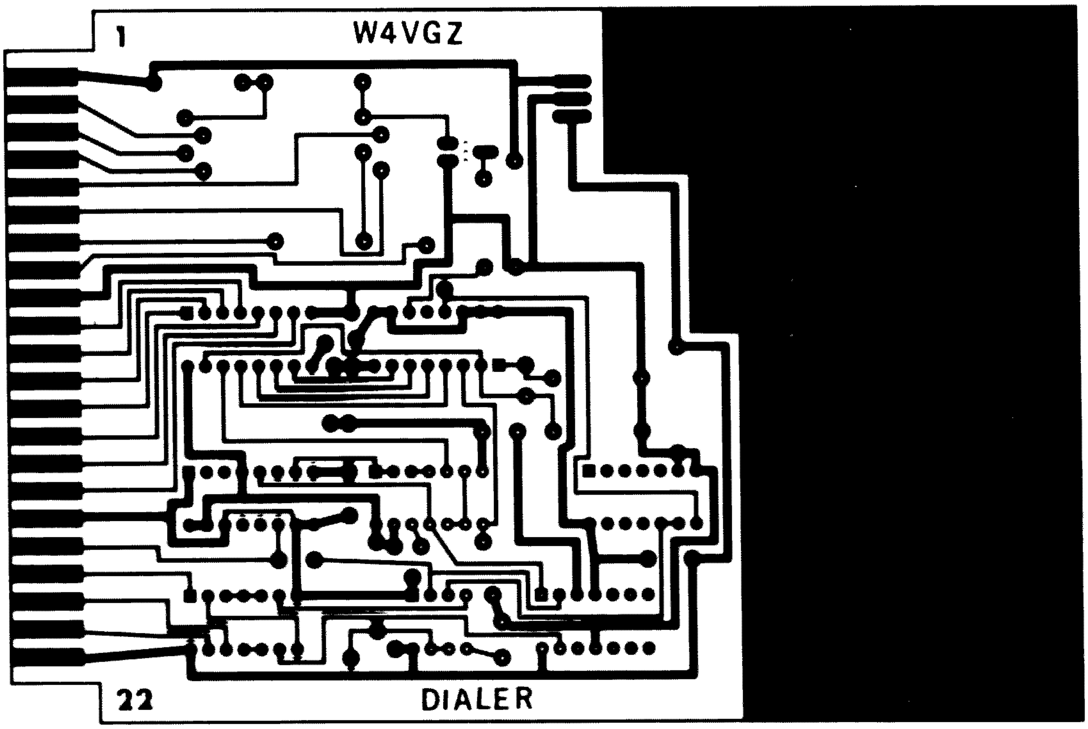


Fig. 9(a). Dialer board.

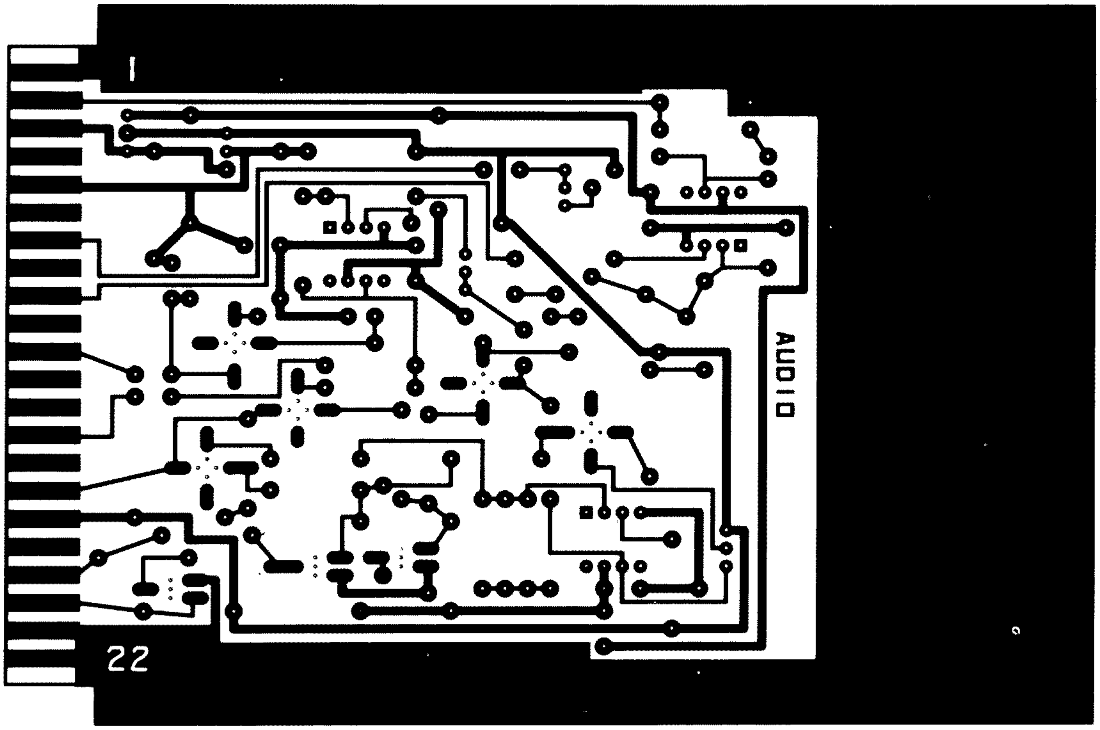


Fig. 10(a). Audio board.

line, and decoder. It has provision for local microphone and ID audio, and has a compression amplifier for boosting the phone line signals. The compression amplifier has high gain for weak signals and less gain for strong signals. All switching is done by FETs. The carrier operated switch (COS) input is active high. If you have touchtone signaled exchange, the audio board, the decoder board, and the additional logic (Fig. 7) are all you need.

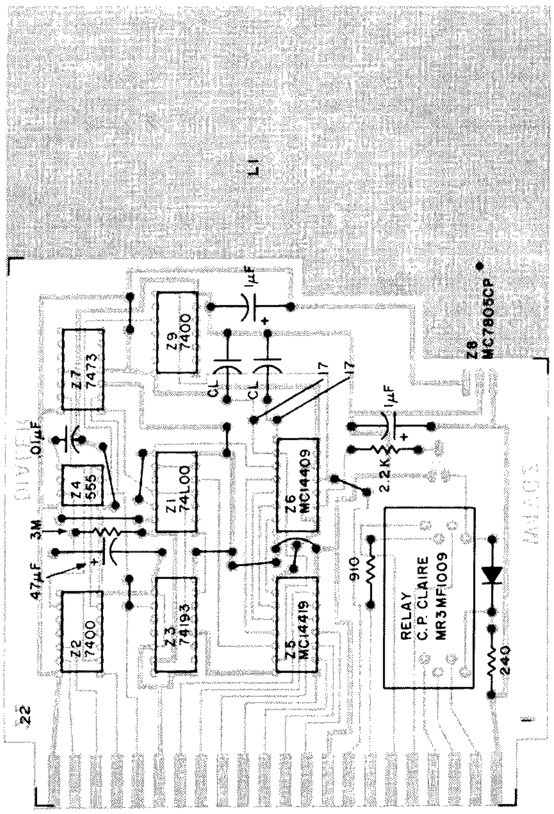


Fig. 9(b). Dialer board component layout.

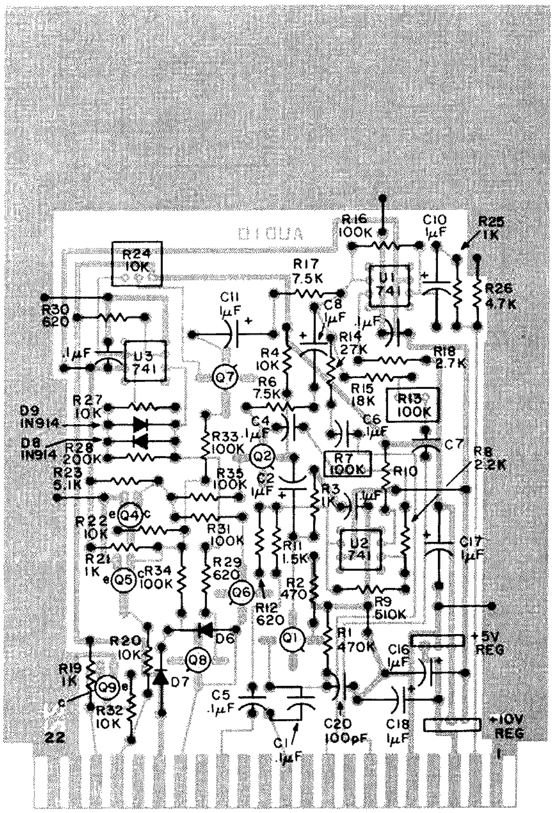


Fig. 10(b). Audio board component layout.

Parts List

Decoder

Description	Qty
220 Ohm, ¼ W	8
8.2k Ohm, ¼ W	8
10k Ohm, Pot, Bourns 3299W	10
0.1 uF, 100 V, Dipped Mylar	4
0.047 uF, 100 V, Dipped Mylar	4
0.1 uF, Disc Ceramic	2
1.0 uF, Axial, 20 V, Tantalum	8
10 uF, 20 V, Dipped Tantalum	9
10 mA Red Light Emitting Diode	8
XR2567 Dual Decoder	4
7402	1
7404	1

Dialer

Description	Qty
910 Ohm, ¼ W	1
3.0 Megohm, ¼ W	1
240 Ohm, ¼ W	1
2.2k Ohm, ¼ W	1
47 uF, 20 V, Tantalum	1
0.01 uF, Disc Ceramic	1
1.0 uF, 20 V, Tantalum	2
5 mH (See Text)	1
.04 uF (See Text)	2
74L00	1
7400	1
555	1
74193	1
7473	1
MC14419P	1
MC14409P	1
1N647	1
Relay, C.P. Clare, MR3MF-1009	1
MC7805CP	1

Audio

Description	Qty
470 Ohm, ¼ W	1
620 Ohm, ¼ W	3
1k Ohm, ¼ W	5
1.5k Ohm, ¼ W	1
2.2k Ohm, ¼ W	1
2.7k Ohm, ¼ W	1
4.7k Ohm, ¼ W	1
5.1k Ohm, ¼ W	1
7.5k Ohm, ¼ W	2
10k Ohm, ¼ W	5
18k Ohm, ¼ W	1
27k Ohm, ¼ W	1
100k Ohm, ¼ W	5
470k Ohm, ¼ W	1
510k Ohm, ¼ W	1
100k Pot, Bourns 3389W	2
10k Pot, Bourns 3389W	1
0.1 uF, Disc Ceramic	8
100 pF, Disc Ceramic	1
1.0 uF, 20 V, Tantalum	7
2N3823	5
2N3904	3
1N750	2
MC7805CP	2
LM741CN	3

Circuit Boards can be obtained from:
O. C. Stafford
427 South Benbow Road
Greensboro NC 27401

Price is $20.00 per set, postpaid.

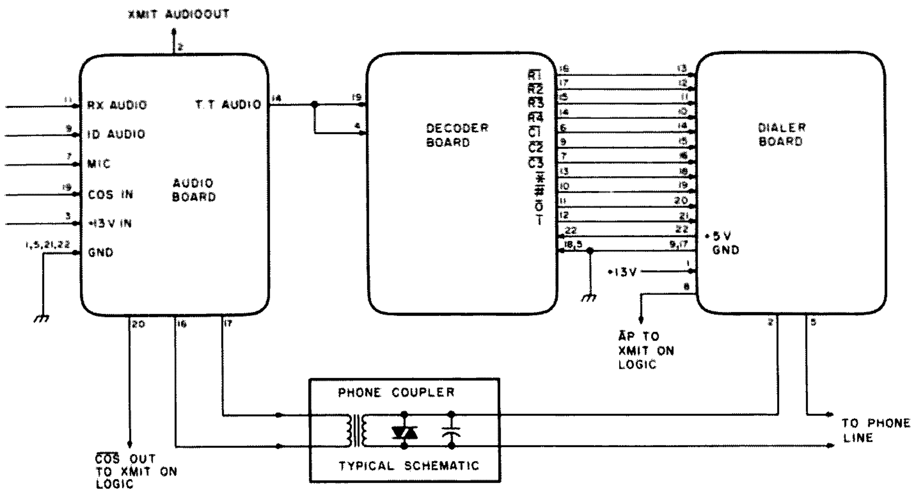


Fig. 11. Overall schematic.

Construction

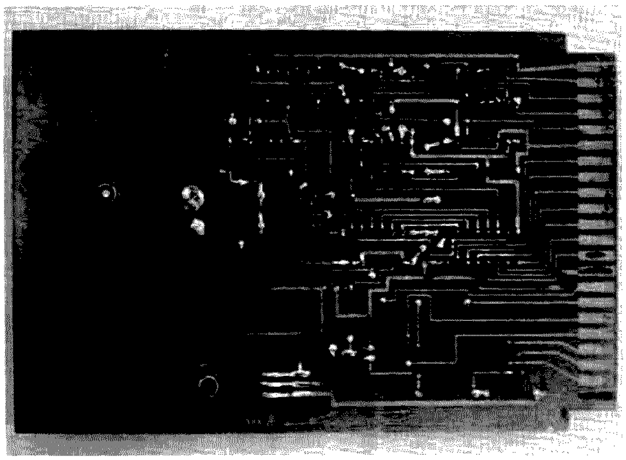
Any local print shop can make the negative (or positive) you need for making your own boards. You can purchase, from Kepro, presensitized boards in the 4 x 6 size. Just follow the directions given in every package of boards and you shouldn't go wrong.

The inductor for the 16 kHz clock oscillator shouldn't be a problem. I have used coils from 3 to 10 millihenries (with the appropriate capacitors) and they worked OK. You can mount the coil on the area used for the 5 volt regulator heat sink. The formula for finding the value of the capacitors is:

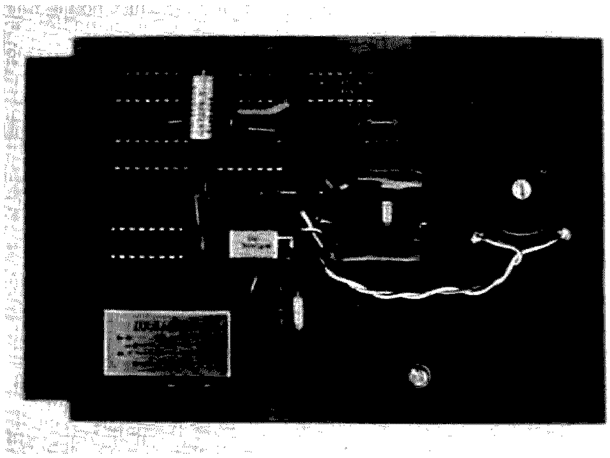
$$C_L\ (\text{uF}) = \frac{2}{10\ L(\text{mH})}$$

Cheapskate Shortcuts

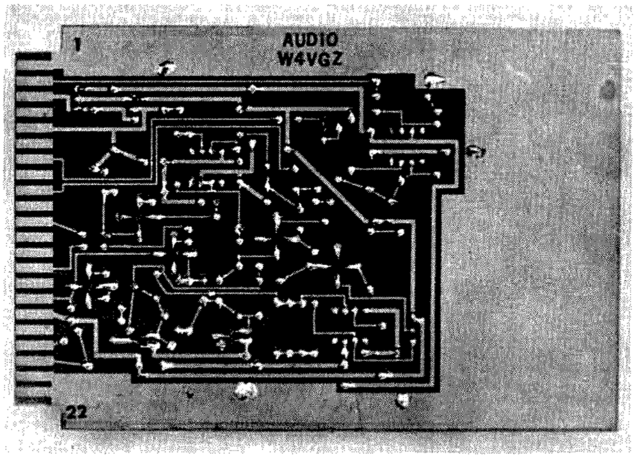
All boards mount in 22-pin card edge connectors. You could solder directly to the fingers and save some



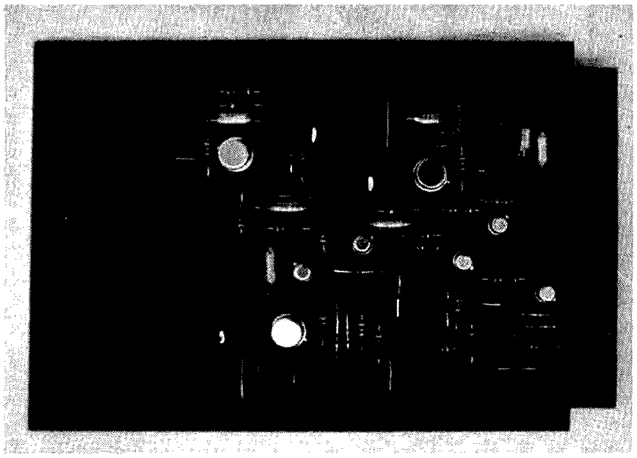
Dialer board, foil side view.



Dialer board, component side view.



Audio board, foil side view.



Audio board, component side view.

money. Fixed value resistors could be used for the audio input on the decoder board to limit the input to less than a quarter of a volt rms or so. The level is not critical at all. You could soldertack a pot to find the value needed for proper frequency and then substitute fixed resistors if you want to save about $15 in pots. Watch out for the orientation of ICs, especially the MC14409. Make sure you don't put them in backwards. Pin 1 on the PC board is square instead of round. You could get by without the LEDs. Just increase the load resistor from 220 Ohms to 1k or so, and put in a strap for the LEDs. A junk box relay could be used (instead of the reed relay specified) and mounted externally to the circuit board; just put in jumpers over to the contact fingers.

Parting Shots

An attempt was made to keep a constant impedance on the phone line between transmit and receive. If there is any problem with the phone company on this, you will have to put in a hybrid coil and take out the FET switch Q6.

One day you might find yourself getting wrong numbers. Check first to determine if the phone company is set up for dual mode signaling on the line. They have a setup so that either dial pulses or touchtone will work. The system used here does not mute the tones, so that both the tone and dial pulses will be present on the line. I have not encountered this personally but have talked to others who have. The circuit shown in Fig. 7 should be used if this is the case.■

Cyril Lievesley WA1LET
142 Brightman St.
Fall River MA 02720

Harness the Wind

-- practical hints

The wind bloweth, and the hams want to use it. The articles that I have been perusing are good in theory. In practice they do not work, period. Even the commercial wind electric generators are very disappointing in performance. I know; when I was young I was making a living making those stupid contraptions work. When the power company brought in the wires, I looked for another job.

If you are interested in putting up a wind electric system, follow the outlines of a good theorist, but do the main things he leaves out, which are: You cannot charge a 12 volt battery with a 12 volt generator, the generator being 30 feet in the air, and the battery under cover at ground level. Even the commercial units try to do this. Also, you cannot light a 12 volt bulb with a 12 volt battery over the house wiring. All that you will get is a red light, depending if the battery is fully charged or not. The secret of a successful wind electric system is to have the generator rated at twice the voltage of the lights, to a voltage regulator positioned close to the battery, with the battery one and one third times the voltage of the lights.

At that time I used a six volt system. Thus, a 12 volt generator to a six volt regulator to an eight volt battery. Four batteries were wired in series-parallel. The wiring must be as heavy as you can afford.

Practicality works when the theory leaves much to be desired. The alternators of today would greatly increase the efficiency of the device, as the wind does not blow steadily. Any questions? ■

APRIL						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1 G	2 F
3 P	4 P	5 F	6 F	7 G	8 G Good Friday	9 F
10 P Easter	11 F	12 G	13 G	14 F	15 F	16 G
17 G	18 F	19 G	20 G	21 G	22 G	23 G
24 G	25 F	26 G	27 G	28 G	29 F	30 P

propagation

by
J. H. Nelson

A = Next higher frequency also may be useful

B = Difficult circuit this period

F = Fair

G = Good

P = Poor

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7A	7A
ARGENTINA	14	14	7B	7	7	7	14	14	14A	21	14A	14
AUSTRALIA	14	14	7B	7B	7B	7	7	7	7	7B	14	14
CANAL ZONE	14	7A	7	7	7	7	14	14	14	14A	14A	14
ENGLAND	7	7	7	7	7	7	7A	14	14	14	14	7A
HAWAII	14	14	7B	7	7	7	7	7	14	14	14	14
INDIA	7	7	7B	7B	7B	7B	14B	14	14	14	14B	7
JAPAN	14	7A	7B	7B	7	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14B	7B	7B	7B	7B	7	7	7	7A	14B	14
PUERTO RICO	14	7	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7B	14B	14	14	14A	14A	14	14
U. S. S. R.	7	7	7	7	7	7	14B	14	14	14	14B	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	7B	7	7	7	7A	14	14	14A	21	14A
AUSTRALIA	14	14	7B	7B	7B	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	14A	14A
ENGLAND	7	7	7	7	7	7	7	7A	14	14	14	7A
HAWAII	14	14	14B	7	7	7	7	7	14	14	14	14
INDIA	14	14	7B	7B	7B	7B	7B	7B	7	7	7	14B
JAPAN	14	14	7A	7B	7B	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14B	7B	7B	7B	7B	7	7	7A	14B	14
PUERTO RICO	14	7A	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	7	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	7	7	7A	7A
ARGENTINA	14	14	7B	7	7	7	7	14	14	14A	21	14A
AUSTRALIA	21	21	14	14	7B	7	7	7	7	7B	14	14A
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14A	14A
ENGLAND	7	7	7	7	7	7	7	7	7B	14	14	7A
HAWAII	21	21	14	14	7A	7	7	7	14	14	14	14A
INDIA	14	14	14B	7B	7B	7B	7B	7B	7	7	7	7A
JAPAN	14	14	14	7B	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7A	14B	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14B	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	7A	7	7
EAST COAST	14	14	7	7	7	7	7	14	14	14	14	14


73 AMATEUR RADIO
Our 200th Issue!
YOUR VOTE COUNTS

73

#200 MAY 1977

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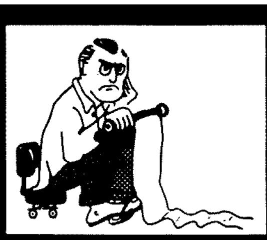


NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

LEARNING CODE

While on the one hand I'm a bit concerned over the code courses that are proliferating . . . thus inevitably touting some newcomers away from the *73* cassette series . . . on the other hand I'm both surprised and delighted to note that none of the competitors seems to have yet grasped the basic concept of how code is learned and what the true significance is of the plateau in learning.

In every objective test of the effectiveness of code courses, the *73* series is at least twice as fast as the next closest course. How can that be?

Let's take a moment to consider just what it is we are trying to do when we learn the code. The usual way of starting the process is to enter the data in the mind, which enables you to translate a di-dah into the letter A, etc. First you memorize the dots and dashes for all of the letters, numbers, and punctuation. Then you listen to them sent slowly and mentally look up each dot-dash pattern in your mind, comparing it with the table you have memorized. When you get a match, your mind tells you what the letter is and you write it down.

Then you gradually speed up this process until you are operating at the fastest speed the mind can handle on a conscious level . . . which means a code speed of around ten words per minute, give or take a little . . . and in no case as high as thirteen (why do you think the scoundrels set the speed at 13?). No matter how hard you try, your mind can't go faster looking up each code group . . . hence the plateau.

But obviously something does happen, for we have people who can copy code at close to 100 words per minute . . . so there is a way past the plateau. What happens is that the code sound patterns . . . not the dots and dashes themselves . . . are automatically translated by the subconscious mind and the character comes to mind seemingly from nowhere. This is why good CW operators can sit and talk with you and then turn around and typewrite the copy they've been hearing while they were talking. The copy had nothing at all to do with the conscious mind processes . . . it was all on a subconscious level. It is this complete retraining which produces the plateau.

The plateau is a long one because there is a long battle in your mind, with the conscious trying to translate the dots and dashes . . . and not being able to keep up . . . while the subconscious is quietly trying to get through and tell you it's got perfect copy . . . shut up already with the other process. This battle defeats all too many prospective hams.

But is this whole battle really necessary? Why should we even bother to go through the conscious mind process at all, since it is of no long range benefit and in fact is about the worst possible way to tackle the project? Tradition . . . as Teyve lauded in Fiddler. Tradition is still with us and bogging down tens of thousands of poor souls who are trapped by it. Tradition keeps the ARRL pursuing this system . . . and sucking hundreds of ham clubs into it with the ARRL tapes. The *Ham Radio* tapes stick rigidly to the ARRL tradition. And so do most of the rest of them.

So how can code be learned without the old process? By starting directly with the training of the subconscious mind . . . starting out above the speed the conscious mind can handle. I'll bet that a newcomer to Morse code can learn the code almost as easily at 25 words per minute as he can at five words per. He has to learn to recognize the sound pattern of the letters rather than the dots and dashes. Even at 50 words per minute, it doesn't take long before you can pick out the letter "E". Then you'll begin spotting the "I"s and so forth. If you let your mind go blank and listen to fast code, you'll start having the letter E jump right out at you with only a few minutes practice . . . and gradually the other letters. You then have to train your fingers to type them as they come . . . or to put them on your mental blackboard and copy them in your head.

There is a limit to how fast we can spell out words, even with the submind doing the work . . . but I don't know what it is. I suspect that the high speed CW fans are copying words rather than letters . . . particularly when they get up around 100 wpm. This is more like speaking a foreign language . . . a lot like it. You have to use a foreign language quite a bit and continue to use it to keep it functioning on a subconscious level where you don't have to translate everything both on receive and send. Eventually you get so you "think" in the new language . . . and this is the way of high speed CW.

A good Morse code course will start the beginner out with each character being set at the end desired speed . . . 13 wpm. Then, as the subconscious gets trained, the spaces between the characters are closed . . . but the sound *patterns* are kept the same. We're trying to recognize these sound patterns, and if we continually change them by changing code speed, we are essentially forcing the brain to start all over again. This is okay if you have the time and a world of patience.

Code instructors from clubs run into hard core cases where people are unable to learn even the whole alphabet. Their conscious mind just won't make the grade. I suggest that these people may well be able to do just fine on a subconscious training program. Send code to them from the *73* 13 wpm cassette and ask them to listen first for the E . . . then the I . . . etc.

The subconscious mind can do fantastic things. Many of the brilliant mathematical skills are done subconsciously. In fact, there have been many cases of people who were barely able to function on the conscious level, but who could do cube roots subconsciously. They didn't have any idea of how it happened . . . the answers just came to them from nowhere.

During my years working as a psychological counselor, I used a direct approach to the subconscious to avoid the protection against mind repairs put up by the conscious mind. The subconscious mind is right there all the time and extremely easy to contact and use, once you get the hang of it. You're using it all the time . . . trying to remember a name . . . which "comes to you" a bit later. Or trying to solve a problem and a solution "occurs to you" later, etc.

Starting right out to learn the code with a 13 word per minute tape is a shock . . . it staggers the conscious mind . . . heck, everyone knows you can't learn the code that way. Nuts . . . you can start out at 20 words per minute if you want, and you'll be able to copy it perfectly in a fraction of the time of the chap who starts out at two . . . five . . . seven . . . ten . . . plateau . . . plateau . . . twelve . . . thirteen . . . grunt . . . and slowly upwards.

I have no doubt that loyal ARRL fans will continue to make life miserable for prospective Novices and Generals with the traditional code system as epitomized by the ARRL tapes and W1AW transmissions . . . even though it goes against everything we know about how the brain works. In the meantime, those who have lucked onto the *73* cassettes will have a tremendous advantage . . . and they will mostly end up enjoying code instead of hating it.

It is difficult to love anything

which causes you a whole lot of pain . . . and learning the code via the traditional method is a big pain in the . . . ah . . . mind. No wonder so few amateurs go on to stick to the CW bands! Code can be easy and fun, if it's taught right. It can be a skill to be proud of, and not a dark and unpleasant stumbling block which you have to overcome to get a ham ticket. Which way are you making it for the new hams?

AVUNCULAR ADVICE ASKED

You are probably not unaware that the Novice training courses started by ham clubs around the country are generating thousands of Novices and that the drop in the number of hams has been turned around. A good deal of the recent growth of readership of *73* has been due to these Novices subscribing . . . mostly as a result of their use of the *73* Morse code tapes and the *73 Novice Class Study Guide*.

Perhaps you, as an old-timer, have some advice for these newcomers to our hobby. You may have an antenna that you think they should know about . . . perhaps there is a rig that you think is great and you'd like to recommend . . . maybe you have some modifications which would help them . . . or you might like to suggest books or magazines which would benefit them.

You can reach these newcomers to hamming via the pages of *73* . . . with a letter to the editor or perhaps a short article. It's easy to write for *73* . . . just be sure to type it double-spaced so we can fix up them grammar or speling errors. Give these chaps a helping hand through *73*.

SIGNS OF DECAY

A letter from John Askew W4AMK suggests that every member of the ARRL hierarchy be required to read C. Northcote Parkinson's book, *Parkinson's Law*. He refers in particular to chapter six, which seems to almost have been written with the ARRL directly in mind.

The gist of the chapter is that the building of a well-planned headquarters is achieved only by institutions on the point of collapse. Parkinson has done his homework well on this, and gives voluminous proof to support his contention.

As far as I know, the members of the League were not consulted about the use of nearly $1 million for additions to the headquarters building. Here we are at a time when more and more amateurs are becoming seriously concerned over the approaching debacle at Geneva with the ITU and WARC . . . and money that could have gone for some ham ambassadors to visit third world countries and garner support for amateur radio is being spent on newer, bigger, and better offices. Just think how far a million dollars would go toward protecting amateur radio!

Parkinson points out that a vigorous institution spends its time getting things done and pays little attention to its surroundings. A visit to the ARRL's enormous building, with its chrome furniture and pile rugs, can be contrasted with the utilitarian *73* offices, with old desks and a strictly make-do atmosphere. We have over 60 people working at *73*, jammed into a 250-year-old house and having the time of their lives.

It isn't until an institution is running down that it spends its time erecting an edifice . . . and this turns out to be its monument to the better days of the past.

Here we are with the U.S. government ready to take away half of our 75 meter phone band and the whole 40 meter phone band as their official proposal at WARC . . . and the ARRL is spending most of the money it has gotten from us over the years on administrative space to provide comfortable offices for even more assistants to the assistants.

You may put me down as being overly critical of the League only if you can come up with an alternate proposal which will help protect amateur frequencies and include spending $800,000-plus for more office space in Newington. I don't think anyone has more input on what is really going on than I do . . . and I see no cause for complacency.

SELLING THE SALESMAN

I'm a real sucker for anything new . . . and Chuck Martin WA1KPS, down at Tufts Radio, knows it. I blundered into his store the other day to drop off some of our newly published books . . . *The New Hobby Computers* . . . and the store was so packed with hams that I had trouble finding a spot to park! Chuck was up on the roof putting up more antennas.

Once he was back on the ground and we'd eyeballed for a while, I mentioned that my IC-230 had one lamp out . . . maybe he could fix it. Oh, pshaw, he said (or words to that effect), "Why are you driving around with something as out-of-date as that? You should be using the latest in digitally-synthesized ham gear." That sounded good to me, I admitted . . . and before I knew what was happening, my IC-230 was out and a brand new IC-245 was in. I sure hope he gets a good price for the 230 for me.

The IC-245 is quite a step ahead. No longer do I have to be bewildered over the 15 kHz splinter channels. I had 'em all on the IC-230, but I never knew which was which, and when I visited another area I just had to fly blind. With the 245 I get a readout of the receive frequency when receiving and the transmitting frequency when transmitting. I can program the darned thing for 600 kHz splits, for 1 MHz splits . . . or any other splits that repeaters may come up with. It knows all about transmitting high in the 147 band and transmitting low in the 146 band, but this can be defeated for the upside downers.

After some months with the 700A Kenwood at the home shack, I have been accustomed to tuning in the receiver with a regular tuning dial . . . and liking it. They sure don't hide any repeaters from me any more! The 245 tunes the dial in 5 kHz synthesized jumps. This makes it so I can tune up and down the band, checking active repeaters as I go. If I want to break any of them, my transmitter is right on channel automatically. No more trying to remember if the upper/lower switch is in the right position . . . no more using a switch to go from the 146 segment to the 147 . . . and the whole package isn't any larger than my old IC-230.

Chuck was so slick about it that I never did notice when I had agreed to take the thing . . . he just assumed that I would, and the next thing I knew I was driving away programming the new rig as I went. I did have to run a separate power wire for it to keep the synthesizer powered. When you turn the rig off with your ignition switch, you then have to reprogram the synthesizer again — and that gets old. You can use a transistor radio battery for the keep-alive current, if you are too lazy to run the extra wire.

And that isn't all. The audio from the 245 sounds a whole lot better, both on receive and transmit. Mr. Inoue, you've done it again!

SPIES NEEDED

If you are anything like me, once you get your hands on a tunable two meter receiver, you set about making a list of every repeater you can hear . . . and every simplex net. You look for the inputs of strange repeaters and get the call letters of all that have any identification . . . and listen a lot on the channels of repeaters which are obviously being kept sub rosa. In other words, you are curious and a snoop.

If you are cut from the same bolt, how about making a copy of your list of repeaters and sending it in so we can be sure to keep our repeater list updated? We'll update the *Repeater Atlas* and publish late changes in *73*.

We want to keep the *Atlas* as up to date as possible as a help to traveling hams . . . so do your part . . . be sneaky and send us your secret agent reports . . . send them to Fearless Leader, *73 Magazine*, Peterborough NH 03458. That goes for DX hams, too, by the way.

HAMS VS CB

For some reason I seem to get a lot of newspaper clippings from *73* readers which involve CB radio. I have two things to say about this . . . first, please keep it up. I appreciate every clipping you can send me about CB (good or bad) . . . about ham radio . . . or about any of my other not too secret interests such as Jordan, submarines, UFOs, microcomputers, and things like that.

A recent clipping sent in by good friend K7EML was an ad in a newspaper for a 100 Watt CB amplifier (not to be used on CB) for $120. This points up a question . . . is the FCC serious about CB linears or not? Another dealer ran an ad for a linear in a magazine and got a phone call from Charlie saying in effect to go ahead and sell 'em, but don't advertise, because that would force them to put on the heat.

Even though about 80% of the new hams are coming via the CB ranks, there is a question in my mind as to whether what goes on there is really any of our business. We don't mix with the mess on the marine channels . . . or the terrible things on taxi and police channels. CBers have no patent on bad language over the radio. CB is another separate service, and I feel like we're butting into a family problem . . . someone else's family . . . when we get involved with CB.

Since I do write a weekly newspaper column for CBers, I have a personal interest in CB . . . not a whole lot . . . I don't get involved with any base station baloney or rag chewing with base stations. My column is mostly devoted to explaining the facts of life to CBers and pointing out the advantages of getting into hamming . . . what skip is and why . . . what the sunspots are going to actually do to them . . . stuff like that.

WAYNE TALKS

I'll be on the program at Atlanta on June 18-19th . . . come armed with questions. I often forget to cover things people want to know about, so make notes and bring 'em. I'll also be talking at Seattle July 29th, if you're in the vicinity. Both of these are going to be superb conventions, so I hope you'll be there and say hello.

COMPUTERIZED POLICE

More and more police departments are following the lead of the Las Vegas PD and installing computer terminals in the road cars. This permits them to check on car licenses automatically and find out if the car is wanted anywhere in the country (or if there are any warrants out on the registered owner). The whole business takes about 10 seconds, versus the pre-computer time period of 10 minutes or more.

The police officers were against the innovation, but when they found out how useful it was, opinion changed. It didn't help when one officer got involved with using the terminal while driving and wrecked the car, the terminal, and almost himself. Most of the officers now pay more attention to the rules about stopping before using their terminals.

The system provides automated dispatching of the patrol cars and automated report writing, in addition to the computer data base on people and car licenses.

In Washington DC, this has made it possible to check on parking tickets quickly and put one of the "Denver" yellow boots on the wheel of a car which has outstanding tickets against it. The boot locks on and keeps the car from being moved until the owner settles up on the unpaid parking tickets.

HAM COMPUTERISTS

I've been asked to give a talk on the ham uses of computers at the 1977 World Altair Conference in Albuquerque (May 3-7). Although I've heard from a few hams who have been using microcomputers, there are a lot of you out there who haven't written. I'd appreciate getting as much information as possible on any applications you may have developed.

LETTERS

PART 97.112

Federal Communications Commission
Washington DC 20554

This is a request for the FCC to consider modification of FCC Rules and Regulations, Part 97.3(b).

I propose that the following words be deleted from the part mentioned above: "and without pecuniary or business interest."

This particular phrase, while questionable as to its intended implications, is virtually unenforceable, the subject of wasted controversy, and overtaken by events that continually transpire on repeater autopatch facilities.

It is agreed that Part 97.112 is valid and needed regulation; however, the broad and ambiguous wording of Part 97.3(b) is detrimental to the amateur service because of the unnecessary confusion created by it.

While the primary reason for requesting this change is to realize the full advantages of repeater autopatch technology, the parallel case is operation of the Class D Citizens Band under Part 95. We have virtually no difference between a Class D operator ordering a pizza via his CB radio or an amateur doing the same via a repeater autopatch – except that the former is authorized while the latter is steeped in controversy. The question of avoiding telephone company tariffs is moot, because in the case of the CB operator the telephone is avoided completely, while the autopatch is providing an income for the phone services.

Your expeditious consideration of this subject is solicited and a copy of any germane request for comment or rule and order is hereby requested.

William J. Howard
FPO San Francisco

HAM SCHOLARS

The Foundation for Amateur Radio, Inc., a nonprofit organization with its headquarters in Washington, D.C., announces its intent to award four scholarships for the academic year 1977-78. All amateurs, wherever resident in the U.S. and holding an FCC license of at least General class, can compete for one or more of the awards if they plan a full-time course of studies beyond high school.

The John W. Gore Scholarship pays $750. Applicants must intend to pursue a career in electronics or a related science and have completed at least one year in an accredited college or university toward a baccalaureate or higher degree. Preference will be given to residents of the District of Columbia, Maryland, and northern Virginia.

The Richard G. Chichester Scholarship also pays $750. Applicants must be members of the ARRL and be sponsored by an ARRL-affiliated club. There is no restriction on the course of study, but applicants must be enrolled in or have been accepted by an accredited university or college and intend to seek a baccalaureate degree. Preference will be given to residents of Ohio, Kentucky, Indiana, Illinois, the District of Columbia, Maryland, and northern Virginia.

The Edwin S. Van Deusen Scholarship pays $250. Applicants must have been accepted or enrolled in an accredited 2-year technical school and intend to seek an Associate degree in a science-related area. Area preference is the same as the Gore Scholarship.

The Radio Club of America Scholarship also pays $250. There is no restriction on the course of study, but applicants must be enrolled in or have been accepted by an accredited university, college, or technical school and intend to seek at least an Associate degree. There is no area of preference.

Application forms can be requested from FAR Scholarships, 8101 Hampden Lane, Bethesda, Maryland 20014. Requests must be postmarked prior to June 1, 1977.

The Foundation is devoted exclusively to promoting the interest of amateur radio and to scientific, literary, and educational pursuits that advance the purposes of amateur radio.

Foundation for
Amateur Radio, Inc.
Washington DC

TV 3320

The following is a rundown on my experiences with the TV Typewriter 3320 designed by Jeff Roloff and sold by Mini Micro Mart. Possibly you haven't built this model TVT, but maybe my experiences will help you in shooting trouble with the one that you are building. This happens to be the third TVT that I have built, and each time the various models develop new problems, so this time I am going to put into writing the problems that I ran into. I feel sorry for the fellow 40 miles from nowhere who runs into some of these problems.

First off, the delivery of the kit was somewhat late. Apparently the supplier of the PC board lost the prints and didn't make delivery on time. So really this was not the fault of Mini Micro Mart. I would like to make mention that when I called Mini Micro Mart, they at least answered the phone, and at one time accepted a collect call from me. I completed the assembly on Christmas Eve, getting all of the bugs worked out at that time. It prints a very nice copy.

One of the things that I would highly recommend you use is the timing chain waveforms if you have a scope but don't have a counter. Most scopes will count the crystal frequency and then the prints indicate the divide by n as you go through the circuits or ICs. If you lay out the exact number of waveforms on the scope for the input frequency (let's say 10 square waves to start with for 10 mm of deflection), then if the timing chain indicates the next test point is half the frequency, you will come up with 5 square waves for 10 mm of deflection (which says that the next IC has divided by 2).

As you go through the complete timing chain, you will note this takes place. Also, any offsets will be apparent. Also, if you take a ruler and extend the various waveforms back up the sheet, you will see where they compare to some previous waveform that should indicate whether the circuit is working correctly or appears to have trouble. As you continue down the chain, you will discover where the scale changes, and you will have to recalibrate the timebase (frequency of scope) setting of the scope. This will give you a new setting to start with, and then you can continue from there. Frequencies in the timing chain of Mr. Roloff's TVT all come out correctly. I also found that the timing chain in SWTP TVT #1 came out OK; I built two of their units.

Getting back to the TVT 3320: I found some printing errors on the schematics. In Fig. 16 showing timing, the output of IC #2 pin 9 is L or 7920 cycles, pin 8 is M or 3960 cycles, and pin 11 is N or 1980 cycles. All of these terminals and readings are correct. These frequencies go to IC #14, and this is where the first error occurs. The first error shown is L going to pin 13 – really it's N. Pin 9 of 14 shows N going there, and it's really L (the final addition of the frequencies comes out OK, but if you attempt to check the input to IC #14, it can throw you). L1 comes out 7920, which is correct from the timing chain. I might mention at this time that L1 and L1 bar are the same frequency-wise but have a phase reversal; that is, the wave train on the scope will be right side up for L1 and upside down for L1 bar.

Also at this point, I would like to mention that the waveforms should be all of the same height. I had a condition where I had 5 mm of height going into the IC but less than 1 mm of height coming out of it (due to a small piece of wire from a piece of steel wool that had accidentally gotten onto the bench). A defective IC following this loading effect can also cause loss of power in the drive.

Another schematic error is in Fig. 16 on timing. IC #17 pin 3 is shown as going to Fig. 18 (next line blanking), IC #41 pin 11. Instead, IC #17 pin 3 goes to IC #12 pin 11 and then IC #12 pin 10 goes to IC #26 pin 5. So IC #2 is used in place of IC #41 as this particular inverter. The final frequency and inversion is correct, but if you are tracing trouble with a scope, you can be talking to yourself.

At this point, we were feeding a composite video signal into the video display. The problem was that we were getting broken and distorted letters and numerals. The consistent thing was that any letter trouble was always the same as if it were hardwired, which indicated that the trouble was not a spike or frequency problem. The trouble appeared as if maybe a solder ball might be underneath some socket (which I used throughout).

At this point, I used a piece of wire from the five volt supply with a 330 Ohm resistor in series, and touched terminals 17, 18, 19, 20, 21, and 22. This will give a letter display on the screen as follows: 17 will give an AT's in some circuits, but in this circuit it gives an A; 18 terminal will give a A when an AT's appears before, but if an A appears, then a B will appear; 19 will give a D on the full screen (same as above); 20 will give an H; 21 will give a series of P; and 22 will give a blank. You can tie any or all of these input terminals together, and get any letter or numeral in the ASCII code. With this type of input, I proved that the trouble was either in the 2513 character generator or the 74166 shift register. The only letter that was distorted was the A, as on both outputs the above letters were all OK.

I now duplicated the circuit of the 2513 and 74166 on my proto board and fed the output into the transistor buffer that fed the video display. Lo and behold, all of the letters and numerals that I could generate were alright.

Now the problem was to find the cause of the trouble. At this point, I would like to make the comment that I have found that you can short the inputs and outputs of the 2513 and the 2519 and the 74166 and not get into any trouble.

So I started by shorting the outputs of the 2513 character generator, which is also the input to the 74166 shift register. As I am going along, I discover that I can duplicate my exact condition by shorting pins 6 and 7 of the character generator (which says I have duplicated the trouble). This bears out the above assumption that it must be hard-wired and possibly a solder short. After looking very closely, I conclude that the trouble has to be under the 2513 character generator.

Well, this is a 24-pin socket soldered to a double-sided board, and God had better be with you if you are going to unsolder and remove the socket. After very careful consideration, I decided that unsoldering was not the answer. Rather, I took a small screwdriver and pried the plastic holder up, leaving the terminals soldered into place. It came off very easily, and nothing broke, believe it or not.

Now I checked terminals 6 and 7 with a continuity meter again and the

short was still there. Getting the magnifier into operation, I could not find a solder glob of any size. I did find an eyelet just barely touching a piece of foil. This was corrected with a very sharp knife, and the short disappeared on continuity. The black plastic form for the 2513 socket was gently pushed back on the soldered terminals and then taped into place, and everything looked real good. I fired up the TVT and it worked beautifully — giving me the excellent Christmas Eve present of a workable TVT, which I believe was worth all the trouble I went through.

George F. Hatch W9VMG
Fort Wayne IN

NITTY GRITTY

I am a CB to ham convert. I came across a deal on a SSB CB radio in Sept. '76 that I could not pass up. It was installed in my vehicle and I listened (not having anything to say) on various AM channels for about two weeks. I found for the most part that it was crowded with people who had nothing to say.

The next step was to try upper and lower SSB. I did and could not make sense out of what I heard on the channels. Somewhere along the line, I found lower 16 and intelligible conversation. It didn't even resemble the nonsense on AM.

I found a "home" for listening on lower 16, but I did not understand a lot of things, i.e., QRT, QSY, QRX, go down ten, Apache 45, Ex-Calibre 99, etc. I found no one used their FCC callsigns. Anyone not conforming to procedure (using the 10 code, AM talk, using callsigns) was quickly ridiculed by the "knowledgeable" frequency cops. I once heard a guy call, "CQ 11 meters — CQ 11 meters," to which he received a chewing out about not understanding radio. (Only now do I realize that the poor guy was probably only a ham with at least a General ticket and more radio knowledge and ability than anyone on 16.)

One way or another, I came in contact with one of the SSB club members, went to a meeting, and joined the club (needed one of those funny callsigns). I learned what the codes meant and messed up my radio with all the "trickstuff" a good SSBer has.

I was OK for about three months, until I finally realized that I was running as illegally as possible, going nowhere, calling myself an 11 meter radio operator (never a CBer) and being just plain frustrated.

Several members of the club have ham radios they run on 11 meters only (what a waste). I saw their radios and knew I had to have one, but it would never transmit on 11 meters.

I dropped out of SSB, sold my radio, passed my Novice written back in January, bought a radio and am awaiting my ticket.

Now the nitty gritty!

I turned on my radio tonight to monitor the Novice bands. I tuned 40 meters and found a QSO where the guys had a good fist and were a little faster than I could copy (good practice). All of a sudden, right on the frequency of a QSO, some lid began tuning up and calling CQ.

This is not the first time I heard this, but tonight it made me sick and reminded me of CB.

I did not try to put down CB, but ham is heads above. It makes me sad.

Louis C. Berry
Simi Valley CA

P.S. You do not have to plead with CBers to upgrade to ham. It takes some longer than others, but it is a natural transition (if they will spend as much time learning the code as they do bad-mouthing it).

What more can we say? — Ed.

WORD FOR WORD

I hope that you will print this letter word for word in *73*.

To begin with, I am sorry that I have ever spent a cent for *73 Magazine*. I feel that the magazine spends a lot of space on slandering — that's right — slandering the ARRL and its publication *QST*. If you use all of the space that you waste doing this on amateur radio issues, you might find that radio would benefit from it.

For example, in February, 1977, *73*, we find Wayne Green attacking the League on the WARC. Nowhere in his editorial did he offer any concrete evidence on what the ARRL is doing. Unless he can back up malicious statements like "... but I know they are far more interested in spending $800,000 on a new wing for the HQ building than trying to protect our bands." Wow! A magazine that would print such a thing as this with not one single word of supporting evidence (i.e., names, dates, places, or even quotes from the WARC) must be a really poor publication. I don't know how many hams have benefited from the HQ services, but without the nightly (and daily) code practice sessions, I am sure that there are many hams out there who would not have gotten their General (and above) tickets. (By the way, I don't see *73 Magazine* operating a service like this to the amateur radio community.)

Come to think of it, and correct me if I am wrong, outside of publications of various kinds, I don't see where *73* does anything at all, save sit around and condemn the ARRL. It is easy to sit in a chair and say what the ARRL is doing and what you *think* they should do. After all, you're not the one who is doing anything, except perhaps misconstruing and taking out of context everything in a League publication. You aren't in the position where decisions have to be made, and sitting in a chair with a good hindsight is a lot easier than having to make the decisions.

Then I read articles like "Talk About DX — WOW!" in hopes of finding out some new research in propagation and see how much of a waste of space it is. Or then there is "CB Can Do Some Things Better." Could we have these spaces filled with something worthwhile about amateur radio? (Before the CB world comes down on me, I have a CB and a license for it, but if I wanted to know something about CB, I would go to a CB publication.)

Then, the mere fact that you print some of the letters you do — do you select as many anti-League letters as you can? Letters using great and outstanding examples such as HAL discontinued a keyer or that one of the thousands of electronics companies has a PEP wattmeter and then saying something like,"ARRL is really on top of things," just shows how foolish these readers are. I hope that if they miss anything in the field they are in for a career, that their credibility will never again be trusted. (By the way, if I may use the same unsupported logic from these people, if *73* has ever printed an ad for Trigger, which I have also had trouble with, I hope that we realize that it is not as interested in the amateur radio world as it is in securing advertisers to increase its greedy income — see, I can speculate too — but, in doing so, I have condemned everyone who writes or works for *73*. Are you letter writers really using your heads?)

I am not saying that *73* is all bad — I have seen good things. But some changes have to be made. For instance, when the term "dBm" is used in the "Novice Q & A" column, it ought to have a definition. Many beginners, as well as old-timers, may not understand such things, as the only place I have seen it is in the commercial broadcasting.

Secondly, if you, or any of the letters you publish, condemn the ARRL (or any other organization), do it — but don't do it without any proof. I have seen no proof of any kind that is substantial enough to say the ARRL is doing more for themselves than ham radio or that they are behind the times.

The space you waste on condemning the ARRL and then the fact that you don't seem to be doing anything about it really gives me a negative attitude on the whole magazine. In fact, it is hard to trust the credibility of any article in a magazine whose editors spend their time blatantly cursing everything else. If you are against something and can show substantial evidence, then I might withdraw my ARRL membership. But as it stands now, you only help support my belief that the ARRL is the finest organization available to amateurs. If you want to put the ARRL down, quit talking and get up your own teams of lobbyists and go to the WARC. Prove yourself. I am only sorry that readers often tend to listen to writers of poor editorials. If everybody agreed with your philosophies, then we would all read *73* and the FCC would be able to pass any regulation they wanted to and amateur radio would be the loser.

I hope that you will publish this entire letter, as I feel that it has a lot to say. I am sure that a lot of readers will condemn me for this letter, but if they cannot prove their points by showing good evidence that I am wrong, then they only prove my point further.

David O. Wever WB2CQX
Greenwich NY

GOOD BUDDY

Received my March issue of *73* today. While I am a very recent subscriber to your publication, I must rate it tops in its field. No offense intended to *QST* or *CQ* magazines, as I have subscribed to both of them in bygone years.

First off, I was a ham long before the 11 meter Citizens Band was even thought of. I used to work the 11 meter ham band, as I am almost certain that Wayne Green did (judging from his call letters). The thing that irks me, and probably most hams who did not rise from the ranks of the CBers, is the very fact that we were chased out of the 11 meter band, in order that it could be handed to a group, on the proverbial "silver platter," and used in the same manner in which the hams had been using it. Except, no examination requirements were involved. This provided many would-be hams with a cheap and effortless way to enjoy hamming. This probably was not the intent of the FCC. But, what else could the FCC expect? After all, a person who did not possess enough intelligence to plug in an electric coffeepot could obtain a Class D Citizens Band license, with no questions asked. That is, provided he or she met the age requirements and could produce the license fee. Pretty cheap price to pay for hobby-type communications privileges.

Many articles which are published in *73* seem to promote the idea of ham clubs going all out to recruit prospective hams from the CB ranks. This seems ridiculous to me. If these CBers had desired to become hams, they would have done so in the first place, the same as thousands of us did in years past. I am employed as an electronics technician for a railroad, and have a shop in a terminal. Many railroaders, who are also CBers, come into my shop, asking if I can furnish them with railroad frequency crystals for their CB rigs. The railroad radios operate on approximately 1-3/4 meter FM. These same people refer to themselves as radio operators (not as electrical appliance users). When mention is made to them that they

may be interested in becoming a ham, the first question is, "What have I gotta do to get a ham license?" When the ham licensing requirements are explained to them, the immediate response is, "too much trouble." One young man accepted my offer of assistance, and is now a very devoted amateur radio operator. So, it is possible to make a radio operator out of a CBer.

I was amused by the letter from Jim Cullen WA2ENR, in which he asks, "Where would hams be without CB?" I wonder if Jim believes that all hams rose from the ranks of the CBers. For his information, there were hams long before CB was even thought of. As a matter of fact, there have been hams since the very beginning of radio, as we know it today.

There are many complaints of jamming, tuning up on net frequency while nets are in session, profanity — the list could go on and on. This is not good for ham radio in general. It seems as though this sort of thing has become more prevalent within the last decade. One cannot help but wonder if these offenders did not rise from the CB ranks.

Anyone reading this letter may draw the conclusion that I am down on the Citizens Band radio service. That conclusion would be far from true. However, I am down on the inconsiderate people who use this band strictly for hobby purposes. CB was intended for small businesses and individuals who had need for an economical two-way radio service for business use. Many persons who invested money in CB equipment for business use soon learned that CB had been taken over almost entirely by "The Good Buddy Set," who can talk all day and say nothing.

During the 25 years that I have been a licensed ham, I have tutored many people to hamdom. I have lost count of the number. This was not done through a recruiting program. Anyone who expressed a desire to become a ham received my encouragement, cooperation, and assistance. If we go out and start a full scale recruiting program from the CB ranks, we might well end up with the 80, 40, 20, 15, 10, 6, and 2 meter Citizens Bands. There is strength in numbers, but quality should also be given some consideration. Lest we forget, hams must demonstrate their ability as radio operators before they are permitted on the air. Let's keep it that way. Let us not permit people to become licensed amateurs simply because they have enough money to purchase a ham rig. The ham license has already been cheapened enough.

Verle D. Francis W0SZF
McCook NE

220-420 CB?

This letter is regarding the use of 225-420 MHz by the government and the letter by Merrill See W8BGZ, of Kalamazoo MI. Although I am not a government agent who can give you an official report, I can give some informal information as a bit of background.

For the past 8 years I have been a Ground Radio Maintenance Technician (that is, a radio repairman) for the US Air Force. A major portion of my job in that time has been with radios that operate in the 225-400 MHz frequency range. These radios are used mainly for Air Traffic Control (ATC) of military aircraft. They are also used extensively for other information to pilots, and for command and control. These uses mean that these radios are used continuously on a 24-hour, 365-day-a-year basis. The only thing I've ever run across that is used more is CB's channel 19, and the VHF ATC radios used by both the military and civilian airports. To open this frequency range up to Citizens Band type use would require that not the military but the Congress of the United States and the budgetary bodies of many foreign countries allocate a very large sum of money to scrap a working worldwide system and design something new to replace it with. Moving all operations to the VHF ATC frequencies would not work, because of the increase in congestion and because some places use more spectrum space than is available in the entire VHF ATC band (which in itself is larger than the entire 2-30 MHz HF range).

The 406-420 MHz band is also used worldwide by the military. Although it doesn't carry as much traffic as the 225-400 MHz band, it is used daily for ground mobile radio service. Moving this would also be an expensive proposition.

The preceding is not meant to be a complete report; it is just my observations of one user that I have worked with on three continents.

As an answer to question #3, "Careful evaluation of the priorities of the needs of the United States Citizens," I personally think our needs are being served fairly well for an important purpose on these frequencies. They are not very visible to the public, but they are used extensively for a public service.

If anyone still wishes to convert these frequency allocations to a direct citizens' use, I recommend that they practice by removing their local police, fire, and other government services from the frequencies now used by those services.

Ronald E. Seibel
Edwards CA

NEW DIMENSIONS

My three-year-old son is one of the estimated 335,000 Americans who cannot hear any speech; he is able to hear or feel sounds below 800 Hz only with much amplification. Unlike the many blind who are able to participate in our hobby, he and another estimated 13,000,000 hearing-impaired persons have, by the nature of our early emphasis on audio communications, been excluded.

We do have one thing in common — the desire to communicate. FCC code regulations would seem to limit licensing, but my son Kurt can recognize most of the code alphabet and will certainly be able to copy as soon as he can write (although much of the chatter on our CW bands is trite and hardly a learning experience).

In the past few years, relatively expensive telephone TTY equipment has been offered to the deaf. The slow data rate utilized by most limits use to local calls, but mass production should bring the cost down and thus make for more availability to amateurs. I am sure you can see the possibility of a "deaf net."

A new, exciting communications mode has been made available to us through the efforts of the Public Broadcasting Service and FCC order RM-2616. If you have ever tried watching TV with the sound off, perhaps the Muppet Show, you soon realized that something is missing. PBS has developed a system by which captions can be sent on the previously unused scan line 21.

Persons desiring captions would use a simple decoding device. Mass availability of this device, estimated to cost around one hundred dollars commercially (probably less through our surplus channels), would also give us easy access to any TV for TTY, computer, or code conversion uses.

The basic system is described in graphic form in Figure 17, Section 73.699, of the television standards.

Line 21 would start with the normal blanking pulse and program color bursts. This would be followed by seven cycles of an approximately 0.503 MHz signal to synchronize the decoder clock, two cycles of spacing, and then 17 cycles to transmit two 7 bit plus parity ASCII characters. Line 21 of the next field would be used to send a 9 bit pseudo-random framing code to indicate where the two characters should be located. Each eighth frame would consist of a pulse to set the zero crossing bias point.

While this system has the disadvantage of slow speed (52.5 characters per second or 630 5-letter words per minute), it has the advantages of being CMOS-compatible (cheap), not sending unless space data (the pseudo-random code) is provided, and requiring minimal onboard memory.

It should be obvious that dropping the clock run-in, slowing the clock rate to one telephone-compatible, and adding memory would allow the same system to be used for other purposes.

A letter to your local PBS station might speed adoption of this system, and give us yet another equipment dimension.

Our efforts to introduce the deaf to our newer modes of communication might well add a new dimension to our hobby.

Lawrence E. Stoskopf, M.D. W0PSF
Wichita KS

LEVY REPLIES

I would like to take a moment to correct a gross misrepresentation of the facts presented in Mr. Briggs' letter in a recent issue of *73*. It can be expected that there may arise misunderstandings in business dealings, but there is no excuse for distortions of the magnitude represented there.

Mr. Briggs purchased a prescaler kit in February, 1975. Nothing was heard from him until the summer of 1976, over a year later, with a complaint about low sensitivity. A suggestion regarding the possibility of shorted input protection diodes was made, and a set of diodes was sent, free of charge, for him to try. Failing in that, I advised that the cost of a new scaler chip, if that were the problem, would be about $35.00. He subsequently returned the unit, advising that the diodes did not cure the problem. He had mounted the scaler board in a box, from which it was removed, and examined. The difficulty was in fact a defective chip. There was a delay of several weeks prior to the completion of the repair, for various reasons. It was decided to make the repair at no charge. The chip was replaced, the unit reinstalled in Mr. Briggs' enclosure, tested (despite what Mr. Briggs may say), and the unit and his check returned. A nasty letter containing the same allegations as in his letter to *73* arrived a couple of weeks later.

If Mr. Briggs had taken the trouble to open his box and examine the scaler prior to making his allegation, he would have noticed that the chip had on it a date code subsequent to his original purchase date, which is pretty good evidence that it was in fact replaced. The unit was tested prior to being returned with an in-calibration $2300 signal generator; why it did not function for Mr. Briggs is merely conjecture on my part. However, any suggestions to remedy the problem were cut short by his letters.

There are no other manufacturers that I know of who do service on kits eighteen months after sale for free; Mr. Briggs might like to try that with a large manufacturer and see what happens. In any event, there is no excuse for accusations of "sunshine" repair at any price when they are simply not true. Mr. Briggs would do well to check his facts next time.

Stanley P. Levy WB6SQU
Levy Associates
Monrovia CA

CB TO 10M

I just read your article in the *73* Holiday edition, 1976, about the possible changes of CB equipment to a usable 10 meter system. This sounds great to me. I am a frustrated CBer who is working on a ham license.

I fell in love with 2 meters during my recent exposure to The Salvation Army work in Guatemala, where I was responsible for establishing an emergency radio system. We used 2 meter equipment with a repeater on top of a mountain for 200 mile coverage of the area. Now I just need that extra push to get at least a Tech level.

But back to the article: This is something that needs to be followed up with some organized system. There sure are a lot of people with closets like mine, used to store CB equip-

ment. It just got too noisy!

Keep up the good work. Could you put in some novice (simple) projects for beginners? I'm not quite an electronics engineer yet — but working on it!

Fred Musgrave
Baltimore MD

We have a series of CB to 10m conversions coming along, Fred. With the current depressed prices of 23 channel equipment, the time is right to obtain a rig and get in on the fun on 10. See you there. — Ed.

BRIEFS BOOSTER

The recently expanded "Briefs" section is great. Warren Elly is to be commended for his efforts in searching through countless club newsletters to keep us all up-to-date on interesting news. I have seen to it that *73* has been added to the mailing list of *Spark Gap* from the Two Rivers Amateur Radio Club.

After reading the Editorials, Briefs, Be My Guest, Looking West, the FCC news (with and without commentary), and the vast quantity of readers' letters each month, I find myself very well informed on what is happening in ham radio. The rest of the magazine seems like a free bonus!

Also like the corrections letters grouped together rather than scattered as they were in the past.

Don't change a thing (except for the better).

Joseph R. Nelis, Jr. K3JZD
Trafford PA

THE RASCALS

I find myself puzzled at the logic of many of the amateurs who write letters to *73*. So many complain that ARRL is not representative of the amateur fraternity and that *QST* simply does not fill the bill as a "ham rag," so — as so many have written — they refuse to join the League until *QST* becomes the kind of magazine they want.

In view of the fact that ARRL is a membership organization, and that *QST* is its journal, the way to *least* affect the nature of the organization or the content of its journal is to resign or not join. That leaves it with members like me who like the journal as it is now published — in fact, it gives us almost total sway in keeping it much as it is now. Quitting such an organization and railing at it from the outside is much akin to telling the baseball team you'll quit and take your football home if they don't let you be the quarterback, when every other member of the team has a football in his hot little hand. Obviously, your leaving makes it even easier for the rest to do things without regard to your wishes.

If you honestly want to see change — in what is clearly an important spokesman for amateur radio (perhaps in a way you dislike) — don't quit. Join, and get your buddies to do the same. Then "vote the rascals out," electing directors who espouse your point of view and who will move to make *QST* what you want. I'll still be there trying to buck you, but I don't even have to try while you're outside. Obviously, the League must, legally and morally, pay more attention to my wishes than to yours. After all, I am a member.

Don't holler at me in the pages of *73* (to which I am also a subscriber). Join the League and take me on where you can influence the things you dislike.

David G. Boyd WA9GBW
Waukegan IL

You could not have summed the editorial position of 73 more concisely, Dave. For your information, most of the hams at 73 are League members. — Ed.

A WORLD OF GOOD

First of all, thanks to you and your fine staff at *73 Magazine*. You've done it again. Through an unfortunate mistake, I lost my faith in Heath Electronics, and with your help all is going great guns again. They *do* stand behind whatever they sell . . . even to the point of refund. So, here is to Heath, keep up the good work.

Another unbelievable first for a "biggie" — I wrote KLM Electronics concerning technical advice on their PA10-160BL 2 meter amplifier, and guess who I got an answer from? Mr. Leland M. Farrer wrote me personally and in simple terms, so a lid like myself could understand. He explained my problem and how to correct it. This exchange of information took less than ten days. Now we know why Mr. Farrer is president of KLM; let me say they are fine folks to do business with!

Just one last word about you and *73 Magazine* — please, please, keep up the good work. So many amateurs become discouraged too easily with one thing or another and give up this fine hobby. But, with your help, the editors' "feedback" section, and reporting good things along with the bad, it does us all a world of good. Please accept my personal thanks for making my hobby much more fun!

David L. Martin WB9UKJ
Evansville IN

MISUNDERSTOOD

I would like to come to the defense of a group of misunderstood people.

After reading in your magazine about "steely-eyed" examiners, and such comments that would make someone think of the FCC as an enemy of sorts, I cannot hold my silence.

Having taken my General, Advanced, and Extra class exams, all from the Boston office, or outlying examination points, I have never gotten an unkind word, and, as a matter of fact, have found that these people really extend themselves to help you, and make you feel as relaxed as they possibly can.

They won't break any rules for anyone, but we really couldn't have it any other way, could we?

Your books are great, and I could not have gotten my Extra without their help.

E.L. Melanson W1HOB
Montville ME

A SWIFT KICK

The controversy about I/O is still going on, in spite of the handwriting on the wall, huh? Please do me a favor and eliminate all that wasted space devoted to DX, super basic electronics, CW, 6800 micros, RTTY, history, etc. I am really not interested in any of that. (Did I miss anyone's toes?) Oh, the argument is that there are magazines devoted to computers, and you should leave it to them? How about saving the space you waste on contests? "You know who" has many, many pages of contest data every month. Leave it to them.

Seriously, a year ago, I could have written a 10 cent article (at your rates) about everything I knew about computers. Now (the XYL will never forgive you) I have George Morrow's 8080 and I am slowly putting a system together. Who knows? Another year and I may learn some programming.

By the way, how about asking those wonderful, talented Fergusons if they could rewrite that OS (Ahhh! beautiful system) for 8080 with no monitor. You could probably find a half page to print the dump.

As far as leaving I/O to computer magazines, I am a charter subscriber to *KB* (same as in the radio area, only 1 mag) but *KB* is not really the place to print Oscar locator programs or (dare we hope?) Don Alexander's program for winning RTTY contests without even being there.

I have only one complaint. Why didn't you give me a swift kick at an RCB meeting many years ago, when I didn't give you my $37 for a lifer?

Al Klein W2PMX
Miller Place NY

SOFTPEDALING

I really have enjoyed *73* the last three years and am looking forward to the next 36 issues.

One thing, though, for *myself* and perhaps many other hams — I hope you soft-pedal the I/O section. There are so many areas of amateur radio, e.g., slow scan, ATV, Oscar, and many others that we haven't touched yet, that there is no time for I/O.

The amateurs who have been at it for years and have explored all the other facets of the hobby perhaps go for it, but I changed to *73* because it had more projects for the *average* ham, with more down-to-earth projects. Don't spoil it all.

73 is put together nicely, and the advertisers I have dealt with, such as James and Poly Paks, have given good service. I don't always agree with your ideas, but that's a free press.

D.S. May WB8ATR
Van Wert OH

Sorry 'bout that, Don. If you check through past issues of 73, I think you will see as many "general" articles as always, including the I/O section. Computers are to some as RTTY is to others, and should be considered a special interest area of ham radio. I don't think you would knock the RTTY content of 73, so lay off those who are interested in computers — everyone has his thing! — Ed.

1635 UTE

Recently, while monitoring 3725, I began to note a strange popping coming over the speaker. At first I did not pay too much attention to it, as QRM and QRN are quite commonplace on all the bands. As the intensity increased, I suddenly realized that my antenna was being bombarded by a form of radiation. The longer I sat there, the more intense it got. I began to get a little shook, having kept track of the latest Chinese nuclear explosion for a while after, due in part to its size and the cloud it had created. I called the local police to find out who monitors the environment in this area. I was told they couldn't help, as they had no contact with any group or individual who did. Then I called the local air base and the operator put me in contact with base environment. I was told that their reading was normal. I couldn't believe it, so I called downtown to the American Atomics Corporation to see if they would take a reading for me. Their man had already gone home for the day, but an individual gave me the phone number of a local civil defense official here in Tucson. His secretary told me she would try to locate him and ask that he call me, and he called in about ten minutes. I explained to him what was happening over my receiver and he said that he would take a few readings and call me back.

He called back and notified me that I had nothing to worry about, as they could not detect anything more than normal. About 30 minutes went by before Les Heru W7WIT called and gave me another number to call. This is what I learned. Some parts of the universe are studied more than others, and our area, the Crab Nebula, is studied rather extensively — in the constellation of Taurus the Bull.

Recently, a strong emission of gamma radiation was detected in a tight band of wavelengths coming from the Crab Nebula pulsar. This radiation is caused by positrons (a subatomic particle the size of electrons but opposite charge) and electrons destroying themselves.

Some of this radiation may have been what I heard coming over my speaker. I really can't say without more research, but as the Chinese radioactive cloud created by their latest endeavor was out-of-phase with my QTH at the time, it is unlikely that it was the cause.

If some of the hams who read your magazine have also heard this, I would like very much to hear from them as to time of day and date and approximate intensity. What I heard came over the speaker 19 Jan. '77 and seemed to peak out at 1635 UTE. The sound is somewhat like popcorn being popped or, for those of you who have heard radiation in a geiger counter, the sound is the same.

Bill Morris WB7ETZ
Tucson AZ

Are you sure it wasn't a noisy 12AU7, Bill? — Ed.

POTSHOTS

In the March '77 "Letters" column, Bob Billson WA2TXY, regarding the 1976 Hudson Division Convention, complained that "he could not afford that type of a hamfest and that it cost $4.00 to get into the flea market." In addition, he felt it chased CBers away. Well, Bob, I've got some news for you — the convention (not hamfest) registration cost was $4.00, which included all forums, exhibits, flea market, and hotel activities. Forums take a lot of time and effort, besides expense, to put together. They are a platform for exchanges of ideas and a place to learn. Anyone can wander around a flea market all day — it's only one part of a convention.

Over a hundred of your fellow hams spent 12 months of spare time and time off to put it all together, not to mention considerable personal expense, and we had to buy our own $4.00 tickets. We don't deserve cute potshots by people who don't take the time to find out what it's all about. The hotel was sold out . . . and over one third of the registrants were CBers who thought more about the hobby than you did. Many of them requested training and license information. If you can find us a site and workers to put on a hamfest for three to four thousand people at no cost, please let me know. By the way, have you ever attended a convention?

As for cheap shots from the Editor regarding nonprofit organizations, you should be interested to know that we donated $1,000 to the ARRL for WARC preparations and $500 to AMSAT. So go the profits. We welcome requests for funds to be used by worthwhile national and division projects. See you in '78.

Henry Wener WB2ALW
East Hills NY

OKALOOSA

The time has come to take my favorite editor to task with respect to the article "CB Can Do Some Things Better" by David Norman in the March, 1977, issue of *73*.

I would like to correct some implications in the "Public Service" section with respect to Hurricane Eloise. First, we hams did not fold our tents and fade into the sunset when the repeater went down. We knew for a long time that our split site repeater on Okaloosa Island was vulnerable to high water. Therefore, our emergency plans did not include a great dependence on WR4ABZ. (As a matter of interest, the repeater was off the air for less than 24 hours.) Our operations shifted immediately to 52 and 94 simplex. Even when the antennas were lost at the Civil Defense Center (primarily due to the wind loading of the large CB antenna on the mast), WB4VJP, the Civil Defense Station, was back on the air in minutes with an emergency antenna.

As far as "the odds of having two units equipped with 2 meter rigs in both those places at that particular time," there was at least one instance during Eloise where a heart attack victim was provided rapid ambulance service because there were 2 meter rigs at both the emergency shelter and the hospital.

In addition to the local communications efforts, local hams handled hundreds of pieces of traffic from all over the country with relation to Hurricane Eloise, a function which cannot be supplied by CBers.

I do not mean to downgrade the effort put forward by the local CBers (which was outstanding), but to dismiss the effort of over 40 local hams with "and then the lights went out all over town" is, to say the least, misleading.

You would have been surprised, and pleased, at the number of hams that showed up with HTs, battery packs, mobiles and home stations with emergency power, and spent many hours in public service during Eloise. Further details on Hurricane Eloise can be found in the February, 1976, issue of (excuse me) *QST*.

Please keep up your usually good editorial work with *73*.

S.M. Allen K4JEM
President
Playground Amateur Radio Club
Fort Walton Beach FL

NUTS!

I haven't had any gripes with your magazine until now.

I am speaking about the article in the March issue, "CB Can Do Some Things Better."

That article should be in a CB magazine. If a person wants to read about CB, just pick up one of the tons of CB mags on the market. I want to read about stories pertaining to ham radio. If you ask me, the article had no place in *73*.

Not taking anything from *73*. It's still a great magazine.

John Kotras WB9UIL
Milwaukee WI

Nuts! We have had several letters like yours concerning the CB contents in 73. I find it hard to believe that hams are still affected by the '60s CB image. Personally, I became a believer this winter when, had it not been for a CB radio, I would have spent several cold hours on the shoulder with a broken fan belt. No, John, we are not becoming a CB magazine, but 73 definitely feels that CB has its place when it comes to public service. I really wonder if you've ever listened lately, John, or is your reaction to the article purely emotional? — Ed.

KEEP ON FIGHTING

I am currently awaiting my Technician license and am interested in 2m FM. I would also like to take this opportunity to congratulate you on an extremely fine magazine. I have recently had 2 letters from the ARRL wanting me to join. Hi hi. Who are they trying to kid? Keep on fighting them and the FCC. Speaking of the FCC, I had passed my Tech exam on November 12, 1976, but still no license. I see no reason for an over 12 week wait for it. They did not even reply to a letter I sent over 3 weeks ago concerning this. All this government nonsense has got to stop, but I see no solution myself.

Finally, I would like to commend International Crystal for their prompt and friendly service in processing a recent order, not to mention your own in sending me the back issues I requested. Also thanks to John King W9KZO for his patience in getting me started in ham radio.

Steve Royer
Greenville IL

500 MILS

Re: "Logical Storage for Logic," March issue.

Enjoyed the article very much, as is typical of your articles. A couple of points/hints:

1. The technique adapts readily to CMOS by the simple expedient of laying a sheet of aluminum foil over the styrofoam. For best results, bond it with glue to keep it from tearing as parts are inserted or removed. This keeps the device pins shorted, preventing static buildup, which is the major problem in CMOS storage. (Always be careful not to touch the pins when handling the devices. An easy way to extract them is to use a plastic alignment tool to pry the parts out.)

2. Conductive foam solves the whole problem. This is what commercial bulk users use (among other things). It is available in reasonable quantities from distributors or bulk IC users, who often throw it out after the parts have been disposed of.

3. Spacing between pin rows is almost always 300, 400, or 600 mils, never the 500 mils stated.

Frank Bates W6IPB
San Jose CA

CUSTOMER SERVICE

This letter is about an unusual company, Godbout Electronics. Last May I bought their 8 Amp 12 volt power supply kit. In October, when I finally got around to putting it together, it drove me crazy trying to figure out why it would only produce 300 mA before shutting down. A letter to Godbout brought suggestions from Kevin Fisher in their service department. More pulled hair and no solution. Another letter and a reply with a new pair of pass transistors and an offer to fix it free. I could not find the problem, so off to the post office with my 300 mA supply. I enclosed a check for return shipping. The supply returned with the check. Thanks, Godbout, for your assistance. Thanks for being a company providing outstanding customer service.

Ross Weber WA0SHA
Killeen TX

PONIES?

By gosh — I've sure heard about the lousy service for some outfit named Trigger, but let me tell you the other end — the business end of the rifle — Bullet Electronics of Dallas sure gives service to their customers. I ordered one of their kits on Feb. 7th, sending a personal check in payment. They received it on Feb. 12th, shipped on Feb. 14th, and I got it on Feb. 18th. How's that for real service?

Now if we could only convince Uncle Sam to stop using ponies — and — well — I can always dream, can't I?

Bob McCormick K4FRX
Columbia SC

A GIFT HORSE?

I have heard a lot of on-the-air criticism about Docket 21033, but those who criticize should ask themselves, am I, or am I not, mature and responsible enough to operate? Yes, there is the possibility of another CB-type bedlam situation developing, but the amateurs I know and associate with are mature enough to handle this relaxation of rules and expansion of privileges. For those who are against Docket 21033, I feel you don't realize that you are looking a gift horse in the mouth and, by rejecting the docket, I feel that you are saying that you are an irresponsible person unable to accept the additional responsibility the FCC is willing to give us. I am willing and able to accept it, are you?

Bill Fulcher W4AST/K4RTA
Hendersonville TN

For the uninitiated, 21033 is the "Repeater Docket" that would, among other things, allow HF repeaters. See Jan. 77 Briefs. — Ed.

HATS OFF

Let me tell you about the "GOOD GUYS." I have been a ham for about 15 years, and have been buying equipment for just as long. In all of this time, I have not found a dealer that I trusted 100%, that is, until Electronic Distributors, in Muskegon, Mich. Some time ago I called them and spoke to Carl. At this point I ordered 2 Kenwood TR-7400As. Right from the start I was told the truth! I was told that the rigs were back ordered, and that I might have to wait 4 to 6

weeks. I sent in a check for a deposit and asked that they ship them C.O.D. Some time later, the active filters came, but no radios. I called; Carl told me that they were shipped 3 weeks before my call. He told me to please give it a few more days and then call back. Well, a few days later the radios came and in good shape. My hat is off to Carl and all the boys at Electronic Distributors. Keep up the good work — they will be getting more (all) of my business!

Keep up the good work!

John M. Bernstein WB2GKT
Midland Park NJ

RECOVERY

I would like to congratulate the members of the Birmingham Amateur Radio Club who participated actively in advertising the fact that some amateur equipment was stolen last December from the Instructional Resources Center of the University of Alabama in Birmingham. This equipment was to be installed in our ham shack. The equipment was a Yaesu FL2000B linear amplifier and two Yaesu digital readout devices, as well as an antenna.

Thanks to the Birmingham Amateur Radio Club, in cooperation with the University of Alabama in Birmingham Radio Club, the equipment was retrieved by the University Police and the culprit will be prosecuted.

Robert M. Ervin WB4VNH
Instructional Resources Librarian
The University of Alabama
Birmingham AL

THE I/O DEBATE

I really like the articles on amateur radio. I will cast my lot with those who say keep the I/O portion to an absolute minimum or else *73* will lose its spot as one great amateur publication. I know there is a lot of interrelated theory, but if you broaden the scope of your magazine too much you will lose the amateur radio buff. Personally, I could care less on what makes a computer tick or how to build or program one. *73* can either be a good amateur publication or a good computer publication — but not both. Somewhere it will cross that dividing line and just fade into a blur of images.

Paul Overdier WBØODK
Westminster CO

BIRDSHOT

I only wish I had subscribed to *73* years earlier! It seems you should start a column devoted entirely to Trigger Electronics, Inc. Up until last month, when I inherited a year's back issues of *73*, I gave Trigger the benefit of the doubt *and* my money. I have suddenly realized that my three or four polite letters to Trigger were like using birdshot on a rhinoceros, and I will have to develop stronger weapons. My thanks to your "Letters" column and WBØPTM (June '76) for the ammunition. Wish me luck. Meanwhile, I have sent for *your* code tapes to begin my long-awaited start in hamming (which has been waiting since May '76 for code tapes from Trigger). I am looking forward to your sensible code approach. Much thanks for an alternative to the ARRL method, which I hear "ain't so hot."

Keep up the good work, and count me in on your side.

Sam Prepelka
Pittsburgh PA

BUILT-IN STATIC

Can anyone top this for a code course on records?

I have a set of five 78 rpm records put out by the "Victor Talking Machine Company in collaboration with the Marconi Institute" in 1918. These recordings are all in the old spark gap mode and progress from the basics to 20 words per minute. Boy, talk about weird-sounding code. The last record has built-in static to teach operators to pick the code out of the QRN. Imagine the task those brasspounders had in those days, picking manmade static out of nature's.

This course was put out to train World War I Signal Corps operators, but the cover says, "commercial students and amateurs may, through these records, become competent operators at home or in camp." So hams had recorded code courses almost 60 years ago.

Elmer W. Hill W8RFB
Wakefield MI

EXTRA CLASS

I had found a note in my 21 wpm code tape that asked for some comments as to the value of the practice tape in preparing for my Extra Class.

I first started out with the 14 wpm and, after copying about 70% of it, I started with the 21 wpm. Both tapes are excellent practice, because when copying tapes of mixed groups, you have no time to think about what is next and it starts to become automatic in a sense.

The FCC has changed the written exam, so you cannot memorize the license manual and pass the test. Some of the questions on my written were right out of the blue.

Cliff Riley K9ZPN
Fort Wayne IN

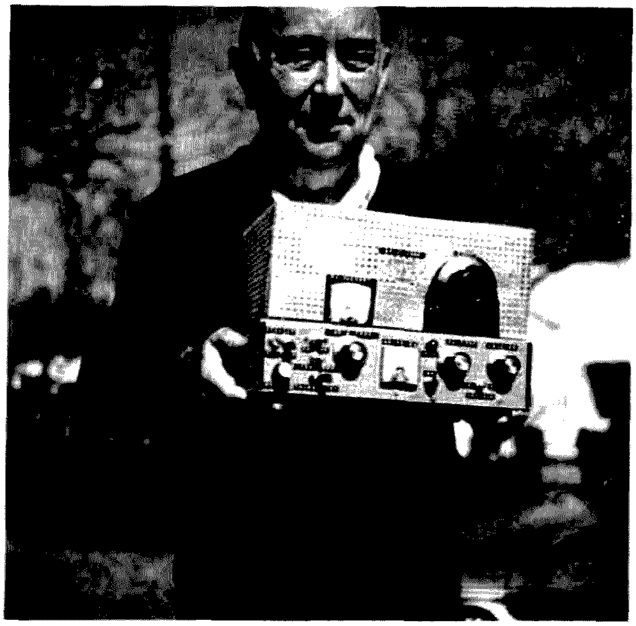
HOME BREW

I built this transmitter from scratch using mostly parts from my old black and white TV set. I have had many QSOs over the years with this little rig and a great many inquiries about it, so perhaps somebody will be interested in seeing it.

The circuit uses a 6AU6 VFO, 6W6 driver/mult. (TV audio output tube), and a pair of 6QD6s in the final (TV horiz. output tubes). And if my measurements are correct, I run a maximum of about 160 Watts input with about 120 Watts out.

John C. Conner
Chattanooga TN

Come to think of it, I haven't seen a good tube article come in for quite awhile — hmm. — Ed.



John Conner holds his home brew transmitter built from his old TV.

GREENBAUM REPLIES

This is in reply to WB6OIM's comments in Letters to the Editor, March, 1977, to my gross oversight by not touching upon the subject of 10m FM in my January, 1977, article, "Ten Meters: Dead Or Alive?"

My article simply explains one facet of enjoyment on 10m, namely Ten-Tenning. I did not intend to imply that any mode was better or more fun than another. This is a personal preference and also subject to considerable controversy.

I also would like to see more use of FM on 10m with a possible gentlemen's agreement to keep it on 29 MHz and above, avoiding the Oscar downlink frequencies, of course.

He mentions the thrill of working your next-door neighbor through a repeater 3000 miles away. Is this really necessary when you can do it simplex with a milliwatt?

Propagation conditions being alike, to work a DX station on FM with full quieting will still take an appreciable increase in power over other modes and can still be worked on SSB with a fraction of that power. Again, this is a personal preference.

To monitor 29.6 for band openings would prove fruitless if no one was on at that time or if the channel was being used by locals. This is why I prefer monitoring 24-hour beacons in different parts of the world to see if an opening has occurred and to where.

I do not intend to degrade FM, as it has proven its worth tenfold on the 2m band. My personal preference, as far as DX is concerned, is still SSB for its efficiency whether it's on 10m or 2m. To each his own.

Ten Meter Beacons

They transmit a carrier with CW identification.

Call	*QTH*	*Frequency (MHz)*
VP9BA	Bermuda	28.165
VE3TEN	Canada	28.175
ZC4RY	Cyprus	28.180
GB3XS	England	28.185
3B8MS	Mauritius	28.190
WA1IOB	Massachusetts	28.150
DLØAR	Germany	29.000
JA1GY	Japan	28.200
XL2HMF	New Zealand	28.170

Martin Greenbaum K2HTO
Bronx NY

SORRY 'BOUT THAT

In your Novice Q and A for March 77, you state that a transmitter can easily be set up for CW operation by plugging an af oscillator into the mike jack, and keying it.

A setup like that will have us Novices producing MCW or A2 operation, definitely a no-no on any Novice band, or any band at all below 50.1 MHz.

Please make the distinction between doing the above on an AM transmitter and an SSB rig (the latter will produce A1 operation).

Thomas Marquardt WB9UHX
Sharpsville IN

Briefs

Compiled by Warren Elly WA1GUD and Stan Miastkowski WA1UMV

Got a good ham radio news story? Drop us a line, or call it in, and take home the 73 publication of your choice, provided we publish your news tip. Be sure to specify which book you want. OK?

The WARC situation is not looking much better. The latest word from our Washington sources relates to the upcoming 5th notice on the frequency allocations tables proposed for the 1979 WARC conference. (A fourth notice will probably not contain any reference to the frequency allocations.) In the 5th notice, due out by late spring, the FCC is expected to drop two large segments of the 75m and 40m amateur bands. The proposed table (which still, of course, must withstand WARC scrutiny in 1979 and domestic debate at the FCC level) calls for *elimination* of amateur allocations between 3.9 and 4.0 MHz and between 7.2 and 7.3 MHz. Both segments would be allocated for international broadcasting. These latest developments would seem to indicate a better chance of amateur allocations at 10, 18, and 24 MHz, although they would probably be shared with other services. Underscoring the FCC proposals is word from the Canadian DOC, whose WARC allocations plan should be public by the time you read this. The DOC plan would also delete 3.9-4.0 MHz, along with 3.8-3.9 MHz, from amateur use. As for 21 MHz, the word at deadline was that there is a good chance of restoring the band to its original status of 21.0-21.450 MHz.

Senator Barry Goldwater K7UGA has again introduced RFI/TVI legislation in Congress. The bill, assigned number S-864, resembles previous RFI bills Senator Goldwater has written, all of which failed due to heavy lobbying by the manufacturers. Goldwater's latest bill would force TV sets and hi-fi equipment to be designed with better front ends and suppression.

Contrary to some conflicting reports in the media, instant upgrade of amateur licenses was effective at all FCC field offices on the first day of March. Initial reports from around the country indicate that offices have been packed to the walls with applicants during the last few weeks. In a *73* interview, Frank Skeiber, examiner at the Boston office, said that since the elimination of the license fee and the start of instant upgrade, Boston and many other field offices have been forced to schedule a separata day for handling the crush of applicants. Although Skeiber declined comment on the percentage of applicants who pass their exam, he did indicate that it seems that many people feel that with the no-fee test, if they don't pass the first time, they can try again.

The on-again, off-again comprehensive code exam plans of the FCC are on again ... this time, FCC spokesmen say, the exams will begin nationally on or before July 1st. But, it is important to emphasize that target dates have been set before, and a call to your district engineer's office *prior* to taking the trip may be in order. The word at deadline was that the code exam tapes had been duplicated, but the latest hang-up was the actual written exams.

As many prospective Novices have discovered, the FCC goofed on one version of the current exams. A circuit diagram Ohm's Law question is impossible to answer in its published form, so Gettysburg has been instructed to give all applicants taking that particular exam credit for the question.

We're still scratching our heads over this CB QSL from Switzerland. It came addressed to "BX 250," Peterborough, but we've been unable to find anybody answering that description. The Swiss op reports BX 250's signals were 58 to 9.

W1AW may be losing its license! That's if an FCC proposal becomes law. It all started with the incredible flood of license applications (CB and amateur) that has swamped Gettysburg since the first of the year. Over a million applications were received in January alone, and amateur applications reached the highest rate in history — well over 21,000 received in a month! A thousand 1x2 callsign applications were coming in per week at press time, and secondary license applications (undoubtedly fueled by the suspension of license fees) were coming in by the hundreds. By late February, FCC staffers were scrambling for a solution, and the results may not be very easy for most amateurs to swallow. The Commission has frozen all new secondary call applications, and proposed a rulemaking which would eliminate club and military club calls, secondary tickets, RACES calls, and special events calls. What's more, the proposal would phase out all existing secondary and club calls upon expiration. (The proposal may well be modified to set up a specific expiration date instead.) In the future, all calls except 1x2s and 2x2s for Extras (yes, 2x2s) will be issued systematically, thus eliminating all other requests for special or reassigned calls. The docket, assigned number 21135, can be commented upon until June 2nd, with reply comments due by June 30th. Needless to say, a strong reaction is expected from the League, as well as from clubs now holding club calls.

Hidetsugu Yagi, the man who did pioneering work on antennas in the early 1920s, died in January in Japan. He was 89. Besides the antenna that bears his name, Yagi did the first work in UHF. In 1926 he had equipment working on 2.5 GHz. Thanks to *Break-In*, the Journal of the New Zealand Association of Radio Transmitters.

Amateur radio played a big part in the Visveswariah Industrial and Technological Museum Science Fair in India this past January. According to the *ARC News Letter*, published in Coimbatore, VU2VTM was on 40 meters for the entire week of the fair, with more than 200 QSOs logged. Leaflets explaining amateur radio were distributed to all visitors, with a lecture transmitted by VU2ARC on the final day of the event. Incidentally, in the January *ARC News Letter*, 30 US stations were listed as being worked/heard by VUs, although only five made the difficult 20m SSB list — KP4AST, WA3TZT, WA4AMJ, WA4KMY, and W4JY.

Smokey reports don't violate the law, ruled a judge in Pontiac, Illinois. A CBer was cited by a state trooper for "obstructing a police officer," after the CBer gave the lawman's position over the air. The Radio Association of Erie PA said that the state is considering an appeal.

In an effort to decrease the amount of HF activity, the FCC is continuing to take legal action against members of the so-called "HF International" group. Late in January, show cause license revocation orders were issued against 21 alleged members of the group. According to a source at the FCC, six of those requested hearings, twelve waived a hearing, and three did not answer and were considered to have waived hearings. As this issue of *73* was going to press, the first of the hearings were taking place in Houston TX and Sacramento CA, before administrative law judge Walter Miller. Also scheduled was a hearing in Los Angeles on the renewal of the amateur license of Jack Randall, the alleged publisher of *SSB News*.

Meanwhile, the enforcement division of the FCC continues to work around the clock to apprehend offenders. Field Operations Bureau Chief Richard Smith told *73* that the 13 fixed monitoring stations have increased their staff and added a number of mobile monitoring vans. Smith added that the main concerns of the FOB at the moment are operators using illegal high power and the TVI that results.

In a related development, an Atlanta GA area CBer was recently sentenced to 90 days in jail on charges of using obscenity on the air. It's the second conviction this year that has resulted in a jail sentence.

The FCC's bandwidth docket (20777) may be delayed, but it's not dead. In early March came the first Report and Order on bandwidth (more are expected to follow), which sets harmonic and spurious emission limits on all amateur transmitters. The specifications call for suppression of at least 40 dB under carrier level for emissions under 30 MHz, and 60 dB for emissions between 30 and 235 MHz. The regulation affects *all* amateur equipment, whether home brew or commercial. FCC spokesmen say they believe most amateur equipment currently in use can pass the specifications, which in essence adopt the ITU standards recognized around the world. Another angle is that FCC engineers believe the new limits are likely to give them another handle on "black box" amplifiers and CB transceivers that are manufactured under the guise of being amateur gear. Keep in mind that this is not a proposal — it becomes law in late April.

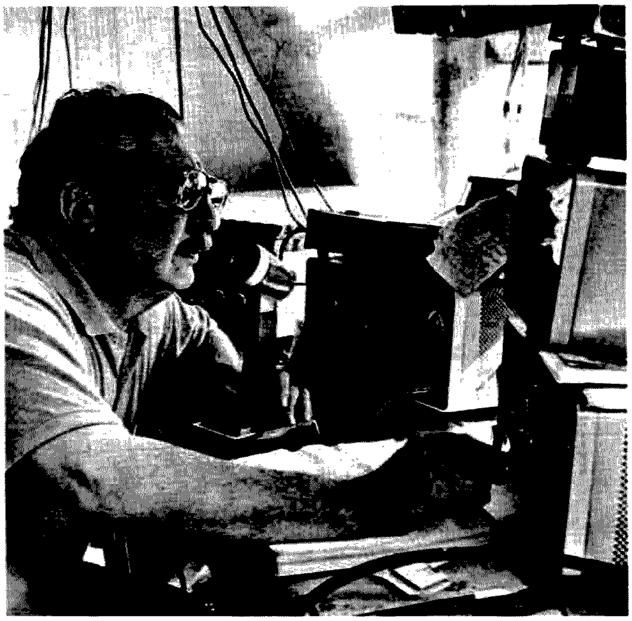
From one end of the country to the other, the interference problem continues to grow. In northern New Jersey, an amateur who saved the crew of a ship in trouble in the Caribbean (see "Be My Guest") continued his fight against a $2000 fine over zoning regulations and towers. In Texas, the state legislature saw introduction of a bill that would put $100 fines on interference convictions, without even considering the equipment being interfered with and the possibility that it could be at fault. Representative Samuel W. Hudson III reportedly introduced the bill after a citizen in

his district got nowhere with a TVI complaint to the Dallas FCC office. After some quick jawboning by the American Radio Council (led by Frederick Maia W5UTT), Representative Hudson agreed to let the bill die in committee. According to a report in the *Atlanta Journal and Constitution*, the National League of Cities is circulating a proposed model ordinance which would limit antennas to no more than 25 feet off the ground or six feet from the rooftop. In Lee, Massachusetts, a CBer was ordered by a district court judge to stop "the annoyance" of stereo interference. He ruled that RFI/TVI represents a disturbance of the peace. The CBer was given thirty days to comply. John Gallo, of the Personal Communications Foundation (PCF), was quoted as saying, "What we are experiencing is a crisis of unprecedented proportions . . . law suits are falling like rain in a hurricane against two-way radio operators." (The PCF has taken the position that interference ordinances are illegal because they are discriminatory and in violation of the 1934 Communications Act.) And in an AP story datelined Washington, Senator Barry Goldwater K7UGA was quoted as saying that he has an inexpensive remedy when neighbors complain about interference: "I just pick up a .00 or .50 resistor and go over and install it for them." We're hoping AP might run a correction, or, as K6QQN put it in a note accompanying the clipping, "Barry, I think you have a great idea, but I would stick with the first value of the two resistors." Thanks for the above items goes to K6QQN, WA4FSK, W5UTT, and WB2NEL.

The pressure on amateurs from the big money groups continues as WARC '79 draws closer. Recent spokesmen for the broadcast industry have noted that their services address millions of people every day, while the total number of amateurs is less than 300,000. Also mentioned was the fact that a comparatively large portion of spectrum space is assigned to amateurs which "could be better utilized elsewhere" . . . like broadcasting. Thanks to the *West Coast DX Bulletin*.

Reports continue to filter in to *73* of the valuable emergency services provided by amateur radio operators during the snow and cold weather that hit the east and midwest early in 1977. The Holland MI Amateur Radio Club reports that area hams manned CD and National Guard emergency shelters throughout the emergency. At several points, overloaded telephones caused 2 meter autopatch facilities to be used.

Alien hams operating in the U.S. under reciprocal agreements must still notify the FCC when operating portable. Although U.S. amateurs need not notify the FCC of portable operations, aliens must still file form 410 with Washington.



Hank Greenberg W2LTP, of Cranford NJ, saving lives and fighting to keep his antennas. Photo courtesy of The Daily Journal, *Elizabeth NJ.*

With all the controversy surrounding strict new tower ordinances and RFI complaints throughout the United States, *Overmodulation*, the newsletter of the Poinsettia Amateur Radio Club in Ventura CA, reminds us that it was the case of Whitehurst vs. Grimes in the United States District Court for the Eastern District of Kentucky in 1926-1929 that *denied* municipalities the right to regulate or restrict amateur operation.

Some postscripts to reports on the 220 MHz CB situation — *Sight and Sound Marketing* quotes Hy-Gain cofounder Andy Andros as supporting 220 CB. "It's a bad situation in that there are five megahertz of band space (at 220 MHz) occupied by only some 250,000 to 300,000 amateurs, and of that number it's estimated that only 150,000 at most, are active . . . on 220 MHz, it's estimated there are fewer than 3,000 amateurs who have had any equipment since the beginning of time." As for the amateur service, the other founder of Hy-Gain, Ted Andros, is quoted as saying that ham radio may have outlived its usefulness as a generator of technological developments through experimentation. Andy Andros (the Hy-Gain president) is quoted by *PerCom* as saying, "It is a national scandal that 2,000 to 3,000 people (hams) can hold on to that space, when 15 million CBers could use that band . . ." Thanks to WB2VUJ, WA2JXE, WB2ZLA, and *CFAR News*, Oak Park IL.

One area of interest to the authorities is the merchandising of "black box" linear amplifiers and amateur gear to CB types. The mailing of these advertisements may be in violation of Federal law. We are looking for any ads mailed to our readers, for the purpose of forwarding to the FCC. Especially of interest are sale sheets (and other paraphernalia) aimed at dealers. Several we've received include 100 to 500 Watt amplifiers, labeled "illegal for use on 11 meters." Think about the mark-ups on these TVI/RFI generators — a 100 Watt "bi-linear" which puts out "an honest 100 Watts," list $179.95, dealer price $92. Or a "Pride DX300 500 Watt Amature Linear" (their spelling), which promises a $200 profit for dealers. The same wholesaler proudly announces availability of a major line of amateur gear, just above his listings for "common mixer crystals" — great for putting that 11m rig up onto the "HF" band (or sliding a ham transceiver down to 11 from 10m)! Thanks to WA1FIH.

Before the FCC released its proposed ban on the sale of linears capable of 10 and 11m operation, the San Antonio Repeater Organization had already filed a counterproposal. The club's docket and legislative committee chairman, Robert Weaton K5PKK, says that abuse of the type acceptance exemption by manufacturers and dealers has made new regulations mandatory. The San Antonio group's petition asks the FCC to restrict the sale of transmitting and rf power gear to licensed persons, establish a dealer licensing program, and provide for mandatory penalties against anyone involved in the unlicensed use of transmitting equipment. As for type acceptance, the San Antonio petition argues against it: ". . . We submit that the inclusion of amateur equipment into the type acceptance program would fail to get to the heart of the problem. Conversely, a total ban on all forms of linear or rf power amplifiers . . . would be shortsighted and prejudicial to many lawful and conscientious users, but would also fail to stop the availability of high-powered transmitters to unlicensed operators. The amateur transceiver offering a power input of two kilowatts PEP, with 11m "receive only" provisions, would simply replace the lower powered versions currently available."

The San Antonio petition concludes that the issue is not the actions of the majority of radio amateurs who would be affected, but instead commercial greed. "We are hopeful that strong regulation of sales will stop the rash of new state and local laws attempting to deal with the radio and television interference problem, most of which . . . usurp the Commission's authority to regulate transmission of radio signals."

Our friends to the north have not gone unaffected by the linear amplifier problem. Shortly after the FCC proposed a ban on the manufacture and sale of commercial amps covering 24-36 MHz, the Canadian DOC released a plan of its own. According to reports in *The Canadian Amateur*, the sale of amplifiers would have to include (within ten days) paperwork addressed to the DOC. Specifically mentioned in the Canadian proposal is the General Radio Service (CB), but the Amateur Service is not mentioned. The proposal calls for $1000 maximum fines and up to a six month jail term. Editorializing on the DOC plan, *The Canadian Amateur* didn't seem very optimistic: ". . . this measure is coming on the scene too late to prevent the present chaos prevailing in the GRS, which sports illegal transmitters, illegal amplifiers, illegal procedures and various and sundry other illegal operations, much to the detriment of those who need the service for legitimate purposes." But the strongest point of the editorial was aimed at the DOC itself. ". . . In our opinion, this amendment will be as useless in cleaning up the situation as the rest of the Radio Act has been — unless the political leadership of the DOC and its top management show some fortitude in enforcing the proposed amendment and the rest of the Radio Act and the Regulations . . ." Along with the linear amplifier proposal, however, the DOC moved against RFI/TVI on the manufacturer's side. The plan would ban the sale of "machinery, apparatus, or equipment that causes interference to radio reception," within yet to be defined (at press time) limits. Yet another section of the Canadian proposal limits the sale of emergency locater transmitters (ELTs) to aircraft and seaworthy vessels. The closing date for comment to the DOC was March 17th, although an extension had not been ruled out at deadline.

A stolen repeater? Yes, unfortunately that's right. WRØALU, the only free-access autopatch repeater in Minneapolis/St. Paul MN, abruptly went off the air on March 2nd. The 16/76 machine, located on the 23rd floor of the Shellard Tower building, had been vandalized. Left behind were

the transmitter and receiver strip, but the autopatch and duplexer had been ripped from the rack. The thieves apparently jimmied a stairway door. Owner KØFHC was expected to have the machine back on the air by the time you read this. Thanks to WBØSCV.

Still more changes in the works at FCC — the Commission has proposed eliminating the 4 month requirement for notification of a change in station location. According to FCC staffers, the idea is to leave notification up to the judgment of the individual amateur — keeping in mind the remaining regulation that FCC mail be able to reach you promptly. Another issue under consideration is elimination of group Novice exam mailings, a procedural matter not requiring a rulemaking. FCC spokesmen say that hams have let them down by failing to send back unused exams, so the result is counterproductive. Instead of cutting the paperwork, as the FCC had hoped, only more paperwork has been created!

With the release of the dockets on linear amplifiers and type acceptance of amateur radio equipment, the FCC also had something to say about ham radio. Chairman Richard Wiley wrote of his reservations, "... While I concur in the Commission's proposals to ban use of linear amplifiers in the 11m citizens radio band, and to require type acceptance of amateur equipment, I must admit to doing so with some reservations ..." Wiley went on to say, "... in attempting to deal with the rapidly proliferating and sometimes troublesome CB service, we may appear to be penalizing the amateur community which, in my judgment, is one of the most professional and self-regulated services within the Commission's jurisdiction ..." And Wiley concluded that, whatever happened to the linear amplifier and type acceptance proposals, he wanted to take the opportunity "... to express my respect and admiration for the amateur community..."

Chairman Wiley also had some comments of interest in testimony before the House Appropriations Committee in Washington. The topic was the FCC's nearly 60 million dollar budget. Wiley, according to wire service reports, testified that the FCC will not attempt to institute a new fee schedule, because of a lack of accounting personnel necessary to meet the federal court order which struck down the original schedule. Documentation filed with the committee showed that the FCC has collected over $150 million in fees since 1970.

There isn't much left of Guglielmo Marconi's giant antenna system erected at the turn of the century on the dunes at South Wellfleet MA. There were originally twenty masts in a 200-foot circle on the sand dunes, but they blew down in a northeaster during November of 1901. Marconi replaced them with four 200-foot wooden towers. Today only two of the tower bases remain, the rest of the famous pioneer's station having been eaten by the erosion of the Atlantic. As reported earlier on these pages, the Town of Barnstable Radio Club will celebrate the 75th anniversary of Marconi's first transatlantic radio transmission. We've learned since that the US Postal Service is working on a commemorative stamp for the event, which runs multi-operator style from the South Wellfleet site between next January 14th and 22nd. The Barnstable Club still needs help with donations, and is offering a commemorative cachet envelope, 10 of which are available for a donation of $1.50, postpaid. Contact Robert J. Doherty W1GDB, RFD 1, 14 Pine St., Sandwich MA 02563.

A second phase III satellite for amateurs may be in the works for 1979. AMSAT president Perry Klein told *73* that NASA approached them early in March with a tentative proposal to allow one of the space shuttle flights to carry an AMSAT satellite. At press time, Klein said it was not a sure thing, but looked good. Asked if AMSAT had the capabilities for building a second phase III spacecraft, Klein replied that the goal of a new fundraising program just underway has been raised to $250,000 over the next three years, with $50,000 hoped for by the end of 1977.

Under the program, contributors can buy solar cells for the new satellites in multiples of $10.00. Each contributor will receive a certificate attesting to the fact. Each of the phase III satellites will carry approximately 2500 solar cells.

Both Oscar 6 and Oscar 7 continue to have their problems. Oscar 6, according to Klein, is "limping along," despite battery problems. Oscar 7 was reported to be jumping modes inexplicably early in March. Klein added that the mode jumping was taken care of by Canadian control station VE3SAT, the first completely microprocessor-controlled command station. It's hoped that all earth stations will eventually go to full computer control. Both phase III satellites will have micros onboard.

An FM repeater system aimed at keeping hunting and fishing parties in reliable radio contact with settlements up to 75 miles away is now being tried out in an Eskimo community in Quebec's arctic region.

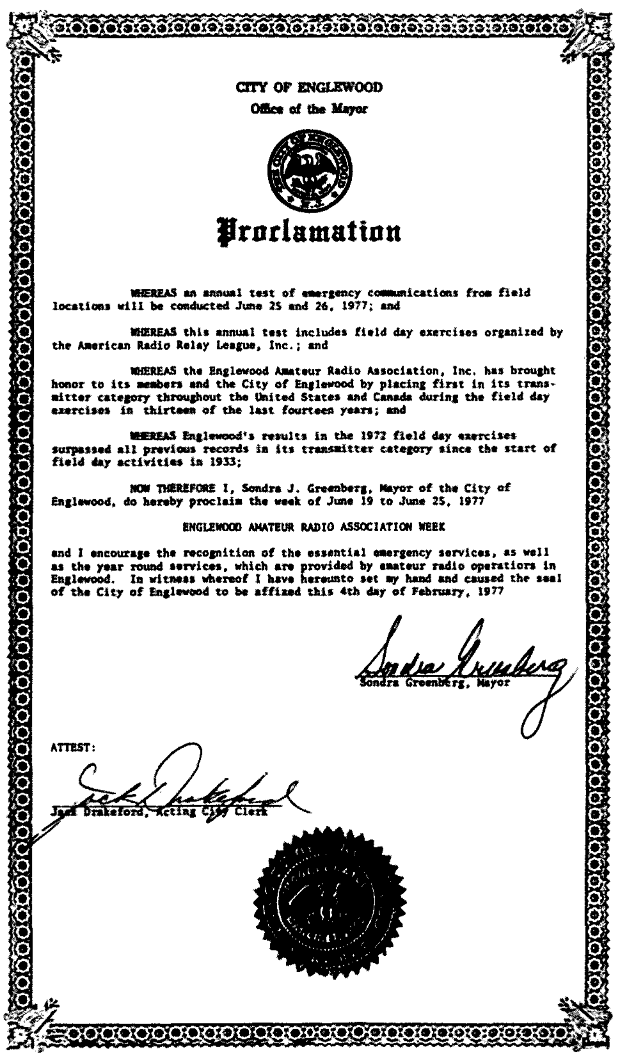
Snowmobile portable rigs will work back to the repeater base station in the settlement of Koartac, about 300 miles north of Fort Chimo.

The original development work, complete with a phone patch, was tried out in the Ottawa area utilizing a 2 meter repeater set up by DOC's Communications Research Center in the hills north of the city. The station, VE2KPG, boasts an autopatch, and with the participation of local amateurs, provided development information for the prototype now being given field trials. The station has now reverted to amateur use. Thanks to the *Canadian Radio Amateur*.

In a trend that seems to be surfacing throughout the country, the theft of two-way radios from cars has been decreasing over the past few months. The Plano TX amateur radio club reports that in the Dallas area the theft rate dropped for the seventh month in a row. In January, 390 radios were ripped off, as compared to an average of 920 per month throughout most of 1976.

Sondra Greenberg, Mayor of Englewood NJ, has declared the week of June 19 to June 25 Englewood Amateur Radio Association Week, in honor of the city's amateur club. She cited the fact that recognition should be given to amateurs for their essential emergency services. The Englewood Amateur Radio Association has placed first in its category during 13 of the last 14 field days. In 1976, they were in a class by themselves (21A), chalking up a total of 10,186 points (with 2845 contacts).

Our English friends, who have been leagues ahead of us for years in the microwave ranges, have adopted a new callsign system for ATV and SSTV. A report in *CQ-TV*, published by the British Amateur Television Club, says that the Home Office has discontinued issuance of /T (television) licenses. Instead, existing amateur sound A and B licenses will be replaced with new ones, which will include both ATV and SSTV authorization.



CITY OF ENGLEWOOD

Office of the Mayor

Proclamation

WHEREAS an annual test of emergency communications from field locations will be conducted June 25 and 26, 1977; and

WHEREAS this annual test includes field day exercises organized by the American Radio Relay League, Inc.; and

WHEREAS the Englewood Amateur Radio Association, Inc. has brought honor to its members and the City of Englewood by placing first in its transmitter category throughout the United States and Canada during the field day exercises in thirteen of the last fourteen years; and

WHEREAS Englewood's results in the 1972 field day exercises surpassed all previous records in its transmitter category since the start of field day activities in 1933;

NOW THEREFORE I, Sondra J. Greenberg, Mayor of the City of Englewood, do hereby proclaim the week of June 19 to June 25, 1977

ENGLEWOOD AMATEUR RADIO ASSOCIATION WEEK

and I encourage the recognition of the essential emergency services, as well as the year round services, which are provided by amateur radio operators in Englewood. In witness whereof I have hereunto set my hand and caused the seal of the City of Englewood to be affixed this 4th day of February, 1977

Sondra Greenberg

Sondra Greenberg, Mayor

ATTEST:

Jack Drakeford, Acting City Clerk

A proclamation from the mayor of Englewood NJ honoring the accomplishments of the Englewood Amateur Radio Association.

Japanese amateurs working on the AMSAT A-O-D mode J transponder prototype. The ARRL will be responsible for all operations aspects of the satellite, which will be designated AMSAT-OSCAR 8 after launch late this year.

Officer Jay Webb of the Plano TX police and Marvin Arnold WB5BWW check out 5/8 wave 2m antenna during simulated emergency test that saw all police communications traffic switched to amateur frequencies.

Here are some details of the AMSAT-ARRL agreement on OSCAR 8, as reported in last month's "Briefs." According to the document signed by representatives of both groups, the ARRL will pay AMSAT $50,000 within two weeks after launch (the delay to allow a period of time to assess performance). ARRL General Manager Dick Baldwin's draft goes on to say, "Once in orbit, it is understood that both the ARRL and AMSAT will consider the spacecraft to be in the public domain without specific ownership." Baldwin's letter to AMSAT goes on to outline the League's intentions: "Our principal interest in this spacecraft is for providing continuing ten meter downlink signals for the OSCAR Education Program, and the performance of the spacecraft will be evaluated with this application in mind." The agreement calls for AMSAT to continue offering technical assistance on a no cost basis during the operational lifetime of the spacecraft. As we reported earlier, the ARRL, in addition to the $50,000 payment to AMSAT, will loan two staffers to work full time (at League expense) in Washington on the A-O-D project.

A word of caution about tubes and transistors using beryllium-oxide ceramics: While normal use is perfectly safe, the fumes and dust are highly toxic and can result in serious injury or death. Almost all ceramic power transistors use BeO, as well as Eimac 4CX250 tubes. Most are not labeled as containing the chemical. Never alter, grind, or clean any ceramic part of the tube that could generate dust or fumes. They should be returned to the manufacturer for disposal. Thanks to VE3AAC.

As mentioned in last month's "Briefs," part of the observance of Armed Forces Day will be the traditional military/amateur communications tests. Crossband operations will be conducted from 1300 UCT on May 21 to 0245 UCT on May 22. Military operators will transmit in their portions of the band and listen on amateur frequencies. The following is a list of frequencies that will be used. The left-hand column is the military frequency in kHz unless otherwise noted. The right-hand column is the appropriate amateur band in MHz.

NPL, (Naval Communications Station, San Diego CA)

14.389 (1500Z-2100Z)	SSTV	14.225-14.250
7.370 (1500Z-2100Z)		7.16-7.19

NMH (Coast Guard Radio Station, Alexandria VA)

14.470	SSTV	14.225-14.250
7.346.5		7.16-7.19

WAR (Army Radio, Washington DC)

4001.5	CW	3.5-3.75
4020	LSB	3.775-4.0
4030	RTTY	3.65-3.775
6997.5	CW	7.0-7.15
14405	CW	14.0-14.2
20994	USB	21.25-21.45

NAM (Naval Communications Station, Norfolk VA)

3385	CW	3.5-3.75
4040	LSB	3.775-4.0
6970	LSB	7.15-7.3
7301	CW	7.0-7.05
14385	USB	14.2-14.35
14400	CW	14.0-14.1

NPG (Naval Communications Station, San Francisco CA)

4001.5	LSB	3.775-4.0
4005	CW	3.5-3.65
4010	CW	3.65-3.75
6989	CW	7.0-7.075
7301.5	LSB	7.15-7.3
7347.5	RTTY	7.0-7.1
7365	CW	7.075-7.150
13922.5	RTTY	14.0-14.15
14356	USB	14.2-14.275
14375	CW	14.0-14.1
14389	USB	14.275-14.35
20983	CW	21.0-21.2
20998.5	USB	21.27-21.4
49.995 MHz	AM/USB/CW	50.0-51.0
143.995 MHz	AM/USB/CW	144.0-146.0
148.40 MHz	FM/RTTY	146-148
148.95 MHz	FM/RTTY	146.0-148.0
222.0 MHz	AM/USB/CW	221.0-222.5

AIR (Air Force Radio, Washington DC)

4025	LSB	3.775-4.0
7305	LSB	7.15-7.3
7315	CW	7.0-7.3
14397	USB	14.2-14.35

The "CW" receiving test will be conducted at 25 words per minute for any person capable of copying International Morse Code. The "CW" broadcast will be a special Armed Forces Day message from the Secretary of Defense to all participants. A ten minute CQ call for tuning purposes will begin at 22/0300 GMT. The Secretary of Defense message will be transmitted precisely at 22/0310 GMT from the following stations on the frequencies listed.

WAR – Army	4030, 6997.5, 14405
NAM – Navy	3385, 7301, 14400
NPG – Navy	4005, 6989, 14375, 49.995 MHz, 143.995 MHz
AIR – Air Force	7315

The RTTY receiving test will be transmitted at 60 words per minute. A ten minute CQ call for tuning purposes will begin at 22/0335 GMT. The special Armed Forces Day message from the Secretary of Defense will be transmitted at 22/0345 GMT. Transmission will be from the following stations on frequencies listed.

WAR – Army	4030, 6697.5, 14405
NPG – Navy	4010, 7347.5, 13922.5, 148.410 MHz
AIR – Air Force	7315

Transcriptions should be submitted "as received." No attempt should be made to correct possible transmission errors.

Time, frequency, and callsign of the station copied, as well as the name, callsign (if any), and address, including zip code of the individual submitting the entry, must be indicated on the page containing the test. Each year a large number of acceptable copies are received with insufficient information, or the necessary information is attached to the transcription and was separated, thereby precluding the issuance of a certificate.

Entries should be postmarked no later than 25 May, 1977, and submitted to the respective service copied.

Stations copying NAM and NPG should send their entries to: Armed Forces Day Test, Chief, Navy-Marine Corps MARS, Building 17, 8th St. & So. Courthouse Rd., Arlington VA 22204.

Stations copying WAR should send their entries to: Armed Forces Day Test, Commander, United States Army, Communications Command, ATTN: CC-OPS-OM, Fort Huachuca AZ 85613.

Stations copying AIR should send their entries to: Armed Forces Day Test, Air Force Communications, Service/DOYF, Richard Gebaur Air Force Base MO 64030.

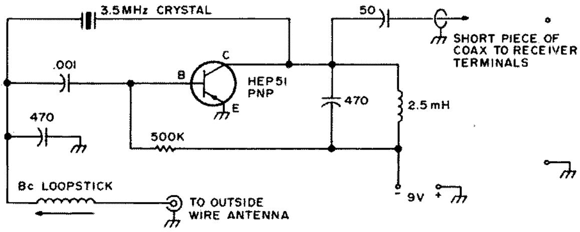
The Plano TX Police Department recently tested an emergency communications system provided by the Plano Amateur Radio Klub and Plano area amateur radio operators. All car-to-car and car-to-base communications were performed on the two meter amateur band. This exercise was a Civil Defense simulated emergency test to familiarize the police department personnel and amateur radio operators with operating techniques that might be utilized in the event of a natural disaster or failure of the police department radio equipment. Plano area amateur radio operators undergo regular training by the National Weather Service and provide weather watchers in the event of severe weather. During severe weather, the amateur radio operators provide a station at the police department, and the National Weather Service has direct contact with the amateurs. Frequently, the National Weather Service requests the amateurs to check storm cells in a particular area that look threatening on the weather radar. Thanks to W5FQA.

A County Circuit Court judge has ordered a temporary injunction against Trigger Electronics. The injunction, which bars any catalog mailings or magazine advertisements, is to be followed with a request for a permanent injunction, according to Assistant Illinois Attorney General John McPhee. Among the witnesses testifying against Trigger owner Irael Treger: an official of the Federal Trade Commission, six amateurs, and an SWL. The rub may come, however, when people who have ordered merchandise from Trigger and not received it, try to collect. The consumer fraud office at the Illinois AG's office

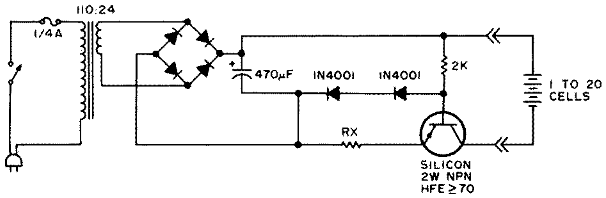
Continued on page 40

Circuits²

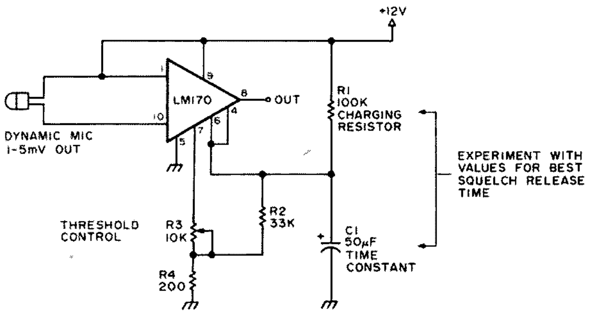
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice. Just be sure to specify which book you want. OK?



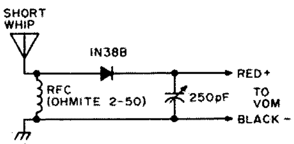
Here's a simple LF converter allowing coverage from 25 kHz up to 500 kHz. Be sure to use short coax from the converter to receiver antenna input. Here's how to use it: Tune receiver to 3.5 MHz, peak for loudest crystal calibrator signal. You are now tuning the 25 kHz range. As you tune your receiver higher in frequency to 3.6 MHz, you're tuning the 100 kHz range. 3.7 MHz puts you at 200 kHz, 3.8 MHz equals 300 kHz, 3.9 MHz yields 400 kHz, and 4.0 MHz gives you 500 kHz. Thanks to James Dates W2QLI.



A great way to keep those nicads at full charge. R_X = 0.6 volts divided by the desired current limit. We suggest 12 Ohms at R_X for 45 mA into 450 mA/hr AA cells. Thanks to Arvid Evans K7HKL.

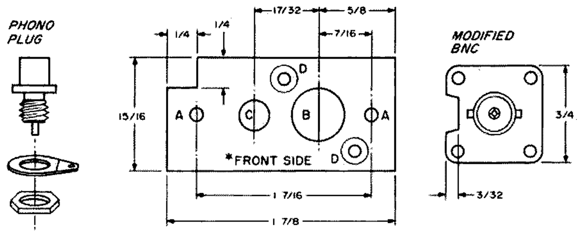


Wondering how to squelch out amplifier fan noise and assorted ham shack racket between sentences? This circuit will do all that, and make for more reliable VOX operation when a compressor is in use. Built as an addition to the IC compressor-expander circuit published in the January '77 73, the audio gate is placed in the early stages of the audio chain. It attenuates the audio path below a preset input level, and functions just like the squelch circuit on your 2m radio. Thanks to John Webber WA7ZMC.



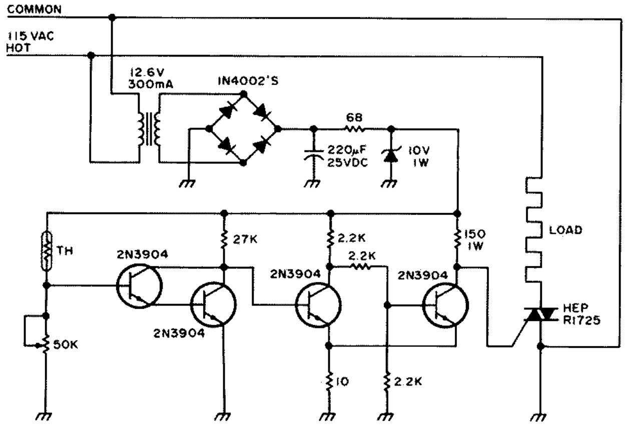
Ever wondered how to make a VOM do double duty as a field strength meter? Well, here's how to do it, with thanks to Dick Peters WA1PWF.

Here is a handy way to get -9 volts for your 1702A EPROMs from your regulated -12 volt power supply. Note: Each diode drops 0.6 volts (5 x 0.6 = 3.0 V). Diode type is 1N4004 (or equivalent). Current limited to 1 Amp through diodes. Thanks to Don Parks K4IJV.

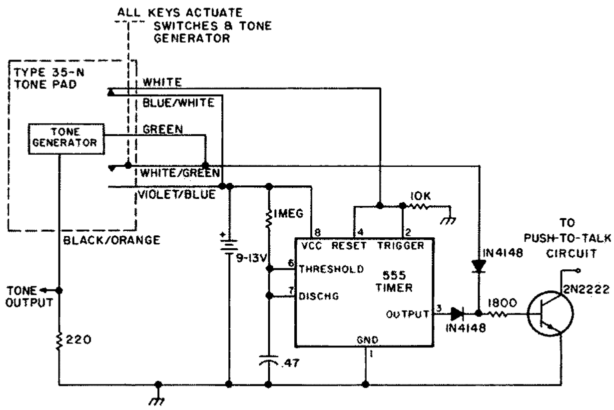


*FACES TO REAR OF RADIO

If you're as fond of phono plug rf connectors as we are, you'll be interested in this mod for the Heath 2036 2m FM transceiver. To replace the phono plug with a BNC, first make the adapter illustrated above using 1/16" aluminum stock. Drill "A" holes with a #33 drill and tap them with 6-32 threads. Drill "B" hole 7/16" and "C" hole 1/4". Drill two "D" holes and countersink for 4-40 flat head screws. Then attach the phono plug to the adapter with the nut and ground lug on the rear side, at hole "C". (Note that it is advisable to use a washer on the front side for clearance at the PC board.) Now attach the modified BNC connector with the notch towards the phono plug nut. The flange is on the back of the adapter. Attach the adapter to the rear panel plate with the notch at the slide switch cutout using two 6-32 screws. It may be necessary to enlarge the oblong hole slightly. Drill a round hole in the antenna connection pad on the power amplifier PC board, just large enough to accept the BNC pin. Now assemble in a manner described in the Heath manual, starting on page 103. (Be careful to pay attention to the tightening and strain warnings.) Thanks to Bill Chedeville W3GOD.



Believe it or not, this circuit was originally designed to control the temperature of water in a slow cooker at the ideal level to make yogurt! The temperature controller uses a model K600A thermistor available from Allied Electronics. The potentiometer value can be changed to allow triggering of the circuit at proper temperature. A polarized power plug should be used for proper circuit operation. Thanks to Jim Arner, Jacksonville FL.



Here is a way to end the autopatch-while-in-motion blues. The circuit operates your rig's push-to-talk whenever any touchtone pad button is pushed, thus ending the need to engage mike before dialing. The circuit remains active for about 2 seconds after the button is released. Thanks to Harry Ketler W1DGD.

BE MY GUEST
visiting views from around the globe

Hank's Dilemma

His name is Alfred "Hank" Greenberg W2LTP. Greenberg is a retired deputy sheriff in Cranford NJ, and he's up to his ears in legal trouble over his antenna farm. Greenberg says he's the victim of political shenanigans, and his antenna fight is bound to affect similar cases in New Jersey, and possibly across the country.

More than 30 years a licensed amateur, Greenberg is considering a mortgage on his house to finance his appeal of a $2000 fine brought by a municipal court judge earlier this year. At issue is the classic question of an amateur's right to erect antennas.

Greenberg's troubles began last September, when a neighbor complained his four 55' telephone poles were an eyesore. That brought down the local building inspector, who promptly filed a complaint charging Greenberg with violating the local building code. Greenberg erected the poles during the summer of 1975, hoping to stack beams on them to supplement his Christmas tree array on a frontyard tower. Four poles were put in, two in his side yard, and two in the rear. Two of the poles aren't even in Cranford, because the Kenilworth town line runs through his property.

The Cranford building inspector told Greenberg the issue wasn't TVI. Instead, the town was wondering why he hadn't applied for a building permit before erecting a structure over 16 feet high. Greenberg contends that no one has ever had to obtain a permit in Cranford for antenna towers before and he points to much higher antenna supports in the commercial district, including the town's own fire station, public works building, and first aid squad headquarters. All are higher than Greenberg's telephone poles, and he contends that the others never even asked for permits. In one case, the town actually sent people over to direct traffic while the tower was being put up. Greenberg then asked the town if it wasn't violating its own ordinances. That approach got nowhere, and Greenberg's lawyer, Elson Kendall W2INL, advised that it was time to go to court.

On December 8th of last year, Hank Greenberg was convicted of violating the Cranford zoning ordinance and fined $2000. What's more, Greenberg was ordered to pay $200 a day for each day the phone poles remained in the air after January 15th. Sixty amateurs turned out for the court case, all prepared to testify on Greenberg's behalf, but Judge Charles J. Stevens would not let them testify, ruling that no further testimony was necessary. Defense witnesses who did get to take the stand included Dr. Jerry Sevick, a physicist and antenna expert with Bell Labs, and Dr. James M. O'Kane, a sociologist at Drew University. Dr. O'Kane testified on the social value of the volunteer services performed by amateurs, and his testimony would, months later, be underscored by an emergency at sea.

The decision was quickly made to appeal Judge Stevens' ruling, and as this issue goes to press, Hank Greenberg says he's determined to win. Greenberg is so committed to his cause that he's planning to mortgage his house, if necessary, to continue the fight. In the interim, Kenilworth town officials moved to bring charges of their own on the poles within their borders.

While he waited for the appeal to come up in county court, Greenberg's case began to attract more and more attention in the local media. Front page stories in the *Elizabeth Journal* and *Daily Journal* soon brought a flood of letters to the editor. Most supported Greenberg. Wrote Irene Kowalski of Elizabeth, "This is a sad state of affairs when a retired man has to mortgage his home in order to defend himself against attacks by officials. People who attended his trial have told me that everything he, his attorney, or witnesses had to say was objected to . . ." Wrote Jim Dembeck of Elizabeth, ". . . It seems to me that the question boils down to this: Is one man's hobby, for fun, justified, when it has an adverse effect upon his immediate neighbors? . . ." And Lorraine Bardack of Roselle Park wrote, ". . . One man who lives behind Mr. Greenberg told him that he could put his antenna on his garage . . . I know of the fine work Mr. Greenberg has done . . ." And so it went, until February 18th — when Hank Greenberg's "unsightly" telephone poles helped save nine lives.

According to Greenberg, it was a pretty normal Friday night at W2LTP. "It was about 4:30 am and I was working KH6FC on 40m SSB," Hank told *73* in an interview. "All of a sudden I heard this super-weak signal on frequency calling 'break — Mayday, Mayday — this is W3' . . . but I couldn't get the rest." Several tries later, Greenberg had copied W3LBU maritime mobile, but getting the rest of the frantic call wasn't easy. Minutes passed and the pieces began to fit together — it was a distress call from a

RETRACTION

It was stated in the newspages last month that Robert Booth W3PS not only is the General Counsel of the American Radio Relay League (ARRL), a nationwide organization of amateur radio operators, but also represents the National Association of Broadcasters (NAB) and, therefore, does not and cannot adequately represent the ARRL. That statement was incorrect. Although Mr. Booth and his law firm, Booth and Freret, do represent AM, FM, and TV broadcast stations before the FCC, we know of no instance in which such representation has limited or conflicted with his representation of the ARRL and amateur radio before the FCC, Congress, or elsewhere. We offer our apologies.

The QTH of Hank Greenberg W2LTP. His property happens to lie in two towns, both of which are trying to force him to remove the telephone poles.

vessel somewhere in the Caribbean. The bilges were flooded, and the ship's pumps were not working. W2LTP, with the help of those "unsightly" antennas, kept W3LBU transmitting and called the Coast Guard in New York. They called New Orleans and Galveston and the FCC. Direction-finding put the troubled craft (named the *Explorer*) between Cuba and Jamaica. Five hours later, a Coast Guard plane out of St. Petersburg FL dropped portable pumps to the *Explorer*, and the twin-masted 180-foot sailing vessel and her crew of 9 were saved.

Hank Greenberg speaks of the rescue matter-of-factly. He's got other things on his mind these days . . . like how he's going to pay the $5000 worth of legal expenses his lawyer estimates the case will end up costing. The appeals process was just getting underway as we went to press, and Greenberg says he's confident of a reversal. We'll follow up on W2LTP's ordeal later, but in the meanwhile, there is a contributions drive underway to help out with the legal bills. Send them to Amateur Radio Legal Defense Fund for the Benefit of Hank Greenberg W2LTP (ARLDF/W2LTP), Midlantic National Bank/Raritan Valley, PO Box 996, Edison NJ 08817, Attention — Mr. S. J. Lieberman WA2FXB.

Greenberg's attorney told *73* at deadline that as the appeal case opened in Union County Court, the judge overruled the lower court, ordering subpoenas re-issued for defense witnesses. (Municipal Judge Stevens had denied them on a technicality at the lower court level.) In the view of Greenberg's lawyer, that means Hank will finally get his chance to present his defense. Among the records Attorney Kendall has subpoenaed: the Cranford building inspector's files on permits.

Warren Elly WA1GUD
Assistant Editor

see page 189

Over a Barrel

Summer vacation time is almost upon us again, and it's probably a good idea to start planning that annual trek. In that same vein, we present one ham's letter home during last summer's vacation . . . a letter delayed, undoubtedly, by the Pony Express. — Ed.

Dear Mort:

Harriet and I made it OK. The trip was nearly perfect. The car ran fine all the way to Paris, but I had a little trouble there. It all started when I noticed we had stopped, and I had done nothing to stop us. Oh, don't be too worried, because we didn't stop fast. We just sort of coasted. I was talking to a fella near there on the rig, and next thing you know, the whole car was screaming at me to do something. Homer jumped into the front seat sort of suddenly, and sat on my Atlas. I couldn't see where I was. I was lost. For all I know I could have been on 80 meters and all of a sudden causing QRM or something. I hit him with my logbook. It was a good hit, it was, right on his wet nose. I think I scared him, 'cause in all the confusion Homer ran away. Harriet started crying, and the kids kept screaming something about my antenna . . . and their model airplane . . . they wanted us to go fast again so their plane would fly some more. I tell you, Mort, I almost lost it right there by the Walkers' mailbox.

Well, Mort . . . I see we've been a little deregulated again by Washington. Boy, when I heard about it I was furious . . . really mad! Just think! I shouted to myself, no more comedy when I forget what call area I'm in, no more DX on the 2 meter rig until you ask the guy where he is . . . no more . . . and then it hit me!

Ya know, Mort . . . the FCC doesn't *make* us call CQ . . . we just sort of do it. Fact is, the FCC doesn't make us hams do a lot of the things we do. We do them 'cause they're fun. Like RST and QTH. We don't have to do that; if someone really wants to know where we are, they could look us up . . . but all the hams do those things 'cause they're part of the fun we have on the ham. Radio, I mean, ya know?

I gotta admit, it took me a time or two to make sense out of all this, but I think I'm doin' it. The FCC sort of trusts us, in one sense . . . probably cause they're over a barrel over not having enough people or money or something like that . . . why, when a government agency suddenly gets real popular, all that red tape, budget approvals, and the like could take years.

Think of the tons of paperwork this whole thing is gonna save 'em. Maybe they'll take some of the money they save, and send someone after that terrible noise I've been hearing all over 40 meters.

Seems like there's something in Part 97 about improving amateur radio (oops, I missed that one, didn't I Mort?) . . . something in there anyway about improving amateur radio thru rules that make us sharpen our skills, and advance the communications thing. Maybe that goes for relaxing rules, too.

More I think about it . . . more I think I'm gonna make "mobile," "portable," 5, 6, 7, KL7, or lost . . . a part of my every transmission . . . just like always, and show them that we don't need all that paperwork to make good hams out of us.

Whaddya think, Mort? . . . think it's a good idea?

73,
Woody

P.S. The family don't like Mauve, Tex., too much. We're gonna keep going.

Reprinted from the bulletin of the Plano Amateur Radio Klub, Plano TX.

The CB Debate

With WARC, repeater deregulation, instant upgrade, linear amplifier bans, and type acceptance of amateur equipment all bottling up our perspective on where ham radio is going, it might be time to think again about CB. Here's one man's perspective . . . but the editorial door is wide open for more. What's your reaction to WB4APC's ideas? — Ed.

All too often, we refer to the CBer as an undesirable amongst us. Many an old-timer, myself included, can remember when it was unthinkable to be seen talking to a CBer. For many years, both the ham and the CB operator have gone their separate ways, each enjoying his own hobby. Whether we like it or not, CB radio is here to stay, and it is time to take a look at what each has to offer the other. Most of us are familiar with the advancements being made in communications. True, hams have made the most contributions to the state of the art, but we also are able to find a wide variety of people using Citizens Band radio.

Many a CB operator has an interest in amateur radio but does not have the opportunity to really get to know and see what amateur radio is all about. For example, I live in a small town close to a large military installation. I have had amateur call plates on my car for four years now, and have yet to meet more than two other hams in my area. Having recently started a small business, I found the need for a two-way radio that would enable me to keep in contact with my office and also allow my customers to contact me with their questions or problems. I bought a CB radio and applied for and got my FCC license.

Then I started to meet and get to know the average CB operator. Through my day by day association with them, I found that the majority of them are very sincere in their use of the radio. I also learned of the real dedication of the CBers in wanting to help others, no matter how small or large the need.

In the area where I live, CBers have set up 24-hour coffee breaks along major interstate highways. They offer free coffee and donuts, and a chance to stop and rest on a long drive. They also have mobile units patrolling the interstates, working with CB radio-equipped State Police cars and wreckers, to offer assistance to stranded motorists. Their action puts many a stalled car back on the road home, or gets them out of the traffic lane, thereby removing a possible traffic hazard. During last Memorial day alone, there was not one accident on the interstate between Louisville and Bowling Green, Kentucky.

In addition to the coffee breaks, during the tornado of 1974 in Brandenburg, Kentucky, CB operators were working around the clock to assist the local police and fire departments, and even used their personal cars for ambulances. At the end of the three day disaster, we knew exactly how many people were lost or missing.

How wonderful it would be if we could get amateurs and CBers working as a team, to coordinate the emergency operations and eliminate dupli-

cation of effort. With CB units furnishing the "eyes" and helping to perform traffic control and person counts, and the amateur-CB station acting as a sort of control-coordinator station, we would have an unbelievable system of radio communications. Imagine the capabilities of the well-equipped ham station, with CW/SSB and RTTY capabilities. Almost any type of emergency assistance could be well on its way in a matter of minutes. In addition, the amateur station, with phone patch capabilities, could contact Red Cross officials, the governor, and other officials directly. In this manner, help could be sent when and where it is needed the most.

With the use of SSTV, facsimile, and video tape systems, actual pictures could be transmitted to the proper officials, showing them conditions as they really exist. Can you imagine the effect of such a system, not only within your own state, but on a nationwide basis? Who knows what may develop? With the ARRL (ugh) talking about a Communicator license, and the FCC looking for more CB frequencies, maybe someday a common frequency will be allocated where hams and CBers may talk to each other. The potential is unlimited, and in this modern age of computers, even a list of standby emergency stations and their capabilities could be maintained. In addition, a list of emergency supplies, alternate emergency routes, and up-to-date status reports would be only a button away. Let us remember, that as amateurs, there are many avenues of research and system development still open to those that are unafraid to try. We can make it work!

Billy L. Nielsen WB4APC
Radcliff KY

Knighthood

Amateur radio operator David Urfer EL5B/WA7ROJ had the honorary title of Knight Official in the Humane Order of African Redemption bestowed upon him for his role in aiding the Liberian government in bringing the 1972 Lassa fever epidemic under control. The presentation was made by the Liberian Minister of Health and Welfare, on behalf of President Tolbert of Liberia.

Dave received the knighthood because he had stayed at his amateur radio station for over 86 consecutive hours, coordinating communications between the health authorities in Zorzor and Monrovia, Liberia, and the United States. He had been a ham for less than one year, and was a maintenance supervisor for a Lutheran hospital located in Zorzor (a remote section of Liberia).

Lassa fever is named after the town in Nigeria where the first case was isolated. It is highly contagious, like cholera, and the dead are buried hurriedly.

All traffic on 20 meters, during the crisis, was coordinated between Dave EL5B, Eloise Duncan EL2AQ, Walcott Benjamin EL2BA, Bruce Adams EL2CG, Dr. Gadegbeku of the Zorzor hospital staff, and Charlie Wells, Jr. K4SKI, located in the U.S.

The date that called these ham radio operators into action was April 12, 1972 – Easter. Dave was on the African net on 14.292 MHz around 2130 GMT, with Walcott and the other hams living in that part of the region. During the casual round table, Dave mentioned that there was an outbreak of some sort going on in Zorzor, and that the doctors, Paul Merten and Joe Baum, were not sure of what it was.

A letter had been mailed, but the radio proved to be timesaving when EL2BA made a phone call to the Minister of Health and Welfare to notify her of what was happening.

After the authorities were notified, doctors and specialists were brought in from the capital of Liberia, Monrovia.

Charlie K4SKI had maintained an on-the-air relationship with those involved with the emergency, and he broke in to see if he could help. Dave mentioned that he and other members of the hospital unit wanted to let their friends and relatives in the United States know what was happening. Dave then started running phone patches through Charlie, who was located in Greenville, North Carolina.

K4SKI's log showed the following chronology of the traffic he ran for the hams in Liberia for the next 5 days:

April 2, at 2150 GMT, I ran 3 phone patches over 20 meters to relations in the U.S. to let them know what was happening in Zorzor. April 4, EL2CI, Doc (Dr. Gadegbeku) and EL2CG (Bruce) were on 20 meters talking about the epidemic. On April 5, Bruce had me run patches to the Communicable Disease Center in Atlanta, Georgia. These patches were run between doctors in Zorzor and doctors at the Atlanta center. They lasted 2½ hours. The next day, similar patches were run between the doctors in both countries. I was told that the Communicable Disease Center in Atlanta had a ham station (WB4GFE) and that they would try to have it on the air on 15 meters for us the next day. April 7, I looked for WB4GFE on 15 meters at 1710 GMT, and barely could make them out. KP4DLW joined in to help with a relay between us. Realizing that it was a cumbersome situation, I told the disease center that we would run patches with them via 20 meters.

The Lassa fever episode struck nine people in Zorzor and killed four of them. Of the survivors, two became deaf.

One of those who died was an American nurse, Miss Esther Bacon of Hawarden, Iowa. She had given 30 years and her life for humanity.

Dave Urfer became a knight not solely because of his own action, but because of the responses of several amateur radio operators who spanned two continents.

Lawrence I. Cotariu WA9MZS
Skokie IL

Mrs. Mai Padmore, Liberian Minister of Health and Welfare, decorates David Urfer EL5B during ceremonies in Monrovia, Liberia.

Join 'em!

More times than I'd care to count, amateur friends have remarked to me, "Your husband is so lucky to have you share an interest in our hobby," or, "I wish my wife could meet you so that you could tell her about ham radio and get her interested," or "How can I get my wife interested in ham radio – how did you get into it?" So, I thought I'd make an attempt to answer these questions in a way that can be helpful to those wives whose husbands would like their company!

Ham radio is a relaxing hobby to most people. Your man comes home and settles down in front of his radio and unwinds in a variety of ways – by telling somebody about the frustrations of the day, how lousy the Massachusetts drivers are, how bad the traffic was, etc. Or he finds some excitement in chasing some rather rare station halfway across the world, while his wife is wrestling with the pots and pans upstairs. At any rate, for numerous reasons, he enjoys the hobby. Perhaps he enjoys it so much that you find it difficult to tear him away long enough to get his attention. Aha! When various diversions fail to work, you can always adhere to the old adage, "If you can't lick 'em, join 'em."

All kidding aside, if you think about it, our life-styles seem to separate families a lot more than they should for the health of the family. Everybody is so busy doing his own thing that we lose sight of the most important aspect of life – our re-

lationships with those we love. In my view, anything that a woman can do to increase the amount of time shared with her husband is bound to improve their relationship. This doesn't have to be a great deal of time, but the knowledge that you care enough to make the effort can mean a lot. Nobody expects you to be an expert on subjects electronic. I pretend to no one that I am interested in the technical side of the hobby, though I've absorbed enough to have a very basic understanding.

Is it hard to pass the licensing exam? If you managed to learn to drive, you can do the same with ham radio. However, it *is* easier if you attend a class with competent instructors, rather than trying to muddle through the license manual on your own. Learning the code is simply a matter of concentration and determination. It doesn't take any great genius.

Besides improving family solidarity, I've made an awful lot of friends and met many people that I would never have met without ham radio. And ham radio is probably the most democratic hobby I know of. You are judged by the signal you put on the air and by your manners, not by how much money you have or have spent on equipment, not by your job or by your education. After listening to several hundred people going back and forth to work on a daily basis, it crosses most people's minds (or I hope it does) that they are just like you in the place where it counts, with all the externals that we like to put up around ourselves stripped away by the limitations of the airwaves.

My children have become involved in the hobby because they see the enjoyment their parents get from it. We have all come to depend on 2 meter FM as an adjunct to the phone and other modes of communications in keeping us in touch with each other and as an aid in times of emergency. Having a ham radio license has very practical advantages, as I have discovered on several occasions when my car broke down. I had help each time within minutes, and this is very comforting when you are at the mercy of an unpredictable machine.

For whatever reason you find most appealing, amateur radio is a hobby well worth the effort to become a part of, and which you can pick up at any time and *enjoy*.

Cindy Rudin WA1MZO
Lexington MA

Reprinted from The Minuteman, *Newsletter of the Minuteman Repeater Association, Lexington MA.*

Applying ATV

The technology to economically apply interactive television to educational purposes is here. It is based on the techniques being utilized in amateur television — ATV for short. Amateur television is an upgraded offshoot of ham radio, using a television transmitter, a TV camera, and a regular TV set with a special converter attachment. It allows an operator to broadcast a television picture and voice to another ATV operator. Through the use of a repeater on UHF frequency, it is possible for schools and other educational institutions to apply this technology — within a 15 to 150 mile radius — for educational purposes. The potentials are endless, ranging from use in traditional classroom activity to continuing and extension education. It can be used for homebound instruction, for seminars among experts at different universities in New York and as far away as Philadelphia, for a variety of community services (including linking a classroom with other segments of the community), and to provide educational services when severe weather and fuel shortages force school closings.

In order to insure that in the public interest certain frequencies within the UHF channels be allotted specifically to educational purposes, the City University of New York Graduate School, through its Center for Advanced Study in Education, and the nonprofit Communicasting Association of America, has filed a petition (1/21/77) with the Federal Communications Commission for the establishment of a new educational radio service, to be known as "communicasting" — i.e., the use of co-channel multi-lateral communication to educate and enlighten the participants as well as a listening/viewing audience. The use of radio repeaters, whose value has been proven in the land mobile and amateur radio services, is cited as the most cost-effective way to blanket an urban, suburban, or rural area with audio and television signals. Spectrum space is being requested in the 470 and 930 MHz range with preference being given to the use of television channels 70 through 83 (806-890 MHz).

The Graduate School's Center for Advanced Study in Education, through its Institute for Research and Development in Occupational Education (IRDOE), is currently engaged in pilot research and development activities surrounding curriculum development and delivery systems, evaluation of protocol approaches as they would apply to airborne transmission, protocols for interaction in multiple-station situations, and assessment of delivery ranges over various terrains and distances via both direct and repeater transmissions. It is anticipated that this research will have a direct bearing upon initial efforts to demonstrate airborne delivery systems for educational purposes in New York State.

Dr. Lee Cohen, Director of IRDOE, believes that the utilization of new technology is imperative if education is to remain viable in the current and future economic and social climate. "In addition to the ability to deliver education in a more cost-effective manner, we have the potential to serve additional populations not heretofore served and to provide lifelong learning opportunities to those who cannot avail themselves of the traditional classroom learning opportunities. We are on the cutting edge of something we cannot totally envision as yet, since application of the technology is only limited by educators' imagination and inventiveness." Interactive television, he quickly adds, "is not the one-way broadcast TV we've come to know, which limits learning to the lecture mode. Given the same considerations as have been provided to the Citizens Radio Service, for example, educational agencies properly licensed could experiment with the delivery of quality education, health, and social information, and enable viewers to question, challenge, and even present their accomplishments for grading purposes over the airwaves. For the FCC to deny education on these frequencies and, at the same time, expand non-essential mobile and fixed station operations, is to reject the populace in favor of the few."

City University of NY
New York NY

The Key

In the world of business and industry, there's an adage which states that when your boss asks you to give up your key to the executive men's room, you're in deep trouble.

Looking closely at the recent decisions by the FCC affecting the amateur radio service, I can't help but wonder if we hams aren't being asked to turn over our keys. And, if so, just how much trouble are we in?

It's called "deregulation," and over the past few years it has meant the elimination of log books, the closing of many official monitoring stations, the abolition of the requirement to identify portable and mobile operations, and so forth. To be certain, they are all seemingly small things, but hidden among them may lurk a more sinister meaning.

On the surface at least, the FCC has said that since we're doing such a great job of policing and regulating ourselves, there's no need for government to become involved. This is great; I'm for less government. But in light of the bucket of worms in which the FCC finds itself as a result of the snowballing CB service, I can't help but be a little skeptical about the FCC's rationale.

Over the years, the history of amateur radio has been one of compliance with regulations and courtesy in operation. They have become our hallmarks. In short, we have been a most disciplined group. Discipline can be effected in one of two ways: First, we do something because we know an enforcer is looking over our shoulders. Or second, we act for the common good. The latter is certainly the ideal situation, but, alas, it is also the more utopian of the two. Thus we're left with the first type of motivation.

In the 1920s, the early days of radio, chaos reigned supreme. A regulatory agency was desired and necessary. It was created, and with supervision, guidance, and enforcement came order — law and order, if you will, as opposed to the law of the jungle. We learned that according to a regulation, something had to be done in a certain manner, and then we came to appreciate the need for doing it just that way in the first place. One notion complemented the other. And most of us grew up in amateur radio with this concept. Take away the concept and the prospects are frightening.

Amateur radio is growing. It is not growing perhaps quite as rapidly or as extensively as some may envision, but it is growing nevertheless. If new members join our group who have never been exposed to the tight discipline under which we've operated all these years, how will they behave? How can they be expected to behave? They will probably act in much the

same fashion as the spoiled child who wants something done his way at the particular time he wants it, knowing full well that the threat of a spanking doesn't exist because there is no one there to administer the punishment.

Personally, I have always felt that there should only be just enough federal government to insure that the things which have to be done in a democracy get done. The FCC's abdication of its role in the amateur service can, over the long run, pose a very real threat to the existence of amateur radio itself. Consider another adage: "Out of sight, out of mind." I doubt whether we as a group are sufficiently strong enough to (a) police ourselves entirely, (b) look out for our interests in international frequency allocation conferences, and (c) protect ourselves against the interests of powerful electronics manufacturers' lobbies when they threaten us.

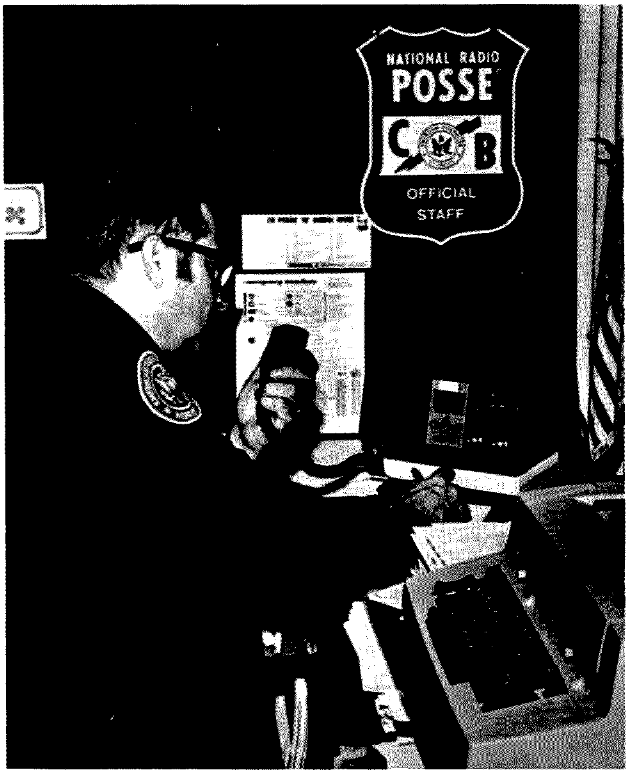
In short, we still need the FCC. If deregulation is coming about because amateur radio has in fact matured to the point where strict supervision and guidance are no longer necessary, then it should be continued on a slow basis and explained very thoroughly. On the other hand, if deregulation is only an excuse for the FCC's inability to govern all the radio services within its purview, then we are in deep trouble indeed.

Hopefully, in future decisions affecting the amateur service, the FCC will act judiciously and cautiously, and certainly not give the appearance of the boss coming into your office and asking for your key.

Daniel T. Davis W8LUX
South Bend IN

The Posse

There has been much discussion on these pages in recent months about the "HFers" and the consequences of the RFI/TVI problem. (See "The Ban Moves Closer" and "C'mone Texas Salt Rat . . ." in April and March 73, respectively.) There is, like any other issue, another side to the story. So, in the same vein as "CB Can Do Some Things Better" in our March issue, here is more testimony to the usefulness of Citizens Band. — Ed.



Capt. Gerald S. Arenberg, CB Posse Training Officer, is shown at the monitor at the National Headquarters.

With some twenty million Citizens Band radios, the "eyes and ears" of local police are driving criminals off the streets and into jail. Drunk drivers are being spotted and reckless drivers are being reported to "Smokey the Bear" by the Citizens Band operators. Why? The answer, claims Chief of Police Robert Ferguson, president of the National CB Radio Posse, is very simple. "We monitor emergency channel 9 like many police, sheriffs, and state patrols. People are tired of the drunks that are running up auto insurance bills, the reckless driver who may kill or maim your friends or mine. 'Smokey' is now as close as your CB radio and you can get help quickly. With CB you don't get involved. You report what you see and the police act on your information."

The National CB Radio Posse was the brainchild of Chief Ferguson, whose department is located at a major crossroad near Akron, Ohio, in Bath Township. "There are not enough police to cover every street and highway. So a lot of good people feel it's time they made the streets safe again. They are reporting crimes as they happen. We are able to send aid to motorists quickly because of reports by CB radio to our station. Lives are being saved. Criminals are being caught and jailed, all because a man or woman picks up the 'mike' and calls on the emergency channel (9). The CB Posse got started because some CBers wanted to do a bit more by organizing into community radio patrols. We encouraged this because we and thousands of other police and sheriff's departments can use trained eyes and ears.

"In our case, we designed an emblem to wear, a metal shield, car tag, and asked for volunteers throughout the nation to carry first aid kits, flares, warning flags, a flashlight, and other equipment. These are items that everyone should carry as a safety rule, anyway. The CB Posse member is not a police officer. His or her role is to use the radio, patrol, and aid a motorist or request aid be sent. In one southern city, 1900 calls were logged in one month, resulting in the arrest of a rapist, a burglar, a number of armed robbers, a murderer, and many rescue missions to distressed motorists.

"Like the Marines, the National CB Radio Posse is looking for a few good men and women who want to help via radio as unpaid eyes and ears for their own community police. Our program is a national one. We have chapters springing up in many parts of the nation. We have chartered the National CB Posse as a nonprofit fraternal organization with modest dues for benefits and services provided members — everything from a special ID card and emblem to a death benefit if a member is killed while assisting any police officer or fire fighter."

American Federation of Police
N. Miami FL

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud *in exchange for a spot on your ham or computer club newsletter mailing list. Deal?*

Hamming/G5

If you want to "ham it up" in England when visiting, "plan ahead" to take advantage of the reciprocal licensing procedure available. Remember, there is nothing to listen to on what we most popularly use: 146 MHz. It takes a little time to get it (license), so start early and surely allow more than a month. Airmail your request to: Home Office, Radio Regulatory Department, Radio Regulatory Division, Licensing Branch (Amateur and Special), Waterloo Bridge House, Waterloo Road, London, SW1 8UA, England.

There are eight different classes of licenses available. Four are for fixed stations, four are for mobile stations.

Most commonly, a reciprocal license is granted for six months. After expiration, the callsign is reserved for your use for any UK license granted you in the future. Some of the regs are quite different — no other person may speak over your rig, no third party traffic, no code speed over 20 wpm—and no equipment capable of transmitting on CB frequencies (similar to ours) can be taken into the country without advance permission.

As noted before, frequency allocation is different — their two meter band is from 144 to 146, with 11 specific frequencies between 144 and 145 that *must* be avoided. 150 Watts is the maximum input power. FM is between 145 and 146.

A copy of your license must be enclosed with your application for the British license; don't send any money until you are advised of your application being accepted — at that time they'll tell you what to send. In December, 1976, the fee for a fixed station license was about $10; for a mobile station license it was $5. You can buy British currency at a large bank and send it, saving the cost of international money orders ($3 or more).

Continued on page 78

New Products

THE HEATH HW-101 TRANSCEIVER

With all the growth we've been seeing in the amateur ranks, we thought it might be time to look over some of the less expensive ways to get on the air. Outside of home brewing a transmitter from a battered old TV set and using a bargain basement receiver (as many of us did years ago), we thought we'd examine some middle ground – the kit transceiver. The choices are pretty narrow, especially when economy is the major concern, so here's what the editors have come up with – the Heath HW-101. As our reviewer points out, the HW-101 has been around long enough, and enough hams have been using it satisfactorily, to put the Heath well up the ladder on anybody's list of choices. Having used HW-101s of various vintages in situations from field day to emergency operations, we can testify to the transceiver's reliability and simplicity. – Ed.

The HW-101 is by far the best buy for the ham who wants a five band SSB and CW transceiver. With 180 Watts input and 125 Watts output on 75 and 40 meters, and 90 Watts out on the higher frequencies, the Heath is perfect for the seasoned amateur or a Novice or Technician with hopes of upgrading to a higher class license. I decided on the HW-101, after a long absence from "the low bands," because of economy (list price is $339.00 plus ac supply) and reliability. There are thousands of these rigs operating all over the world.

From date of order, it only took 10 days for the kit to arrive. I was pleasantly surprised to see my new Heath come in such a compact carton. Those Heath engineers must spend countless hours planning every last detail. Heathkits (for those of you who have never built one) use an ingenious system of subpacks. Gone are the days of a kit being just instructions and a carton full of miscellaneous parts. (The HW-101 had 10 subpacks.) During the process of building the kit, a subpack is called for as it is needed. I'll bet this has saved many a call to Benton Harbor from frantic kit builders who have almost completed their projects only to find a diode or transistor has been sucked up by the XYL's vacuum cleaner or eaten by the family Labrador retriever. Essentially, what this system does is provide only the parts necessary for the phase of construction on the bench at the time. No sorting through muffin pans full of parts.

After opening the carton (and looking at the empty Heath green cabinet and dreaming of DX on 20m), I saw that the hams at Heath had sent me a little note explaining that they had received a bad batch of 6HS6 tubes. They enclosed 6AU6s as substitutes, and all I had to do was fill in my name and address on a postcard they enclosed, so the proper tubes could be shipped as soon as Heath received them from the manufacturer. The tubes had not arrived as of this writing, but the 6AU6s work just great, with just slightly reduced receiver sensitivity.

The 200+ page manual is well illustrated and easy to follow. It includes chassis layouts, voltage and resistance charts, x-ray views, and schematics. In addition to the troubleshooting charts, the manual has many foldouts that give parts locations for construction. After reading through the manual, I started putting my new radio together. The first steps Heath outlines are the installation of parts on the switching boards. These are special circuit boards with built-in wafer switches to help eliminate intricate switch wiring. This is a good place to start since the components are not spaced extremely close together. That kind of a start gives the first-time kit builder a good chance to check out his soldering paraphernalia. I was somewhat surprised to see that Heath did not use glass-epoxy circuit boards. But, judging from the number of HW-101s on the air, I would venture to say that the composition of their boards is more than adequate. What could have been a very tedious part of the construction was already done for me at the Heath plant, namely, the construction of the wiring harness. This harness contains all the necessary wires and cables that run between the circuit boards. It certainly was nice having those multi-color coded wires neatly arranged and prepared. It really saved me quite a few headaches.

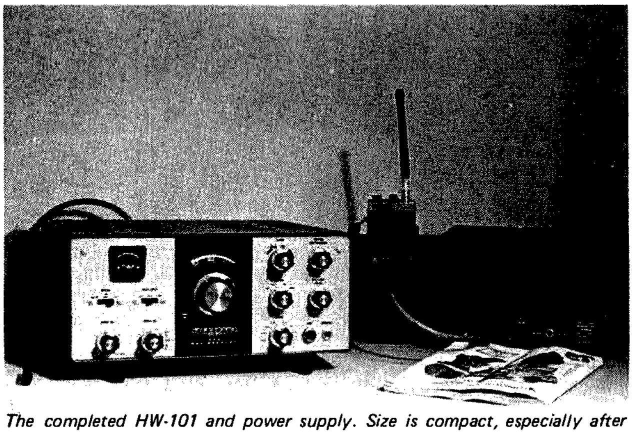
The kit went together amazingly well, although it is not advisable to spend really long stints at the work bench doing such precise work. I found that evenings after dinner I could work for a couple of hours without experiencing too much lower back pain. One evening I worked on the HW-101 for over six hours, with only one fifteen minute break. This is when the only wiring error that I made occurred. But, it *was* avoidable. If I hadn't been in such an all-fired rush to get the rig completed and on the air, it probably would not have happened. A slight amount of patience is a virtue when constructing anything, be it a home brew keyer or a model airplane. My only words of advice are, when you're building a kit and your body tells you it's time for a break, listen to it and take one! Heath's manuals are so well thought out that you can stop virtually anywhere during construction, and have no problems at all picking up where you left off. A couple of times during construction, I had to run off to emergencies (I am a volunteer firefighter up here in New Hampshire). But, despite the interruptions, I had no problem returning to the kit. Another thing that Heath has nailed down is what I call the "boredom factor." In other words, they know just when a certain portion of construction may become tedious, and before you get there, they'll have you go to another section of the kit.

The HW-101 went together in just under 60 hours (including 3 or 4 hours for alignment). After completing the transceiver, I moved on to the matching HP-23B power supply. This popular supply, which has powered all kinds of amateur equipment in addition to the Heath units it's made for, provides the operating voltages necessary for fixed station operation. It seems very well filtered, and went together in a couple of hours.

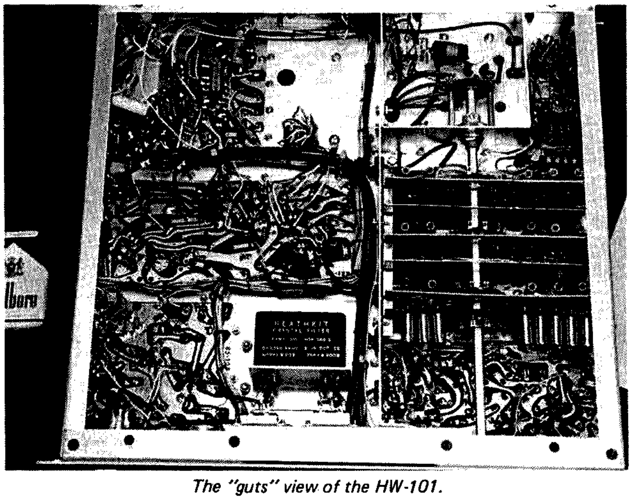
Alignment of the HW-101 is very simple, and can be completed without thousands of dollars worth of test equipment. Actually, all that is required is a VTVM and Heath's trusty alignment tool (which is included with the kit). I thought that the VFO alignment might be a little tricky, but it really wasn't at all. During alignment of the VFO, I found that the frequency counter on WA1UNN's test bench was quite handy for initially determining the VFO's frequency. Heath does give you a method of using another receiver to hear the VFO's output, so a counter is not essential. The remaining alignment is very simple and straightforward. The built-in crystal calibrator is used as a signal source and the S-meter as a peaking meter. We got the receiver section alignment completed and connected the unit to a dummy load. Now for the infamous "smoke test."

I turned the mode switch to tune and, uh-oh . . . nothing! Well, not quite, but the output was very low. I turned the unit off and mumbled something about Murphy showing up on schedule. Then I took the unit home and went over all the step-by-step instructions, but could not find any wiring errors. Now what? As the manual suggested, I had another pair of eyes look at it. Rich WB1ASL found the problem in less than an hour. I had placed one lead (from a resistor on the driver circuit) in the wrong hole on the circuit board, and it ended up to ground instead of going to the rest of the circuit like it was supposed to. If I had only been a little less anxious, this minor error would not have happened. Well, anyway, the rig fired up just great after correcting the wiring error, and the rest of the alignment procedure was completed.

At home I had raised a 500-foot longwire antenna, and had no idea how the swr would stack up. I got home just in time to listen in on the first weekend of the ARRL DX contest. The swr on 15 meters was about 3 to 1. The Heath pi-network output section took it right in stride and fired right up. Had I been using transistors instead of tubes in the final, such a match would have been impossible.



The completed HW-101 and power supply. Size is compact, especially after locating the supply in Heath's matching speaker (not illustrated).



The "guts" view of the HW-101.

One of my first contacts was with Len W8LF in Senegal! Since then, I have received many excellent reports from stations all over the country and the world, with high marks for audio quality. The performance of the HW-101 has been more than satisfactory.

For CW operation, I later added the optional 400 Hz filter. It really makes the weak ones come right up out of the mud. It's good and sharp, yet not so sharp as to cause any annoying ringing. Break-in on CW is accomplished by operating VOX from a keyed tone, which works out quite well. Those of you who are high speed CW ops may want the VOX delay set in a position that facilitates quicker receiver recovery. That position may not be best for VOX operation on voice, but it is no problem to quickly readjust the VOX delay (since all VOX controls are mounted on the right-hand side of the transceiver and are easily adjusted without any cover or cabinet removal). Located nearby are the S-meter zero control and bias adjustment.

Although the HW-101's dial readout is only in 5 kHz increments, the receiver has plenty of selectivity and bandspread. This is evident on SSB, due to a 2.1 kHz crystal filter and the fact that it takes 35 turns of the large tuning knob to go from one end of the band to the other. I found the tuning to be surprisingly smooth, without any discernible backlash. After about a 20 minute warm-up period, the rig seems to be very stable. No measurable drift could be detected after warm-up.

Transmitter tune-up is simple – the preselector is tuned for maximum received signal at the desired operating frequency. This also sets up the transmitter driver tuned circuits to the approximate peak position. The final tune and loading controls are then tuned for maximum output. The mic/CW level is then turned up to maximum output, and you're all set. The meter switch may then be moved to the plate position to check for proper plate current.

The front panel controls are laid out well. In the receive mode, there is metering of signal strength. While in transmit alc, plate current or relative output may be monitored. The dial and meter are both backlit for easy readability.

The HW-101 is quite a rig to build on. I'm looking forward to constructing the mobile power supply and trying my luck while on a camping trip this summer. Also in the works are modifications for working RTTY. There is plenty of output to drive any linear amplifier on the market today, and the front panel level control is quite handy for this purpose.

I'd like to say that, in these inflationary days, I agree with Heath that the HW-101's price/performance ratio is an exceptional value. *Heath Company, Benton Harbor MI 49022.*

Bob Cunningham WB2UIJ
Fitzwilliam NH

73 TESTS THE TUNERS

We began this series back in March with the idea of covering as many antenna tuners as possible. Our staff has gotten to the point where they almost cringe with each new arrival, but you'd be hard-pressed to find one of us operating without one these days. To a man, we've all discovered the advantages – greater efficiency, reduced TVI, and cooler running finals. In future months we'll be looking at some of the less expensive tuners ($40 price class), and hope to finish up with a look at some home brew versions. So read on, and keep us posted on what gear you'd like us to test for you!

DENTRON 1 KW SUPERTUNER

In the middle ground between the $59.50 Dentron 80-10 Skymatcher random wire tuner (see the March *73*) and the $299.50 Monitor tuner (see April) lies the area where most amateurs hang their hats. If you live in an apartment or move a great deal, the random wire is your best antenna bet. On the other hand, if you run a full gallon all the time and are one of those people who go through long periods without food or rest to catch that rare DX, the super-duper model is probably what you need.

In a recent *73* survey, we found that the average amateur is on the air 8-10 hours a week, runs between 200-500 Watts, and budgets a few hundred dollars a year toward updating the shack. "Average" ham, meet the Dentron 1 kW SuperTuner! Retailing at $129.50, this unit is the perfect way to solve all of your matching problems without blowing your entire equipment budget in one fell swoop.

The SuperTuner is set up for just about any matching situation that you'll run into. A quick glance at the back panel shows sturdy screw terminals for balanced, unbalanced, and single-wire feed. An SO-239 for the more conventional antenna setup is also provided. The front panel features three controls for transmitter matching, inductance, and antenna matching. Tuning the unit is simplicity itself, using either an swr bridge or transmitter output meter. I had no problems perfectly matching a random wire, a standard dipole, and a beam. No worry about those finals going up in a puff of smoke either.

see page 188

The SuperTuner is compact enough to fit easily in any shack, but it's still solidly built. After taking out all the screws necessary to expose the guts, I found the unit well laid out, with heavy-duty components used throughout.

The Dentron SuperTuner covers the entire range of 160-10 meters. For the sideband gallon crowd, it's also available with the capability of handling 3 kW at $229.50. *Dentron Radio Company, Incorporated, 2100 Enterprise Parkway, Twinsburg OH 44087.*

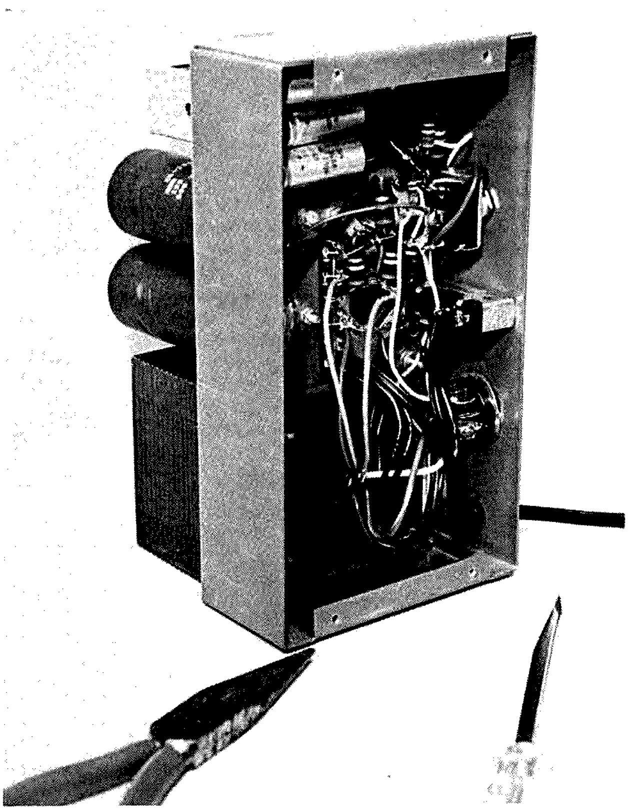
Stan Miastkowski WA1UMV
Associate Editor

73 TESTS THE COMMUNICATIONS RECEIVERS

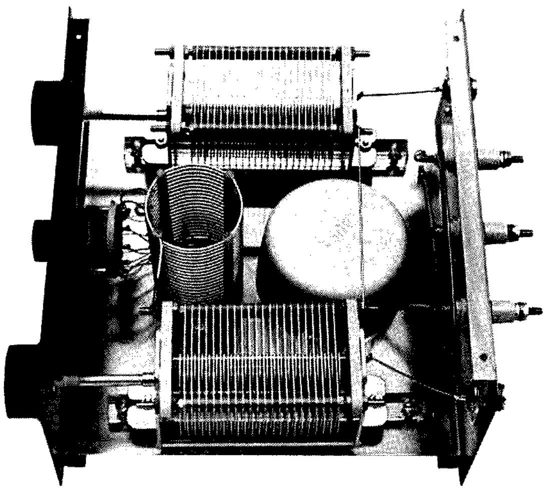
We continue this month with our series on general coverage receivers. Plans call for us to include some smaller, portable sets in future issues, along with the communications units we started off with. As one reader pointed out in a recent letter, SWLing is an integral part of ham radio in many foreign countries, where the prospective ham is required to confirm a specific number of countries before moving on to an amateur exam.

YAESU FRG-7 COMMUNICATIONS RECEIVER

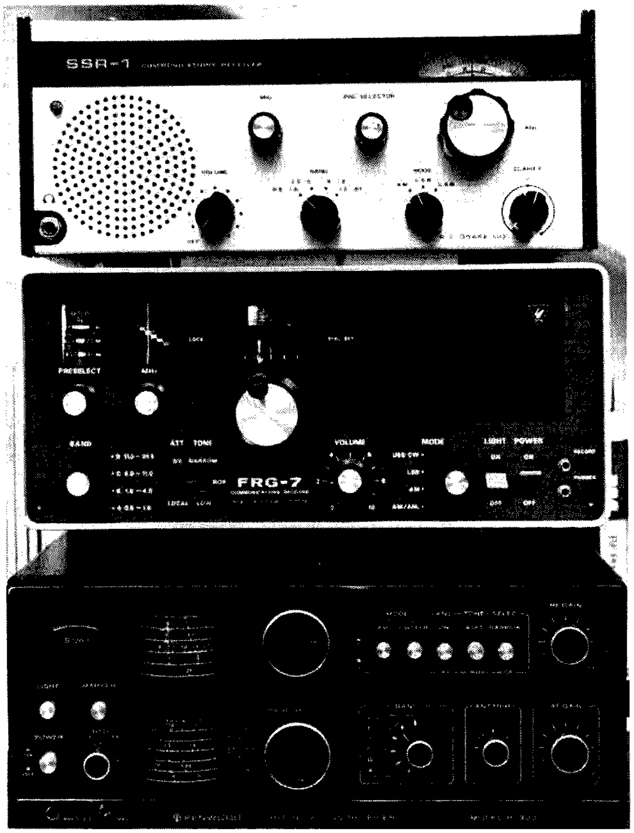
My first real exposure to the world of communications receivers occurred many years ago, a few weeks before Christmas. I had just obtained a new WN8 call, and was ready to tackle the



The matching HP-23B ac power supply.



The SuperTuner interior view – a lot in a small package.



Several of the general coverage receivers undergoing testing by 73 staffers.

Novice bands. A search through greater Cleveland's ham emporiums unearthed a vintage Hammarlund HQ-129X general coverage receiver that served me well for quite awhile. However, as with most receivers of yesteryear (and of more recent days), there were several problems.

General coverage receivers have always been plagued with problems that result when a device is designed to satisfy the requirements of many. Tuning accuracy and stability are adequate for SWL use, but marginal for amateur use in bands overloaded with QRM. BFOs are optional on some general coverage receivers, rendering them ineffective for SSB and CW use. Many hams avoid general receivers for the simple reason that "bandspread," or the capability of stretching a small band segment over many revolutions of the tuning dial, is lacking.

I still have my classic Hammarlund, even though it is so unstable that I cannot accurately copy the evening RTTY bulletin on wide shift. However, a whole new breed of general coverage communications has recently arrived on the scene, filling a gap several years wide left when few radio manufacturers were paying attention to the SWL and general listening community. Recently, I was fortunate enough to obtain one of the newest and most technically advanced receivers to test, the FRG-7, manufactured by Yaesu.

My first reaction to the receiver was one of surprise when I picked up the box. Amazing! I could lift it and carry it with ease. It is totally solid state, and its design is based on the latest advances in digital technology. The tuning scheme is based on the phase locked loop frequency synthesis technique, which eliminates the dial inaccuracies characteristic of older communications receivers. It works as follows: The user selects the single megahertz band he desires to tune. This is accomplished by rotating a knob that turns a drum calibrated from zero to 29 (MHz). An LED indicator lamp next to the MHz control remains illuminated until the synthesizer "locks" on the desired megahertz band. When the LED goes out, the FRG-7 is locked into calibration, allowing perfect main dial accuracy. The main dial is calibrated from zero to 1000, and is covered by 10 full turns of the backlash-free tuning control. Resolution of 5 kHz is easily possible by splitting the eighth-inch dial divisions. The best part of the tuning scheme is, however, the fact that the same accuracy is provided for each MHz range. For the first time, an SWL can search for that elusive foreign broadcast station knowing he is on frequency, and the ham can use the main tuning control as a bandspread, due to the one MHz per band feature of the FRG-7. A "dial set" adjustment is provided to accommodate mechanical wear of the main dial components. A calibrated antenna preselector control is provided, and normally must be peaked several times while tuning across a one MHz segment. An rf attenuator is also provided, calibrated "normal," "DX," and "local." I found the "normal"

The Yaesu FRG-7 communications receiver, with some QSLs familiar to SWLs everywhere.

setting to be adequate for all listening, as no receiver overload was experienced while testing the radio. The remaining front panel controls consist of a volume control, a three-position "tone" control, a mode switch, and two toggle switches. The latter switches control power and panel lamp illumination. The panel lamp switch is necessary, as the FRG-7 may be powered by an internal battery, consisting of eight "D" flashlight cells, rendering the receiver perfect for weekend trips. A front panel speaker is provided, as well as an earphone jack and recorder jack. The receiver is logically organized, and it only took a few moments to switch bands once the MHz switch and main tuning dial were mastered.

Operating the FRG-7 is a pleasure. I have always enjoyed SWLing, even though it has been a few years since I sat down and actively chased foreign broadcast stations. The tuning scheme is remarkably accurate, and all the stations appeared on the dial exactly as they were listed – no 5 kHz fudge factor as with non-synthesized communications receivers. The FRG-7 should appeal to the avid SWLer or broadcast DX hound for that reason. Sensitivity is good on all bands, and only an occasional tweaking of the antenna preselector was necessary to bring 'em out of the noise. (The antenna used for the SWL sessions was a 350' longwire.) The mode control has positions for AM, AM with noise limiting, LSB, and CW/USB. Each functioned correctly.

Performance on the ham bands was as expected for a receiver in the FRG's class. The "wide" main tuning dial effectively doubles as a bandspread control, and there was no difficulty copying stations on the low bands. Sideband reception was excellent, and it was strange not using a BFO control to tune them, as is common practice with older communications receivers. However, it was difficult to sort them out during the pileups on contest weekends. A "clarifier" control would have been a nice feature for SSB reception, but then again, the FRG-7 was not designed as an amateur receiver. In my opinion, the FRG-7 would make a fine Novice receiver, or a "second" receiver for the seasoned amateur. In any case, it's a perfect rig for vacation and weekend trip use. The battery pack makes it usable even in remote cabins, or onboard a boat.

The FRG-7 has three antenna connectors, a ground, and a muting connector on the rear panel. The broadcast band requires a separate antenna, and both a clip-type and standard SO-239 coax connectors are provided for high frequency use.

The Yaesu FRG-7 is definitely a big improvement over my old Hammarlund workhorse receiver. Its performance is definitely "ham standard" in the areas of accuracy and sensitivity. Its price and versatility, as well as portability, make it an ideal SWL receiver. At *73* we even used the FRG-7 as the low i-f receiver for tuning up a 432 MHz converter destined for EME use. No problems were encountered, and the battery power sure beat running a fifty-foot extension cord which would have been required for other receivers. For those of you needing a second receiver with state-of-the-art features, it would pay to consider the Yaesu FRG-7. Who knows – you might end up retiring your present receiver! *Yaesu Electronics Corp., 15954 Downey Ave., Paramount CA.*

John Molnar WB2ZCF
Executive Editor

MFJ 1030BX RECEIVER PRESELECTOR

Recognizing that most receivers are perfectly adequate on frequencies below 10 MHz, MFJ Enterprises has designed its new model 1030BX preselector to cover 10 to 30 MHz, where many receivers, particularly the older and less expensive sets, do fall short on performance.

Using a protected dual-gate MOSFET for extremely low noise, the unit has excellent strong signal handling ability and easily meets the manufacturer's claim of providing a typical increase in gain of 25 dB.

Although a bit more expensive, the 1030BX uses separate input and output tuning controls to provide maximum gain and selectivity while eliminating the tracking problem of a dual-gang capacitor.

The two high-Q double-tuned circuits provide a real improvement in weak signal reception while significantly reducing out-of-band signals and images. With the preselector on and properly "tweaked," you can cut back on the receiver's gain, reducing receiver cross modulation and overload problems while maintaining an excellent signal to noise ratio and the ability to pull out the weak ones.

Using the model 1030BX with a Radio Shack DX-160, a World War II vintage BC-348, and a Barlow-Wadley XCR-30 resulted in a significant improvement in performance in each instance. In fact, at one midtown New York City location, the preselector made the difference between useful reception and a total wipeout. The MFJ 1030BX preselector can be highly recommended to both amateurs and SWLs seeking to improve the performance of their receivers.

Packaged in an attractive Ten-Tec enclosure measuring 2-1/8 by 3-5/8 by 5-9/16 inches, the model 1030BX receiver preselector sells for $49.95. Unconditionally guaranteed for one year, the preselector is available from dealers or direct from *MFJ Enterprises, PO Box 494, Mississippi State MS 39762.*

Morgan W. Godwin W4WFL
New York NY

The MFJ Receiver Preselector.

MICROWAVE ASSOCIATES "GUNNPLEXER" 10 GHz AMATEUR TRANSCEIVER FRONT END

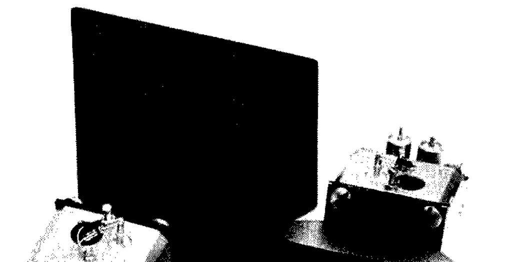
Microwave Associates of Burlington, Mass., has introduced a microwave transceiver "front end," designed specifically for amateur use. The MA-87127 Gunnplexer is an electronically tunable, frequency modulated oscillator operating in the amateur 10.0 to 10.5 GHz band. The oscillator produces about 20 mW of microwave energy directly from a 10 volt supply. A Gunn diode is used in the oscillator, and a portion of the energy is used to provide injection for a receiver mixer diode. The oscillator and receiver are isolated by a special ferrite circulator. The oscillator may be frequency modulated by applying voltage to a varactor diode included with the rf head. The Gunnplexer has a mechanical tuning range of about 100 MHz, and may be electrically deviated over a 60 MHz range.

In order to use the Gunnplexer as a communications device, the user must provide an i-f receiver and modulating source. The i-f range is customer selectable at time of purchase, and is typically in the range of 30-200 MHz. A standard broadcast FM receiver may be used as an i-f receiver for experimental applications. Microwave Associates claims that a communications range of up to 100 miles can be achieved with two Gunnplexers under optimum conditions. A narrow (10 kHz) i-f is required for such DX communications.

The microwave devices are not limited to communication applications, however. A Doppler effect radar transceiver can be built using a single Gunnplexer, based upon application information available from the manufacturer. Options for the Gunnplexer presently consist of a gain horn antenna that bolts to the rf head.

The *73* staff has recently obtained two Gunnplexers. A complete communication system is being developed employing a phase locked control circuit. Watch *73* for complete details as the system is refined. Preliminary tests indicate, however, that the Gunnplexers perform as advertised. These devices should eventually interest repeater owners, as the potential for a troublefree, wireless link is definitely attractive.

The following are available from Microwave Associates: MA-87108—Gunn Oscillator and Varactor, $60; MA-87127—Complete Transceiver, $85; MA-87140—Complete Transceiver and Antenna, $108; MA-87141—Two Transceivers and Antennas, $180. *Microwave Associates, Inc., Burlington, Massachusetts, (617) 272-3000.*



The Microwave Associates "Gunnplexer" 10 GHz Front End.

THE HEATHKIT ET-3300 LABORATORY BREADBOARD

Breadboarding has traditionally been a necessary, but often tedious, part of amateur and professional electronic design. Although a number of methods of breadboarding exist, none has really made the job easier, only different. On the one hand, we find projects tacked together on little pieces of perfboard or some sort of "universal printed circuit stock." On the other hand, there are those who prototype their projects on little pieces of phenolic material equipped with any of several types of horrid little spring clips.

The first really convenient breakthrough in breadboarding techniques came a few years ago when several companies began to offer terminal blocks set up as DIP-IC sockets with several contacts bonded together on 0.1 inch centers required for IC mounting. The only problem with these for amateur use was that they are expensive, especially when purchased as a lab breadboard with internal power supplies.

I recently bought and assembled the Heathkit Model ET-3300 laboratory breadboard. Total assembly time was a little under four hours, and there were no hitches worthy of mention.

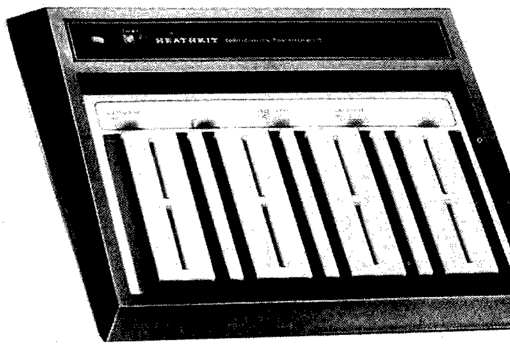
The ET-3300 has four solderless IC breadboarding sockets. Each socket has 48 rows of contact pairs on 0.1 inch centers, and will hold up 6 14-pin DIP ICs (24 total). There are also three common bus sockets that each have two rows of common terminals running the length of the socket.

To me the biggest attraction was the ET-3300's built-in power supplies. In the past, regular bench supplies were used and that meant alligator clip leads or solder-tacked power wires all over the place. Besides being clumsy and just plain unsightly, it also produced more than a few problems with hum pickup, ground loops (especially troublesome in rf or those logic circuits operating at high speed), and layout. These problems are reduced considerably and, in many cases, eliminated, by the socket designs and internal power supplies of the ET-3300.

There are actually three ground-referenced power supplies in the Heath breadboard. One is suited for TTL and other digital logic elements because it will provide up to 1.5 Amperes at +5 V dc. I personally feel that the 1.5 Ampere figure is a little high, because it is based on a heat sinked LM309 regulator, normally rated at 1.0 Ampere. Even though I have drawn 1.2 Amperes for about two hours, the device survived nicely. The remaining power supplies are +12 volt and -12 volt at 100 mA, and they will accommodate operational amplifiers, microprocessors, and certain linear (non-op amp) ICs. These supplies are regulated to within ±2% and the specs were found to be conservative on the model I tested. I noticed only a few millivolts difference in the 12 volt supplies as current was increased from 0 to 100 mA. These supplies are also current limited to prevent damage from the almost certain short circuits that will exist in breadboarding.

The cabinet design is easy to live with, and is suited to long breadboarding sessions with little fatigue. In other brands of breadboard (of similar design) I've used, the panel was either sloped too high or too low for comfortable use over a long session. The Heathkit version appears to have been designed by an engineer who has done extensive breadboard work using some of the same products I have dealt with. The others will tire out your forearm and wrists in much the same

see page 192



The Heathkit Laboratory Breadboard.

manner as an inappropriate or poorly designed telegraph key.

Two things annoy me about the ET-3300, although others may feel that they are too minor for comment. One of these is my old paranoia over fuses inside the case, where a simple fuse replacement is a major undertaking. The other is that those four IC sockets are not assembled at the factory. They ship the empty shells and a zillion multi-pin inserts. I spent the better part of a half hour inserting those little metal contacts into the shell. My personal feeling is that I would prefer to pay a little more and have that chore done at the factory by a machine. Of course, this kit only costs $79.95 ($120 assembled), so I guess it isn't too bad.

It is my judgment, based on several years of experience, that the Heathkit ET-3300 is well suited to industrial, commercial, and amateur breadboarding requirements for both IC and discrete designs. It will cut your breadboarding time considerably, but in my view that is only the icing on the cake. Its main attraction is that it facilitates flexible breadboarding procedures by allowing you to make changes rapidly – and that will reduce not only breadboarding time, but also the anxiety quotient. Of course, its most endearing quality is that it gives these advantages while forming a closer impedance match between the world's money supply and my bank account!

Joseph J. Carr K4IPV
Arlington VA

ANALOG COMPANDOR FOR NOISE REDUCTION IN COMMUNICATIONS AND AUDIO EQUIPMENT NOW AVAILABLE FROM SIGNETICS

A dual-gain control circuit which incorporates a complete compressor and expandor into one linear IC is now available from Signetics.

Designated the NE570/571 Compandor (compressor/expandor), the analog device is designed for applications in consumer communications equipment, including telephone subscriber or trunk carrier systems and hi-fi audio equipment.

In such applications, the compandor can be utilized as a means of reducing noise, as well as interference from other communications equipment, according to Neal Williams, Marketing Manager, Consumer Products, for Signetics' Analog Division.

Either channel of the dual-gain circuit can be used as a dynamic range compressor or expandor. Each channel has a full wave rectifier to detect the average value of a signal; a linearized, temperature-compensated variable gain cell; an operational amplifier; and a bias system.

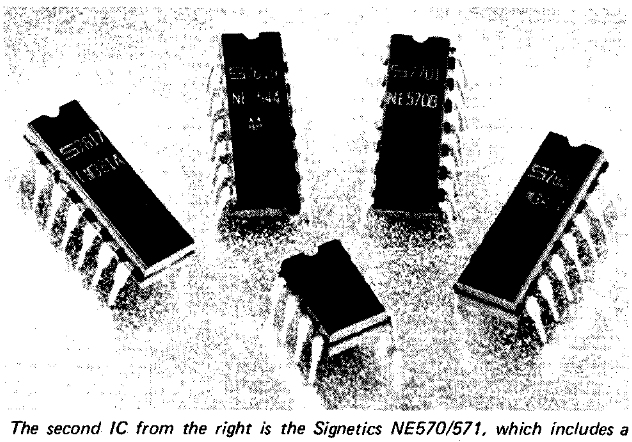
The arrangements of these blocks in the NE570/571 result in a circuit which can perform well with few external components and yet can be adapted to many diverse applications, according to Williams.

The new units are ideally suited for application as a telephone trunk or telephone subscriber N2 compandor which is fully compatible with the Bell System's low level tracking curve; as a high level fast attack limiter making possible small signal gain reduction by factor of 10; as highly flexible basic expandors or basic compressors, in which the size of input and output signals are adjustable; and as a "noise gate" which will mute the output when the input signal drops below -60 dBm.

The NE570/571 compandors are also useful for applications in similar dynamic noise reduction systems, in voltage controlled amplifiers, and in dynamic filters.

The compandor features a THD trim terminal in the circuit, which provides a means for trimming out offset voltages and thus trimming the distortion they produce.

Other features include operation down to a 6 V dc supply voltage (maximum rating is 16 V dc), a dynamic range of greater than 110 dB, maximum power dissipation of 400 mW, and an operating temperature range of -40° to +70°C. *Signetics, 811 East Arques Avenue, Sunnyvale CA 94086.*



The second IC from the right is the Signetics NE570/571, which includes a complete compressor and expandor in one chip. The rest of the ICs are also Signetics products.

JANEL LABORATORIES MODEL 01-A PRECISION CRYSTAL OSCILLATOR

Janel Laboratories has announced a new crystal oscillator capable of outstanding frequency stability. This new oscillator, Model 01-A, is ideal for counters, synthesizers, and communications systems, where it is possible to achieve about a 10 times improvement in temperature stability over commonly used TCXOs. The oscillator is available as a standard item for 10 and 4 MHz, and is therefore readily adaptable to most counters and other equipment. Adapter boards are available for lower frequencies such as 1 MHz or 100 kHz.

The 01-A oscillator features a proportional crystal oven that holds the crystal frequency within 2 Hz at 10 MHz, over an outside temperature range of -25 to +50°C. The rf output is TTL compatible, and only a single 12 volt power source is required. Self-contained voltage regulation provides immunity from changes in the supply voltage. The oscillator is much smaller than the usual oven oscillators – only 1-7/8 x 1-5/16 x 3/4 inches. Solder pins are provided for PC board mounting, or the unit can be mounted to a chassis.

A typical amateur application would be for use as a time base for a frequency counter. When measuring the frequency of a two meter transmitter, a temperature stability of about 30 Hz would be achieved. This compares with a stability of 300 to 700 Hz for most TXCO-type oscillators and 750 Hz to 3 kHz for uncompensated, high accuracy oscillators. *Janel Laboratories, 3312 S.E. Van Buren Blvd., Corvallis OR 97330.*

NEW SEMICONDUCTOR REFERENCE HANDBOOK

Just issued by Radio Shack, the nationwide electronics store chain, is a book every electronics experimenter or hobbyist will want. It's their new *Archer Semiconductor Reference Handbook*.

A cross-reference listing is included in the handbook for replacement of transistors, diodes, and other interchangeable devices. The total number of cross-referenced devices exceeds 36,000. These cross-reference/replacement listings are computer-selected and based on careful analysis of the important parameters of the listed devices.

The *Handbook* is a compilation of data on Radio Shack's line of Archer brand semiconductors. According to Radio Shack, every Archer device covered in this handbook is guaranteed prime – not "fallouts" or "seconds" – all are top quality, with known JEDEC, EIA, or manufacturer's numbers.

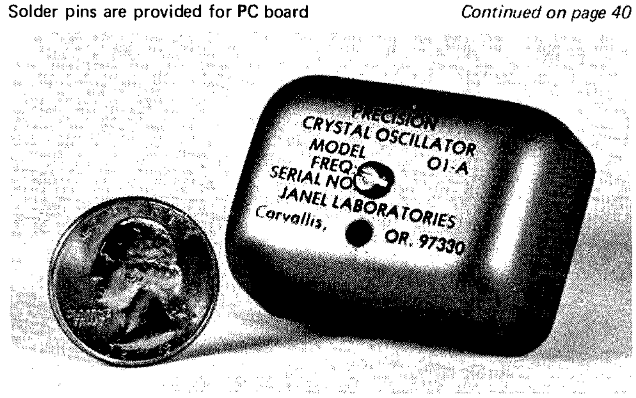
The handbook also has sections on the care and handling of transistors, soldering precautions, case styles and dimensions, and how to test transistors, as well as a glossary of words, symbols, and abbreviations.

The *Archer Semiconductor Reference Handbook* is available exclusively from Radio Shack stores and dealers. The 128 page handbook is priced at $1.95. *Radio Shack, a division of Tandy Corporation, Fort Worth TX 76107.*

PORTABLE DIGITAL MULTIMETER FEATURES 200 HOURS OPERATION

Data Tech announces a new low cost 3½ digit digital multimeter, with

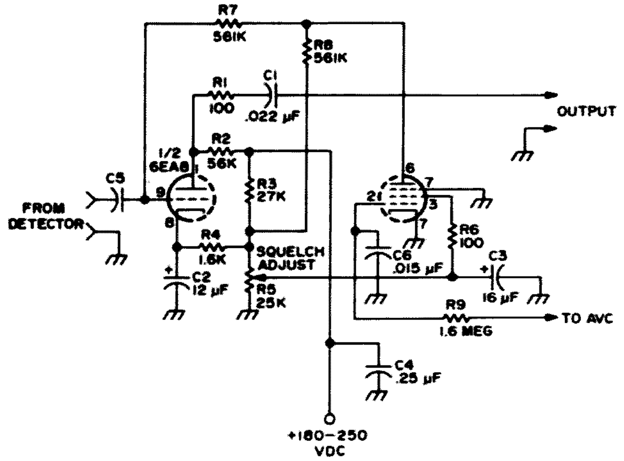
Continued on page 40



The Janel Laboratories precision crystal oscillator.

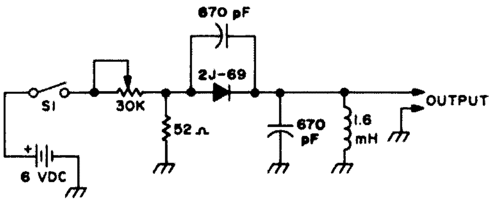
Q&A

This column will be a monthly feature of 73 Magazine. It is hoped that it will be of assistance to beginners and old-timers alike. We only ask that your questions be kept as general as possible. We will try to answer all queries received. Please mail your questions to Technical Editor, 73 Magazine, Peterborough NH 03458.



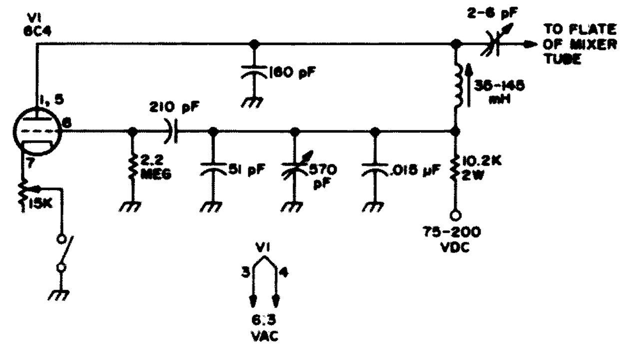
Q. Using one tube, how about a diagram for a squelch circuit?

A. See the figure. The only tube used in this circuit is a 6EA8. It must, however, be used with a set having avc. As shown in the diagram, this squelch is inserted between the second detector and the af volume control. For proper action, be sure there is good filtered dc. Use 1 W resistors throughout.



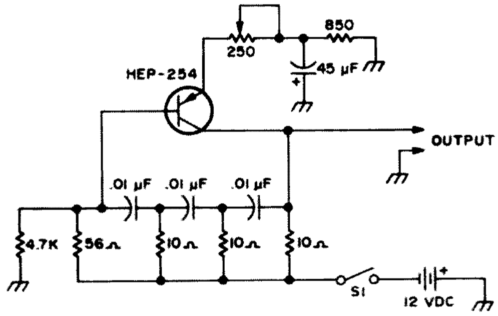
Q. Not using any crystals, and preferably a solid state device, recommend a 100 kHz sine wave oscillator which has a fair amount of stability.

A. This is a tunnel diode sine wave oscillator (see the figure) using a GE ZJ69 TD. When compared to a crystal oscillator, frequency was found to be stable as long as there were no drastic temperature changes. The sine wave output was nearly perfect. For long-term accuracy and stability, a crystal oscillator is recommended.



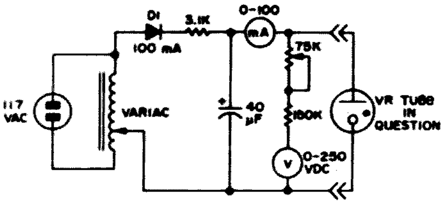
Q. Can a Q-multiplier be added to a receiver which uses an i-f of 1650 kHz?

A. Use the circuit shown. Mount the parts in a minibox for good shielding. Any voltage from 75 to 200 V will work fine. Although a 6C4 is used in the circuit, a nuvistor such as the 6CW4 also can be used. After installing, check the i-f alignment of the receiver.



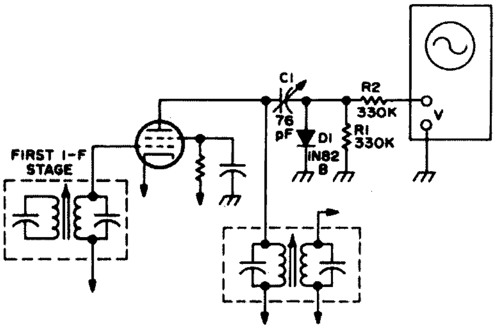
Q. Is there a way of designing an af oscillator so that it has an 800 Hz output?

A. Refer to the figure. The following transistors may be used in this oscillator: HEP-254, O.C.-2, SK-3004, AT30H. To increase the frequency, decrease the value of the capacitors in the ladder network.



Q. Is there a circuit for a simple VR tube checker?

A. The circuit in the figure works well. The variac voltage is varied up. When the VR tube fires, read the milliammeter and voltmeter. Good tubes will fire at their rated voltage and current.



Q. Is it possible to connect a scope to a receiver to see what incoming signals look like?

A. After installation of the signal takeoff and detector network (see the figure), the i-f stage may have to be realigned a bit.

Q. Is there an easy way to check the power output of a simple SSB exciter?

A. Yes – Connect the rf output of the SSB exciter to a dummy load (matching the output impedance). Across the load connect a vacuum tube voltmeter. Apply tone modulation to the exciter. Use the formula E2/R = P. Your answer will be average power, if you use an rms-calibrated VTVM. Make sure the VTVM is suitable for rf measurements.

Q. If, in nulling the carrier of an SSB transmitter, difficulty is experienced, what steps should be taken?

A. Disassemble the carrier null-trimmer capacitor and clean it with chloraphene. Remember, the carrier null should be set after the transmitter has thoroughly warmed up. For full carrier suppression, wait at least 20 minutes.

Q. Is it worthwhile to add a pot for vertical gain control to a scope with a step attenuator?

A. The circuit used for step attenuation is very effective and has a very wide range. Little will be gained by adding a pot. Furthermore, the vertical input is frequency compensated. The high input impedance of a good scope will be affected if a pot is added.

Q. Any idea as to what a sputtering noise within a small transmitter – when modulated – could be caused by?

A. With the room darkened, check for rf arcing in the final rf amplifier. Also look for arcing in the B-plus circuit due to close connections (sometimes due to vibration during transportation). Check for possible corrosion of various parts which could cause arcing.

Special Report

by Stan Miastkowski WA1UMV

REPEATER DEREGULATION — THE BOMBSHELL DROPS

It appears that the face and substance of amateur radio as we know it may be changing drastically in the near future. The key word is *deregulation*, a word that conjures up a wide variety of opinions. Is it good? Is it bad? Will it further amateur radio? Will it destroy it?

The process of deregulation has already started. It has come in small, bite-sized chunks. Novice class privileges were granted to Technicians, and instant upgrade has become a reality, as have code comprehension exams and the elimination of license fees. FCC field offices report that the number of new hams is climbing at an accelerating rate, portending great changes for our hobby.

Deregulation has come to the amateur community mainly because of one thing . . . Citizens Band. The explosive growth of CB has created a migraine headache for the licensing, enforcement, and rulemaking departments of the FCC. Their limited budget and limited staff means that the most effort must be focused in the area of most concern. That has become CB.

Amateurs can be justly proud of their record of self-enforcement. The FCC realizes that we have so far managed to mold ourselves into a service that can be left alone, for the most part. But can it last? With the increased numbers come increased problems. Repeater wars, malicious interference, bad language, and even violence have been cropping up lately. Where it will lead remains to be seen.

Deregulation can be a double-edged sword. Like the elementary school class that is forced to stay after school because of one person's misbehavior, amateurs must suffer and pay (literally) for the misbehavers on CB. Witness the two notices of proposed rulemaking before the FCC at the moment. The sale of linear amplifiers would be banned in the 24-35 MHz band under one. Under the other, type acceptance of all amateur equipment would be *required*. Although the linear amplifier ban can be lived with since licensed amateurs would still be allowed to home brew them, the type acceptance proposal hurts . . . right in the wallet. It's estimated that the price of an average transceiver would rise between \$150-\$300. It may be that amateur radio will become a rich man's hobby, like flying, horse racing, and yachting.

Despite the regression of type acceptance, deregulation is still the word within the FCC. The biggest bombshell is Docket 21033 . . . repeater deregulation. In brief, it would completely eliminate the present repeater licensing system and allow any licensed amateur to set up his own repeater on any amateur band.

The second bombshell is Docket 20777, which would change the emission-type limitations within a band to bandwidth limitations. This docket contains the seeds of both increased regulation and deregulation.

These notices of proposed rulemaking are two of the most important dockets ever out of the FCC that concern the amateur community. What does the average amateur think of them? Is he even aware of them? *73* has made an effort to find out. Hundreds of questionnaires were recently mailed to a cross-section of amateurs throughout the country. The poll included everyone from new Novices to old-timers, from professional radio engineers to clerks. The common denominator is the amateur license and the love of the hobby. The questionnaire polled amateurs on repeater deregulation, bandwidth proposals, and general operating habits.

This month, *73* concentrates on repeaters — both the current situation and where it is going. The results of the survey are contained elsewhere in this report. What seems clear is that there are as many different opinions as there are amateurs. Many hams who responded to our questionnaire took the time to remark at length about the state of things as they now stand. There seems to be a feeling running through the ranks that *something* has to be done to keep our hobby from being swallowed by the combined forces of unplanned deregulation and CB pressure.

THE CALIFORNIA SITUATION — AN EXAMPLE

The following is a letter from a Southern California repeater owner to a person who is alleged to have caused interference.

Dear Mr. :

I have called your home on three occasions and spoken to you twice (and your wife once) concerning the activity. The only result I have gotten so far is an immense telephone bill. Thus this letter. Since you came close to promising moderation last time we talked and the next day started transmitting a tone every time your telephone isn't off the hook in an apparent attempt to "clear the channel," and generally threaten people with violence and mayhem on the air (which is what I was asking you not to do), I can't wait to see what you come up with next.

I will certainly admit that there are people in the Valley who are trying to jam you off the air — included in that group is at least one guy who is a bootlegger and a guy who routinely stomps on established conversations through his own, as well as others' repeaters, and a guy who claims 146.94 as his exclusive channel. They are unreasonable, irrational imbeciles. Unfortunately, so are you. If anything can be proven by seeing who can *jam whom* off the air, it will probably be eventually settled by the FCC, the cops, or whoever can hire the biggest, meanest hit-men.

As a minimum, I insist that you not use your repeater to jam simplex conversations. If it is in fact true that your users cannot hear existing simplex conversations, installation of a lockout receiver and/or reducing transmit power or antenna height will be required. Jamming conversations is definitely illegal, and if you don't know that it's taking place, you are not properly functioning as a control operator.

Since your end of this conflict is a club, whose members pay money to use the repeater, it is in their best interest to take solution-oriented (as opposed to gum-beating) action. Being a club, it should be easy to take this up with the membership at a meeting or through your newsletter. It is somewhat harder to stop jammers in three counties, but if an honest attempt is made on your part to end this funny business, I and a number of other individuals will help you find and take legal action against the jammers — which you are apparently unwilling or unable to do.

I am not threatening to invoke the FCC. I doubt they will do anything — they seldom do, and I hope this can be solved without them, anyway. However, I am sending copies of this letter to several amateur radio magazines and the SCRA, in hopes that peer pressure will cause moderation on both sides, or that at least people laughing at you will slow you down. I regret that any of this is necessary.

COORDINATION: IS IT WORKING?

Despite an overwhelming response that frequency coordination is working, respondents to the *73* survey indicated that they believe that a national system of frequency coordination is needed. What is the state of frequency coordination? The latest issue of the *73 Repeater Atlas* shows nearly 3000 repeaters in operation throughout the country. According to our files, some of the more popular frequencies contain the following number of repeaters:

146.64 — 91
146.67 — 75
146.70 — 72
146.73 — 78
146.76 — 164
146.79 — 78
146.82 — 133
146.85 — 90
146.88 — 149
146.91 — 72
146.94 — 229
146.97 — 73

With numbers like those on one frequency, problems are bound to crop up — and have. See recent *73* "Briefs" for a running account of the Ohio RTTY war over the use of 146.70. *On the west coast, it* appears that behavior on many repeaters has regressed to the kindergarten level.

IS CALIFORNIA THE SHAPE OF THINGS TO COME?

James Rieger WA6EZL tells *73* that, "The problem here is that ham operators are at war with one another. Neither will vacate a channel which neither can use because of jamming, because they would then be the 'loser.' Additionally, the jamming signals, the threats, the playback of party tapes, and other pranks cover substantial areas of Southern California. The channels are rendered useless to operators.

"My hope is that peer pressure and publicity will cause both sides to take a more adult attitude toward the problem. It apparently will not solve itself. It's been going on for months and is increasing in nastiness. As an amateur operator, I am embarrassed and disturbed by these activities." For an example of the California problem, see the letter elsewhere in this report.

What is to be done? Whether repeater deregulation is approved or not, it appears that some type of national coordination system, or at least some sort of interaction of coordination activity, will have to be instituted. As part of the *73* poll, we asked frequency coordinators what criteria they use for geographical separation. Here are some of the answers:

"Strictly non-interference. The older machine has priority."
"HAAT, ERP, terrain, anticipated area of coverage."
"75 miles."
"Try to minimize overlap."
"100 miles."
"Common sense."

Those are just a few of the responses that we received. It becomes obvious that there is little consensus. In 1975, the ARRL proposed a system of national frequency coordination which never got off the ground, due primarily to the opposition of many of the large repeater coordination groups. The proposal would have used ARRL-designated area frequency coordinators, who would have had power to enforce coordination in conjunction with the FCC. One of the plan's requirements was that the coordinator be an ARRL member.

Whatever the pros and cons of national frequency coordination, amateurs must remember one thing: The FCC wants no part of it. The key word in Washington, especially with the new administration, is *deregulation*. The time, personnel, and paperwork involved is something the FCC wants no part of.

THE 73 SURVEY

73 sent out nearly 300 questionnaires, of which 236 were returned filled out. The breakdown of license classes is as follows:

32 Novice
34 Technician

THE ARRL BANDPLAN

Repeater Channels INPUT	OUTPUT	Direct Channels
146.01	146.61	146.40
146.04	146.64	146.43
146.07	146.67	146.46
146.10	146.70	146.49
146.13	146.73	146.52
146.16	146.76	146.55
146.19	146.79	146.58
146.22	146.82	147.42
146.25	146.85	147.45
146.28	146.88	147.48
146.31	146.91	147.51
146.34	146.94	147.54
146.37	146.97	147.57
146.40	147.00	147.60
146.43	147.03	147.63
146.46	147.06	147.66
147.60	147.00	
147.63	147.03	
147.66	147.06	
147.69	147.09	
147.72	147.12	
147.75	147.15	
147.78	147.18	
147.81	147.21	
147.84	147.24	
147.87	147.27	
147.90	147.30	
147.93	147.33	
147.96	147.36	
147.99	147.39	

97 General
51 Advanced
22 Extra

According to the survey, amateur radio operators spend an average of 8-10 hours a week on the air. Most also subscribe to two or more amateur radio magazines.

What do amateurs think of the FCC's repeater deregulation proposal? Here are the results from the *73* poll.

1. In general, do you agree with this proposal?
Yes 38%
No 61%
No opinion 1%

2. Do you feel that the existing licensing system for repeaters is working well?
Yes 72%
No 22%
No opinion 6%

3. Should the existing repeater licensing system be eliminated?
Yes 18%
No 77%
No opinion 5%

4. Should any licensed amateur be allowed to set up a repeater without the need for a special license?
Yes 24%
No 74%
No opinion 2%

5. Should repeater operation be allowed in all amateur bands?
Yes 19%
No 74%
No opinion 7%

6. Should crossband operation be allowed?
Yes 77%
No 22%
No opinion 1%

7. Should repeater logging requirements be eased?
Yes 77%
No 20%
No opinion 3%

8. Should repeaters be monitored at all times by control operators?
Yes 34%
No 62%
No opinion 4%

9. Should remote bases be allowed to operate on simplex frequencies?
Yes 70%
No 18%
No opinion 2%

10. Is frequency coordination working in your area?
Yes 80%
No 1%
Don't know 19%

11. Is frequency coordination working on a nationwide basis?
Yes 30%
No 1%
Don't know 69%

12. Is a nationwide system of frequency coordination needed?
Yes 69%
No 23%
No opinion 8%

13. If so, who should administer the system?
FCC 9%
ARRL 18%
National System of Frequency Coordinators 41%
No opinion 33%

14. Should nationwide frequencies be set aside for RTTY and simplex?
Yes 72%
No 20%
No opinion 8%

THE PROPOSAL
(Excerpts from Docket 21033, Released January 6, 1977)

"Petitioners request explicit recognition of so-called 'remotely controlled base stations.' They state that considerable confusion exists concerning the definition and operation of remotely-controlled base stations, and that there is a need for specific rules to regulate the operation of such stations. Petitioners have proposed specific rules which, if adopted, would both add to the rules several provisions concerning remotely-controlled base stations and substantially relax the requirements for the operation of such stations.

"The petitioner seeks simplification of the Amateur Radio Service logging requirements, particularly the rules requiring the notation of all third party traffic sent and received, the retention of station logs for one year, and the recording of transmissions from 'open access' automatically-controlled repeater stations. The petitioner states that much of the logging required by the Rules is of little benefit to either Amateur operators or the Commission and requests that logging requirements be relaxed ac-

A FEW THOUGHTS FROM W2NSD ON THE REPEATER SITUATION

What About Creeps?

Since the FCC does not give psychological tests when they give ham exams, we have our fair share of nerds — and some manage to get set up for two meters, more's the pity.

A little kerchunking of repeaters now and then is not a capital offense, but some characters carry this to a fault. This isn't as serious as the frustrated ham who gets mad at a repeater group who decides to get even via the garbage mouth route. We are all used to hearing only the cleanest of language on our repeaters, so when one of these guys starts with the dirty words, many of us are liable to overreact.

If you stop and think about it for a bit, you'll realize that, though the stuff may be objectionable, it really isn't going to hurt anyone. So don't make a great big deal out of it. You do want to do what you can to get rid of the idiot, and getting angry is your worst response . . . that's what delights him. He'll win a lot more attention that way.

Your best bet is to shut up and get busy with a direction finder on the input frequency (not the output — everyone knows where the repeater is). With a friend or two, you should be able to find the chap rather quickly. Then there is the question of how to get him to stop. If a phone call or a personal visit doesn't do the trick, you might think in terms of a personal visit by the entire club. A mob of fifty or so hams driving up and knocking on his door may get his attention.

Kerchunkers are harder to find. Their transmissions are usually a bit short for direction finding. There have been some successes with the use of a triggered scope. If you can get the chap on the input frequency and then measure the delay through the repeater, you can get a rough estimate of how far he is from the repeater. Another good trick is to use a fast triggered scope to see the leading edge of the kerchunker's signal. Oddly enough, every transceiver has a slightly different rise, and you can compare the kerchunker's pattern with those of other users later in the day. It is very unlikely that the kerchunker will never use the repeater normally. Eventually you'll spot him.

Open Repeaters, Closed Repeaters

As a traveler, you may run into the same thing I do. I get around a lot to hamfests, to see advertisers, etc. It is most discouraging to call in on the local repeater when you get to town and get no answer. I like to say hello, maybe find out a good place to eat, or a recommended place to stay. I announce myself on the repeater and hope for an answer. Nothing. I try again . . . "This is W2NSD portable 8 standing by; anyone around to say hello?" Nothing.

Okay, perhaps there is no one listening right now — that can happen. But then about 20 seconds later on comes W8—— calling WA8—— and standing by for him. WAS—— comes back and they talk. It takes a very short time to get the message . . . visitors unwelcome.

Other repeaters will put out the red carpet for you and make you happy you are a ham.

While I think we all appreciate that repeaters are not inexpensive to set up and maintain, on the other hand there is a nonprofit clause in the amateur regulations (no pecuniary interest) which must be kept in mind. Is it really legal for a repeater to use our non-commerical frequencies and force people to pay for the use of a specific frequency? I suspect not.

It would be a bit more expensive for closed repeaters to be set up on commercial channels, but it might be more honest. In the early days of repeaters, when there were far more channels available than were needed, perhaps we could afford the luxury of a small group settling down on a repeater pair and staking their claim . . . all others keep off. Today, when new repeater groups are unable to find a single available pair for a new repeater, I wonder if we can still afford the luxury of private channels.

If it were brought to the attention of the FCC in any formal way, I'm sure that closed repeaters would be outlawed. Our rules are very specific about all of our frequencies being open to all. Not even long-time nets have any "right" to a frequency. A repeater does not have a "right" to a channel. The FCC felt strongly enough about this to spell it out . . . if there is a station using the repeater output channel, the repeater control operator is not supposed to permit the repeater to be turned on and interfere with the chap on channel. Control operators do *not* observe this rule, but it is still the way things are as far as the FCC is concerned. Think about it.

LOOKING AHEAD

With the two meter band almost filled to capacity, and higher frequencies becoming increasingly crowded, the Southern California Repeater and Remote Base Association has planned ahead a bit. Here's a bandplan for 2300-2450 MHz.

Pair #	*Input*	*Output*
	2300.0 Lower Band Limit	
1.	2300.8	2350.8
2.	2301.6	2351.6
3.	2302.4	2352.4
4.	2303.0	2353.0
5.	2303.5	2353.5
6.	2304.0	2354.0
7.	2304.5	2354.5
8.	2305.0	2355.0
9.	2305.6	2355.6
10.	2306.4	2356.4
11.	2307.2	2357.2
12.	2308.0	2358.0
13.	2308.8	2358.8
14.	2309.6	2359.6
15.	2310.4	2360.4
16.	2311.2	2361.2
17.	2312.0	2362.0
18.	2312.8	2362.8
19.	2313.6	2363.6
20.	2314.4	2364.4
21.	2315.2	2365.2
22.	2316.0	2366.0
23.	2316.8	2366.8
24.	2317.6	2367.6
25.	2318.4	2368.4
26.	2319.2	2369.2
27.		2380.0
28.		2390.0
29.		2400.0
30.	2330.0	2410.0
31.	2340.0	2420.0
32.		2430.0
33.		2440.0
	2450.0 Upper Band Limit	

cordingly.

"We believe some of the proposals in the petitions we have received merit serious discussion, and we are herein proposing revision of Part 97 of the Rules which, if adopted, would result in a substantial simplification of the licensing and operation of stations in the Amateur Radio Service presently licensed as repeater stations, control stations, auxiliary link stations, and all other remotely-controlled stations, such as remotely-controlled base stations. The revisions we are considering would both accommodate many of the petitioners' wishes and be a significant step in the Commission's program of deregulation of the Amateur Radio Service.

"Since adopting rules governing the operation and licensing of associated stations in 1972, the Commission has steadily reduced the burden placed on applicants for and licensees of complex systems of amateur radio stations and has afforded such licensees increasingly greater flexibility in the operation of such stations.

"Our experience since adopting the rules regulating the licensing and operation of repeater and associated stations has demonstrated that amateur radio operators are fully capable of developing and operating complex systems of stations with a minimum of regulation by the Commission. We are aware of no compelling reason why amateurs wishing to operate repeater, auxiliary, control, or remotely-controlled stations should continue to be required to obtain Commission permission before beginning such operation, as they have in the past. For this reason, we propose to delete those provisions requiring that licensees obtain prior approval of the Commission to operate a remotely-controlled station and requiring that repeater stations, control stations, and auxiliary link stations be separately licensed. We would discontinue the issuance of station licenses with 'combined' station privileges: All amateur station licenses would convey authority to operate as repeater, control, auxiliary link, and remotely-controlled stations now operate.

"Similarly, we believe that operators of other remotely-controlled stations, such as remotely-controlled base stations, have demonstrated the capability of adequately controlling the emissions of such stations, and that the prohibition against the operation of such stations from control points in portable or mobile operation, presently contained in Section 97.110(b) of the Rules, may be unduly restrictive. Accordingly, we propose to revise the Rules to permit the portable and mobile operation of all primary, secondary, and club stations, when such stations are in auxiliary or repeater operation.

"Because no new station licenses would be issued to repeater stations, as such, we propose to discontinue our policy of assigning callsigns prefixed with the letters 'WR'. Stations presently assigned such callsigns would be permitted to retain them indefinitely. A licensee wishing to engage in repeater operation and wishing to obtain a 'WR' callsign would be required to request that prefix.

"Because stations in repeater or auxiliary operations would be taking advantage of specialized modes of operation, we believe the transmissions of such stations should be distinctly identified. We propose to require that auxiliary or repeater operations conducted by stations with 'traditional' callsigns be identified by the addition of a distinctive suffix to the station callsign. Stations in repeater operation would be identified by the addition of the suffix 'R', 'RPT', or the word 'repeater' to the regular callsign.

"A petitioner seeks relaxation of certain logging requirements, and we are considering deletion of the requirement that communications from open access stations in repeater operation under automatic control be either monitored in real time by the duty or control operator or recorded and the recording retained for a period of thirty days. This requirement, which was originally intended to ensure that licensees have the capability of determining whether their stations were being used properly during periods when no control operator was on duty, has proven to be of little benefit to the Commission and may unduly burden licensees operating 'open' repeater stations under automatic control. Of course, the licensee of the station would continue to be responsible for its proper operation.

"Additionally, it appears that many Amateur operators seek greater flexibility in the choice of frequencies for repeater and auxiliary operation. We are proposing to permit both repeater and auxiliary operation on all frequencies allocated to the Amateur Radio Service, except 435 to 438 MHz, and to delete the requirement that frequencies below 225 MHz used for auxiliary operation be monitored by the control operator before and during periods of operation. We would revise section 97.63 of the Rules, however, to emphasize the two principles which have made possible the efficient operation of many amateur radio stations in relatively small spectrum space, namely, that a station using a frequency has first priority in such use over other stations, and that all frequencies allocated to the Amateur Service are shared on a non-exclusive basis. It is presently the responsibility of amateur licensees to strike an appropriate balance between these principles to ensure fair and efficient use of the available spectrum.

"The Commission is aware that adoption of the rules proposed herein could result in a significant increase in the number of repeater, remotely-controlled stations, and associated activities pursued by amateur licensees. We are also aware that severe frequency congestion is present in some parts of the country, and that the possibility exists that increased interference might result from adoption of these revisions. Many amateurs have voluntarily established techniques for managing the available spectrum, and we commend such efforts. We are not prepared to make specific recommendations in this area at the present time."

THE LIGHTER SIDE OF REPEATER COORDINATION, FROM THE CHICAGO FM CLUB

Have you ever felt that you should have more power over others in amateur radio. Your ego need a boost? Tired of having sand kicked in your face by other people on the band whose only claim to fame is that they are better operators than you? Make something of yourself the easy "Repeater Council" way!

Just follow these easy steps, and many will think of you as God, just as you do:

1. Create a file of all legitimate articles that claim that repeater coordination is necessary. These can be rewritten and distorted later to support your dynasty when under fire.
2. Coordinate a few repeaters, preferably only those using surplus commercial gear or new commercial repeaters. Ignore the "amateur" amateur repeaters until they come crawling to you on their knees. You are building the base for your power structure.
3. When one of the "amateur" amateur repeater groups (henceforth referred to as "basement repeaters") complains of interference caused by a "coordinated repeater," offer to let them move to another frequency. If they decline, label them as a "pirate repeater," and do your best to destroy their credibility.
4. Attempt to be recognized by some national organization as the sole frequency coordinating authority. This is your big step towards credibility.
5. Be careful not to support experimentation, public service groups, or anything except for narrow band FM repeaters on two meters, 220 MHz, or 432 MHz. Ignore at all costs innovations like crossbanding, ATV repeaters, portable repeaters, SSB repeaters on 10 meters, etc. Steadfastly refuse to recognize simplex as a legitimate, useful mode, and refer to it as if it were merely a squatter on the "repeater band." (An alternative is to form a simplex council to coordinate simplex users.)
6. Above all, refuse to coordinate any repeater group who refuses to pay dues "... to support the council ..." This is easily accomplished by labeling any unpaid repeater groups as pirates and assigning the same frequency pair to another machine in the same area. If a group is not current in dues, even after being coordinated by you, refuse to send them any notices of actions by the council. If the bank account becomes suspiciously large and membership services are nonexistent, open another secret account at another bank.
7. Never allow the membership to vote on anything. Make all decisions in private, and advise the membership that an "executive decision" has been made. If something *must* be put to a vote, put it in final form before asking for comments, and ask for an approval of the "principles" involved, promising a new draft. Never record the promise of a new draft, and treat the first draft as the approved version.
8. If all else fails to maintain your absolute authority over the band, and if too many nonmember repeaters are going up, or coordinated repeaters stop paying you their dues, make a proposal to the FCC to make coordination (and therefore dues) mandatory for all repeaters. This is where the articles on the importance of frequency coordination can be distorted and used to advantage. If this docket is passed, you have established a real dynasty! You can stifle all experimentation and abuse your authority! You've made it to the top of the heap and created a "machine" which will feed your ego (and your pocketbook) for the rest of your life! Congratulations!

Review

THE RSGB VHF-UHF MANUAL
by D. Evans G3RPE and
G. Jessop G6JP,
Published by
Radio Society of
Great Britain, $12.95

The job of keeping manuals even somewhat abreast of the rapidly changing state of electronic communication art must be a frustrating one. It's even worse when the manual's subject is VHF and UHF, the frequencies where techniques have undergone the most rapid change.

In an effort to bring these changes to the radio amateur in handbook form, the Radio Society of Great Britain has brought out the third edition of its *VHF-UHF Manual*. Because UHF-VHF propagation is accomplished by a different mode than that for the high frequencies, the handbook's first chapter is devoted to an explanation of how these higher frequencies are radiated. Each of the several modes of propagation is discussed in great detail, and numerous charts are used to simplify and clarify understanding.

Tuned circuits peculiar to the high frequencies are described next. The transition from lumped constant to linear to cavity is shown. Then the selection of the optimum circuit for a stipulated application is aided by a comparison table. Coupling techniques for VHF-UHF are illustrated in profusion. The variety of transmission lines covered in the handbook may astonish some readers; each is presented in adequate detail. The helical resonator and microstrip lines are shown. In addition to the more conventional tuning methods, the use of varicaps is discussed. A logical transition from tuned circuits to receivers follows.

In the next chapter, noise factors are discussed, pointing out the many sources of noise in a receiver. This, of course, includes both vacuum tubes and solid state devices. Many (tube and transistor) circuits are shown for amplifiers, mixers, and oscillators (crystal-controlled and variable frequency). Unusual devices such as parametric amplifiers and hot carrier mixers are explained. Types of demodulators for FM, PM, AM, and SSB are shown in profusion. (One can never complain of not having every type presented!) Specialized circuits (squelch, etc.) associated with each demodulating method are given ample space. As is the custom in British publications, building instructions are given for many components (and even for a complete 2.3 MHz receiver). And these, still following British custom, are presented in minute detail.

As is to be expected, a chapter on transmitters follows receivers. In it, there is a considerable degree of repetition of information presented under "Receivers." Perhaps this is good, because it saves having to search under several headings to find the whole story. But there is new info, too, including excellent tables to help you select tube types, circuits for tuned stages, and even the length of leads that can be tolerated on fixed capacitors. The section on transistor power amplifiers is outstanding. So is the one on modulation theory. It even dares to explain "capture effect" in FM reception, a subject other handbooks avoid like the plague! Speech processors are touched on lightly, omitting any reference to truly modern methods. SSB, its principles, its several methods of generation, its amplifiers, and its transverters are accorded ample treatment. Much space is devoted to construction information. (As with the receiver section, these instructions are given in great detail.)

There's a short but good chapter on filters (bandpass, trap, etc.). Antennas rate a long chapter that starts out with the concept of an isotropic radiator and then progresses through power gain, bandwidth, aperture, and polarization. Each aspect is covered well. Next come feeders, their design and construction, and their matching to loads (antennas). Finally come antennas in all their multitudinous configurations. You'll find plenty of hard-to-get information, the type that never seems to be at hand when you're searching for it. There are tables for losses due to skin effect, or losses from the resistance of different metals used in elements, and information on electrolytic corrosion, arranged in an anodic/cathodic progression.

Microwaves, with their peculiar form of generator-to-antenna transmission (waveguides), rate a full chapter. Concerning waveguides, one finds out about the mode of propagation within the guide, how to get around a corner, how to tune a waveguide, how to devise a directional coupler, how to fabricate chokes. Next, one comes upon isolators and circulators. Perhaps more could have been said about these circuit configurations. Klystrons and Gunn oscillators (typical examples of vacuum tube and solid state SHF signal generators) are given a few pages. Then one gets to equipment — sixty pages of building instructions! Since there are only two practical ways of acquiring microwave equipment, "liberating" it from military or commercial sources or building it yourself, such a plentitude of construction details is indeed valuable.

The geometry of orbiting satellites starts out the chapter on space communications. This established, there's an explanation of free space path loss, and then a discussion of just what equipment an amateur would have to have in order to make contacts by way of a satellite. Moonbounce communication rates several pages.

The final chapter is on test equipment. Not all of this is unique to VHF-UHF, but the higher frequencies are favored. The measurement of rf power decidedly is slanted toward techniques peculiar to UHF. (I can't say that for the rf bridge described, though!) The several types of VHF-UHF dip oscillators are well-designed and building instructions are good. PIN diodes as attenuators, diodes as white noise generators, and FETs as crystal-controlled signal generators follow usual patterns. A very short mention is given to power splitters and combiners. A data section and an index conclude this book.

As with most publications, no matter how painstakingly proofread, goofs creep in. Small things, mostly, like errors in circuit drafting. These are easily spotted and should cause a careful reader little confusion.

The contributors and the editor of the *RSGB VHF-UHF Manual* have done a commendable job. It's factual. It's even interesting! And that's a large job for any technical book. I highly recommend it to any radio amateur who's truly interested in VHF-UHF. Interested, that is, beyond just playing with black boxes. Interested in expanding his comprehension of all of the many facets of communication in our higher frequency bands. *Radio Society of Great Britain, 35 Doughty St., London WC1N 2AE.*

Carl C. Drumeller W5JJ
Warr Acres OK

THE BIG BROTHER GAME
by Scott R. French
Lyle Stuart, Inc. $7.95

Technology always filters down to the masses, someone once said, and he was right. Just last month, a Princeton University senior unveiled his design for a $2,000 atomic bomb (less plutonium) powerful enough to waste half of Manhattan yet small enough to fit inside a U-Haul trailer. Off-the-shelf texts contained sufficient data for bomb building.

While *The Big Brother Game* won't show you how to be the first on your block to blow up the world, it takes the wraps off well-kept secrets of government, big business, private investigators, and security agencies — how to bug a room, pick a lock, tail a car, play the credit game, change an identity, build a pistol silencer, be a spy. And as author Scott French implores, "If someone is doing it to you, stop it or do it back." He shows how to debug a room, evade followers, tell if your phone is tapped, keep premises secure, keep government out of your business, and obtain your government dossiers.

According to French, the FBI's Identification Division has files on over 190 million Americans. This includes anyone who has been in the armed services or arrested. Agencies other than the FBI keep citizen files, such as Welfare Departments, Public Schools, CIA, FCC, Veteran's Administration, and one of our favorites, the IRS.

Since the passage of the Freedom of Information Act in 1975, these agencies and others must allow citizens access to their personal files. French outlines steps to retrieve them.

While French sometimes skirts the legal edge, he rarely steps over it. After all, if it's okay for the FBI, it's okay for us; right? So, "Buy where the pros buy," French cajoles us. He lists names and addresses of manufacturers and dealers of polygraphs, bugging and debugging devices, shoe heel transmitters, lock-picking tools (used by police everywhere), and more.

And for the do-it-yourselfer, this volume contains 25 pages of James Bondian circuits, from wireless microphones to laser surveillance devices.

The Big Brother Book keeps a lively pace with tantalizing tidbits of private eye lore and nifty fun-to-tell facts — you can declare bankruptcy every 6 years and wipe out all your debts. The French police supposedly use a 25-35 kHz high-powered sound generator for crowd control. A chemical product sold under the name WD-40 spreads a light oily coating on objects which won't support fingerprints. Be the life of the party with these.

It's not the type of book you want to read straight through though. Rather, dip into it from time to time and slowly dribble information into your brain.

But for all this seemingly underground information, French warns us not to judge his motives for telling it all.

"You see," he says, "this information exists . . . Many already have this information and some are using it within the for-the-people, by-the-people law bit, some are not . . . Now by god, we all have it. Should you choose to go into the industrial spy business, start snooping around on your spouse, use this information for personal gain, use it to prevent others from abusing your rights, or simply just read it for the love of curiosity's sake, the responsibility is yours."

So it goes. Mr. French keeps the technology filtering down, and the rest is up to us.

Larry Kahaner WB2NEL
Brookline MA

THE RADIO AMATEUR'S LICENSE MANUAL
Published by the
American Radio
Relay League,
Newington CT, $1.50

The latest ARRL license manual, the 75th edition, has quite a lot of information for the money. It gives questions for study of the five classes of licenses, as well as general information on amateur licensing, international regulations, US regulations, a chart of the frequency subbands, US radio districts, and examination schedules for all the FCC examination points.

A great deal of the information in certain sections is obsolete, due to changes in the FCC regulations, but the corrections are in the back of the book, which you should read first. There are four pages which bring the information substantially up to date.

There are no more fees, for the moment, and the Novice power limit has been raised from 75 to 250 Watts. These two points are not covered. Changes in the logging rules are not as clearly explained as I'd like. The new rules eliminate all logging except the date the station is first put into service

and the date it is taken out of service, unless you have handled third party traffic or have permitted another licensed amateur to control your station. Third party traffic, of course, includes letting anyone, even a member of your family present in the shack, talk on the station transmitter.

Probably the most important change, which is not mentioned, is the fact that Technicians have been given credit for having taken their test before an FCC examiner, and are entitled to become a General licensee by merely passing a 13 word per minute code test. The Technician test was the same in coverage as the General license and thus the amateur has been able to become a General without appearing before the FCC for a written exam. (Of course he must still appear for the code test.) This should inspire a lot of Technicians to become Generals.

The manual does not make specific answers available for memorizing, but gives enough coverage of each answer so that by study you can cope, we hope, with any variation of the question. Often, when an answer is memorized, a slight change in the wording of the question makes the memorized answer completely wrong.

If I were just starting in radio, looking ahead to the material for higher classes of license beyond the Novice would probably scare me a little. If I lacked motivation, I might give up the whole idea. I believe I would rather start with a study guide for a Novice only, and cross the next bridge when I came to it.

The other thing is the fact that with all the changes in the rules evident in the manual, requiring changes in the book, I would wonder if the rest of the book would be useful to me when I was ready to step up to another license. I think I would rather have a current book.

Jerrold A. Swank W8HXR
Washington Court House OH

MAINTENANCE SERVICE MANUAL, FT-101 SERIES
Published by Yaesu Electronics Corp., $25.00

Yaesu has been importing FT-101 transceivers now for over six years, and it's pretty hard to find anybody who doesn't respect their quality and portability. Over those years, Yaesu has steadily improved the 101, incorporating receiver improvements and increased frequency coverage. Three basic versions of the 101 have been produced, ranging from the original FT-101 to the FT-101-B, and the current FT-101-E/EE/EX series. Hundreds of thousands of these radios are in use around the world, along with Yaesu's line of accessories.

Now Yaesu has gone a step further than the normal operating manual provided with the 101 series transceivers — they've produced a maintenance service manual that every 101 owner ought to have. To quote Yaesu General Manager Bernie Tower's (W6RNW) introduction, "We have departed from the traditional 'military format' in writing technique and the style may seem too informal on first reading; however, remember that our goal was to make this manual easy to use." The contents are excellent, with an orderly flow through installation, tune-up, theory of operation, and parts identification in the opening section, plus step-by-step coverage of accessory interface and disassembly of the unit in section 2. In all, there are nine segments to the manual, including thirty pages of factory-recommended modifications. (That will probably be the most sought after portion of the manual.) In addition to the hundreds of schematics and x-ray views of the PC boards contained in the first eight sections of the book, Yaesu also included 9 foldout schematic diagrams covering all three versions of the FT-101. To conclude, we turn again to Bernie Tower's introduction. "You will find inside these covers not just a list of clipped out circuit descriptions and redrawn prints, but also all the tricks and neat stuff that the factory has developed — extras that never show up in operators' manuals, such as part location data, test points, a wealth of 'How To Do It' instructions, and the special information our service files contained." That says it in a nutshell!

Warren Elly WA1GUD
Assistant Editor

RADIO COMMUNICATION HANDBOOK (Vol. 1)
Published by Radio Society of Great Britain, $18.95

One weakness of handbooks is the inability of publishing one that is abreast of the state of the electronic art. This weakness is compounded when revisions are made attendant to bringing out later editions. There's just too much temptation to carry over material from the previous printing, sometimes in its entirety, sometimes with minor updating.

The fifth edition of *Radio Communication Handbook*, edited by Pat Hawker G3VA, shows that a determined effort was made to avoid such a pitfall. The effort was partially successful.

Volume 1 of the new edition shows promise of being a noteworthy advance in handbook publication. Much obsolete material has been eliminated, with old subjects treated in a new way and new techniques introduced.

Why should American radio amateurs go to a British handbook when there are several excellent ones published in this country? In partial answer, it may be said that the British pay more attention to details of theory, and much more attention to precise construction information. Another part of the answer may lie in the manner in which the British authors approach the explanation of principles. It's somewhat different, and there's no doubt that better comprehension of a subject can come from a study of a variety of presentation styles. It's good to bear in mind that this handbook does not replace any of the domestic ones. It serves to complement, not to supplant.

As is the case with other handbooks, this one starts with principles. But, unlike the others, it doesn't mention theory until it has introduced components, giving types and applications. Then it brings on the theory of how these components act in circuits. Although the theory is simple, the handbook does not presume the reader is "simple." The presumption is that the reader is intelligent and not frightened by the sight of a few mathematical equations. It's significant to note that the examples involve modern components and applications, a pleasant contrast to most handbooks (which have not changed from presentations that were old in the 1920s!). The *Radio Communication Handbook* is not totally devoid of faults, however, as it bows to the antiquated custom of having current flow opposite to electron flow!

The chapter on principles is extensive enough to cover not only the simple basics, but also to go far beyond to tuned circuits, filters, rf impedance matching, radiation and propagation, amplification, feedback, modulation in its many diverse forms, and its inverse: detection. It's thought-provoking to note that the British author declares the crystal detector to be the first-used type, undoubtedly causing his compatriots, Marconi (magnetic detector) and Fleming (thermonic diode), to flip in their graves!

Another chapter explains vacuum tubes. It is more or less conventional, except for the profundity of its detail and the space devoted to unusual tube types and applications. Modern design has drifted far away from the mundane applications of tubes, leaving only those instances in which the tube uniquely serves a purpose. And it's for these unique purposes that the text is admirably suited.

Only five pages are used to expound on the theory of semiconductors. Then the book gets into specific types, their behavior, and their applications. The author does it so well he can be forgiven for writing "cat's whisker" instead of "cat whisker." He's not the only one to make that mistake! He is to be congratulated on covering the IMPATT diode, the PIN diode, and the Gunn diode so effectively. Transistors of all commonly-used types are shown, and their uses discussed. ICs get short shift, with a promise to mention them later (in connection with their application in equipment).

Chapter 4, Receivers, starts by defining terms and talking about what would constitute a really good receiver. Then it describes the many generic types of receivers. This is done not so much in detail as in scope — the reader will have an acquaintance with just about every type of receiver used. Terms such as sensitivity, selectivity, stability, spurious responses, cross-modulation, blocking, intermodulation, and tuning rate are defined and expounded upon. Then design factors are discussed, with a wide range of choices. Circuits galore are shown. For the very ambitious, construction details are given. In this, one sees a marked difference between American and British handbooks. The British present much greater detail. Too, they expect the reader to construct more mechanical components. If you're a dedicated do-it-yourselfer, you'll appreciate such instruction!

A separate chapter is devoted to VHF and UHF receivers. As might be expected, it opens with the differences between designs and components for the higher frequencies, and those for the HF region. Next, it presents circuits — oscillators, buffers, multipliers, amplifiers, and mixers. The circuits are followed by construction details (with detail underlined) for a variety of receivers, converters, oscillators, preamplifiers, and power supplies. You'll even see such unusual items as a folded hybrid ring mixer using linear (not lumped constants) elements.

Chapter 6 is on HF transmitters. It follows the usual outline, with just a bit (in this writer's opinion) too much space on crystal oscillators. Oh, it's good. But maybe too good for the strictly limited use of crystal oscillators in modern transmitters. It's equally good on VFO design, discussing the effects of external factors (temperature, following stages, etc.) on short-term stability. There's an astonishing variety of VFO circuits, with component specifications. Both tube and solid state types are shown.

From oscillators, a logical sequence is followed to coupling circuits, and then on to buffers and amplifiers, with a sidestep to frequency multipliers. Power amplifiers, as might be expected, get the big play. A bit too much space is allotted to neutralized triodes. (When was the last time you built one?) The design of tank circuits is given much (and merited) detail. Output circuits for both tube and transistor active elements are also discussed. Construction information is given for several transmitters.

Then, and only then (for some illogical reason), there's a discussion of the principles and merits of SSB. Then comes the usual plethora of circuits for generating DSB signals or SSB signals. Mixers are covered well, as are the considerations for mixing frequencies. The usual advice is given on the selection of a suitable active device (tube or transistor) for an amplifier, with due thought given to the various conditions that lead to linearity of operation. The use of two-tone af inputs to check PEP output is discussed in detail. Omitted, however, is any reference to the use of a spectrum analyzer as the ultimate device for ascertaining overall signal purity. A considerable space is given to construction of SSB transmitters. Both tube and solid state types are shown. In each instance, highly detailed information is provided.

The seventh chapter is devoted to VHF and UHF transmitters. It repeats quite a bit of information on crystal-controlled and variable oscillators. Linear circuits, both transmission line and cavity types, are explained very well, but there is some repetition of the modulation, mixing, and oscillator frequency selection data provided in previous chapters. Construction details are provided for several UHF transmitters, and they are probably

superior to any available in other handbooks.

A short chapter is devoted to keying and break-in systems. Some are simple, others complex. You can take your pick from a variety of types.

Considering current times, the *Radio Communication Handbook* devotes too many pages to the many methods of producing amplitude modulation (AM). It's improbable that a half dozen AM transmitters have been built in the USA or Canada in the past five years, and I doubt whether the system is any more popular among English builders! So why such detail? On the positive side, considerable space is given to frequency and phase modulation. Speech amplifiers are touched upon, as are speech processors, the latter in a rather uninspiring manner. The chapter is concluded with methods of measuring modulation quality.

The final chapter of Volume 1 is on radioteleprinters. It's short but adequate. In this instance, little construction advice is given. Textual material is followed by an excellent index. American readers may not care for the British practice of omitting page numbers in favor of chapter subdivisions. It's easy to live with, though.

In summary, Volume 1 of the fifth edition of *Radio Communication Handbook* fills a niche in radio literature that has been somewhat neglected With a few exceptions, it's thoroughly modern, devoted to current techniques and components. It belongs on the bookshelf of every serious amateur of radio technology. But it should be set away on that bookshelf only after it has been well-thumbed! *Radio Society of Great Britain, 35 Doughty St., London WC1N 2AE.*

Carl C. Drumeller W5JJ
Warr Acres OK

FCC

Report No. 12746
ACTION IN DOCKET CASE
FCC PROPOSES TO SIMPLIFY AMATEUR LICENSING AND CALLSIGN ASSIGNMENT
(DOCKET 21135)

On March 3, the Commission proposed to simplify the licensing and callsign assignment systems in the Amateur Radio Service.

The FCC said that the explosion in interest in personal radio communications had placed a heavy burden on those Commission staff issuing licenses. The Commission noted that it was aware that many Amateur licensees were dissatisfied with the speed of license processing and indicated it was considering methods to improve the process.

It added that its resources for processing amateur applications were extremely limited, and that its lack of resources now precluded all but the most basic licensing functions.

Accordingly, the Commission proposed to simplify Amateur licensing by discontinuing the issuance of all amateur licenses, other than primary station licenses, including military recreation, club, special event, Radio Amateur Civil Emergency Service (RACES), and secondary station licenses. (The Commission noted that in Docket 21033 it had proposed elimination of repeater, auxiliary link, and control stations.)

Licensees currently holding such station licenses would be permitted to retain them, but would not be able to renew them upon their expiration. In proposing elimination of all but primary station licenses, the FCC said that a disproportionate percentage of its resources were devoted to processing applications for non-primary amateur stations, which constitute only a small part of the amateur population, and that such resources must be allocated in a more efficient manner.

The Commission also recognized that elimination of the station types involved would have an impact on some individuals, but that it believed any such impact would be minor.

The FCC noted that the assignment of amateur callsigns also occupied an inordinate amount of staff time, and proposed to simplify the callsign assignment system in the Amateur Service by prohibiting entirely the assignment of specific callsigns and callsigns based on particular formats. All callsigns would be assigned on a systematic basis by the Commission under the terms of the proposal. Licensees holding Amateur Extra Class operator licenses would be permitted to obtain nonspecific 1x2 and 2x2 callsigns, however.

Comments on the Commission's proposals, which would amend Parts 1 and 97 of the Commission's Rules, are due by June 2, and reply comments by June 30.

Report No. 12743
ACTION IN DOCKET CASE
FCC SETS "CLOSED SEASON" ON 2 TYPES OF AMATEUR RADIO APPLICATIONS
(DOCKET 21135)

The FCC has announced that, effective March 3, there will be a "closed season" on filing applications for special event stations and secondary stations in the Amateur Radio Service. (A secondary station is a separate station licensed to an amateur operator for a location other than the primary station site, such as a vacation home or office. A special event station is one licensed for temporary use involving an event of either general interest to the public or of particular interest to amateur operators, and intended to draw favorable public attention to the Amateur Service.)

The Commission said that it had been receiving many frivolous applications for secondary station licenses during the past two months, and that these applications were beginning to burden its amateur radio processing staff. The Commission also said that it anticipated a flood of new applications for secondary and special event station licenses as soon as its proposals in Docket 21135, one of which is to eliminate the availability of such station licenses, are made public.

To make possible the continued efficient processing of other amateur radio license, the Commission imposed an immediate closed season on the filing of applications for special event and new secondary station licenses. All applications for special event station licenses or new secondary station licenses received on or after March 3 will be returned, the FCC said. Applications for renewal or modification of existing secondary station licenses will continue to be accepted.

AMSAT

Mode B users of the AMSAT-OSCAR 7 satellite were treated to an unexpected bonus of over three continuous weeks of orbits in which the 70 cm to 2m mode was kept on. This was done to reduce a battery overheating problem which had developed. In mid-December, 1976, the nicad battery temperature was about 36°C (79°F). As the weeks passed, the temperature began to increase because the orbit of A-O-7 was such that the satellite saw less and less of the earth's shadow. By January 17, 1977, the bird was in complete sunlight, and the temperature continued to rise at an alarming rate to over 44°C (111°F). This overheating was being caused by the constant charging of the battery, especially while in Mode A when the load is relatively light. Switching to the redundant charge regulator had little effect on the rising temperature, so the decision was made to command A-O-7's 70 cm to 2m on continuously, in order to reduce the charging of the battery.

With a number of stations still running excessively more than the recommended maximum 100 Watts ERP, there would have been more occasions of A-O-7 switching to Mode A or even worse to Mode D, the recharge mode. This switching of modes occurs when excessive current demands cause the bus voltage to drop below a preset level. When this occurs, the sensor's undervoltage signal causes the mode switch, which is supposed to protect the satellite's battery from being further run down. Even though the battery was being charged to a normal value, it was not able to supply the very heavy peak currents being demanded when high-powered satellite users were transmitting, so it switched modes.

In order to reduce the number of mode switches which had been occurring in December and January, we tried to keep A-O-7 in Mode C, which is a lower power 70 cm to 2m mode. When in Mode C, there were no more false mode switches, so the primary telecommand station for A-O-7, VE3SAT, commanded the satellite into this mode whenever possible. Because of its design, the satellite switches from Mode C to B after 24 hours have elapsed on the spacecraft's clock, and from Mode B to A after another 24 hours. When a false mode jump occurs, the clock is reset. This lets us know when the jump occurs, so we can see where the satellite was when this happened.

As you can imagine, commanding became very complicated when the mode jumping began to occur, but Randy's 8080 microprocessor-based command station came through with an excellent performance, keeping A-O-7 in the correct mode during the battery temperature crisis. By mid-February, the battery temperature began to stabilize, and then to decrease enough to allow A-O-7 to switch back to its normal schedule of Mode A on odd days of the year and Mode B on even days. This switch occurred on February 18, 1977.

One final note of interest concerning the VE3SAT automated command station: During the last week of the battery temperature problem, Randy was called away from home, leaving the automatic system on to run on the information programmed into its memory. Among the duties which it performed flawlessly were keeping the satellite in the proper mode, automatically commanding the 2m beacon from the codestore mode to the proper telemetry mode for an acquisition by WØLER of sun angle data, automatically loading the on-board A-O-7 codestore memory with a new message, switching the beacon from RTTY teletype telemetry to the codestore run (which played back the new message to the world for a day), again switching the beacon to the telemetry mode, and programming the satellite to switch to Mode A on February 18th.

A-O-6 NICAD CELL FAILS; SUNDAY DESCENDING NODE ORBITS DISCONTINUED

A failure of part of the 18-cell A-O-6 battery has forced the early curtailment of the Sunday descending node (north to south) orbits of the satellite. The failure of the cell was noticed by a number of telemetry gatherers who saw an abrupt drop in the channel 3A telemetry count, from counts around 62 to counts around 48. This indicated a problem in the upper half of the battery series string, since the half battery voltage measurement was normal (the lower half, that is). Since the battery is a series of cells, the failure of a single one has an adverse effect on the bus voltage. The bad cell acts somewhat like a diode when the battery is discharging, and like a series resistance when it's charging. The effect thus is lower available battery voltage and a reduced charging current. Combine the cell loss with the already reduced Ampere-hour capability of its 4-year-old battery, and the result is that the operating schedule of A-O-6 must be reduced.

The Sunday descending node orbits, which were scheduled to be available until the end of March, 1977, had to be discontinued. Also, the worldwide network of A-O-6 command stations has been instructed to turn off the satellite before it goes out of range during scheduled on orbits. The present schedule for A-O-6 calls for the transponder to be on for normal use on ascending node (south to north) orbits on Mondays, Thursdays, and Saturdays, UTC. This schedule will remain in effect as long as the battery remains stable at present levels. In the event of further degradation of the battery, it will become necessary to further cut back on the present schedule of the transponder.

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

My apologies to WA4BMC for incorrectly listing her address in the January issue as being in Lake Worth FL. The correct address is: PO Box 6811, Southboro Stn., *West Palm Beach* FL 33405. A large SASE with return postage for 3 oz. will bring complete information on county hunting and the MARAC organization, as well as mobile reply QSL cards, QSL bureaus, etc. Hope this did not inconvenience anyone.

TRIPLE LETTER QSO PARTY

Starts: 2000 GMT May 7
Ends: 2000 GMT May 8

All amateurs are eligible and invited to participate. Use all HF bands, 160 to 10 meters. One contact per band per mode (CW and phone only) with each station.

SCORING:

One point for each letter repeated in the suffix of the call of the station contacted. Example: WB2GFE = 1 pt.; WØETT = 2 pts.; WØEEE = 3 pts. Two letter calls get one extra point. Multiplier is the total number of states, Canadian provinces, DX countries (other than US and VE), and number of 3-letter calls. Total score = QSO points times multiplier from each band.

EXCHANGE:

Serial QSO number and RS(T).

ENTRIES:

Send logs postmarked no later than June 1st to WØEEE, UMR Radio Club, Eng. Bldg., Univ of Mo., Rolla Rolla MO 65401. Mark the envelope: "ATTN: QSO PARTY."

GEORGIA QSO PARTY

Starts: 2000 GMT,
Saturday, May 7
Ends: 0200 GMT,
Monday, May 9

Sponsored by the Columbus ARC, there are no time or power restrictions, and contacts may be made once on phone and once on CW on each band. Oscar counts as one band. GA mobile or portable stations count as a separate station in each county.

EXCHANGE:

QSO number, RS(T), and QTH – county for GA; state, province, or country for others. GA to GA contacts are permitted.

SCORING:

Each completed contact counts 2 points. GA stations multiply QSO points by number of different states and VE provinces worked. DX stations may be worked for QSO points, but do not count as multipliers. Others multiply QSO points by number of GA counties (159 max.). No repeater QSOs permitted, except via Oscar!

FREQUENCIES:

CW – 1805, 3590, 7060, 14060, 21060, 28050; SSB – 3900, 3975, 7245, 14290, 21360, 28600; Novices – 3718, 7125, 21110, 28110. Try 160m at 0300 GMT, 10m on the hour, and 15m on the half hour during daylight hours.

AWARDS:

Certificates to highest scoring station in each state, province, country, and GA county. Other certificates as warranted. Plaques to highest scorers outside GA and GA mobile/portables.

ENTRIES:

Logs should show: date/time in GMT, call, exchange sent/rcvd, band, emission type, and multipliers claimed. Checklists appreciated. Include a signed declaration (usual) and mail your entry to Columbus ARC, c/o Jeanne J. Hunting K4RHU, 2701 Peabody Ave., Columbus GA 31904. Entries should be postmarked no later than June 6th. Include a large SASE for results. Note: Novices should designate their logs as such!

VERMONT QSO PARTY

Starts: 2100 GMT May 7
Ends: 0100 GMT May 9

Sponsored by the Central Vermont Amateur Radio Club, the contest is open to all amateurs. The same station may be worked once on each band and mode. Mobile stations may be worked from each new county. QSO Party contacts can be credited toward the W-VT (Worked VT Award) for working 13 of VT's 14 counties.

EXCHANGE:

QSO number, RS(T), and county for VT stations; ARRL section for others.

SCORING:

VT stations score 1 point per contact and multiply by the number of ARRL sections and countries worked. All others score 3 points per VT station worked and multiply by the number of VT counties worked *on each band.*

AWARDS:

Trophies to highest scoring station outside VT and single operator in VT. Certificates to high scorers in each ARRL section/DX and to 2nd, 3rd, and 4th highest scoring VTs. Special certificate, too, for multi-operator and mobile stations in VT.

FREQUENCIES:

Try CW on odd hour and phone on even hour GMT ... 3555, 7055, 14055, 21055, 28160, 50260, 144-144.5, 3909, 7290, 14325, 21375, 28600, 50360, 145.8, 3932.

LOGS:

In order to be eligible, logs or copies should be sent with an SASE before June 15th to: Peter Kragh W1AYK/K2UPD, 170 Summit Ave., Ramsey NJ 07446.

KANSAS QSO PARTY

Starts: 2000 GMT,
Saturday, May 14
Ends: 2400 GMT,
Sunday, May 15

Work each station once per band per mode. Remember that CW and phone segments are separate bands.

EXCHANGE:

KS send RS(T) and county; others send RS(T) and state/province/country.

FREQUENCIES:

Look for CW 55 kHz up from the bottom of the band, and phone 25 kHz above Advanced/General split.

SCORING:

KS stations multiply number of QSOs times sum of states, provinces, and other ARRL countries worked. Others multiply total KS contacts times the number of KS counties worked (105 max.).

ENTRIES/AWARDS:

Awards to top scorers in each state/province and ARRL country. Send logs and comments to: Robert Davis KØFPC, 1857 South 4th, Salina KS 67401. Be sure to include your name and address. SASE is not required for summary of results.

MICHIGAN QSO PARTY

Starts: 1800 GMT,
Saturday, May 14
Ends: 0200 GMT,
Monday, May 16

This year's contest is sponsored by the Oak Park ARC. This year phone and CW are combined into one contest. MI stations can work MI counties for multipliers. A station may be contacted once on each band/mode. Portable/mobiles may be contacted as new contacts each time county changes.

EXCHANGE:

RS(T), QSO number, QTH – county for MI; state or country for others.

FREQUENCIES:

Phone – 1815, 3905, 7280, 14280, 21380, 28580; CW – 1810, 3540, 7035, 7125, 14035, 21035, 21125, 28035, 28125. 1600 to 1900 GMT, try 15m on the hour, 10m on the half hour. VHF – 50.125, 145.025.

SCORING:

Multipliers are only counted once. For MI stations: 1 point per QSO times (states + countries + MI counties). KL7 and KH6 count as states. VE counts as a country. Max. multiplier = 80. Non-MI: QSO points times MI counties. Max. multiplier = 83. QSO points = 1 point each MI QSO, 5 points each MI special event station QSO (no ITU suffixes). VHF-only entries, same as above, except multipliers per VHF band are added together for total multiplier.

AWARDS:

Only single operator entries qualify. Several trophies, plaques, and certificates will be given, as appropriate.

ENTRIES:

A summary sheet is requested, showing scoring and other pertinent info (name and address in *block letters*, and a signed declaration that all rules and regulations have been observed). MI stations include club name for combined club score. Results will be final on July 30th, and will be mailed to all entries. Mailing deadline

CALENDAR

May 7-8	Triple Letter QSO Party
May 7-9	Georgia QSO Party
May 7-9	Vermont QSO Party
May 14-15	Kansas QSO Party
May 14-15	Mass. QSO Party
May 14-16	Michigan QSO Party
May 15	World Telecommunications Day – Phone
May 22	World Telecommunications Day – CW
June 4-5	IARS/CHC/FHC/HTH QSO Party
June 11-12	ARRL VHF QSO Party
June 18-19	West Virginia QSO Party
June 25-26	ARRL Field Day
July 2-3	QRP – Summer – Contest
July 4	ARRL Straight Key Night
July 9-10	IARU Radiosport Championship
July 16-17	Apollo II 8th Anniversary Contest
July 16-17	10-10 Net Summer QSO Party
Aug 20-21	New Jersey QSO Party
Aug 20-21	Worldwide SARTG RTTY Contest
Sept 10-11	VHF QSO Party
Oct 1-2	Open CD Party – CW
Oct 15-16	Open CD Party – Phone
Oct 15-17	Manitoba QSO Party
Nov 5-6	ARRL Sweepstakes – CW
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

is June 20th, to: Mark Shaw WA8EDC, 3810 Woodman, Troy MI 48084.

During MI week, May 14 to 21, all MI QSOs may be counted toward the following awards/certificates offered by the governor of MI:

1. A MI ham submits log info and names/addresses of 15 or more contacts made with out-of-state or DX hams with information regarding MI.
2. An out-of-state ham submits log information and names/addresses of at least 5 MI hams who related facts to him about MI (includes VEs).
3. Foreign ham (excluding any resident of Canada) submits the call letters and name/address plus log information for at least one MI ham who has told him about MI.

Only QSOs made during MI Week, May 14-21, will be considered valid. All applications for certificates must be postmarked by July 1st and mailed to Gov. William Milliken, Lansing MI 48902.

WORLD TELECOMMUNICATIONS DAY CONTEST

Phone
0000 GMT to 2400 GMT,
Saturday, May 15
CW
0000 GMT to 2400 GMT,
Saturday, May 22

Sponsored by the Brazilian Ministry of Communications, this contest has been instituted in order to commemorate yearly the "World Telecommunications Day" (May 17th). Each participating radio amateur will attempt to make the highest possible number of contacts with the different ITU zones of the world in order to enable his country to win the ITU trophy. All bands, 160 to 10 meters, and all modes, phone/CW, may be used. Categories include: single op, multiband, fixed or mobile in maritime ITU zones 76 to 90, clubs/associations as multi-op/multiband.

EXCHANGE:

RS(T) and *ITU zone.*

SCORING:

Contacts with stations in same country = 0 points. Different country, same ITU zone: 10-40m = 1 pt., 80 and 160m = 2 pts. Different country, different ITU zone, same continent: 10-20m = 2 pts., 40m = 3 pts., 80 and 160m = 4 pts. Different country, different ITU zone, different continent: 10-20m = 3 pts., 40m = 5 pts., 80 and 160m = 6 pts. Final score is total QSO points times total number of different ITU zones. Same station may be worked on different bands for additional QSO points, but multipliers only count once regardless of bands. The country score will be the sum of the top five scores from the country on each mode.

AWARDS:

Gold, silver, and bronze medals will be awarded to the three highest scoring stations in the world on each mode. Diplomas will be awarded to the three highest scoring stations in each country on each mode. For countries with high numbers of entries, diplomas to the top three in each call area.

ENTRIES:

Separate logs for each mode and must show time/date in GMT, exchange, band, multipliers, and QSO points. Include a summary sheet. Logs must be postmarked before June 30th and addressed to: LABRE, UIT Contest Coordination, PO Box 07-0004, 70.000 – Brasilia, DF, Brazil.

SAN JOSE BICENTENNIAL AWARD

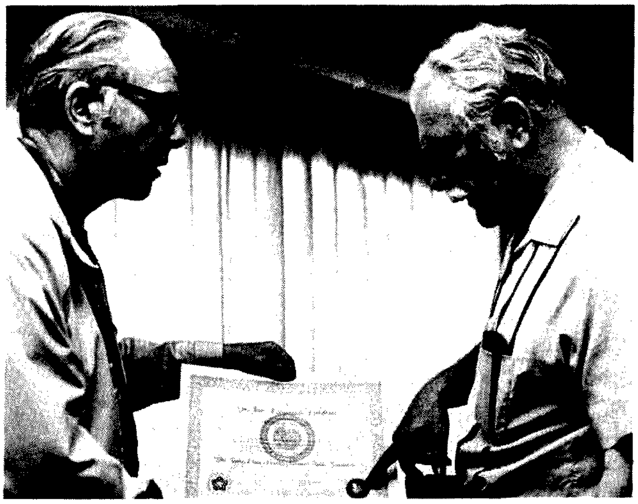
The handsome 3-color certificate of award offered by the Santa Clara County Amateur Radio Association to celebrate the 200th anniversary of the founding of San Jose, California, will now be easier to earn for ham radio operators outside the continental United States. For such stations, point values have been doubled over those originally announced when the certificate first became available. This change was made in recognition of the present low level of sunspot activity and consequent low level of casual DX activity.

The San Jose Bicentennial Award is given to all stations requesting it who accrue a total of 200 points, according to the table below. The list of stations worked must include a specified minimum number of SCCARA members (given in parentheses in the table) and may include contacts with either of the SCCARA club stations, W6UU or W6UW, other stations in the San Jose area (Santa Clara county), and stations outside of Santa Clara County but in the Pacific Division of the ARRL.

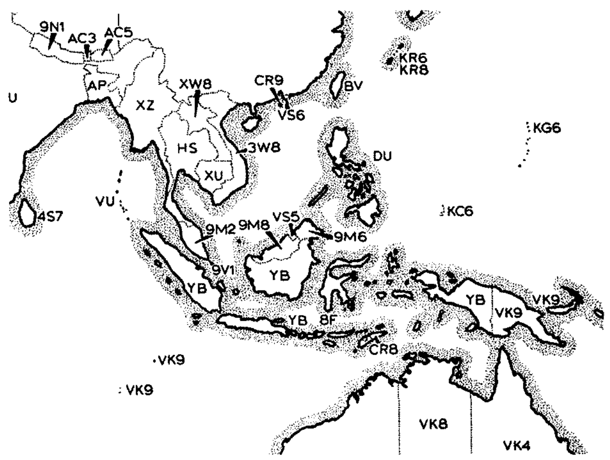
TABLE OF POINTS

From outside cont'l U.S.:	
W6UU or W6UW	100 points
SCCARA Members	50 (2)
Other S.C. County	4
Pacific Division	2
From 6th District outside S.C. County:	
W6UU or W6UW	20 points
SCCARA Members	10 (5)
Other S.C. County	2
In U.S., outside 6th Dist.:	
W6UU or W6UW	50 points
SCCARA Members	25 (2)
Other S.C. County	2
Pacific Division	1
From inside S.C. County:	
W6UU or W6UW	10 points
SCCARA Members	5 (10)
Other S.C. County	1

Applicants for the award should send their list of stations worked, with pertinent log data (no QSLs necessary) to the club secretary at SCCARA, PO Box 6, San Jose CA 95103. With the application, include $1.00 U.S. or 5 IRCs to cover part of the cost of preparation and mailing.



Bill Vette K6TXR was the designer of the San Jose Bicentennial Award certificate. Here he shows it to Dick Barrett W6CFK (on the left). Dick originally proposed that the club issue the award.



Southeast Asia, amateur prefix style. Thanks to Old Man, *the Bulletin of Swiss Short Wave Amateurs.*

RESULTS

RESULTS OF THE 1976 EUROPEAN DX CONTEST, WAEDC – RTTY
Trophy winners:

CT1EQ – Europe single op	W1MX – North America multi-op
I1PYS – Europe Multi-op	DJ4KW/4X – Asia
WAØYDJ/4 – North America single op	I3-13018 – SWL

Of 41 entries listed in the results, only 3 were from the US, in the single op category – How about a little more activity next year?!

Briefs

from page 18

isn't capable of handling the hundreds of complaints, and those who have nothing more than canceled checks to show for their Trigger orders may well have to hire their own lawyers to get their money back. The Illinois AG brought charges against Treger last year, but ran into delay after delay in seeking a court ruling. But, now that the court seems ready to act, Assistant AG McPhee's work is far from over. Next he must begin preparations for answering the hundreds of people who have filed complaints, and help them (or their attorneys) collect. "The trouble with my job," McPhee told *73*, "is that the work only really begins after the trial is over."

Recent interviews with FCC field office officials indicate that since the elimination of license fees early in 1977, the amount of prospective amateurs failing exams has drastically increased. Here are some results from a western office early in February: Technician – 5 passed, 4 failed; General – 3 passed, 15 failed; Advanced – 16 passed, 0 failed; Extra – 1 passed, 4 failed.

Thanks to the *West Coast DX Bulletin*: The FCC has reportedly clarified how to measure Novice power. Now the measurement must be all power into the final tube (exclusive of heater power). Thus a screen-grid final must not only include the plate input power but also the screen-grid input power. The *Bulletin* also reports that the Marconi Memorial Station, II4FGM, is usually active on weekends between 1600Z and 1800Z. That's 20 and 15m SSB and CW. QSL to I4BFY or PO Box 3113, Bologna, Italy.

We stand corrected on our March new product review concerning the Hy-Gain 3750 transceiver. We reported it to be the most expensive amateur transceiver available, but as K4AVU points out, the Collins KWM-2A is priced at $3533, nearly $1500 higher than the 3750.

All eyes had begun to focus on Dayton at deadline . . . the April 29, 30, May 1 extravaganza will hold quite a few surprises in the way of equipment and ham radio politics. It will also mean the naming of "The Radio Amateur of the Year" and "The Specific Event Achievement Award," aimed at one or more radio amateurs for participation in an outstanding event associated with ham radio during 1976. See you there!

IRS (the Interstate Repeater Society) auction in Nashua NH. The 73 booth is at the left center with Technical Editor Rich Force WB1ASL, Executive Editor John Molnar WB2ZCF, and Marketing Director Sherry Smythe hard at work.

Until recently, very little two meter coverage has been available on a large section of the Pennsylvania Turnpike, one of the most heavily traveled routes in the country. That's been changed, with the arrival of WR3AIZ, a 147.75/147.15 machine now operating from Blue Knob mountain, 17 miles southwest of Altoona PA.

Turnpike coverage extends from mile marker 100, near Somerset, to mile marker 200, near Carlisle, assuming average power and antenna. The machine is carrier-access and open to all, 24 hours a day.

Sign of the times in Canada: A licensed amateur operating a rig that was cleaned up to DOC recommendations was recently fined $100 dollars in small claims court in Quebec for "inadvertent jamming of radio and TV shows." Four of the man's neighbors filed the complaints, for which he could have been fined a maximum of $1600. The honorary counsel for the Radio Society of Ontario and the counsel for the Canadian division of the ARRL are currently investigating the case.

The Six Meter International Radio Klub (SMIRK) has proposed some interesting changes to the FCC. Assigned RM number 2832, SMIRK has petitioned for all classes of license (except Novice) to be granted CW status between 50.0 and 50.1 MHz, a segment currently reserved for Advanced and Extra. SMIRK argues that their plan would allow more Technicians access to CW practice through operating, since they'd need to add extra equipment to get on the Novice bands recently authorized at HF. Thanks to K5ZMS.

Updating our guest editorial last month on the Buffalo snow disaster: WBEN's lead in rebroadcasting CB and amateur traffic reports on the BC band has been endorsed by the NAB. In a filing with the FCC, assigned number RM-2830, NAB argues that broadcasters are in a good position to use emergency information taken from ham and CB sources for the public good. No opposition is reported.

With the deregulation of repeaters proposed by the FCC, frequency changes will be common. This could mean added crystal expense for users.

Clubs could follow the lead of the Minuteman Repeater Association, which used a "crystal bank" after their users invested in crystals for a repeater whose frequency had to be changed. Regular users of the Stoneham (MA) machine found that QRM from another repeater made copy difficult. All parties agreed that the Stoneham machine would exchange frequencies with a low power CD machine which was primarily used for emergencies. The Minuteman's editor reports that the frequency exchange is working fine.

An experiment in sporadic-E propagation on six meters is underway on the north coast of Brittany, France. A F3THF beacon is on the air at 50.1 MHz. It uses FSK keying at 170 Hz shift. Initial power is 100 Watts, although if no RFI problems are encountered, that will be raised to 1 kW.

The antenna is aimed toward Central America, and should provide the east coast of the United States some coverage. Initial plans are for the beacon to be on the air from May 1st to August 31st each year. Reports should be sent to Ed Tilton W1HDQ, ARRL, 225 Main St., Newington CT 06111. Thanks to the Six Meter International Radio Klub (SMIRK).

"Contestor's Luck" continued, sunspotwise, through the second weekend of the ARRL DX Contest. European signals on the East Coast surpassed the S9+ mark for two consecutive days, March 5th and 6th. Several long-time DXers called it the best 15m conditions in 3, even 4 years! CW weekends weren't bad either, with the first session serving up superb openings on 15m and 10m as well.

New Products

from page 30

200 hours battery life in a small hand-held case. The unit measures dc volts from 100 uV to 1 kV, ac volts from 100 uV to 750 V, dc and ac current from 100 nA to 20 A, and resistance from 100 uΩ to 20 megs. The basic accuracy of reading on dc V is 0.1% ±1 digit. Features of the Model 22 include: hand-held portability, 200 hours battery life (disposable batteries), large .5 inch LCD display, current measurement to 20 Amps, standard size batteries, overload protection, 0.1% basic accuracy, reading hold feature, and rugged construction.

The Data Tech Model 22 digital multimeter has been called the "Ultimate DMM," because no specifications are sacrificed to implement the small case size. The field service engineer can achieve laboratory grade accuracy in a hand-held DMM that can be read in direct sunlight.

The Model 22 is available with disposable batteries, nickel cadmium rechargeable batteries (60 hours operation per charge), or for ac operation. Optional accessories include carrying case, test lead kit, push-to-hold (reading) probe, high voltage probe, and rf probe. The basic selling price of the Model 22 is $234. *Data Tech, 2700 South Fairview, Santa Ana CA 92704.*

HARRISON HOTLINE

A new tollfree "Order Hotline" has been established by Harrison Radio Corporation for amateur radio equipment and accessories ordering. The new number is (800)645-9187. It will be available for use by retail customers, as well as the dealers being serviced by Harrison's "Two-Step" Division. The new WATS number is nationwide, excluding New York State.

NEW HEADQUARTERS FOR AP PRODUCTS

AP Products, Incorporated, of Painesville OH, is expanding its facilities with the addition of a new headquarters building.

The new building at 1382 West Jackson Street in Painesville is now housing the company's Customer Service, Accounting, and Management offices.

The original facility at 72 Corwin Drive, just around the corner, will now accommodate an expansion of the company's Engineering Services department.

Mail to the company can still be addressed to Box 110, Painesville OH 44077. The same phone number is still in use: (216)-354-2101.

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

It's been just a couple of months since WR6AMD returned to the air after a two month and five day hiatus. You remember WR6AMD, or rather WR6ABE. It had been abused beyond belief, taken over by a small but inconsiderate group of users who had little or no regard for themselves or anyone else. In desperation, Bob Thornberg WB6JPI had taken the system off the air, restructured its operational parameters, and instituted a rather stringent set of regulations to guide its day-to-day operation. It was to be a "make it or break it" attempt to save a repeater system that had been one of the nation's pioneering efforts in this field. I wrote at that time: "Would it be greeted by a group of enthusiastic people, eager to build a new standard of open format repeater operation, or would the promised vendetta of a selfish few be the key to making WR6ABE go dark forever and perhaps signal the end to open format relay communication elsewhere?"

For all intents and purposes, WR6ABE returned to operation on Wednesday, January 5, 1977, rather than on the first, as promised. They had come on at about 10 am on the first, but went dark again in support of L.A.'s first Repeater Appreciation Week. At about three in the afternoon on the fifth, WR6ABE (now under the callsign WR6AMD) came back to life. The first few days were quiet; I sort of suspected they would be. Repeater Appreciation Week had caught virtually everyone by surprise, and that, not AMD's return, was the main topic of discussion. It started over the weekend — the direct violation of the guidelines to see if JPI and crew really meant business; the jamming of the system with noise, carriers, and at times even music; the mild but noticeable "baiting of the control stations" to see what could be gotten away with. Quickly came the response: first the dropoff of the repeat function, followed by a taped statement that said that in the opinion of the control stations, operation was below the standard set for the system and that a penalty of "x" number of minutes was being exacted. Then came the penalty itself, in the form of system explanation, *QST* bulletins, *HR Report*, etc. The control stations were for real and they did intend to enforce the rules.

It took about two weeks for the control operator baiting to subside; it had been expected and anticipated, and the numerous control stations handled this situation in a way that proved that their choice had been the right one. It did not take long for those who had previously held exclusive title to ABE/AMD's air time to find out that their action would not be tolerated. Soon many lost interest or, as I suspect, did not have the necessary backbone to admit their earlier wrongdoing and outright disappeared. Except for the jamming problem, severe at times, WR6AMD was on its way to becoming a model repeater where good manners and respect for "thy fellow man" was the order of the day. Pride was returning; many old faces were returning; they still return.

Five-thirty weekdays is the time you find out when it all happened in the previous twenty-four hours if you were not around. That's the hour when AMD goes away for a while and is replaced by WA6TDD remote. Bob uses the remote to read a list of the penalties incurred, their duration, and the responsible party. At first many people were put off by this QST — embarrassed, perhaps — but as time has gone on, it has only been the hardcore troublemaker who has been heard to protest. After the first week or so, many of those incurring penalties took the opportunity of this "two-way" QST to express apologies to those they had offended. Yes, indeed, "user abuse" could and was being replaced by "user appreciation and support"; apathy was being replaced with courage. The AMD experiment thus far has been successful; users' attitude adjustment could be accomplished; WR6ABE/WR6AMD could be reborn.

To frustrate jamming attempts, users have been instructed that it is a "major no-no" to acknowledge being jammed, that to do so is to incur the wrath of the control stations. Keeping the system on has to date been far more of a temptation than the acknowledgment of jammers, much to the frustration of those jamming. They could jam, but the audience acknowledgment would not be theirs. Slowly, all but the most dedicated of the jammers either have been caught or have given up in disgust and gone away. After all, it's no fun to jam if you do not get the other guy's goat.

Enter "auto-jam." Around the third week in January, a high speed CW signal appeared at random moments on AMD. How do you T-hunt down a signal that seems to come from everywhere and yet nowhere at the same time? How do you locate a hidden transmitter that operates for about four seconds every ten or fifteen minutes? How, when you think you have located the general area where you think it is, do you pack into some rugged Southern California terrain to locate a needle in a haystack? Sound impossible? Not if you have the tenacity of people like the MWRA T-hunters. It took only three weeks of part-time T-hunting to locate the auto-jam and put it out of service. Actually, it really took about two and a half part-time weekends, for at about three in the afternoon on February 12, Rick WA6VSK literally stumbled over the antenna and proceeded to dig auto-jam out of the ground. It took cooperation, tenacity and an "I-per," but as usual even the most technologically skilled of jamming attempts was again thwarted by some most skilled T-hunters.

Taking on a group of T-hunters as well-trained and skilled as the MWRA group is asking for defeat. A jammer just does not have an even chance. I am convinced that if you hid a transmitter in concrete, threw it to the bottom of the Pacific, and then set out to jam the T-hunters as well, they would not only recover the concrete block, but uncover the identity of the others jamming as well, doing so in record time. I know they can do it; I have seen them take on the roughest assignments and never once be faced with defeat. If it's putting out rf, Rick or someone like him will find it.

The Procrastination Will Get You Everything Department: God bless the ARRL — they never make a mistake. You know what I mean ... like incentive licensing and the like. Now they're making sure not to make another mistake, by involving themselves in any form of national band planning that they cannot completely control from HQ in Newington. At a time when the amateur community needs direction and guidance in this, especially with 21033 looming on the horizon, where is the Newington crowd? The answer, to me, is quite obvious.

When their very own questionnaire proved beyond a shadow of a doubt that the amateur FM community would not be ruled with an iron hand from HQ, when the concept of an ARRL-appointed coordinator for each area was given thumbs down by the majority of us, when ARRL membership was made a necessity for appointment to a coordinator's job, the amateur community was smart enough this time to tell them to get lost. So rather than looking at the input they had gathered and acting accordingly, the good old League took their well-known ostrich approach and spent the past year skillfully dodging the issue. In fact, they still might be in a position to keep dodging if 21033 had not come along. Now, there are a lot of us who will not let them dodge any longer. It's a good number of months now since that matter was returned to committee for further study, and I, for one, want to know exactly where they stand.

Hey, Newington, wake up! The world outside does keep on moving, and if you wait, you are going to find yourselves left out in the cold. We have no intention of having you play God and appoint whom you wish on a political level to run things for us. Many places already have things running quite smoothly, and what we want is liaison with other groups and individuals doing similar work. We do not want any super ARRL-appointed head stepping in from left field to try to tell us how things should be done. You have but two choices: Either provide the necessary liaison between coordinating councils, or step aside so that someone who is more qualified can do your job for you. 21033 has a lot to offer, but it cannot work unless there is total open and ongoing communication and cooperation between those involved in coordination efforts. Next month or next year will be too late. Now is the time that necessitates action, and if you are not going to act as a representative to all amateurs, members and non-members alike, I can assure you that there are others who will be happy to do so without you. If, as you claim, you represent all amateurs, you will find a way to build some structure of national band planning that *represents* the views and needs of *all* amateurs involved in relay communication. It's your obligation to do so!

Unlike the rather normalized form of operation that one finds on the low bands, amateur relay communications is ever changing and seeking new horizons. In the next few years, there might conceivably be "repeaters" on satellites in synchronous orbit providing worldwide HT coverage. The technology of relay communications is ever advancing, and along has come a breed of amateur that has no time or patience for those who procrastinate. Newington, if you have no intention of taking on this formidable job, please make your intentions public now so that those of us who are concerned with the future can start building the framework of something that will forever bind all amateurs together. We realize the real impact of total repeater/remote deregulation, and are prepared to take on the responsibility. Are you?

In the June, 1976, issue of this magazine, I authored an article titled, "A Representative Democratic Republic," which in essence presented a basic structure for a national/international band planning council that gave a voice to virtually every concerned amateur and every special interest group. If you have not read it, back issues are available from *73* at a nominal fee. That's issue #188 for those of you who file numerically. I do not propose or hope to propose that I have all the answers, or that this idea is the ultimate solution to our current and future problems. I do say that it is a fairly well-conceived groundwork, built on your input, and from which the ultimate solution might be obtained (with probably a lot of modification to suit regional needs). If you are truly concerned about the future, please take another look at this article, find its faults, and suggest alternatives. See if it or something like it could be worked into the structure of your area. Feel free to tear it apart word by word and idea by idea, and restructure it. Then let us know where you stand. A year ago when it was published, a small need for something along those lines existed, but 21033 makes that need into a dire one. To date, this has been the only comprehensive band planning attempt yet fielded. I know that there are many of you out there with even better ideas, but unless you put them down on paper and let Wayne Green or myself know exactly what you feel, we can do little except present our own ideas, and hope that they satisfy your needs today and in years to come. If the ARRL feels like procrastinating on this subject, let it. VHF, UHF, FM, and repeaters have always been treated by them as a stepchild,

anyhow. We just might be a lot better off keeping them out of it and for once standing up to be counted for ourselves. I sincerely believe we have that ability at our fingertips — if only we would bury our personal apathy for a few moments to sit down with a pen and express ourselves. 21033 places our destiny in our hands, for better or worse. If it gets to the report and order phase intact, which it conceivably might, then it will open up a Pandora's box that we must be ready to accept and help guide. We at *73* are ready and willing to accept our share of the responsibility. We suspect that those of you reading this feel the same, in that you recognize your share of the burden. This leaves but one unknown entity, the ARRL, and it's anyone's guess as to where it stands.

The 220 Department: How many 220 repeaters are there where you live? Would you believe that here in the southland there are already 35 in operation, of which 25 are open systems? Eighteen others are in test status, and if you count the two channel pairs being held open for Mexico and the 223.00/224.60- repeater test channel, you will note that all 220 channel pairs are assigned (with the majority in day-to-day use). In the two and a half years since Bill DuHaime WA6NTW placed the first 220 FM system into operation, 220 has grown to a point where it is starting to approach the 146 MHz spectrum crunch.

How crowded is 220 really getting out here? There are times of the day when 223.5 is as crowded as .52 or .94 on two, and if the growth of this spectrum continues at its present pace, we might have to consider 10 kHz (shudder) splits in the foreseeable future. Let's put it this way: We are doing our part out here to thwart any attempt at 220 MHz Class E CB. If you have the activity level we have, then you have done your part, too. If not . . . what are you waiting for? Remember our motto: "220 — USE IT OR LOSE IT!"

The Six Meter Department and Other Things: Six meters for the most part is still a veritable wasteland FM-wise. As you are probably aware, our local council that coordinates six, 450, and above is diametrically opposed to the band plan dictates of Newington, and has adopted and implemented its own coordination plan for six meters. Rather than the 1 MHz ARRL plan, SCRBBA coordinates on what they feel to be a far more technologically competent 220 kHz plan. However, it's the same old TVI bugaboo that instills fear into the hearts of many a potential six meterite that I consider the prime reason for the lack of activity on six (rather than any band plan conflict). By the way, SCRBBA is anxious to share their views and technology with those interested, and an SASE to the Southern California Repeater and Remote Base Association, PO Box 5967, Pasadena CA 91109, may well bring some rather interesting reading material. In fact, whenever you write anyone listed herein for info, I suggest including an SASE to help defray costs to these organizations and individuals. Especially with the cost of postage these days!

Interest in UHF fast scan ATV is growing, as is the membership of the Southern California ATV Club. With better than sixty members, plans are in the works for a crossband 450 to 1250 ATV repeater for this area — possibly from Mt. Wilson. The crossband mode was selected so as to cause an absolute minimum of problems to adjacent narrow band voice communication, which is the prime communication mode on that band in this area. No date has yet been announced as to when this project will be completed, but it is hoped that by repeating 450 to 1250, ATV and narrow band FM will be able to totally coexist and at the same time interest ATVers in experimenting with this mode on bands other than just 450. Input will be in the same 435-plus area as well as other ATV systems, but output has yet to be pinned down specifically. An SASE to the SOCAL ATV Club should bring some info as to what they are doing and what their plans are. The address is So. Calif. ATV Club, c/o John Ruckert WB6ZPN, Secretary, or Ernie Williams WA6BAP, President; both are good in the callbook.

The Sears and the Two Meter Radio Department: OK, guys and gals. Why all the huff? What is the difference between going to your favorite radio emporium or to Sears, Roebuck and Company to buy a two meter radio? Why is it OK to mail order such a piece of equipment from a dealer in another city, but a no-no for a company with the high credibility factor of the Sears organization to even consider selling equipment for that which we hold so dear? Are we starting to run scared of our own shadows?

I, for one, cannot accept this double standard for a number of reasons. First, the rampant paranoia that says Sears selling two meter equipment will put my radios into the hands of those not licensed is totally ridiculous! Has any salesman in any radio store ever asked you to present your license before he sold you a rig? It's never happened to me. If a person intends to get hold of a piece of amateur equipment for illegal use, it won't matter where he goes to buy it. There is no law that states that one must have a valid license to own a piece of amateur transmitting equipment — only to use it. If a person is going to violate the amateur rules and regulations, then it really makes no difference who sells him the radio, does it?

Secondly, how many advertisements carry a specific disclaimer stating that a specific minimum grade of amateur license is required to operate such equipment? The Sears advertisement in the spring/summer catalog, page 967, sure does. It spells it out in very specific terms that anyone can understand. It states specifically that a Technician, General, Advanced or Extra grade license is required prior to transmitting with the unit. Score one for Sears! Again, this goes along with the very high operating standards that the Sears organization adheres to, standards that have made Sears the world's most respected mass merchandiser.

Then, too, there is the most important aspect of this move by Sears back into the amateur radio marketplace. To me, it signals a rather bright future for the overall amateur equipment market. Remember, Sears did not get to the position it holds in the mass merchandising marketplace by making mistakes. They are at the top because they have good business sense. They see what I see: a new and substantial growth period for the amateur service. They are willing to take on the sale of amateur equipment once again. To me that says we are well on the way to what many of us have been working toward for the past two years: an unexcelled overall growth in the number of licensed amateurs (resulting in the increased numbers we will need to hold our own at the 1979 WARC in Geneva).

There are a few other good points that some of you might not be aware of in relation to Sears. First is the fact that Sears services what they sell, so amateur radio will be enjoying something it never had before. The ease of obtaining the necessary parts and service should a rig run amok some day. How easy? As easy as locating the nearest Sears service center or catalog store. Sears happens to run the world's largest organization, and they are located everywhere. In fact, they're only a phone call away. Have you any idea what having this type of service backing a product means?

Then, too, there is the basic creed of the Sears Roebuck organization — which is the simple policy of "Satisfaction Guaranteed or Your Money Back." This is a policy that is fol-

Oscar Orbits

Oscar 6 Orbital Information

Orbit	Date (May)	Time (GMT)	Longitude of Eq. Crossing °W
NA 20766 BTN	1	0005:39	62.1
N 20779	2	0100:35	75.8
NA 20791 BTN	3	0000:31	60.8
NA 20804 BTN	4	0055:27	74.6
N 20817	5	0150:22	88.3
NA 20829 BTN	6	0050:18	73.3
N 20842	7	0145:14	87.1
NA 20854 BTN	8	0045:10	72.1
N 20867	9	0140:06	85.8
NA 20879 BTN	10	0040:02	70.8
NA 20892 BTN	11	0134:57	84.6
N 20904	12	0034:53	69.6
NA 20917 BTN	13	0129:49	83.3
N 20929	14	0029:45	68.3
NA 20942 BTN	15	0124:40	82.1
N 20954	16	0024:36	67.1
NA 20967 BTN	17	0119:32	80.8
NA 20979 BTN	18	0019:28	65.8
N 20992	19	0114:24	79.6
NA 21004 BTN	20	0014:20	64.6
N 21017	21	0109:15	78.3
NA 21029 BTN	22	0009:11	63.3
N 21042	23	0104:07	77.1
NA 21054 BTN	24	0004:03	62.1
NA 21067 BTN	25	0058:59	75.8
N 21080	26	0153:54	89.6
NA 21092 BTN	27	0053:50	74.6
N 21105	28	0148:46	88.3
NA 21117 BTN	29	0048:42	73.3
N 21130	30	0143:37	87.1
NA 21142 BTN	31	0043:33	72.1

Oscar 7 Orbital Information

Orbit	Date (May)	Time (GMT)	Longitude of Eq. Crossing °W
11242 A	1	0112:06	71.0
11254 BQ	2	0011:27	55.9
11267 A	3	0105:44	69.4
11279 BX	4	0005:05	54.3
11292 A	5	0059:22	67.9
11305 B	6	0153:39	81.5
11317 A	7	0052:59	66.3
11330 B	8	0147:17	79.9
11342 A	9	0046:37	64.7
11355 B	10	0140:54	78.3
11367 AX	11	0040:15	63.1
11380 B	12	0134:32	76.7
11392 A	13	0033:52	61.6
11405 B	14	0128:10	75.2
11417 A	15	0027:30	60.0
11430 BQ	16	0121:47	73.6
11442 A	17	0021:08	58.4
11455 BX	18	0115:25	72.0
11467 A	19	0014:45	56.8
11480 B	20	0109:03	70.4
11492 A	21	0008:23	55.3
11505 B	22	0102:40	68.9
11517 A	23	0002:01	53.7
11530 B	24	0056:18	67.3
11543 AX	25	0150:35	80.9
11555 B	26	0049:56	65.7
11568 A	27	0144:13	79.3
11580 B	28	0043:33	64.1
11593 A	29	0137:50	77.7
11605 BQ	30	0037:11	62.6
11618 A	31	0131:28	76.1

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.

OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.

Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

lowed by all Sears stores and service centers. Few others offer that or anything near it. In today's marketplace such a policy is unheard of, yet Sears lives with it and by it.

So before writing all those letters to Wayne Green and the rest of the staff protesting about Sears or any other large retail chain selling amateur equipment, sit down and think for a moment. If you do, you might realize as I do that Sears re-entering the amateur radio marketplace is really a sign of good times ahead. We need Sears and anyone else who is willing to involve themselves in such a righteous manner. In fact, if everyone lived up to the high marketing standards of Sears, we would have little to worry about.

The WR6AKG Department: Well, friends, as I write this, the first amateur repeater devoted primarily to this city's school children has become a reality. About 24 hours ago, Keith Glispie WA6TFD, its builder/backer, "through the big switch" and two meters, bad a new form of amateur repeater born here in the southland. While credit for the very inception of AKG goes directly to Keith and those who worked with him on the project, one must not forget that it was a cooperative effort also involving the Dorsev High Amateur Radio Team, the Southern California Repeater Association (with Bob Thornberg WB6JPI, its chairman, and Jim Hendershot WA6VQP, of its two meter technical committee), and the people of the Los Angeles Unified School District. It was a cooperative effort across the board, and in my opinion each of the groups involved must be given proper recognition for the part that it played.

Though AKG is on the air at last, it is in what we term "test status," and has yet to move into its permanent home atop the Baldwin Hills. In the meantime, there are still a few kinks to iron out, including that of a RACES group that let it be known that Keith's input was their RACES channel only after AKG went on the air. With all the pre-publicity that AKG garnered here and elsewhere long before it ever came on the air, and with the actual channel pair published in this column a few months back, I am at a loss to explain why the RACES group waited until after AKG went into operation before letting anyone know that they were using the channel. However, I feel that this should be easy to solve, in that either the two can coexist (perhaps with the RACES group using the AKG facilities for its drills and operations) or an operational schedule can be arranged to meet the needs of both. However, the most important step is to get the RACES people and the AKG people sitting down over a cup of coffee for a good rap session. It never fails to amaze me what can be accomplished once people, even hams, learn the art of personal communication. However, it should be noted that such incidents as this could easily be avoided by having non-relay special interest organizations such as RACES groups, AREC (ARPSC) groups, and the like attend and take an active part in the many open meetings held by local repeater and FM councils (such as SCRA and SCRBBA). There is absolutely no way for any coordinating council to know if a channel is in use by a non-relay special interest group unless that group makes an effort to let the rest of the world know it exists. I must ask if it is really that hard for a non-relay group to find a warm body or two who are willing to attend such meetings so as to initiate good ongoing communication with the rest of those using the spectrum. Only such cooperation and communication can avert a reoccurrence of this unfortunate happening. I can speak for the SCRA when I tell you that not only are their quarterly meetings open to all interested amateurs, but also that they invite those truly interested but who are not repeater owners to become active in the organization by obtaining associate membership. They invite open dialogue between repeater owners, users, and other non-relay special interest groups, as they realize that it is only through such dialogue that all spectrum users can benefit.

Anyhow, that really does it for the AKG story: from the idea of an ex-high school student who saw a need to a service to the younger generation of Los Angeles amateur operators. We have all been a part of amateur radio history; we have watched it develop from the embryo of an idea to the reality of today. We can all take pride in the corps of devoted citizens, amateur and non-amateur alike, who worked shoulder to shoulder to give repeater communication a truly new meaning and direction. Looking West salutes them all.

Repeater Update

Compiled by Stan Miastkowski WA1UMV

CALIFORNIA

WR6AWZ	Ridgecrest	146.76	No squelch tail
WR6ABA	LA Mt. Washington	147.71	Delete
WR6ABC	Los Angeles	224.36	Delete
WR6ABI	Los Angeles	147.00	Delete
WR6ABO	Los Angeles	147.27	Delete
WR6ABR	Los Angeles	147.12	Delete
WR6ABU	Los Angeles	147.06	Delete
WR6ACA	LA Saddle Pk	146.70	Delete
WR6ACT	Barstow	146.76	Delete
WR6ADO	Orange County	146.895	Delete
WR6AEP	Ventura	146.88	Delete
WR6AEP	Ventura	147.325	Delete
WR6AEY	June Lake	146.61	Delete
WR6AEY	June Lake	224.14	Delete
WR6AFC	Thousand Oaks	224.10	Delete
WR6AFZ	Redding	146.76	Delete
WR6AGH	Ventura Hall Canyon	146.73	Delete
WR6AGH	Ventura Hall Canyon	224.06	Delete
WR6AHF	Newberry Park	147.67	Delete
WR6AHF	Newberry Park	224.74	Delete
WR6AHR	San Diego	147.625	Delete
WR6AIP	San Diego	147.885	Delete
WR6AJX	San Diego	146.91	Delete
WR6ABW	Los Angeles	147.00	Delete

COLORADO

WRØAFC	Grand Junction	146.64	

ILLINOIS

WR9ALB	Mt Prospect	147.255	
WR9AGQ	Chicago	224.78	AP

INDIANA

WR9	Frankfort	146.61	WX/AP

IOWA

WRØ	Boone	147.39	
WRØAGJ	Cedar Rapids	146.70	RTTY
WRØALW	Cedar Rapids	224.94	
WRØALF	Clear Lake	147.00	Private

LOUISIANA

WR5ADV	De Ridder	146.85	

MASSACHUSETTS

WR1AAI	Quincy	224.02	
WR1ATE	Somerville	224.18	
WR1AFP	Fitchburg	224.34	IN/222.74
WR1AGP	Medway	224.66	DX Alert
WR1ABV	Waltham	224.94	

MAINE

WR1AHO	Presque Isle	146.73	

NEW HAMPSHIRE

WR1AIL	Chester	224.46	DX Alert

NEW JERSEY

WR2AEU	Lawrenceville	224.30	AP
WB2	Montclair	29.64	IN 29.54

OHIO

WR8ALW	Belle Fountain	147.60	IN 147.00

PENNSYLVANIA

WR3AIV	Oil City	147.12	

TEXAS

WR5ACJ	El Paso	146.70	
WR5	El Paso	146.88	VOX/any TT
WR5ANL	Austin	52.525	
WR5ASC	Austin	146.94	
WR5ACY	Austin	146.88	
WR5ALM	Austin	146.79	AP
WR5ACQ	Austin	444.10	Private

WISCONSIN

WR9AFC	Platteville	146.82	Autopatch
WR9AKA	Milwaukee	223.94	222.34 IN

CANADA

VE3GOD	Goderich ON	147.03	146.43 IN
VE3TTT	London ON	147.00 Autopatch	

JORDAN

JY73	Amman	145.70	

Build the World's Simplest Keyer

- - uses 555 timers

Andy Ring
49 Main St.
Yarmouth ME 04096

This keyer is simple and inexpensive to build. The NE555 timers will cost .50 to $1.50 each depending on the source of supply. Your local Radio Shack calls it a 276-1723 and will charge you $1.49. If you like, you can use a dual timer called a 556 (Radio Shack 276-1728). The only difference will be that both timers are in one package and V+ and V- connections are common to both timers. See the specs that come with your IC for pin connections. All other components can probably be found in your junk box. The keyer has no memories but the characters are self-completing and are fully adjustable not only in speed, but length of character as well. The key must be two

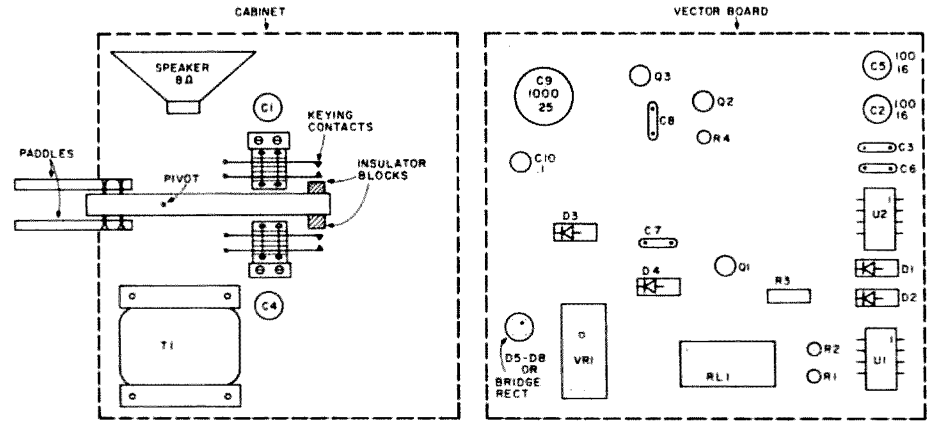
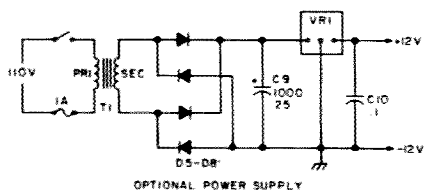


Fig. 1. R1, R2 — 330 Ohm, ¼ Watt; R3 — 10k, ¼ Watt; R4 — 56k, ¼ Watt; C1, C2, C4, C5 — 100 uF, 16 V electrolytic; C3, C6 — .01 uF; C7, C10 — .1 uF; C8 — .05 uF; C9 — 1000 uF, 25 V electrolytic; RA, RD — 1k linear taper pot; RB — 500 Ohm linear taper pot; RC — 10k linear taper pot; D1-D8 — 1N4004 or equivalent 400 V piv, 1 Amp; Q1, Q2 — 2N2222 NPN; Q3 — 2N5964 PNP; RL1 — 12 V reed relay; VR1 — 12 V positive regulator #7812; T1 — any 15 or 20 V power transformer 500 mA or more.



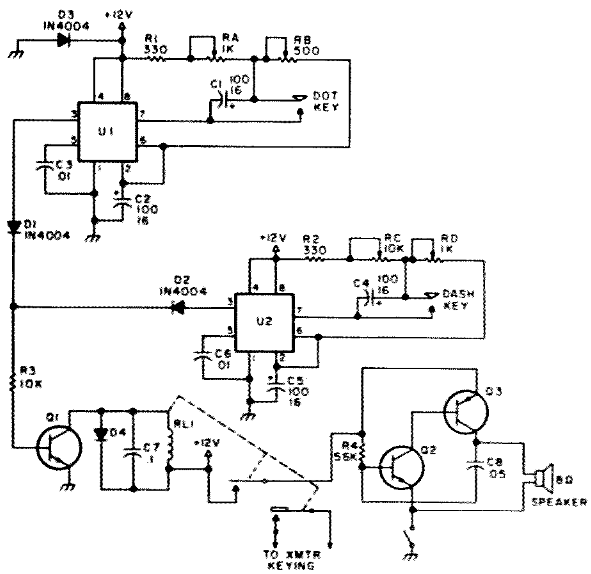


Fig. 2. T1 — 15 to 20 V sec at 500 mA; D1-D8 — 1N4004; VR1 — #7812 12 V 1A positive regulator; U1, U2 — NE555 timer IC; RL1 — 12 V reed relay DPST; Q1, Q2 — 2N2222; Q3 — 2N5964; all resistors ¼ Watt.

SPST switches. The standard SPDT key will not work.

How It Works

When the dot key is closed, U1 becomes an astable multivibrator. The speed of the multivibrator is determined by RB, and the duty cycle or length of the dot is determined by RA. When U1 is turned on, pin number 3 is high, causing Q1 to turn on and close relay RL1. D1 and D2 are necessary because when U1 is high, U2 is low, so pin 3 of U1 must not be tied directly to pin 3 of U2. Most reed relays available on the surplus market today are 3 pole single throw. One set of contacts is used to drive the monitor oscillator consisting of Q2 and Q3, while one or both of the remaining contacts (2 wired in parallel will handle more current and is more reliable) are used to key the transmitter. The operation of U2 is identical to U1 except the timing and length of character.

Construction

There are no special construction considerations except the key as mentioned earlier. I constructed mine on a 2" x 4" piece of vectorboard with .1 inch spacing. This is available at Radio Shack also and can be purchased in several different sizes and cut to desired size with tin snips. The whole keyer is constructed in a 2½" x 5" x 6" box. The 12 volt supply may be taken from your transmitter or the power supply shown may be used with all except the transformer mounted right on the vectorboard. There is ample room in the box for a small 15 to 20 volt transformer. 400 or 500 mA will be sufficient as the keyer draws only approximately 50 mA key closed. A push-button switch is provided to shut off the monitor in case your transmitter has a sidetone monitor of its own. ■

Stop That Autostart

- - mods for the ST-6 circuit

Rick Bourgeois, M.D. WA5EVH
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Lafayette LA 70502

The ST-6 autostart is nice when used in the amateur bands, but doesn't help much when one wants to copy commercial stations that do not drop their carriers when not transmitting any text. As long as there is a mark tone, the ST-6 stays in receive with the motor on. Mechanical motor stops work okay except in noisy conditions. Since the ST-6 stays in receive with a steady mark, any fading or noise keys the loop and the mechanical motor stops just cycle off and on.

However, the circuit shown in Fig. 1 solves the problem.

How It Works

The versatile 555 IC timer is the heart of the circuit. The timer output, pin 3, goes to the input of the ST-6 op amp 5 (OA-5). Normally during receive, pin 3 is high and blocked by D1 so that nothing happens. While RTTY is being received, trigger pin 2 of the IC is drawn low through D2 and starts the timer, but C1 is also kept discharged by this same line through D3 and the switching action of Q1. This prevents C1 from charging and the timer output stays high. Once FSK reception stops, however, and a steady mark tone remains, C1 is allowed to charge up. After a predetermined interval, pin 3 drops to low; this pulls the input of OA-5 low, effectively mimicking a loss of signal condition.

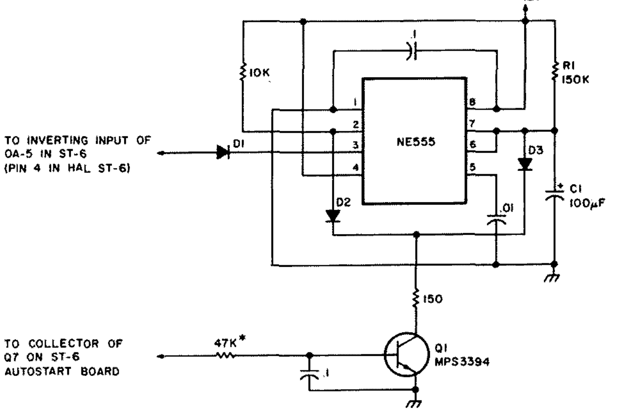

Fig. 1. Time delay (in secs.) = 1.1 x R1 (Ohms) x C1 (farads).
**Increase to 56k if Antispace fails to operate.*

The ST-6 now goes into standby and the regular "motor off" function occurs as usual. The motor remains off until valid RTTY again appears. Note that no previous function of the ST-6 has been compromised, but now the ST-6 goes into standby and the subsequent "motor off" condition with a steady mark as well as with a loss of signal condition. A time of 15 seconds works well, since this, added to the 25 seconds of the ST-6 delay, gives about 40 seconds to turnoff in the presence of a steady mark. An additional added benefit is that the ST-6 now can screen the signal for the presence of valid RTTY before the motor again turns on.

The circuit can be built on a small PC board, and is mounted directly onto the ST-6 Autostart/Antispace board. Only three connections other than ground are required.

If you spend much time copying things like the weather and press, do your printer a favor and give it a rest with this nifty little circuit added to your ST-6. ■

Predict the Weather!

- - a complete satellite receiver

Ralph E. Taggart WB8DQT
602 S. Jefferson
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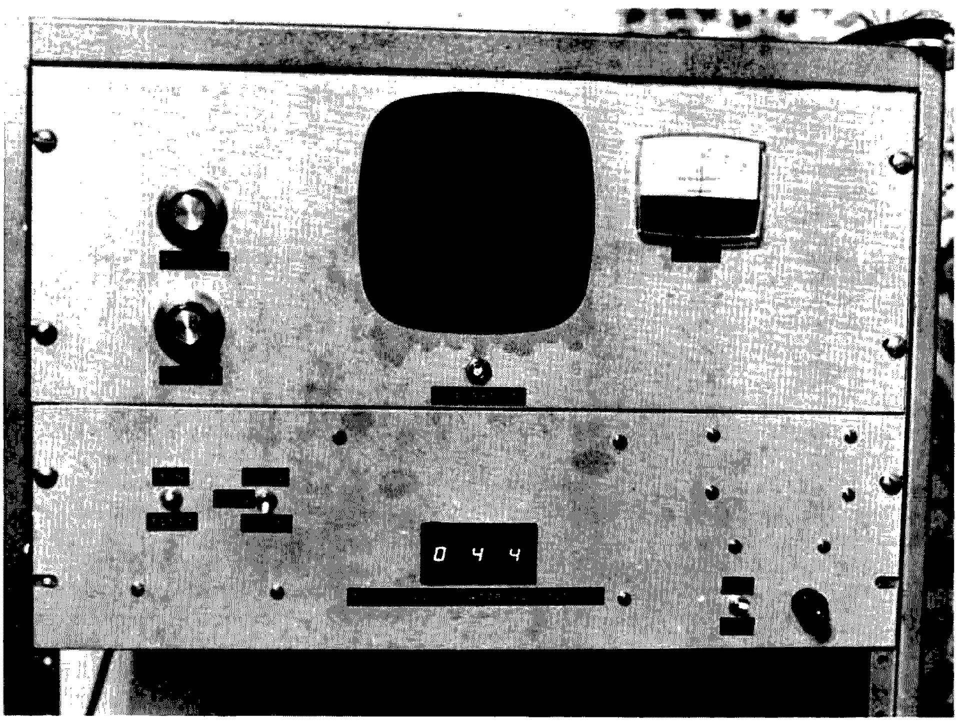


Fig. 1. The author's satellite receiver. The RX-144 modules are mounted in a minibox with the squelch and volume controls on one end. The box is mounted on its side behind the rack panel, secured to the panel by the control nuts of the volume and squelch controls. The signal strength meter and speaker plug into phono jacks at the other end of the minibox. Two other jacks on the same end of the box provide for the 12 volt input and the low level output to the tape recorder. The BNC receptacle is also located on the exposed end of the minibox. The headphone jack illustrated is optional, but does help keep the rest of the family asleep during early morning satellite transmissions. A shorting ¼ inch phone jack in the speaker line is all that is required. The panel below the receiver contains a rack mounted version of the digital orbital timer described previously in 73 and also in the Weather Satellite Handbook. *The timer is programmed for NOAA 4 which was 44 minutes into an orbit when the photo was taken. Since the photo was taken in the morning, the satellite should have been audible on the receiver. If the photo reproduces well, you can see from the signal level meter that indeed it was!*

One of the most important pieces of equipment in the weather satellite station is the receiver that actually picks up the satellite transmissions. The *Weather Satellite Handbook* (available for $4.95 from *73*) outlines several approaches to the receiver portion of the station, including custom receivers available "off the shelf," modification of commercial monitor receivers, availability of kits, and conversion and utilization of surplus equipment. The purpose of this article is to describe the construction of a complete satellite receiver using a readily available kit. Before we start on the details, however, it would be useful

to briefly review the desired characteristics of receivers for satellite service. These characteristics involve mode and bandwidth requirements, sensitivity, frequencies, and various operating conveniences that complement the operation of the satellite station. I will briefly outline some of these requirements and then show how the typical home brew addict can achieve the desired performance.

Frequencies

Two frequency ranges are currently in use for various weather satellite operations – the 135-138 MHz VHF satellite band and the 1691 MHz S band frequency used by the new series of GOES geostationary satellites. If operation in both frequency ranges is contemplated, the logical approach is to begin with a quality VHF receiver and add on the S band capability in the form of a converter. As noted in a previous review article, the S band converter problem is a hard nut to crack, but there are some exciting developments afoot in this area and you can count on the fact that *73* will carry the details on a suitable converter once the system is to the point where it can be readily reproduced. In this article, we will describe a basic VHF receiver which is packaged so the S band converter can be added at a later time.

In the VHF range we are interested in three different frequencies:

135.6 MHz – the ATS geostationary satellites transmitting gridded WEFAX pictures in the APT mode

137.5 MHz – primary frequency for the NOAA polar orbiting satellites transmitting real-time visible light and IR pictures in the 48 line SR mode

137.62 MHz – used once a month for tests with the primary NOAA spacecraft and as the primary frequency for any backup NOAA satellites that are still operational

To insure on-frequency operation when needed, the receiver should be crystal controlled. It may be single channel if your operations involve primarily the ATS or NOAA spacecraft (i.e., 135.6 or 137.5 MHz) or it can be multi-channel with switch selection of all of these frequencies. Since this frequency range is quite close to the two meter band, there should be some useful possibilities for conversion of two meter receiver designs, something we shall take advantage of in constructing the receiver to be described shortly.

Mode and Bandwidth Requirements

The satellite transmissions of interest to us are all FM with a deviation of 9-10 kHz. This means that the basic receiver should have a bandwidth of at least 20 kHz (10 kHz selectivity) in order to accommodate the satellite signal. In the case of the polar orbiting satellites, we have an additional factor to consider – Doppler shift as the satellite approaches and moves away from the ground station. In the case of the VHF satellite range, this Doppler shift is in the order of ± 4.5 kHz. Given worst case Doppler and maximum deviation, we would thus require a bandwidth of 30 kHz (15 kHz selectivity) for a general purpose satellite receiver. This is fortunate, since i-f filters for 30 kHz bandwidth are readily available although no longer standard for most receivers. Most VHF FM operation today is standardized at 15 kHz bandwidth (7.5 kHz selectivity). This is too narrow even to accommodate the deviation of the geostationary satellites, let alone deviation and Doppler shift in the case of the polar orbiters. If such a narrow filter is used, the upper part of the deviation swing will fall out of the

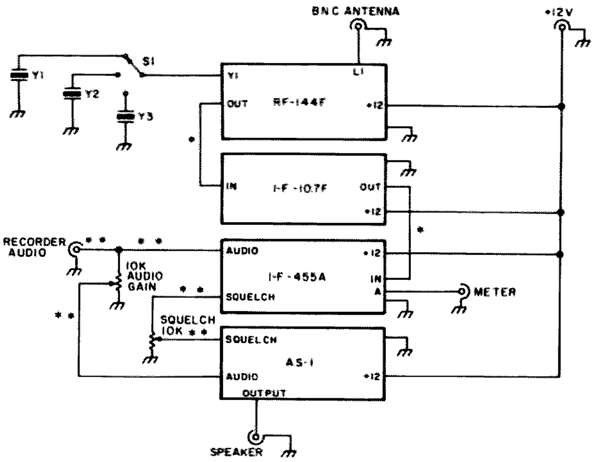


*Fig. 2. Schematic representation of the interconnection of the receiver circuit boards. The kit instructions show the actual location on the boards for each of the connections noted above. The connection between L1 on the RF-144F board and the BNC connector is made with a very short length of the silver-plated wire supplied with the kit. Mounting of the individual boards should assure adequate grounding of each board to the aluminum minibox. Rf connections between boards (marked with *) should be made with the shortest possible lengths of miniature 50 Ohm coax. Connections to the audio gain and squelch controls (marked **) should be made with shielded audio cable. All other connections can be made with ordinary hookup wire. In the case of a multichannel receiver, the wire from Y1 of RF-144F should be routed to the common lug of the crystal selector switch (S1). One lug of each of the three crystals (Y1 – 135.6, Y2 – 137.5, Y3 – 137.62) can be soldered to the switch lugs. The other lug of each crystal can be routed to a common ground connection using the shortest possible leads.*

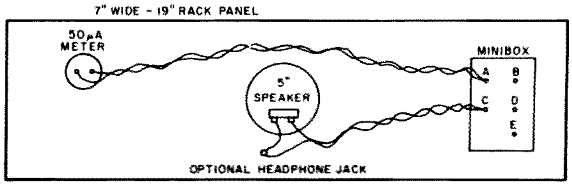
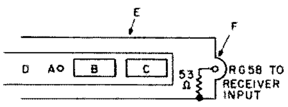


Fig. 3. Diagrammatic representation of the interconnection of the receiver elements on the rack panel. The aluminum minibox with the receiver boards mounts to the panel using the control nuts for the squelch and volume controls. The rear of the minibox contains the four phono jacks (A-D). A is the meter output and connects to the 50 microamp meter on the front panel. The meter leads terminate in a phono plug with the + lead on the center pin and the - lead to the grounded shell. B is the low level recorder output and connects to the tape recorder input with a shielded audio cable. C is the speaker output. Leads from the 5 inch speaker are mated here with a phono plug. If a headphone jack is desired, a ¼" phone jack can be wired into the hot speaker lead – a shorting jack should be used so the speaker is operative when the headphone plug is removed. D is the +12 V plug and is connected to the 12 V receiver supply – +12 V to the center pin of the phono plug and the - lead to the outer shell. E is the BNC connector for the antenna. Ample space remains behind the panel for later incorporation of an S band converter and switching circuits.

Fig. 4. Diagram of a variable strength 137.5 MHz signal source for receiver alignment. A — SPST toggle switch controlling power to the oscillator; B — 9 V transistor battery; and C — an OX oscillator with a type EX crystal on 45.833 MHz. A, B, and C are attached to the end of a wooden ruler or yardstick (D) which slides in and out of a copper tube (E) with a diameter sufficient to clear the oscillator module. Two feet of tubing is adequate. A coax jack (F) is mounted to a copper or brass partition soldered across the end of the tube, terminated with a 53 Ohm resistor. 52 Ohm coax connects this jack with the receiver input. The signal level of the source can be varied by sliding the oscillator in and out of the tube. Signal level to the receiver will increase as the oscillator is moved toward the pickup end of the tube and will drop as it is moved away. If the receiver is built as a single channel unit for 135.6 MHz ATS satellite service, a 45.200 MHz crystal in the OX oscillator will provide harmonic output on the proper frequency.



receiver passband. In the case of the polar orbiters, you would lose the upper end of the gray scale even when the satellite was overhead, and the signal would be virtually impossible to copy early and late in the pass when Doppler shift would slide most of the signal out of the narrow receiver passband.

Other Features

Since most stations make recordings of satellite transmissions, an audio output connection for this purpose is desirable. Ideally, this tap should be made before the volume control so that changes in speaker listening level do not result in changes in record level. If the receiver has a squelch control (desirable to prevent operator insanity when a satellite is not within range), this feature will also permit continuous recording even if the squelch control cuts in and out due to a tight setting. A front panel signal strength meter is also desirable to help in antenna tracking. The receiver ac supply should have virtually no ac ripple to prevent incorporation of undesirable ac hum on the recorded or real-time satellite signal.

In making the decision to buy, modify, or build in acquiring a suitable receiver, you should be guided by your own inclinations. Building will probably not save you much money, but it will provide you with a receiver with all features tailored to your own needs. After a traumatic move to a new house, I made the decision to convert my sprawling station to a neat cosmetic installation in a desktop rack. Since none of the receivers on hand lent themselves to rack mounting, I decided to roll my own. While strolling about the Dayton Hamvention with the other satellite and SSTV fanatics, I decided to plow some of my ill-gotten gains from the sale of some equipment into the purchase of a VHF Engineering receiver kit for two meter FM. I vowed to use the kit as the basis for the VHF satellite receiver with all of the features I required, leaving enough space to add the S band converter that was already under development. The effort was an unqualified success and really very little effort at all. If you still like to heat up a soldering iron and want a receiver equal to or better than anything you can buy, then read on and discover how it can be done.

THE RX-144 RECEIVER KIT

The heart of the receiver is the RX-144 kit available from VHF Engineering, 320 Water Street, Binghamton NY 13902, for $69.95. Given the performance of the completed receiver, this has to be one of the finest values in the amateur radio market today! Their standard RX-144C kit contains boards and parts for the following sub-assemblies:

(1) RF-144F front end board, providing a crystal controlled front end with 10.7 MHz i-f output. Dual gate MOSFETs are used for the rf amp (MPF-121) and mixer (MPF-122). Squelch sensitivity is rated at 0.2-0.3 microvolts but appears to be slightly better in the "real world." Front end gain is approximately 40 dB with 55 dB of image rejection and 100 dB of i-f rejection.

(2) IF-10.7F board providing two stages of 10.7 MHz i-f amplification using ICs with output at 455 kHz. An input crystal filter (2 pole) sets the system bandwidth. Total gain is in the order of 50 dB and the circuit is unconditionally stable.

(3) FM-455A board with a single IC 455 kHz amplifier providing 30 dB of gain and an IC limiter and FM detector. The board has provisions for a signal strength meter and a zero-center discriminator meter.

(4) AS-1 board, providing squelch and COR functions as well as up to 2 Watts of audio amplification for operation of an external speaker.

In order to build the receiver as described, you will require the additional components listed in Table 1. Some of these relate to the specific packaging scheme which I employed, so you can obviously alter these to suit your own needs. The basic kit is packaged as four individual units, each containing a circuit board and the proper components, as well as a set of layout diagrams, schematics, and instructions for construction and testing of each board. In addition, the kit contains a very complete manual. Where appropriate, departures from kit assembly instructions or additions will be noted for each board.

RF-144F: If the receiver is to be operated on only one channel, the kit instructions should be followed. If multiple channel operation is intended, leave off the socket for the local oscillator crystal (Y1) and solder a length of hookup wire (insulated) to the ungrounded land at the socket location. If the receiver is to be packaged as described later, the input terminal and antenna tap can be omitted at this stage in construction.

IF-10.7F: This board should be wired according to the kit instructions except for the input crystal filter. The filter supplied with the kit is a Piezo Technology 2195F with a bandwidth of 15 kHz. In order to accommodate signal deviation and Doppler shift in satellite service, a bandwidth of 30 kHz is required. The crystal filter specified in Table 1, a Piezo Technology 2196F, has the required bandwidth and should be substituted for the unit included with the kit.

FM-455A: Wire according to kit instructions.

AS-1: Wire according to kit instructions.

When all the boards have been completed, make the usual checks for wiring errors. In case you are tempted to simply bypass the latter step, I will confess that I initially left out a jumper on the 10.7 MHz i-f board and spent several evenings attempting to discover why the receiver wouldn't work!

Fig. 2 shows the basic packaging of the three boards in the minibox specified in Table 1. The boards are oriented cross-wise in the box with the rf board to the rear, followed by the 10.7, 455, and audio boards moving toward the front of the box. The back of the box contains

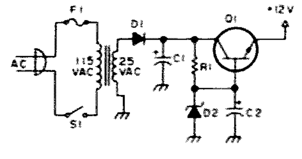
the BNC antenna connector, mounted so that the antenna input tap to L1 of the rf board can be made with a very short length of the silver-plated wire supplied with the kit. The back also contains the 4 phono jacks for the speaker output, +12 V, the S meter output, and the low level audio output to the tape recorder. The front of the box has the squelch and audio gain controls. If you desire multi-channel operation, the crystal selector switch should also be mounted on the front of the box. Fig. 3 summarizes the board interconnections and the connections to the minibox mounted components.

Preliminary Setup

Once the receiver is packaged in the minibox, you are ready for initial checkout and alignment. Connect an 8 Ohm speaker to the SPEAKER jack, the 50 microamp meter to the METER jack, and a 12 volt supply to the +12 V jack. If a calibrated signal generator is available, it can be connected to the antenna input. Applying power should result in typical FM receiver noise output from the speaker. Check the gain and squelch controls for proper operation. Switch S1 to 137.5 MHz and dial up the signal generator to that frequency. The receiver should now quiet. Adjust the signal level so that it drops down to the margin of audibility and proceed to align the rf and i-f boards according to the kit instructions. The name of the game is to keep the signal level down near the noise and keep tweaking for maximum quieting and/or maximum signal level on the meter. What do you do if you can't beg, borrow, or steal a suitable signal generator? The answer is to order a type OX oscillator module with a matching EX crystal from International Crystal Manufacturing Company, 10 N. Lee, Oklahoma City, Oklahoma 73102. The OX oscillator kit and EX crystal for 45.833 MHz will set you back a total of $6.90 for an excellent 137.5 MHz signal source. The problem of keeping the signal level down far enough for alignment can be solved by strapping the oscillator and a 9 V battery to the end of a ruler or yardstick and sticking the whole business into a length of copper tube as indicated in Fig. 4. The tube acts as a waveguide with almost infinite attenuation after several inches. By moving the oscillator toward or away from the pickup end of the tube, you can smoothly vary the signal level to the receiver for alignment purposes. The end result is equal to or better than most signal generators in terms of performance. This rather neat idea is a somewhat simplified version of an idea presented by K1CLL in a previous article in *73*.

Once the alignment is completed, the receiver is now capable of pulling in satellite signals, but let's restrain ourselves and finish the final packaging. Obviously everything can be placed in a cabinet of some sort, but I chose to rack mount the assembly in an attempt to reduce the "sprawl" in the satellite station. A standard 19" rack panel 7" in width was used. Drill holes with the proper spacing to accept the layout of the audio gain, squelch, and crystal switch (if used) placement on the minibox, add a cutout and holes for speaker and meter mounting, and proceed with final assembly. The minibox is attached to the panel by the control nuts. Mount the speaker, speaker grill, and the meter and you are almost finished. The receiver can be powered by an outboard 12 volt supply or a supply can be built and mounted to the back of the rack. Fig. 5 shows a suitable power supply circuit. The layout of my own receiver is shown in Fig. 1. Note that the VHF receiver is offset to one side of the panel. This was to provide room for integration of an S band converter for the SMS/GOES satellites — a goodie that will appear in *73* once I am sure it is at the point where it can easily be duplicated. The meter and speaker connections are made plug-in with phono jacks to provide modularization for connection of other gear if desired. The VHF antenna can be connected to the BNC connector and the 12 volt supply — internal or external goes to the +12 V jack. The RECORDER AUDIO jack provides a low level signal to the station tape recorder that is unaffected by the audio gain setting. As noted in the kit instructions, provisions are made for an outboard COR circuit and a discriminator meter that could be added if desired.

Fig. 5. Suggested power supply circuit. D1 — 2 A 50 piv; D2 — 12 V 1 W zener; Q1 — NPN power transistor (30-90 Watts); R1 — 1000 Ohms ½ W; C1 — 1000 mF/35 V; C2 — 1000 mF/16 V; T1 — 25 V 1 A filament transformer; F1 — ½ A fuse; S1 — SPST toggle switch. Q1 should be mounted on an insulated heat sink. Alternatively, a 12 V regulator IC such as the LM-340-12 may be used to replace Q1, R1, D2, and C2. The IC regulator should have its case bolted to the chassis using mounting grease to provide heat sinking.



Performance

In a word, excellent! The receiver, without an outboard preamp, does better than any previous receiver I have tried with or without preamps. Attaching any of my preamps — and I have some pretty good ones — noticeably degrades receiver performance, indicating excellent low noise performance of the basic receiver front end. No receiver tried up to date, even with added preamps, could deliver a full quieting signal from ATS-3 on my 5 element crossed yagi while ATS-1, located close to the horizon at my location, is barely audible on that particular antenna. The new receiver delivers full quieting signals from *both* satellites on the modest antenna without the use of a preamp. Near-horizon fading of the NOAA polar orbiting satellites is eliminated to the point where the receiver limits as soon as the satellites clear the radio horizon. To say that VHF Engineering has done a superb job is certainly not overstating the case. If you want a first-rate satellite receiver, you can hardly go wrong! ■

4 RCA type phono jacks (Switchcraft 3501 FR or equiv.)
1 BNC panel receptacle (Amphenol 4500)
1 7" x 5" x 3" aluminum minibox (BUD CU-3008A or equiv.)
1 1-pole 3-position rotary switch (if multi-channel operation is desired)
1 50 microamp panel meter (Radio Shack)
1 5" speaker (Radio Shack)
1 5" speaker grill (Radio Shack)
1 7" wide rack panel (BUD PA-1104)
2 10k linear taper panel mounting potentiometers (volume and squelch)
2 or 3 knobs, styled to suit. 2 required for volume and squelch, crystal selection optional.
1-3 crystals for frequencies desired. Third overtone, 20 pF load, HC25/U case style:
41.6333 MHz for 135.6 MHz receive
42.2666 MHz for 137.5 MHz receive
42.3066 MHz for 137.62 MHz receive
1 30 kHz 2 pole crystal filter for 10.7 MHz i-f. Model 2196F from Piezo Technology, P.O. Box 7877, Orlando FL ($10.00).
1 12 volt low ripple power supply or components as listed in Fig. 5.
Misc. hookup wire, solder, etc.

Table 1. Components in addition to the basic receiver kit that are required to complete the satellite receiver.

Loran Joly WB0KTH
432 Central Ave.
Mora MN 55051

Learn A New Language!

- - try CW

The familiar term CW rings a bell in every ham's head. Every ham has, at one time or another, learned the Morse code in order to pass a test for his license. But have they actually learned the code, or have they just memorized it?

CW is similar to a foreign language in many ways. For one, it takes countless hours of work to speak fluently in any foreign tongue. Perseverance and motivation are required. Reading and listening will also help in the mastering of a language.

In other words, the "secret" in learning a language is *diligent practice*. There is no other way to escape the practice that is required. I do not want to discourage you from taking up CW as a serious facet of your hamming time. In fact, I am attempting just the opposite. You will make greater gains when you realize the work, time, and energy required.

There are a variety of tapes and records available for the elementary and intermediate CW operator's benefit. These methods work well, and are a good approach to the CW barrier.

Most ham operators send and receive Morse code between the speeds of five and thirty words per minute. At these speeds, the individual letters of each word are deciphered and registered on paper or in our minds. This method is quite acceptable, provided you wish to converse with people at these speeds.

There is, however, a hidden barrier that crops up when you reach approximately thirty words per minute. At and above this speed, you must begin to develop a vocabulary of words. Just as you learned to recognize a letter by its total "phrase," you will have to learn to recognize words by their total "phrases," not by piecing together letters. As the CW is being sent, you should hear words, not individual letters.

How does one acquire this skill? You can practice by tuning in various CW practice stations that operate on a regularly scheduled basis. Schedules of these stations are available from the ARRL. It also helps to have someone send you the more frequently used words and prefixes.

Out of necessity, a person receiving high speed CW will need to learn the art of "copying behind." To practice, just write everything a few words behind what is being sent. By doing this, fewer problems will occur with spelling and capital letters; there will be an overall improvement in the transcription from the mind to the paper.

No matter how fast you may be able to decipher CW in your head, you must be able to transfer it down onto paper if you wish to prove that you have a high proficiency in the translation of CW. There are various organizations which issue certificates for skills in CW proficiency. The Connecticut Wireless Association gives an award to those able to receive and *put onto paper* a 60 words per minute code proficiency transmission. To transfer code at speeds of over 30 words per minute onto paper, a typewriter is needed. Wear headphones as you are typing, so the typewriter will not drown out the CW!

Sending

Most hams cannot send good quality CW above 20 words per minute with a straight key. Therefore, a high percentage of the hams operating CW today use an electronic keyer. Many features are available on a keyer, such as dot and dash insertion, iambic operation, and automatic character spacing. If you desire the most highly advanced and versatile keyer available, then the Accu-Keyer with memory should fill the bill. The 1976 *ARRL Handbook* gives details on how to build this gem. Designed and built by WB4VVF, it has every feature in a keyer a ham could ever want!

If you enjoy typing, you may wish to build or buy a CW typewriter. As you type, CW appears (electrical form!) at the output of this machine. This is an easy method of sending very accurate CW.

As you begin to increase your CW proficiency, you will begin to enjoy this fascinating facet of ham radio more and more. I would be especially interested in hearing from anyone who is able to receive CW at a speed in excess of 60 words per minute. This *is* possible; it just takes practice, practice, practice. ■

A display of early amateur radio memorabilia now at the Pioneer Village Museum in Minden NE.

Amateur radio conventions and regional get-togethers back in the beginning 1920s were real festivities. The spirit which prevailed did so imbue all who attended that a broad new enthusiasm was born and dominated throughout amateur radio land in America.

Reference was made in our last installment to the 1920 grand finale convention in St. Louis. To prove that all the big-wigs, as well as hundreds of the hoi-polloi, were present, here is reproduced that convention's "Programme of Events."

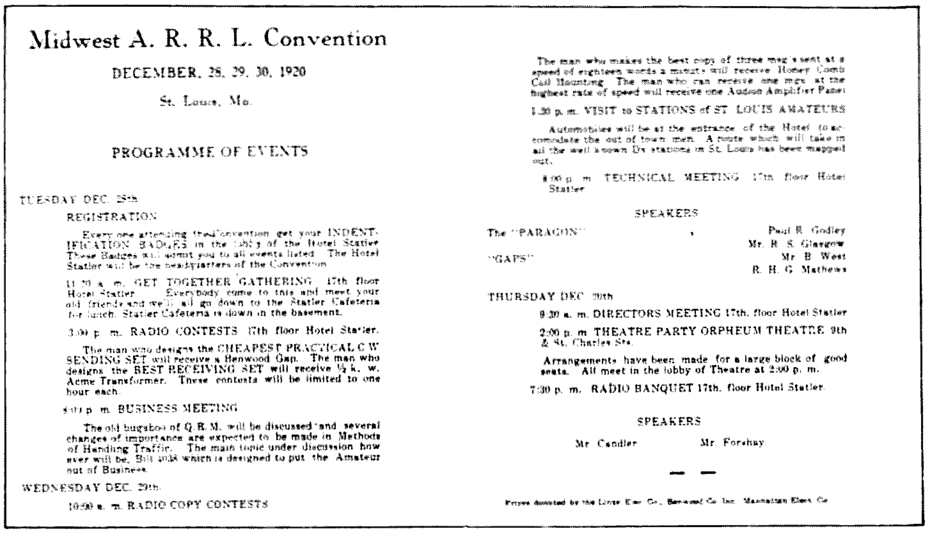
Should any reader who was present have any recollections or recognize any of the "stalwarts" mentioned, I most assuredly would be willing to swap a few yarns.

It would be to the everlasting glory of the proverbial

The History of Ham Radio

-- part III

Eric G. Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571



Midwest A. R. R. L. Convention

DECEMBER, 28, 29, 30, 1920

St. Louis, Mo.

PROGRAMME OF EVENTS

TUESDAY DEC. 28th

REGISTRATION

Every one attending the Convention get your INDENTIFICATION BADGES in the lobby of the Hotel Statler. These Badges will admit you to all events listed. The Hotel Statler will be the headquarters of the Convention.

11:30 a. m. GET TOGETHER GATHERING 17th floor Hotel Statler. Everybody come to this and meet your old friends and we'll all go down to the Statler Cafeteria for lunch. Statler Cafeteria is down in the basement.

3:00 p. m. RADIO CONTESTS 17th floor Hotel Statler.

The man who designs the CHEAPEST PRACTICAL C W SENDING SET will receive a Henwood Gap. The man who designs the BEST RECEIVING SET will receive ½ k. w. Acme Transformer. These contests will be limited to one hour each.

4:00 p. m. BUSINESS MEETING

The old bugaboo of Q. R. M. will be discussed and several changes of importance are expected to be made in Methods of Handling Traffic. The main topic under discussion however will be, Bill 2048 which is designed to put the Amateur out of Business.

WEDNESDAY DEC. 29th.

10:30 a. m. RADIO COPY CONTESTS

The man who makes the best copy of three msg's sent at a speed of eighteen words a minute will receive Honey Comb Coil Mounting. The man who can receive one msg. at the highest rate of speed will receive one Audion Amplifier Panel.

1:30 p. m. VISIT to STATIONS of ST. LOUIS AMATEURS

Automobiles will be at the entrance of the Hotel to accommodate the out of town men. A route which will take in all the well known Dx stations in St. Louis has been mapped out.

8:00 p. m. TECHNICAL MEETING 17th floor Hotel Statler

SPEAKERS

The "PARAGON" — Paul F. Godley

Mr. H. S. Glasgow

"GAPS" — Mr. B. West

R. H. G. Mathews

THURSDAY DEC. 30th

9:30 a. m. DIRECTORS MEETING 17th. floor Hotel Statler

2:00 p. m. THEATRE PARTY ORPHEUM THEATRE 9th & St. Charles Sts.

Arrangements have been made for a large block of good seats. All meet in the lobby of Theatre at 2:00 p. m.

7:30 p. m. RADIO BANQUET 17th. floor Hotel Statler.

SPEAKERS

Mr. Candler Mr. Forshay

— —

Prizes donated by the Lintz Elec Co., Benwood Co Inc. Manhattan Elect. Co

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

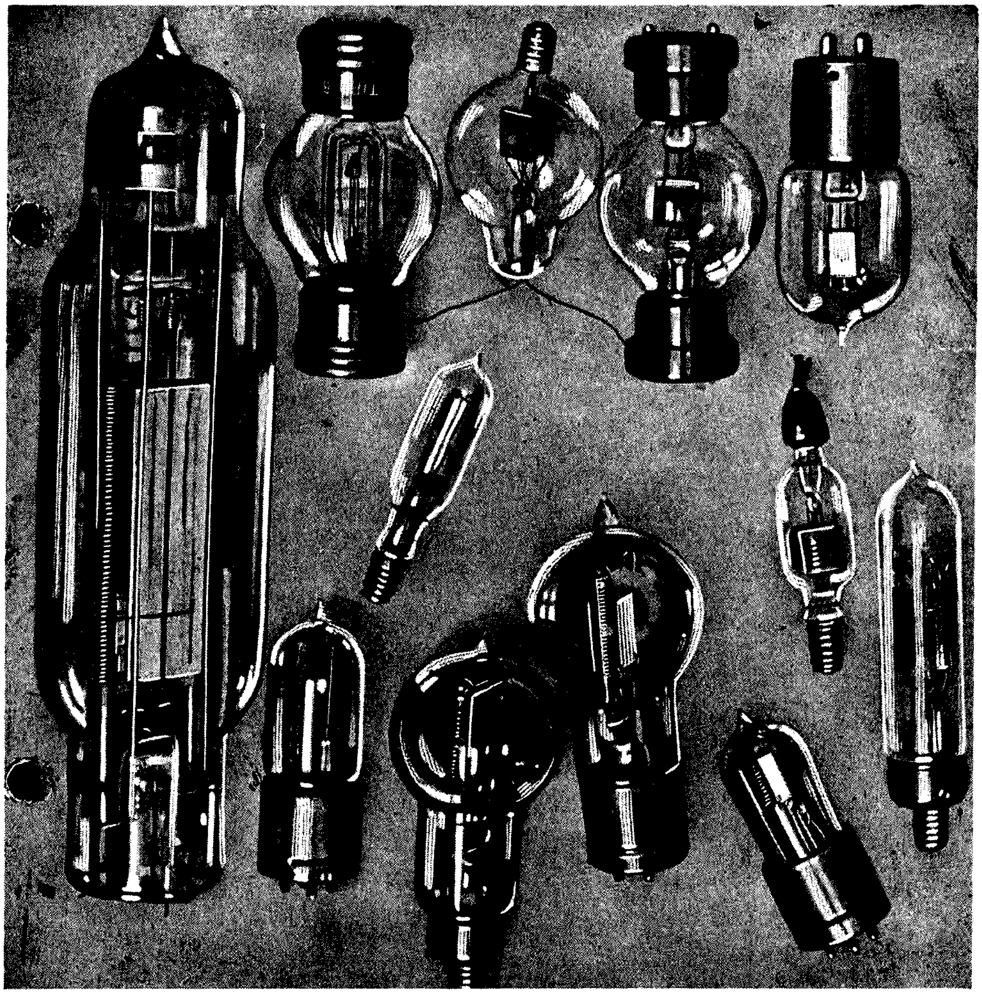
Old Man should any of the sparks of recording effort be transplanted into the pages of amateur history in the future. Probably nothing would surpass the account written in *QST*, February, 1921, pages 9 to 23.

For now, my notebook contains the following account of The American Radio Relay League Convention, as originally written and recorded in January, 1921:

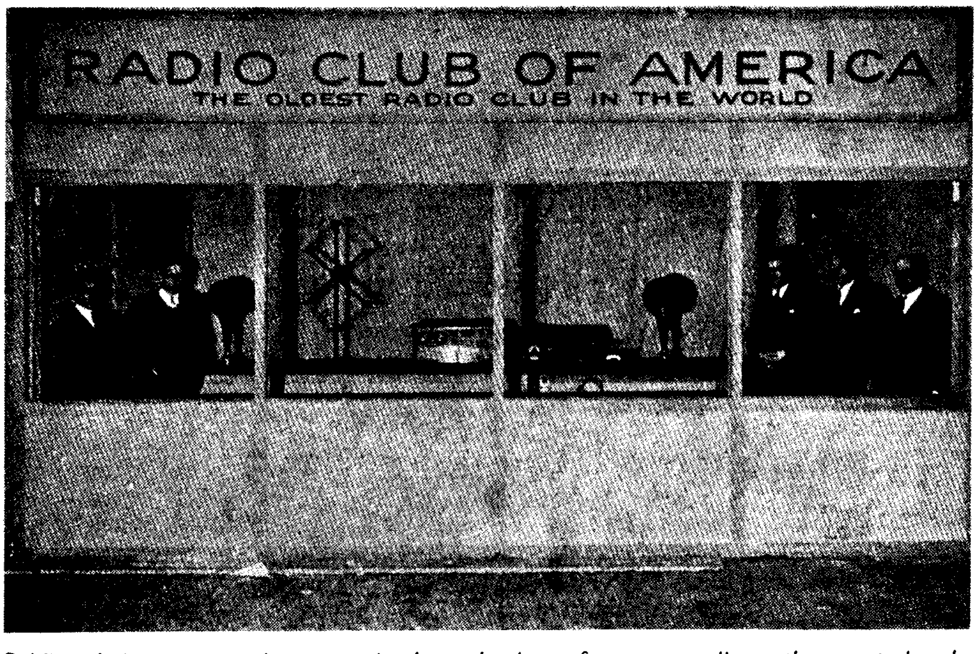
"The Midwest Division of the American Radio Relay League held its convention in St. Louis MO, December 28, 29, and 30, 1920. Representatives from all sections of the country were there, including all of the nine radio districts in the country. Never before in the history of the League has such a successful meeting in the interest of radio taken place. For three days, old and young met, in most cases for the first time, although they had known each other for years.

"Hiram Percy Maxim, well-known scientist and inventor, and President of the League, opened the convention with an address. Mr. Stewart, our representative in Washington, outlined the legislative situation, pointing out how the Poindexter Bill recently introduced in Congress is threatening the existence of amateur radio operators and experimenters. A committee was appointed to draw up definite resolutions to be sent to Washington protesting against the passage of the bill. Mr. Warner, Secretary and Editor of *QST*, gave a resume' of our growth from its inception only a few years prior to the war up to the present time. He stated that membership of over 50,000 has placed the organization in a position where it ranks as one of the largest in the country.

"The technical meeting was held on the 29th. Among the speakers were Mr. B. West 8AEZ, naval radio aide and authority on spark dischargers; Mr. Paul R. Godley, chief designing engineer for



A selection of early vacuum tubes — a far cry from the ultra-miniature transistors and ICs of today.



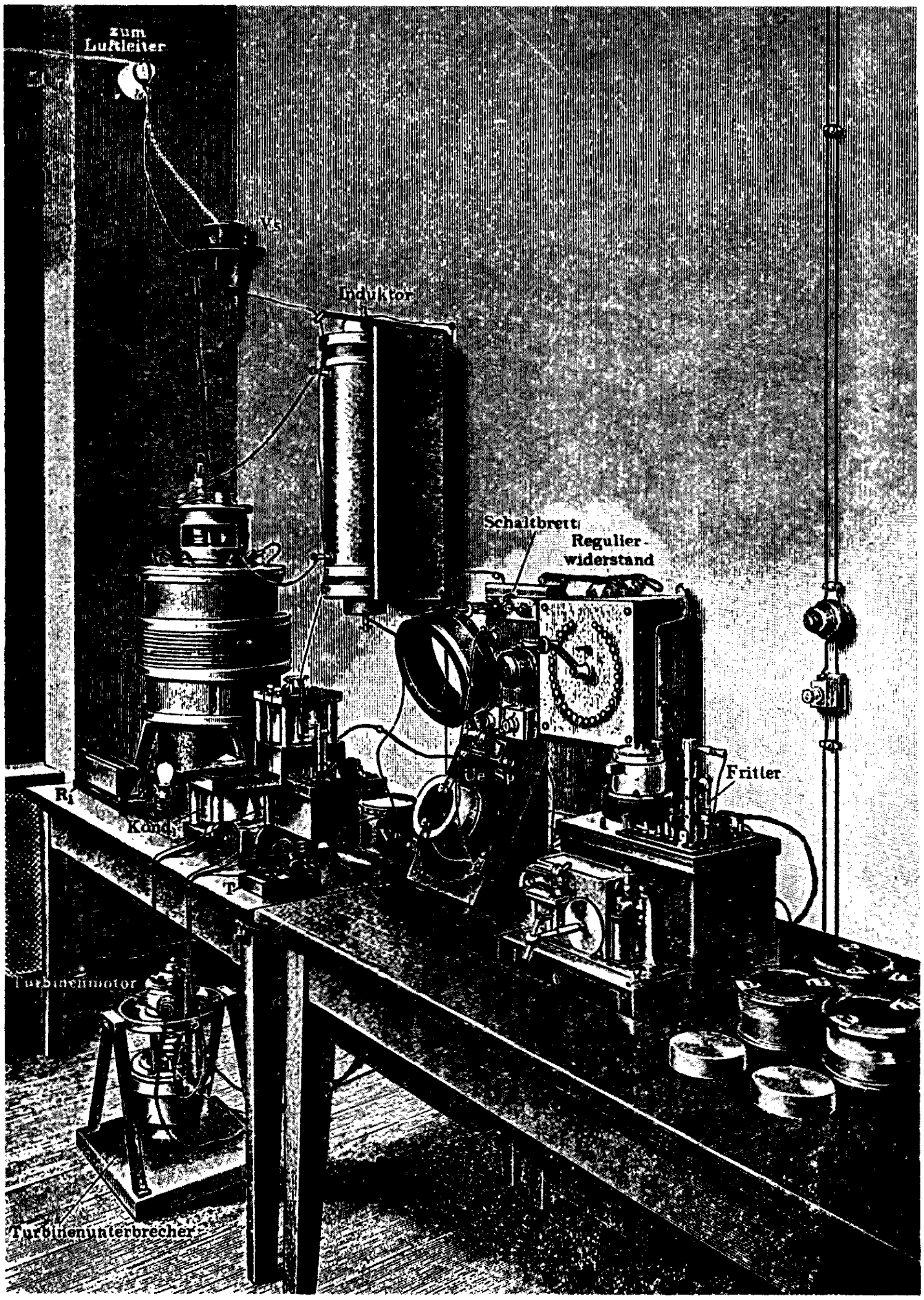
Public relations were as important in the early days of amateur radio as they are today. In 1922, a group from the Radio Club of America set up and manned this booth at a radio show in Grand Central Palace in New York City.

the Radio Corporation of America; and Mr. R. H. G. Mathews, ninth district superintendent of the League. Topics discussed were in connection with apparatus used in amateur radio stations. Since all amateur stations in the country are restricted by law to operate on a wavelength not exceeding two hundred meters and an input not exceeding one kilowatt, it is essential that all energy put into a set be used to best advantage. The maximum efficiency can be obtained only when apparatus is designed accuately and with special attention to details. The realm of radio is still wide open to improvements with new discoveries continually being made.

"Perhaps of greatest interest was the short but spellbinding address given by Mr. Haddaway, a young man seventeen years old. This lad came from a poor family. As a high school freshman, he had to use his spare time to support the family. He gave us a description of how he made the 'moonshine bulb.' Despite various handicaps, he had built a complete and effective amateur radio station, located in a tiny closet in back of his mother's kitchen. How did he go about accomplishing an 'impossible feat'? Every piece of equipment, including the individual components, were meticulously fabricated out of anything and everything imaginable. Even the headphones and tiny vacuum tubes were homemade. He had located a wholesale drug firm discarding waste material and there found scraps of glass tubing, and bits of tungsten filaments from old lamps. With such parts, he made his vacuum tubes. He had built his own mercury pump to evacuate the tubes. He found the mercury from broken thermometers. His headphones were ingeniously fabricated from bits of wood, metal, and wire, but they performed beautifully. Everything else in his station, which was visited during the day, was very cleverly made and assembled. And his only financial expenditure was a 25 cent pair of combination pliers. I have met no one in my lifetime who has displayed such a passionate purpose to succeed.

"The climax of the convention was the radio banquet. To our knowledge, it was the first of its kind ever given in the history of the League. The spirit was there all right! What the St. Louis radio club did not think of was not worth considering. Even the menu savored of sparks and ozone, none of it, however, being charged to very high voltage. Mr. Chandler of 8NG fame, Mr. B. West, and the President, H. P. Maxim, gave short addresses. Bill Wood of St. Louis club acted as toastmaster. To him as well as to the entire club is due the credit for the overwhelming success of the convention.

"The keynote of the meetings seemed to be *More Unity and More Cooperation* between the various clubs and organization as a whole, in



The "ideal" amateur station in 1920, consisting of one transmitter and two receivers. One receiver uses an electrolytic detector and telephone set. The transmitter utilizes a mercury interrupter and an open core transformer.

order to be able to stand behind any move which the League attempts to undertake. Every city in the country should have an organized radio club affiliated with the League.

"The ARRL was organized with the intention of relaying messages from city to city, state to state, and ultimately from country to country. Messages accepted for transmission are not charged for. Amateur radio operators do this as a service for the community and for mutual benefit because they have an interest in the development of radio as a ready means of communication. The stations are privately owned and operated, in many cases entailing an expenditure of hundreds of dollars. To be able to communicate with others hundreds of miles away amply compensates the amateur for erecting a station. It affords one of the most fascinating and at the same time educational fields of research to most any person interested in science.

"Radio is indispensable in many of our present day developments. Steamships and airplanes are lost if they have to do without the services of wireless. On railroad trains and automobiles, its application will eventually revolutionize modern business practices, just as the telegraph and the telephone have done. But to attempt to make far-reaching predictions, not even the most farsighted radio engineer can come anywhere within the actual facts which will be known ten years from now. (Remember that this was written in 1921.) Too little is understood of this greatest of all discoveries. That we will be able to talk directly with our friend riding in his car in another part of the country seems to be a dream still to be realized." (End of 1921 written and recorded message.)

To be continued.

The Oily Resistor Wattmeter

-- how to put 20 W into a I W resistor

George Hovorka WA1PDY
John Hovorka, Jr.
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Milton MA 02186

Often after an FM rig becomes a few years old, it is desirable to retweak the final output stage. But if you don't have a dummy load and an inline wattmeter, this job can be a problem. Here is a simple device to tune up your two meter transceiver for maximum power output. It is both a dummy load and an rf indicator, and can be built for less than a dollar. It can be used for FM rigs up and into the 20 Watt output class.

The usual problem with constructing a dummy load is finding a resistor which will handle enough Watts and also remain relatively nonreactive at 146 MHz. In our design, this problem is solved by using a 50 Ohm, one Watt composition resistor, and immersing it in a small jar of oil. We can run 18 Watts into this setup for a few minutes without the oil even getting warm. I have used this method successfully to tune up my Regency HR2B and my TR-22. The diode and the capacitor serve as an rf indicator.

This device is constructed by wiring the diode, capacitor, and resistor together as shown in the wiring diagram. Then this assembly is wired to the leads of a piece of RG-58 coaxial cable. Run a separate piece of hookup wire out from the diode and then punch a hole in the top of a baby food jar. Slip the assembly through, and seal the hole with epoxy. Then fill the jar with a high viscosity motor oil, such as SAE 30 or 40. Close the jar top tightly. Then connect a PL-259 connector to the end of the piece of coaxial cable.

To use your dummy load-rf indicator, connect the PL-259 to the back of the radio. Put your VOM on the plus 10 volt dc scale, and connect the positive lead of the VOM to the wire which runs out from the diode. Connect the negative line from the VOM to the braid of the coaxial cable or to the chassis of the radio. Place the transmitter on a frequency which falls in the middle of the frequencies which are used (146.52 MHz). Tweak the capacitors in the final output stage and driver stages with a plastic alignment tool, until you have the maximum indication on the VOM.

With this setup, you can peak your transmitter for maximum output both simply and inexpensively. ■

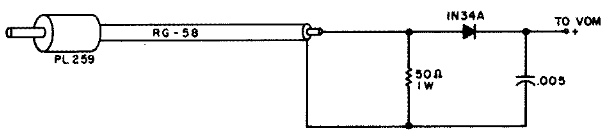


Fig. 1. Wiring diagram.

Parts List
- PL-259 connector
- 18" length of RG-58 coaxial cable
- 1 W 50 Ohm composition resistor
- 1N34A or equivalent germanium small signal diode
- .005 disc ceramic capacitor
- Hookup wire
- Baby food jar
- SAE 30 motor oil
- VOM
- Epoxy

SSTV Slalom Game

-- you don't need a sports car

Dave Ingram K4TWJ
Eastwood Village #604 No.
Rt. 11 Box 499
Birmingham AL 35210

If you've ever been interested in TV ping pong, hockey, space war, or any other popular TV game, then here's an SSTV game I'm sure you'll like. The game features moving action, programmable courses, black or white displays, optional scoring, and much more. The basic unit costs approximately five dollars to build and the optional scoring section costs an additional five dollars.

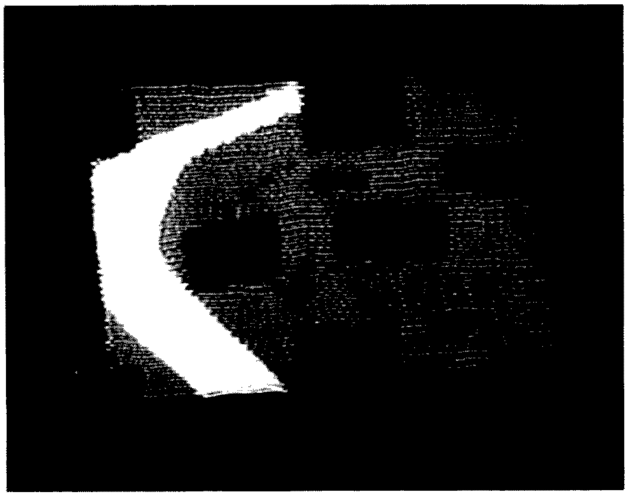
This game is a video representation of the popular sports car autocross, or slalom, races which are conducted by sports car clubs around the world. Contesting autos in a slalom individually maneuver through an obstacle course which is marked by rubber pylons. Tricky courses are commonplace, so driving skills and accuracy are the primary considerations. If you've never experienced an actual sports car slalom, you've missed a treat. Full details on local slaloms can usually be obtained from MG or Triumph dealers in your area. *SSTV Slalom* consists of an obstacle course, displayed on the monitor screen, and a "car" (thin line) which moves down the screen along with the initial trace. A pot is used for steering the line around pylons (black squares), and a simple 1, 2, 4, 8 counter performs optional scoring.

The challenge of slalom driving is captured in the game's positive response to steering commands, and in courses which can be made increasingly difficult as you become more skillful. During a typical "run," the car might be steered left and driven through a pylon. As it's steered back on course, it continues to move down screen, and is again meeting a turn and dodging pylons. A run is completed at the screen's bottom right, and bam! The car restarts at the screen's top left, again dodging pylons to get on course. Each run lasts approximately 8 seconds – the length of an SSTV frame.

Description

SSTV Slalom can be divided into three categories: the course, the car, and the optional accessories.

As this is intended to be a fun project rather than a soldering experience, I chose to utilize one's existing SSTV camera (or tape recorded SSTV) to generate all the necessary timing signals and to permit frequent course changes. This approach (known by computer freaks as letting software make up for a deficiency in hardware) proved to be more flexible and substantially less expensive then other methods of generating TV games. Each slalom course is drawn on a separate piece of paper and sequentially placed in front of the SSTV camera. A forty or fifty Watt lamp will provide sufficient illumination if the courses are placed on small index cards. An alternate method is to draw the courses on photographic slide blanks, then place these in an inexpensive slide viewer and



Six second exposure of a Slalom run. Although not apparent in this photo, the complete course was visible on the monitor screen.

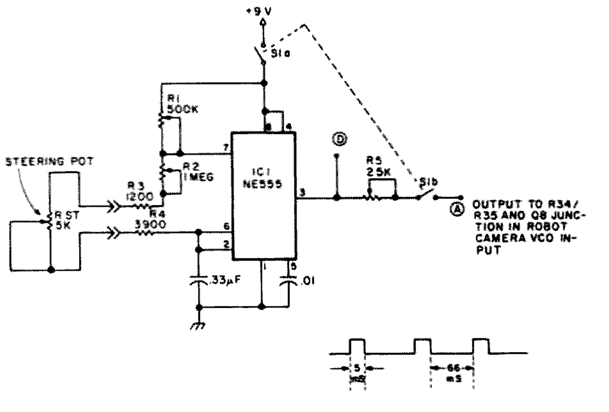
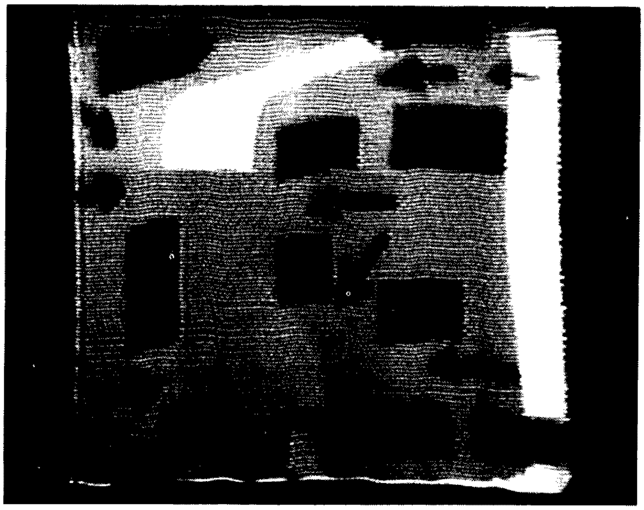
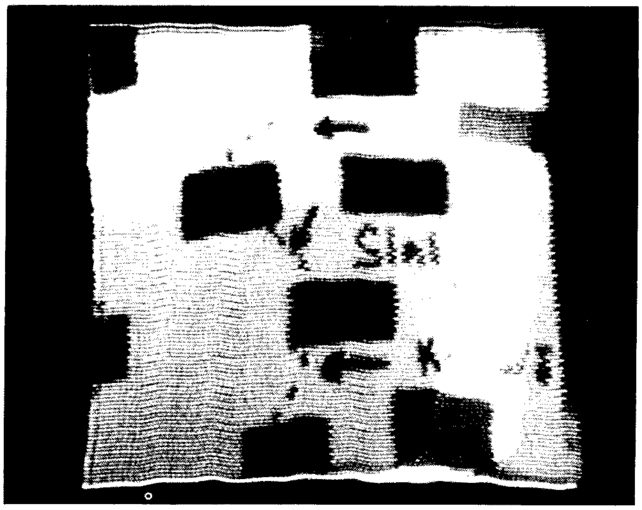


Fig. 1. Basic car generator. R1 – car frequency; R2 – car width; RSt – car steering; R5 – output amplitude.



This ten second "stop motion" photo of Slalom closely resembles an actual run in progress. During the first 8 seconds, the car was steered down the screen's right side. Then it was quickly steered on course before the camera's shutter closed 2 seconds later. I'll let you guess the run's results.

Capturing Slalom's action on film is quite difficult, as each run tends to erase the previous run and an 8 second frame doesn't portray motion. Proper "f" settings of double exposure photos are also difficult.



Another ten second "stop motion" photo of Slalom.

point the SSTV camera's lens into the viewer. Particular attention should be given to the beginning (screen top) and end (screen bottom) of each course for a smooth overall effect. I suggest trying some initial courses with various size obstacles and paths to get the game's "feel." The only remaining requirement is a car which can be driven through the monitor displayed course.

The car is simply an unsynced black (or white) level generator with its exact frequency controlled by a steering pot (see Fig. 1). Span limiting resistors are used with the steering pot to control car swing and produce a sports car type "feel." (No fair replacing this section with a 10k pot. A bug eyed Sprite or Lotus Elan doesn't even handle that good!) Output of the basic generator connects to an SSTV camera's voltage controlled oscillator input to combine car and course. Since I use a Robot model 80A camera, Fig. 1 gives the proper connection points for that unit. A similar concept can be used with other SSTV cameras. Simply connect the car generator's output (point A) to the camera's VCO input, in parallel with modulation voltages from the video amplifiers. Isolate levels as necessary to prevent overloads or low resistance paths. Direct connection of the car generator to the Robot's VCO will require a slight readjustment of the brightness control. I merely reach over and turn the control approximately ½ turn clockwise. However, lazy hams can include the circuitry of Fig. 2 and eliminate this effort.

One optional feature of *SSTV Slalom* is a car generator to be used in conjunction with cassette taped courses received from other SSTVers. This method also allows camera-less SSTVers to play *SSTV Slalom* on tape recorded courses. The additional 1500 to 2300 Hz oscillator circuitry for this feature is shown in Fig. 3. Another 555 IC is used as a 1500 Hz (black car) or 2300 Hz (white car) oscillator. Pulses from the basic car generator (point A of Fig. 1) key this oscillator at a 15 Hz rate. Output tones from the oscillator are directly mixed with SSTV from a tape recorder, and applied to the monitor input. A small amount of interference has been noticed while using this setup. However, it can be eliminated by using bandpass filters. I didn't include a filter because the *Slalom* pictures were merely being viewed rather than being transmitted.

Although *Slalom* in its most basic form provides all the fun of full blown TV games, optional scoring may provide an added bonus. This is accomplished by including the circuitry shown in Fig. 4. Two 7476s are wired as a simple 1, 2, 4, 8 counter and a 7400 is used to AND camera and car generator levels. When the camera produces a black level pulse (indicating a pylon), *and* the car generator produces a black level pulse (indicating the car), a binary 1 pulse is applied to the 7476 counter. Some isolation/processing of input levels is desirable, thus sections A, B, and D of the 7400 are wired as inverters. Light emitting diodes are connected between "Q" and ground of each J-K flip-flop to indicate score. These diodes will indicate counts from 0 to 15 (1111, or all four LEDs lit) before resetting, or S1 can be used to reset the counter after each run. This gives the SSTVer two options: He can score each run separately, or let the counter accumulate several runs and divide its total by the number of runs to derive an average score.

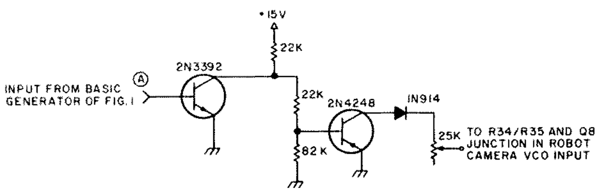


Fig. 2. Optional car/Robot interface.

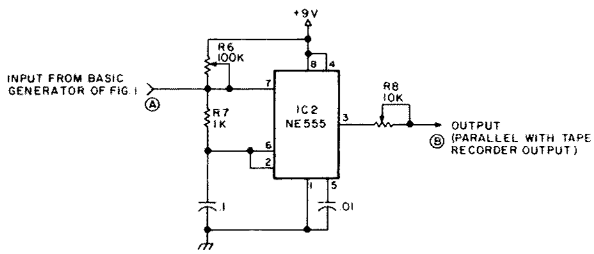


Fig. 3. Optional 1500/2300 Hz oscillator.

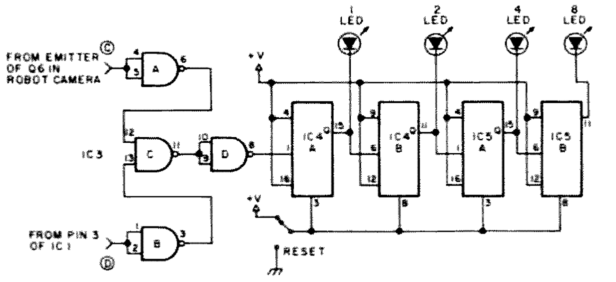


Fig. 4. Optional scoring for Slalom. IC3 – 7400, +V = +5 V. IC4 and IC5 – 7476.

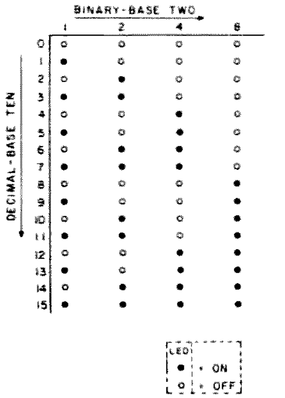
Construction

Because the highest frequency associated with *Slalom* is 2300 Hz, vectorboarding components is quite sufficient. Resistor values shown permit ample variations of frequencies and amplitudes, so there should be no problem getting a properly wired unit working. IC sockets are suggested if surplus 555s are used which may work incorrectly.

The actual game can be built several different ways to suit particular interests, so feel free to "tailor" your design.

I built two versions of *Slalom* and they both worked smoothly after initial alignment. One version consists of a basic "car" generator (Fig. 1) and scoring counter (Fig. 4) mounted on a 3 by 5 inch board. The board is mounted vertically in my Robot camera. Connections for on/off, steering, and paralleling VCO input are output to a small minibox via a Cinch Jones jack mounted on the camera's rear. An eight foot cable permits the minibox to be moved as desired. Of course, the basic unit can be mounted in a cabinet and its output connected to the camera's VCO via a small jack on the camera's rear, if desired. My other version of *Slalom* is a portable unit which uses the circuitry shown in Fig. 1 and Fig. 3. This unit, and some cassette taped courses, allow the game to be played anywhere on an ordinary SSTV monitor. This game generator is built on a 2 by 3 inch vectorboard and mounted in a small minibox. An on/off switch, output jack, and steering pot are mounted on the box front. Scoring is not included in this simple unit.

Fig. 5. LED pattern associated with counter of Fig. 4.



Alignment and Operation

The first step in game alignment requires tuning the car generator for an output of 15 pulses, 5 milliseconds wide, each second. An oscilloscope is helpful in making this adjustment, but it's not mandatory. Clip lead a light emitting diode between pin 3 of IC1 and ground, then adjust R1 until the LED flickers at a slow rate. Next, adjust R2 until the diode's "on" time is considerably less than its "off" time. Now readjust R1 until the LED is flashing almost continuously, and the generator will be very close to calibration. Final "tweaking" can be accomplished while watching the monitor screen.

The basic game is completed by making proper connections to your SSTV camera; place a sketched course in front of the lens and obtain a sharp picture on the monitor. The course should fill the screen precisely, with no overshoot. Switch on the car generator and adjust R5 until a line (the car) is visible on the monitor screen. Don't overadjust R5, or the camera's frequency swing will be excessive. If you have trouble obtaining a line, cap the camera lens and adjust the camera brightness pot. If more than one line is visible, the setting of R1 is too high. If the line is too wide, the setting of R2 is too high. Operations of these controls interact, so stay cool and make adjustments very slowly. A properly adjusted unit will produce one thin line which can be swung to either side of the screen as it moves downward with the initial trace. Uncapping the camera lens should result in both course and car being displayed on the monitor. If everything is properly adjusted, you should be able to maneuver the car through the displayed course.

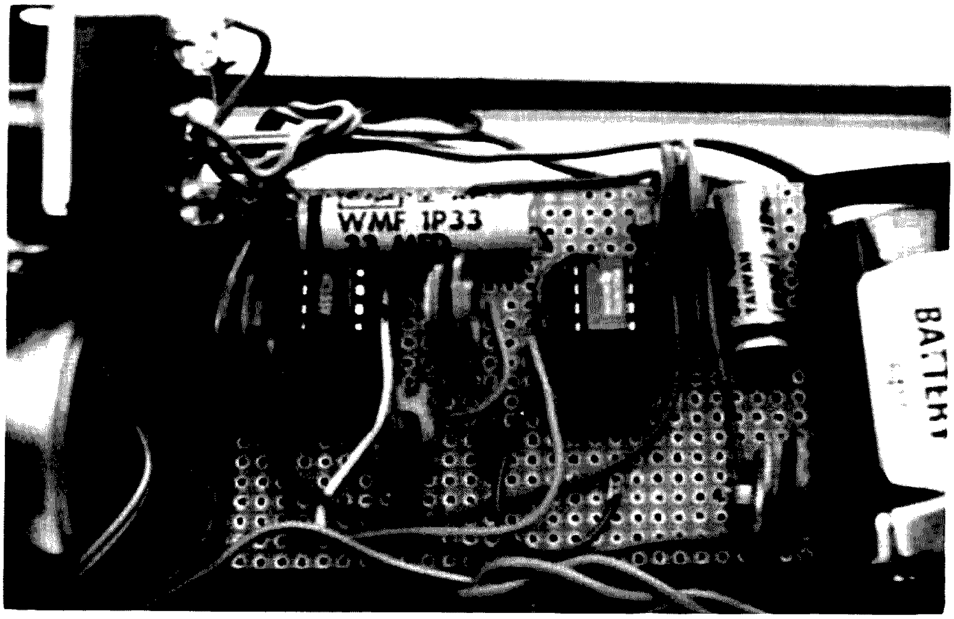
Alignment of the self-contained version of *Slalom* (Fig. 1 connected to Fig. 3) consists of setting the basic car generator using the pre-

This course features two tracks. Runs are alternated between the solid-lined track and the dotted-lined track. When the car finishes at the left bottom and reappears at the left top, it's turning left and must make a sharp right turn. This course keeps you hopping.

A Slalom course as displayed on the monitor screen, with the car generator switched off.

viously described LED technique, then adjusting R6 until IC2 operates at 1500 Hz (black car) or 2300 Hz (white car). IC2 should be adjusted with IC1 unplugged and a small speaker or frequency counter connected between point B and ground. Now reinsert IC1 and adjust R5 until clean, sharp pulsed tones are acquired at point B.

Operation of the scoring counter can be checked by applying ≈ 4.5 volts to point C, then pulsing point D with the same ≈ 4.5 volts. Each pulse should increment the counter one time, as illustrated in Fig. 5. Removing ≈ 4.5 volts from point C should disable the counter when point D is pulsed.



Portable Slalom generator consisting of the circuitry in Fig. 1 and Fig. 3. 15 Hz oscillator is toward front (pot and switch), and 2300 Hz oscillator is near rear (battery). A felt pad insulates board wiring from minibox.

Conclusion

Slalom is an inexpensive SSTV game that SSTVers can enjoy singularly, or in groups. Courses can be designed on paper and exchanged over the air or via mail. Video inversion of courses produces some very striking displays of *Slalom*, and 4 second frames can accelerate game action. I think that you too will enjoy building and playing this simple game.

The idea of *Slalom* hit me during a recent siege of poor band conditions. Continual fruitless calling (at the kW level, no less!) finally convinced me to "do my own thing." Sure enough, it worked. Every time I switched on *Slalom*, the band opened. ■

Mark Herro WB9LSS
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Oconomowoc WI 53066

Computer-Controlled Thermometer

- - take OSCAR's temp with a micro

Browsing through the vast *treasure trove* of articles, labeled as back issues of *73 Magazine* in our high school library, a very good article caught my eye. Entitled "How You Can Take Oscar's Temperature," this particular article described OSCAR 7's telemetry information, including formulas to decode the telemetry. After thinking for a bit, a little bug (actually a PROM memory keyer, I think) flew into my ear and said, "Heck, Herro, you could write a computer program for that!" I said, "You're right!" So I did. Thus, this article was born.

A Little Background

For the few (very few, especially if you read this magazine) who may not know, both OSCAR 6 and OSCAR 7 are alive, well, and

Fig. 2. Program listing.

```
LIST
OSCAR7     03:06 PM          11-FEB-77
10 PRINT"OSCAR-7 TELEMETRY DECODING PROGRAM"
20 REM BY MARK HERRO, WB9LSS
30 INPUT"TYPE DATE (GMT) OF COPY (DAY, MONTH, YEAR)";D,M,Y
40 INPUT"ORBIT #";O
50 DIM A(24)
60 REM 'A' CAN NOW HAVE 24 INPUTS
70 REM GET READY FOR INPUTS
80 PRINT"TYPE ONE NUMBER PER '?', DELETING THE FIRST NUMBER"
90 PRINT"OF THE THREE NUMBER SET (I. E. USE 23, 43, 77, 80. . ."
100 PRINT"INSTEAD OF 123, 143, 177, 180,. . .)"
110 FOR Y=1 TO 24
120 INPUT A(Y)
130 NEXT Y
140 REM ****DECODING MEAT****
150 PRINT"TOTAL SOLAR ARRAY CURRENT (MA)="
160 PRINT 29.5 * A(1)
170 PRINT"+X QUADRANT CURRENT (MA)="
180 REM LET N=A(2) THEN GOSUB TO RIGHT EQUATION
190 LET N=A(2)
200 GOSUB 9000
210 PRINT"-X QUAD. CURRENT (MA)="
220 LET N=A(3)
230 GOSUB 9000
240 PRINT"+Y QUAD. CURRENT (MA)="
250 LET N=A(4)
260 GOSUB 9000
270 PRINT"-Y QUAD. CURRENT (MA)="
280 LET N=A(5)
290 GOSUB 9000
300 REM SO MUCH FOR THE REPEATS FOR GOSUB 9000
310 PRINT"70/2 OUTPUT POWER (WATTS)="
320 REM IF INPUT IS '00' ODDS ARE 70/2 IS SHUT DOWN
330 PRINT 8*(1-.01*A(6))↑2
340 PRINT "SHIP TIME (HOURS)="
350 REM TIME INCREASES 1 INCREMENT EVERY 14 MINUTES
360 PRINT .253*A(7)
370 PRINT"BATTERY CHARGE/DISCHARGE CURRENT (MA)="
380 PRINT 40*(A(8)-50)
390 PRINT"BATT. VOLTAGE (VOLTS)="
400 PRINT .1*A(9)+6.4
410 REM I DONT KNOW WHY THEY PUT THIS NEXT ONE IN,BUT. . .
```

```
420 PRINT"ONE HALF BATT. VOLTAGE (VOLTS)="
430 PRINT .1*A(10)
440 PRINT"BATT. CHARGE REGULATOR #1 (VOLTS)="
450 PRINT .15*A(11)
460 PRINT"BATT. TEMPERATURE (CELCIUS)="
470 REM START SECOND SET OF REPEATED NUMBERS (9500)
480 LETN=A(12)
490 GOSUB 9500
500 PRINT"BASE PLATE TEMP. (CEL)="
510 LET N=A(13)
520 GOSUB 9500
530 PRINT"P.A. TEMP. 2/10 TRANSPONDER (CEL.)="
540 LET N=A(14)
550 GOSUB 9500
560 PRINT"+X FACET TEMP. (CEL.)="
570 LET N=A(15)
580 GOSUB 9500
590 PRINT"+Z FACET TEMP. (CEL.)="
600 LET N=A(16)
610 GOSUB 9500
620 PRINT"P.A. TEMP. 70/2 TRANSPONDER (CEL.)="
630 LET N=A(17)
640 GOSUB 9500
650 PRINT"P.A. EMITTER CURRENT 2/10 (MA)="
660 PRINT 11.67*A(18)
670 PRINT"TRANSPONDER MODULATOR TEMP. 70/2 (CEL.)="
680 LET N=A(19)
690 GOSUB 9500
700 REM END OF ALL THE REPEATED EQUATIONS
710 PRINT"INSTRUMENT SWITCHING REGULATOR CURRENT (MA)="
720 PRINT 11+.82*A(20)
730 PRINT"2/10 TRANSPONDER POWER OUT (MW)="
740 PRINT A(21)↑2/1.56
750 PRINT"435 MHZ BEACON POWER OUT (MW)="
760 PRINT .1*(A(22)↑2)+35
770 PRINT "2304 MHZ BEACON POWER OUT (MW)="
780 PRINT .041*(A(23)↑2)
790 PRINT"MIDRANGE TELEMETRY CALIBRATION (VOLTS)="
800 PRINT .01*A(24)
810 REM GOSUB EQUATIONS
820 GOTO 9700
9000 PRINT 1970-20*N
9100 RETURN
9500 PRINT 95.8-1.48*N
9600 RETURN
9700 END
```

broadcasting their onboard Morse code telemetry, transmitting the ship's status to anyone who happens to be listening. So although this article describes the OSCAR 7 telemetry decoding, the same technique can be applied to OSCAR 6 (and future OSCARs) as well. OSCAR 7's telemetry during Mode A (2m/10m) is transmitted on 29.502 MHz. Thus, anyone with a low band receiver (which means most hams and SWLs around) is capable of at least listening to the satellite and copying telemetry.

The telemetry itself consists of a cycle (called a *frame*) of twenty-four numbers divided into a pattern of six *lines*, and divided again into four *channels* to each line. Channels are designated A, B, C, and D. Thus, any specific number could be referred to as "channel 5C," or whatever. Fig. 1 illustrates. Each number represents a different function or status of the ship. Coming from OSCAR, the telemetry might read like this: HI HI 114 127 143 195 218 223 262 . . . Notice the pattern of 1A, 1B, 1C, 1D, 2A, 2B, 2C, . . . The "HI HI" at the beginning merely separates each full frame of numbers – the telemetry transmits continuously.

LINE #	1	2	3	4	5	6
Channel						
A	1—	2—	3—	4—	5—	6—
B	1—	2—	3—	4—	5—	6—
C	1—	2—	3—	4—	5—	6—
D	1—	2—	3—	4—	5—	6—

Fig. 1. Telemetry channels.

The Program

Although the program is written in BASIC for a DEC PDP/11-45 (the only system I have access to – heck of a toy!!), I tried to keep the program straightforward enough to adapt to any of the other forms of BASIC floating around. It shouldn't take that much memory either. See Fig. 2 for listing.

A little explanation of the program seems to be in order. First of all, the "Date of Copy" and "Orbit #" inputs (lines 30 and 40) are for the operator's information and convenience only. I included them to keep the reception and orbital data straight for future reference, especially if the output is to a TTY or other hard copy device.

Another possible confusing feature is the request to delete the first number of each channel (line 80). The first digit in each channel – the line number (i.e., *1*23 . . . *2*15 . . . *3*67 . . . etc.) – is for reference only and is not involved in any calculation! So if you use the program as is, you would type "23, 41, 77 . . ." instead of "123, 141, 177 . . ." It's possible, of course, to delete that first number within the program, but for the sake of simplicity (and less hassle for the programmer, not to mention memory!), I chose to do it this way. Fig. 3 shows a sample run to illustrate the program operation (I used a "1" as the input in each case).

Since some of the formulas use the same math equation, instead of just retyping that same thing over and over again while putting in the program, I just stuck in the GOSUB statements for lines 9000 and 9500. Let the computer do the work. This is first demonstrated with the "+X Quadrant Current" statement. There are two separate formulas used repeatedly. The answers to *all* the equations will be in the units specified in the preceding PRINT statement. The usual abbreviations apply: milliamp = mA, milliwatt = mW, temperature in Celcius (later in the program, just "Cel"), etc. If you still don't quite understand the program operation, see the flowchart in Fig. 4 for help.

Bells and Whistles

Once you have the bloody thing running, it's kind of fun to see for yourself how OSCAR is doing up there. And, of course, you don't have to stop where the program ends; there are a number of possible modifications. Subtracting out the first number of the channel by the program is one thing, as I said earlier. Or you could try to just calculate one number out

```
READY

RUN
OSCAR7     03:14 PM           11-FEB-77
OSCAR-7 TELEMETRY DECODING PROGRAM
TYPE DATE (GMT) OF COPY (DAY, MONTH, YEAR)? 00,00,00
ORBIT #? 00000
TYPE ONE NUMBER PER '?', DELETING THE FIRST NUMBER
OF THE THREE NUMBER SET (I. E. USE 23, 43, 77, 80. . .
INSTEAD OF 123, 143, 177, 180,. . .)
? 1                        TEST
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
? 1
 TOTAL SOLAR ARRAY CURRENT (MA)=
  29.5
+X QUADRANT CURRENT (MA)=
 1950
-X QUAD. CURRENT (MA)=
 1950
+Y QUAD. CURRENT (MA)=
 1950
-Y QUAD. CURRENT (MA)=
 1950
70/2 OUTPUT POWER (WATTS)=
 7.8408
SHIP TIME (HOURS)=
 .253
BATTERY CHARGE/DISCHARGE CURRENT (MA)=
-1960
BATT. VOLTAGE (VOLTS)=
 6.5
ONE HALF BATT. VOLTAGE (VOLTS)=
 .1
BATT. CHARGE REGULATOR #1 (VOLTS)=
 .15
BATT. TEMPERATURE (CELCIUS)=
 94.32
BASE PLATE TEMP. (CEL)=
 94.32
P.A. TEMP. 2/10 TRANSPONDER (CEL.)=
 94.32
+X FACET TEMP. (CEL.)=
 94.32
+Z FACET TEMP. (CEL.)=
 94.32
P.A. TEMP. 70/2 TRANSPONDER (CEL.)=
 94.32
P.A. EMITTER CURRENT 2/10 (MA)=
 11.67
TRANSPONDER MODULATOR TEMP. 70/2 (CEL.)=
 94.32
INSTRUMENT SWITCHING REGULATOR CURRENT (MA)=
 11.82
2/10 TRANSPONDER POWER OUT (MW)=
 .641026
435 MHZ BEACON POWER OUT (MW)=
 35.1
2304 MHZ BEACON POWER OUT (MW)=
 .041
MIDRANGE TELEMETRY CALIBRATION (VOLTS)=
 .01

READY
```

Fig. 3. Program sample run.

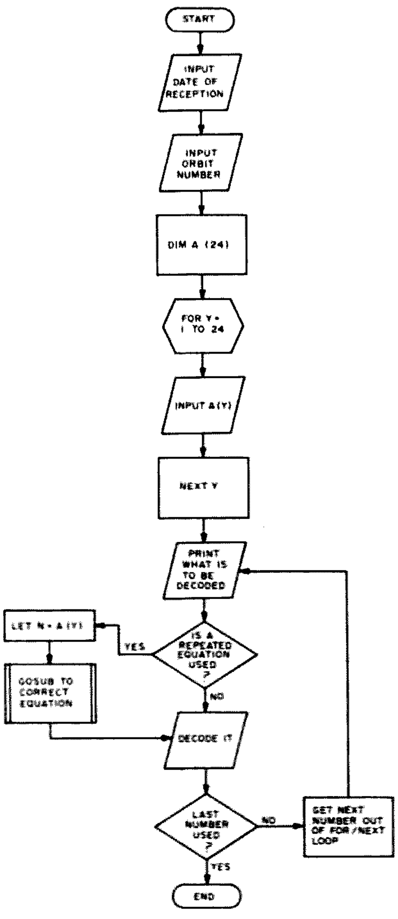

Fig. 4. Program flowchart.

of a whole frame. If you really wanted to go all out, you could try getting your system to take the telemetry Morse code off the air (adjusting for the Doppler shift), decode the information, and print it out at the same time!!

Conclusion

With a minimum of time and effort, it wouldn't be hard to "take OSCAR's temperature" the easy way. If you have a hard copy printout, all the better. You might even try taking a long-term survey of the satellite's performance by saving the information you collect for a time, then graphing the data with your new graphics system! Don't forget AMSAT; I'm sure they would be interested, too.

Now, after you have all that set up, try checking into OSCAR 9's telemetry. That'll have 128 channels when it is launched. ■

References

Kasser, "Oscar Facts," *1977 Ham's Almanac*, Number 2, 1977, p. 2.

Kasser and King, "Oscar 7 and its Capabilities," *QST*, February, 1974, p. 56.

"Oscar News," *QST*, February, 1975, p. 63.

Soifer, "Getting Started in Satellite Communications," *AMSAT Newsletter*, Vol. VI, June, 1974 (revised ed., Dec., '74).

Tater, "How You Can Take OSCAR's Temperature," *73*, July, 1975, p. 57.

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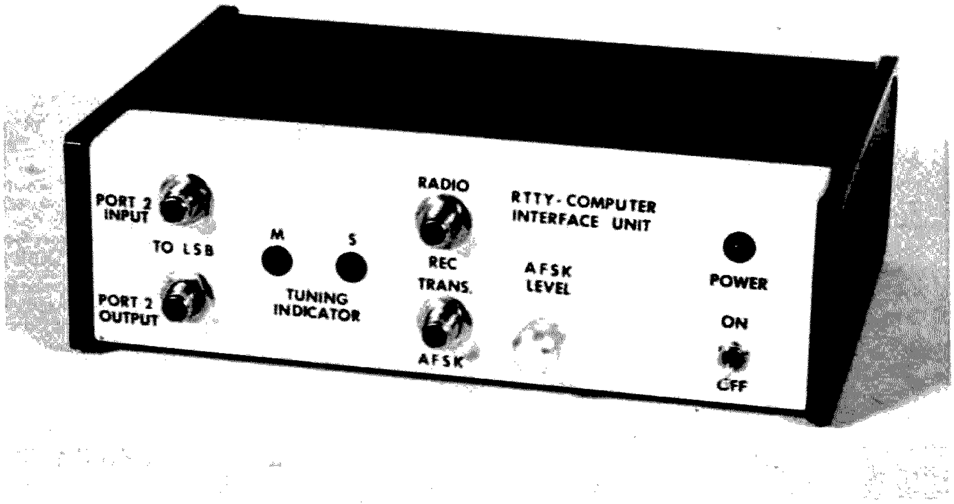
Bellevue WA 98006



Completed RTTY-Computer interface unit.

Computerized RTTY Takeover!

-- Digital Group cassette to TU conversion

A previous article[1] described how to connect a microcomputer to the ST-6 RTTY TU and how to program the computer for RTTY operation. Since all those interested in computer generated TTY may not have an ST-6 TU, I looked into the possibility of using The Digital Group Cassette Interface PC card[2] as a RTTY TU. This article presents the results of those efforts.

The Digital Group Cassette Interface PC card is designed for recording data as well as receiving data previously recorded in a microcomputer system. AFSK is used, with the MARK being 2125 Hz and the SPACE being 2975 Hz. Several circuit modifications were made to the PC board to change it into a low cost RTTY TU. These include shifting the SPACE frequency to 2295 Hz for narrow shift operation and adding two LED tuning indicator circuits to aid tuning in the RTTY signal.

The units as now configured will detect narrow shift RTTY signals, generate narrow shift AFSK signals, provide keyed input for CW ID, and will directly interface with the input/output ports of The Digital Group 8080 microcomputer.

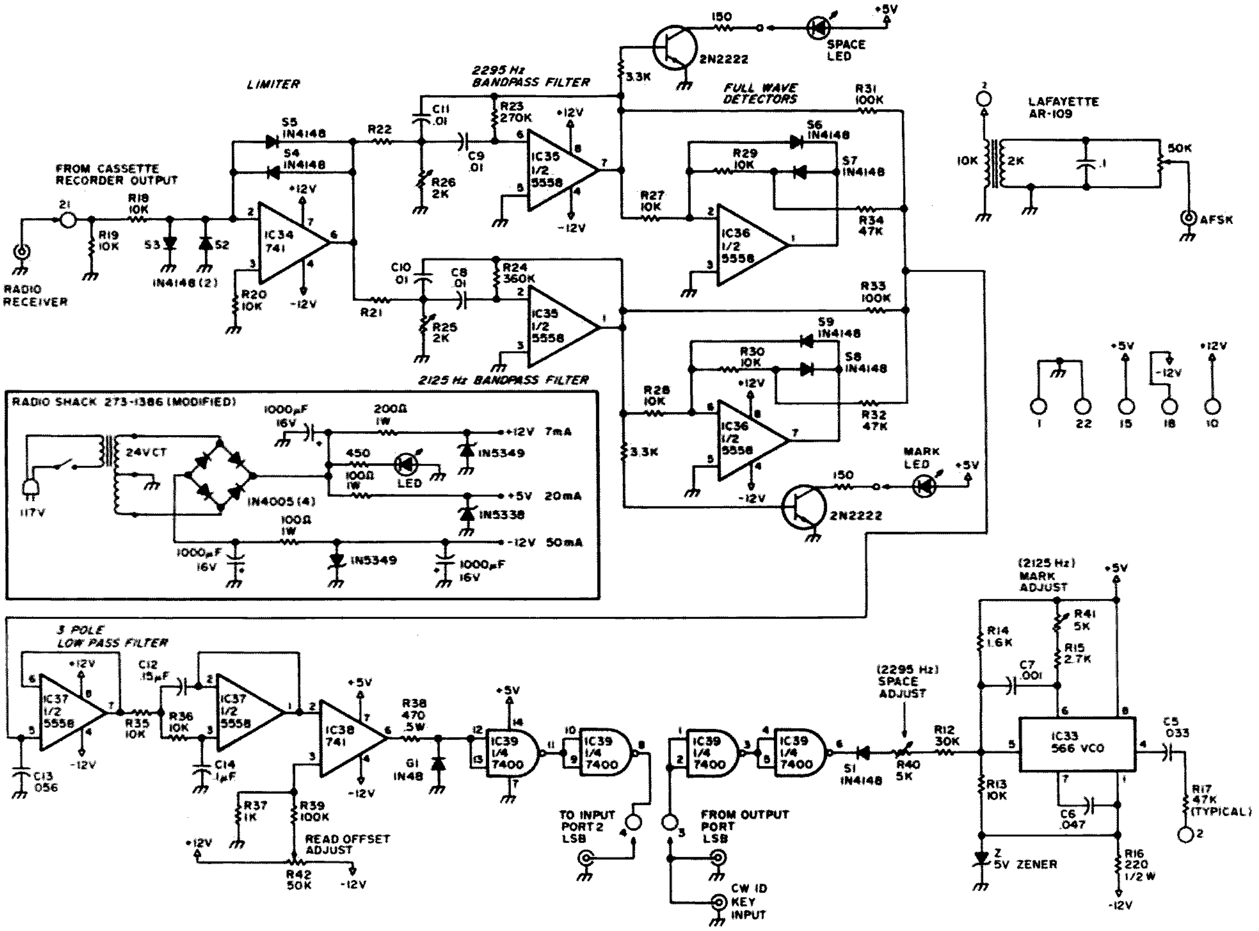
A very detailed circuit description of the cassette interface board is given in the kit assembly instructions and will not be repeated in this article.

Circuit Board Modifications

In order to find space to install the LED drivers, a portion of one of the voltage bus lines was cut and rerouted by adding two jumpers. The cut segment of the line was removed, and holes were drilled in the board to mount the LED driver transistor sockets and resistors as shown in the PC board sketch. External connections from the LED indicators were made to PC board pins 16 and 17. The selected resistors and capacitors required to retune the filters and VCO to the narrow shift frequencies are also noted on the PC board sketch. No other modifications were required to put the PC board into operation.

Construction

The PC board and power supply are mounted in a cabinet 8" wide by 5-3/4" deep by 2" high, a Ten Tec model JW-8. The power transformer selected did not originally have a center tap. The transformer laminations were disassembled and the primary windings were removed and stored temporarily on an empty wire spool. The secondary dc resistance was measured and sufficient turns were unwound until the center tap point (½ the dc resistance of the secondary winding) was reached. The center tap was brought out and the wire rewound on the form. The primary was then rewound on the transformer form, and the part was reassembled with the coil form inverted 180 de-



	Low Filter			High Filter			Low Pass Filter			VCO	
	R21	R24	R25*	R22	R23	R26*	C13	C12	C14	R12	R15
2125-2975 Hz 1100 Baud	6.8k	68k	938	4.7k	47k	697	.0056 uF	.01	.015	2.7k	1.3k
1200-2400 Hz 300 Baud (Simple)	6.8k	68k	4173	4.7k	47k	1162	.0056 uF	.01	.015	470k	2.7k
1200-2400 Hz 300 Baud (Correct)	12k	120k	1668	5.6k	56k	906	.015 uF	.033	.047	470k	2.7k
2125-2295 Hz 100 Baud (Simple)	6.8k	68k	938	4.7k	47k	1301	.0056 uF	.01	.015	47k	2.7k
*2125-2295 Hz 100 Baud (Correct)	36k	360k	156	27k	270k	179	.056 uF	.15	.1	30k	2.7k

* means that the value so indicated is the typical calculated value. The precise value is dependent on component tolerance.

Fig. 1. System block diagram.

grees to put the terminal lugs as far away from the mounting feet as possible.

A power ON pilot light indicator was made by monitoring the rectified secondary voltage with an LED protected by a current limiting resistor. The output of the VCO is a triangularly shaped wave, and is not suitable for modulating an SSB HF transmitter. An output transformer was installed in the unit and a .1 capacitor was connected across the secondary of this transformer to modify the wave shape into a sine wave. A gain control was added to aid in adjusting the output to a level suitable for the microphone input of the SSB transmitter. When the unit was first constructed, the output transformer was mounted near the power transformer. This caused hum to appear in the output of the AFSK signal, so it was moved up to the front of the unit and out of the strong ac field of that transformer. This

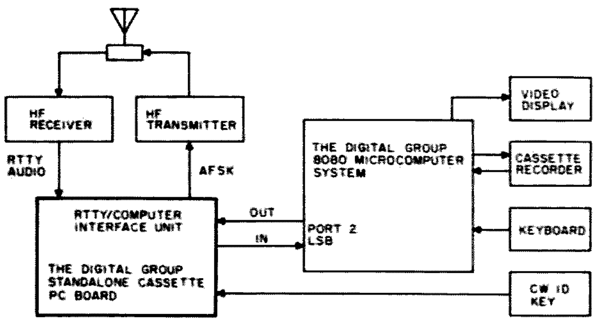


Fig. 2. Schematic diagram of modified Digital Group cassette interface circuit.

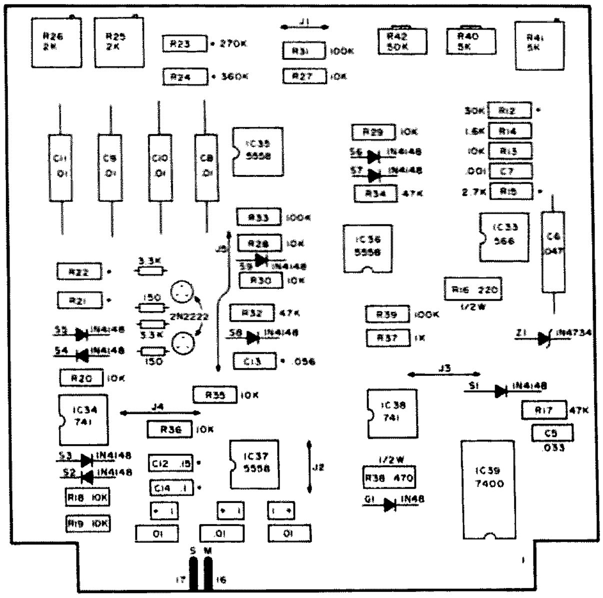


Fig. 3. Modified component layout for Digital Group standalone cassette interface.

cleared up that problem.

Adjustment

The power supply was wired up first, and before the circuit board was plugged into the connector (furnished in the kit), a check of the output voltages for proper voltage and no ripple was made. Some ripple was noted on the -12 volt line after the PC board was inserted. This was eliminated by adding the capacitor across the -12 volt bus as shown in the power supply diagram. The alignment instructions provided by The Digital Group data sheets were followed, except that the audio frequencies used were 2125 and 2295 Hz. The unit tuned up without any complications as per the instruction data. Incidentally, I used an audio frequency synthesizer[3] as a standard signal source. This unit generates the RTTY audio tones accurate to within several tenths of a Hertz. A digital counter[4] was used to monitor the adjustments of the VCO.

Operation

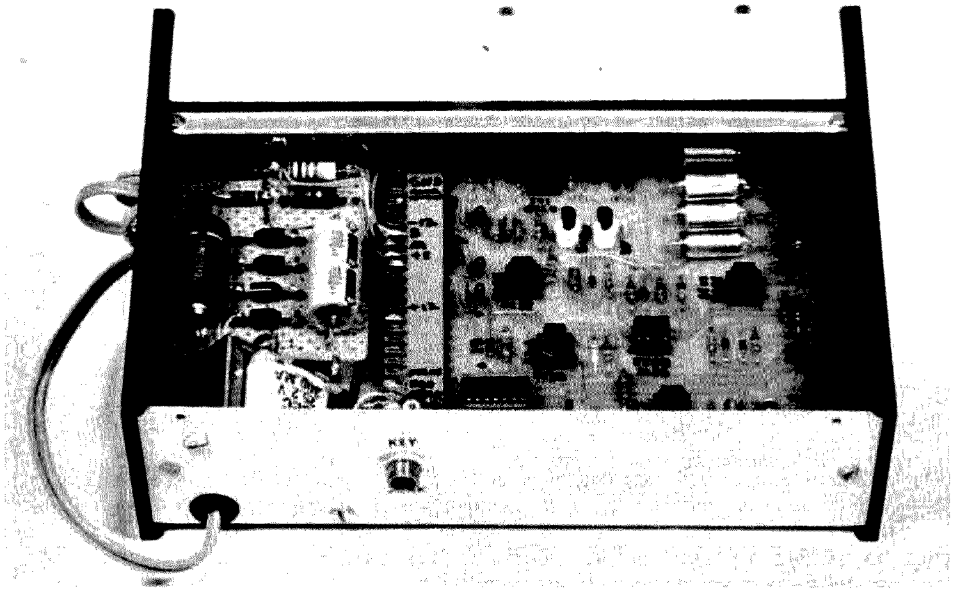
With the RTTY/Computer interface unit connected between the amateur station receiver and transmitter and computer as shown on the block diagram, the HAM-1 tape is loaded into the computer. A RTTY signal (60 speed, narrow shift) is tuned in on the receiver while the two LED indicators on the interface unit are watched. As the receiver is tuned across the RTTY frequency, first one LED will flash, and then both. Then the other will flash on and off. The optimum point is when both are flickering, indicating that both the MARK and SPACE signals are being received properly. A 7-1-1 is keyed on the computer keyboard to tell the computer to set the speed at 60 wpm, receive mode, in upper case letters. The resulting decoded Baudot signals should begin appearing on the video monitor beginning in the upper left-hand corner of the screen.

To transmit the TTY signal, the RESET key is depressed, and when the computer monitor program appears an instant later, the key 8 is depressed. This calls up the computer in the TTY keyboard mode. The transmitter is keyed, and as the keyboard is used, the AFSK signal will be modulating the transmitter in 60 speed, Baudot RTTY.

If the computer is loaded with The Digital Group Tiny BASIC Baudot,[5] the RTTY system is capable of receiving and sending data in the Tiny BASIC format. Listings of games and programs may be sent when the computer is programmed for Tiny BASIC Baudot. Received listings in this format are printed on the TV screen, and if an interface box as described in reference 5 is used in conjunction with this unit, a hard copy can be printed out on the TTY machine. These various modes have been very successfully used here at K7YZZ in receiving and sending both RTTY and computer data on HF to WA7RZW and others.

Conclusions

From on-the-air operation on RTTY and computer data information interchange, it has been noted that as long as you are receiving a strong signal, there is no problem, but when the signal fades, the TU is subject to interference such as CW. The addition of a bandpass filter such as that used in the ST-6 or the DT-600 would help in that situation. Of course, on data transmission you cannot afford an error, so the signal must be very strong with *no fades*. Under those conditions, a bandpass filter is not really required. ■



Inside view of interface unit showing modified Digital Group cassette interface board on the right and power supply on the left.

References

1. "An Intelligent RTTY Station," Louis Hutton K7YZZ, *73 Magazine*, April, 1977.
2. "Standard Cassette Interface Kit," $30, The Digital Group, PO Box 6528, Denver CO 80206.
3. "The Audio Synthesizer for RTTY, SSTV, and Whatever," Dr. Robert Suding WØLMD, *73 Magazine*, July, 1975.
4. "A Modern VHF Frequency Counter," Peter Stark K2OAW, *73 Magazine*, May, 1972.
5. "How to Use Those Old Teletypes," Louis Hutton K7YZZ, *73 Magazine*, February, 1977.

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2N1692	15.00	2N3925	6.00	2N5635	4.95
2N1693	15.00	2N3927	11.50	2N5636	11.95
2N2631	4.20	2N3948	2.00	2N5637	20.70
2N2857	1.80	2N3950	26.25	2N5643	20.70
2N2876	12.35	2N3961	6.60	2N5641	4.90
2N2880	25.00	2N4072	1.70	2N5643	20.70
2N2927	7.00	2N4073	2.00	2N5764	27.00
2N2947	17.25	2N4135	2.00	2N5841	11.00
2N2948	15.50	2N4427	1.24	2N5842/MM1607	19.50
2N2949	3.90	2N4430	20.00	2N5849/MM1622	19.50
2N2950	5.00	2N4440	8.60	2N5862	50.00
2N3287	4.30	2N4957	6.30	2N5942	49.50
2N3300	1.05	2N5070	13.80	2N5922	10.00
2N3302	1.05	2N5090	6.90	2N6080	5.45
2N3307	10.50	2N5108	3.90	2N6081	8.60
2N3309	3.90	2N5109	1.55	2N6082	11.25
2N3375/MM3375	7.00	2N5177/MRF5177	20.00	2N6083	12.95
2N3553	1.80	2N5179	.68	2N6084	14.95
2N3571	4.10	2N5184		2N6094	5.75
2N3818	6.00	2N5216	47.50	2N6095	10.35
2N3824	3.20	2N5583	5.60	2N6096	19.35
2N3866	1.09	2N5589	4.60	2N6097	28.00
2N3866 JAN	4.14			2N6166	85.00

RF TRANSISTORS

MRF207	2.00	Amperex BLY90	22.50	MM3002	1.65
MRF208	10.20	Amperex A209	8.60	MM3009	1.80
MRF209	12.35	MSC 2001	20.00	MM3375	7.00
MRF237	1.85	MSC 3000	20.00	MM3904	1.50
MRF238	8.55	MSC 3001	20.00	MM3906	1.43
MRF450	16.55	MSC 3005	20.00	MM4000	1.24
MRF453	19.55	MSC 80205	20.00	MM4001	1.39
MRF504	6.75	MSC 80206	20.00	MM4003	1.85
MRF509	5.50	MSC 80255	20.00	MM4036	1.60
MRF511	8.60	Fairchild SE7056	3.00	MM4044	3.00
MRF620	27.00	MM1051	2.00	MM4545	3.00
MRF8004	1.90	MM1500	32.20	MM8006	2.15
HEPS3013/75	2.95	MM1550	10.00	MM1552	50.00
HEPS3014/76	4.95	MM1601	5.50	MM1553	56.50
HEPS3002	11.03	MM1602	7.50	HEPS5026	2.48
HEPS3003	29.88	MM1607/2N5842	8.65	MSC 80256	20.00
HEPS3005	9.55	MM1614	2.75	CTC D1-28	20.00
HEPS3006	19.90	MM1620	17.50	CTC D10-28	20.00
HEPS3007	24.95	MM1622/2N5849	19.50	CTC E1-28	20.00
HEPS3008	2.18	MM1661	15.00		
HEPS3010	11.34	MM1669	17.50		
RCA TA7994	50.00	MM1943	3.00		
RCA 40290	2.48	MM2605	3.00		
Kertron K2126	5.50	MM2608	5.00		
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Let BASIC Control Your Next Contest!

- - with Extended Tiny BASIC language

Dick Whipple
305 Clemson Dr.
Tyler TX 75703

In the November, 1976, issue of *73 Magazine*, we described a simple BASIC operating system for use with Baudot teletypes. Although TBX (Tiny BASIC Extended) was satisfactory for beginning programmers, it lacked several features that could be useful for amateur radio applications. Since the November article, we have modified and expanded TBX to include some of these features. The present article describes this new version of TBX which we call TBX-A (Tiny BASIC Extended-Amateur Version).

String Handling Capability

One of the first additions to TBX was string capability. Message handling, logging, and contest operation all require some form of string storage and manipulation. In its original form, TBX only permitted integer variables. TBX-A recognizes both integer and string variables. As with most other BASICs, string variables are distinguished from numeric variables by affixing a dollar sign to the name. For example: A – numeric variable name; A$ – string variable name. Further, TBX-A requires that strings be stored in dimensioned arrays with two characters per array position. Consider the following example:

```
10 DIM A(20)
20 LET A$(1)="CQ CQ CQ DE W5CUD"
30 END
```

After executing the program, the message "CQ CQ CQ DE W5CUD" would be stored in the A array beginning at position 1. Fig. 1 shows the arrangement of characters within the array. A PR (PRINT) command could then be used to output the stored message to the printer (underline indicates operator input). Example:

```
(Direct command mode)
: PR A$(1) CR
CQ CQ CQ DE W5CUD
: . . .
```

The array argument can be changed to alter the beginning of the string. Suppose you only wanted to output the callsign. The PR command above could be modified with the following result:

```
: PR A$(7) CR
W5CUD
:
```

Printing begins at the seventh character pair and continues to the end of the string. In addition, the array positions not used by the original string can be used for other strings or numeric values. Example:

```
: LET A(15) = 1920
: LET A$(16) = "HRS"
: PR A(15)-20;A$(16)
1900 HRS
: . . .
```

TBX and TBX-A permit the use of two-dimensional arrays. In the case of strings, the second array argument can be used to create separate data blocks with the same variable name. The program shown in Fig. 2 illustrates this technique applied to the creation of logging entries.

The index variable I, used as the second array argument, creates up to ten different log entries. The first argument is used to set up data items for each log entry. The data items, or fields, as they are called, are reserved as shown in Fig. 3.

Fig. 4 further illustrates the two-dimensional storage technique.

When the strings are stored as array elements, they can be further manipulated under program control. In the station log example of Fig. 4, you might want to reorder the file by call area. TBX-A has a string function LEFT(string,n) that creates a temporary string consisting of the leftmost n characters of the given string. By using the LEFT function, the program in Fig. 5 rearranges the log

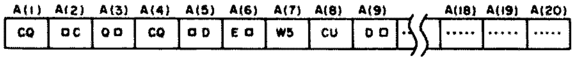

Fig. 1. A diagram showing the storage of a message as a string in array A.

```
10 DIM A(10,10)
15 FOR I = 1 to 10
20 IN A$(1,I),A(5,I),A$(6,I)
30 NXT I
40. . .
. . . .
: RUN CR
?W2XYZ CR ?1620 CR ?7425KHz CR
?W5UUV CR ?1635 CR ?7430KHz CR
. . . .
```

Fig. 2. Two-dimensional array example.

#	Item	Array Positions
1	Callsign	1 to 4 (Max. 8 char.)
2	Time (GMT)	5 (1 integer value)
3	Frequency	6 to 10 (Max. 10 char.)

Fig. 3. Data items placement within array.

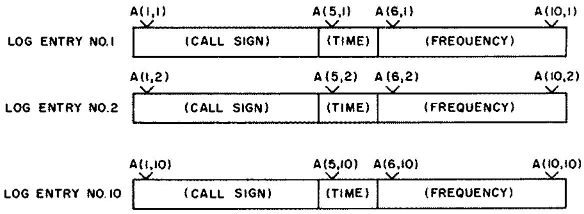

Fig. 4. This diagram shows how two-dimensional arrays can be used to store station log entries. A 10 by 10 array is used to store 10 blocks each, consisting of callsign, time, and frequency values.

file by call area and prints out the result.

Note that the LEFT function is used to extract the leftmost two characters of the callsign, which is the call area. Fig. 6 is a sample run of this program showing the data files before and after reordering.

Ways to Output Strings

Once stored, character strings can then be output to various devices as needed. Output to the local printer is accomplished by the PR statement as in the example program of Fig. 6. TBX-A has two other output modes of special interest in amateur applications:

1. As a RTTY signal to the transmitter; and
2. As a Morse code signal to the transmitter.

Let's consider the RTTY case first. Suppose you have a message such as "CQ CQ CQ DE W5CUD" stored in array A$(1). You are ready to transmit the message over the air as a RTTY signal. On the keyboard, you would type the following command:

:XMT(A$(1),100) CR

The XMT command in TBX-A has two arguments. The first is the string variable to be transmitted, while the second is a number indicating the rate at which transmission is to take place. Thus you are able to send pre-stored text at any desired speed — even faster than your local teletype. The XMT command can appear as part of a program as well as a direct command. For instance, the message above could be sent several times in succession if the XMT command appeared in a FOR-NXT loop. Consider the short program below:

```
10 DIM A(20)
20 LET A$(1) = "CQ CQ CQ DE W5CUD"
30 FOR I = 1 to 3
40 XMT(A$(1),100)
50 NXT I
60 END
```

After entering the RUN mode, the message would be transmitted three times, one after the other.

To transmit a string via Morse code involves the use of the SM command. It is very similar to the XMT except that the characters of the string are output in Morse code to a single bit (on-off) output port. The appropriately interfaced port in turn keys the transmitter. Thus, it is possible to automatically send a coded message. The example program below illustrates the use of the SM command:

```
10 DIM A$(20)
20 LET A$(1) = "WA5NBQ DE W5CUD"
30 FOR I = 1 to 2
40 SM(A$(1))54)
50 NXT I
60 SM(" K ",54)
70 END
```

As with XMT, the first argument of the SM command is the string to be sent, and the second is a speed constant. The program above might be used at the beginning and end of RTTY transmission.

Corresponding to the transmitting commands outlined above are two commands that permit you to use the local keyboard as the source of data instead of stored strings. Let's again take the two commands separately. To enter the RTTY mode, you use the following command:

:XMD(100) CR

At this point, the local keyboard will act as the data source for the RTTY transmission. Each keystroke will result in that Baudot character being transmitted at a speed determined by the single argument of the XMD command. To exit the XMD mode (bringing the local keyboard back to the TBX-A command level), one enters two FGS in succession. Note that the transmitted speed is not limited to the local machine. It can be made faster or slower by simply changing the speed constant.

The second direct transmitting command allows the local keyboard to generate a Morse code signal. In our original version of TBX-A, a keystroke would immediately cause the corresponding Morse code for that character to be sent. We found this to have several undesirable effects. The code generated was not sufficiently regular in

```
10    DIM A(10,10), T(10)
. . .
100   LET C = 0
110   FOR I = 2 to 10
120   IF LEFT(A$(1,I-1),2) < LEFT(A$(1,I),2)GOTO 230
130   LET C = 1
140   LET T$(1) = A$(1,I)
150   LET A$(1,I) = A$(1,I-1)
160   LET A$(1,I-1) = T$(1)
170   LET T(5) = A(5,I)
180   LET A(5,I) = A(5,I-1)
190   LET A(5,I-1) = T(5)
200   LET T$(6) = A$(6,I)
210   LET A$(6,I) = A$(6,I-1)
220   LET A$(6,I-1) = T$(6)
230   NXT I
240   IF C = 1 GOTO 100
250   FOR I = 1 to 10
260   PR A$(1,I);A(5,I);A$(6,I)
270   NXT I
280   END
```

Fig. 5. Program for rearranging the log file by call area and printing the results.

	BEFORE	
W2XYZ	1620	7425 kHz
W5UUV	1635	7430 kHz
W1AAC	1810	7420 kHz
W1QRX	1912	7420 kHz
	AFTER	
W1AAC	1810	7420 kHz
W1QRX	1912	7420 kHz
W2XYZ	1620	7425 kHz
W5UUV	1635	7430 kHz

Fig. 6. The two listings show a group of station log entries as first entered and then as rearranged by call area with the sorting program given in the text.

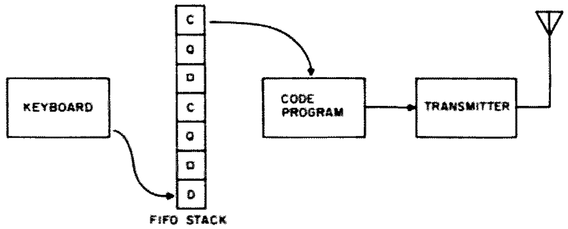

Fig. 7. This diagram indicates the flow of data from the keyboard to the transmitter during direct Morse code operation. The FIFO stack is constantly expanding and shrinking to compensate for different keyboard and code generation speeds.

inter-character spacing, which resulted in copying difficulties. In addition, it caused the operator to type at the code speed (or less), which created a certain awkwardness, especially for people with regular typing rhythms. We then decided that the typing and Morse code generation should be handled independently by the software so that the typist could work at his own speed while the Morse code was being sent with standard character and word spacing. What was needed was a FIFO stack (First In First Out). To illustrate the technique, see Fig. 7. As the keyboard is struck, the Baudot character is placed on the bottom of the stack (actually a group of 72 consecutive memory locations). Each new keystroke "pushes" that Baudot character onto the stack from the *bottom*. The Morse code generation program "pops" or takes the characters from the *top* of the stack and sends the appropriate code to the transmitter. Here is the really important point: the *pushing* and *popping* operations are completely independent and take place at rates determined by the typist and speed constant of the SMD command, respectively. Thus the code produced has an evenness and readability far improved over our original method. Two additional points:

1. When the stack is exhausted (keyboard entry stopped), Morse code transmission also stops; and
2. The buffering action of the stack will only permit the typist to get 72 characters ahead of the Morse generator.

The latter has not been a problem for us, but an overenthusiastic typist could fill the stack. By the way, exiting the SMD mode is accomplished by simply typing a BLANK.

Special Receiving Capability

TBX-A has a couple of receiving modes for RTTY. The first is the RCV mode which is entered using the following command:

```
:RCV(A$(1),100) CR
```

The string variable, A$, will receive and store the incoming RTTY message for later printout. The second argument is once again a speed constant. This mode is useful for receiving RTTY at speeds above that of the local teleprinter. We have not found this to be a very satisfactory approach, since the printout is necessarily delayed. Although not yet implemented, we have given some thought to setting up a FIFO stack as mentioned earlier so that receiving at one speed and simultaneously printing at a slower speed would be possible.

Another RTTY receiving mode uses the RCD command. It has the following form:

```
:RCD(100) CR
```

The receiving speed is determined by the single argument. In this mode the printer is actively copying the incoming signal, which may be at any speed less than or equal to the speed of the local printer. For instance, if the local machine is a Model 28 operating at 100 wpm, RCD will permit direct copy of 60 or 75 wpm signals by using the appropriate speed constant. Exit from this mode is made by typing a BLANK on the local keyboard.

To date, we have not added any Morse receiving software to TBX-A. We have felt that such capability would be of limited usefulness except when receiving machine-generated code.

That about completes our description of TBX-A. Implementing it on your 8080-based system will not be as simple as some of our other programs like BM/E and TBX. For this reason, we are not making a specific offer for a data package as we did previously. We would prefer that those readers who are interested write us at this address: TBX-A Information, Rt 4, Box 52-A, Tyler TX 75703. We will then make an effort to assist by providing the necessary information at a nominal charge (to cover reproduction costs, etc.). ■

BE MY GUEST

visiting views from around the globe

from page 24

You can buy crystals before you go, or, for some of the more popular hand-helds, you can get them in London and have them netted at about the same cost as you pay here. If you will be mostly in London, you won't need many crystals — no two repeaters are permitted within a fifty mile radius! Just get one repeater pair and one simplex. The London repeater is on Channel R7 — 145.175 in, 145.775 out — and it is just frantically busy about 21 hours daily. Since the timer is just 55 seconds, it leads to fast exchanges — and since most users ID themselves and the other guy with each and every exchange, there isn't time for much else to be said! It is tone burst access; if you don't have tone burst, you can get in for 10 seconds. Oh, yes — if your deviation is too low, the repeater will "time out" on you; if you are too low in frequency, you will get an "L"; if too high, an "H". It also sends a "K" at the end of each transmission. Timeouts are very frequent.

You will hear some rather strange sounding signals because much of the equipment is home-built — current state-of-the-art gear already manufactured such as we obtain so readily here is extremely expensive by our standards.

Language barrier? The UK ham will have no difficulty understanding you because he's largely exposed to rebroadcasts of American TV shows. But you might have a few problems understanding his English — especially since he must rush to get in under the 55 second timer! However, his phonetics are the same as yours — Alpha, Bravo, Charlie, etc.

Remember — plan ahead — and be prepared to prove ownership of your equipment when passing through customs. The best way to do this is by registering it before leaving this country with the Customs office. Last but not least: Expect to encounter more than normal interference from other transmissions when operating over there — interfering signals are plentiful by unlicensed stations.

Warren Geary K9KMX/G5BPL
Hinsdale IL

Reprinted from Squelch Tale, *Bulletin of the Chicago FM Club, Chicago IL, and* Repeater Newsletter, *Bulletin of the Lake Erie ARC, Lakewood OH.*

Satellite Zapper

-- effective antenna for weather birds

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Antennas for reception of polar orbiting weather satellites can be vexing and complicated affairs. Since the satellites generally track in a north-south direction (actually NNE to SSW for daylight passes and SSE to NNW for evening passes) when near overhead, it might seem that a simple dipole oriented east-west might be ideal, since the satellite would always be in the main lobe of the antenna pattern. Unfortunately, the signal from the satellite is linearly polarized and as the satellite changes orientation in respect to the ground station as it passes overhead, the signal polarization as seen at the ground will vary considerably. The solution, of course, is to use circular polarization, resulting in a maximum of 3 dB of signal loss regardless of the polarization of the satellite signal. This is a relatively small price to pay compared to signal losses of up to 20 dB that can occur with polarization mismatch between the ground station antenna and the satellite signal. The two most common antenna types that are useful for satellite service are the helix and the crossed yagi, the latter with its elements properly phased to yield circular polarization. A helix of four or more turns or a 5 element or larger crossed yagi will do an excellent job, but there is one major price that must be paid for the directivity of such antenna arrays – the satellite must be tracked! This generally requires two antenna rotors (one for azimuth and one for elevation) and precludes picture aquisition when the operator is not present. In a past article in *73*, and in the *Weather Satellite Handbook* (available from *73*), I described an automated satellite station that provides a degree of automatic operation so that pictures can be logged without the operator being present. This system is highly effective but is somewhat complex. If the system is set up for logging daylight passes, it is not particularly effective for evening passes and vice versa. Additional programming can be done to permit automatic tracking of daylight and evening passes and the system is useful for obtaining picture data from horizon to horizon.

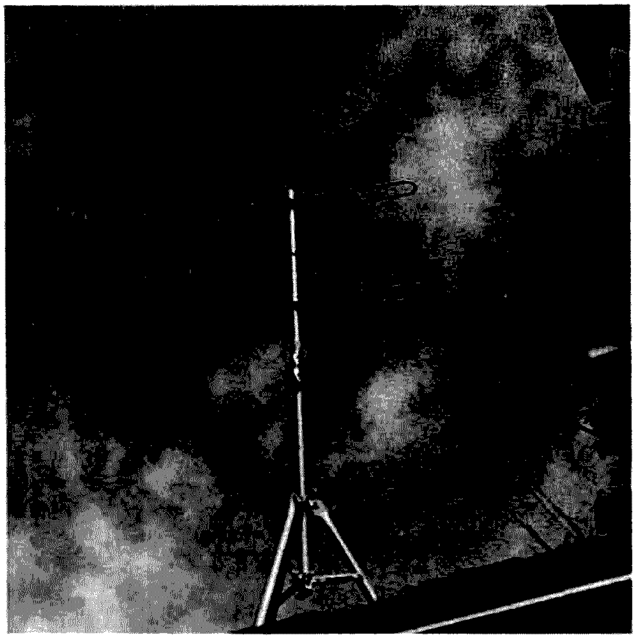

Fig. 1. Photograph of the author's antenna system. The relationship between the phased folded dipole driven elements and the two parasitic reflectors is obvious.

In the process of moving into a new house, I decided to take the opportunity to repackage the satellite station to make it somewhat more attractive and, while wrapped up in that project, I also decided to rethink the antenna situation. Now some of the locals around here will say this is because the house was a magnificent Victorian relic with very steep roof lines and that I was simply chicken to risk my skin crawling about doing antenna work. This, of course, is simply not true – the whimpering sounds that drifted down to the ground during antenna sessions were entirely due to our cat, who is deathly afraid of heights. The fact that the cat was never observed on the roof is immaterial! The real reason, of course, is that I needed room up there for the S band antenna system plus the normal complement of VHF and UHF arrays and simply wanted to see if a simpler approach could be made to work. What we ideally want for polar orbiting satellites is an omnidirectional antenna (with circular polarization) that will yield an acceptable

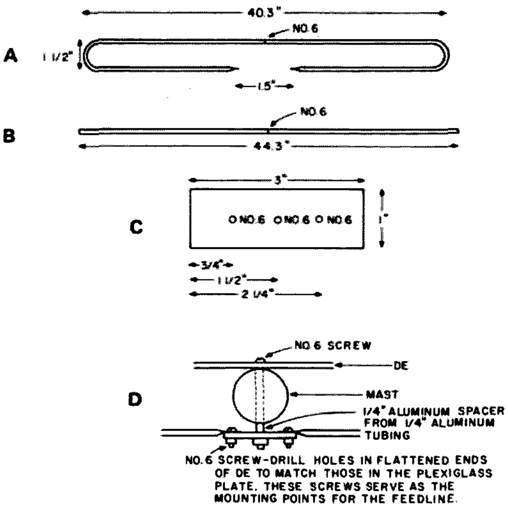

Fig. 2. Antenna element details. (a). Driven element folded dipole fabricated from ¼" aluminum tube. A #6 hole is drilled through the center of the element and 1" of the free ends should be flattened with a 1.5" gap between the ends. Two of these driven elements are required. (b). Details of the reflector element (2 rqd.) of ¼" aluminum tubing. (c). Plexiglas mounting plate (¼" thick) for the free ends of the driven element. (d). Mounting of the driven element to the mast. A #6 screw is placed through the hole in the element, through the mast, and a ¼" spacer is placed over the screw and a nut is attached. Using the holes in the plexiglas plate as a guide, drill matching holes in the flattened end of the elements and secure to the plate with #6 screws.

signal whenever the satellite is more than 5-10° above the horizon. Such an antenna would be ideal for casual operation with the polar orbiters while vastly simplifying the programming required for unattended operations.

The solution came about by listening to the conversations of the folks using the OSCAR satellites. A number of stations were having considerable success using crossed dipoles (properly phased) over plane reflectors for their 2 meter uplink antenna. Such an antenna is not particularly spectacular for receiving downlink signals on two, but I reasoned that part of the difficulty here was that the OSCAR downlink signal is from a translator and the relatively low satellite transmitter output is spread over a considerable bandwidth, thus reducing signal strength from any one station. The 5 Watt transmitters of the NOAA satellites, however, operate at one frequency and thus the signal should be considerably stronger. Since I had all sorts of parts available for the many crossed yagis I have built at one time or another, I decided to see if the crossed dipole idea would work. Most OSCAR operators place the antenna over a plane reflector — usually made out of screen or hardware cloth — and it seemed that the antenna should work equally well with simple reflector elements, thus simplifying design. Part of an evening was spent putting together the antenna illustrated in Fig. 1, and the results have been outstanding. The satellites can be heard whenever they are above the local radio horizon and the signals are full quieting for most of that time. As an example, a daylight or evening overhead pass should permit signal acquisition for a total of about 21 minutes. Such a pass is audible for that entire period on the omni antenna. My own receiver quiets completely at a signal level of between 8-10 microamps on the S meter, and for over 13 minutes of an overhead pass the meter is pinned at 50 microamps! Watching the meter before and after this 50 microamp interval indicates that the antenna has some lobing to the pattern, or less than perfect circular polarization, but these signal variations are minor and the signal will stay full quieting to very near the horizon. If you have a reasonably sensitive receiver and would like a very simple but effective antenna system for satellite work, read on.

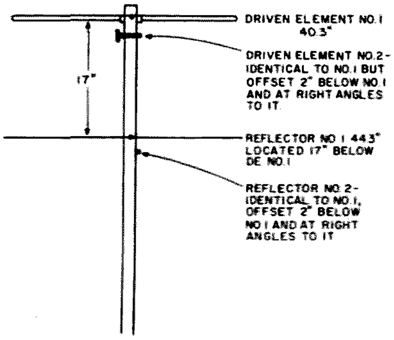

Fig. 3. Relationship of the two driven elements and reflectors. The antenna mast is a 5 foot length of 1¼" aluminum tubing. Driven element #1 is mounted 1" from the top of the mast. Reflector #1 is mounted 17" below it with the same orientation. Driven element #2 is at right angles to DE #1 and reflector #1. Reflector #2 is two inches below R #1 and is oriented parallel to DE #2.

Construction

The antenna elements are fabricated out of ¼ inch aluminum tubing. This tubing size is not critical and even aluminum rod could be used, although the antenna would be considerably heavier. Fig. 2 shows all of the significant dimensions. Support for the two driven elements and the two reflectors is provided by a piece of aluminum TV mast.

Construction begins with the fabrication of the driven elements and reflectors from ¼" aluminum tubing. Bend and drill the two driven elements as shown in Fig. 2. Similarly, cut and drill the two reflectors. Fig. 3 is the guide for preparing the mast. One inch from the top of the mast, drill a #6 hole completely through the mast. Two inches below this hole and at right angles to it, drill another hole. Seventeen inches below the *first* hole,

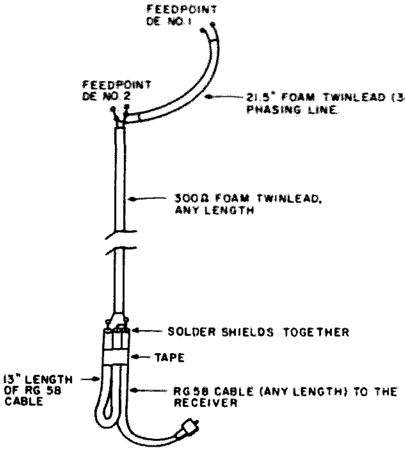

Fig. 4. Details of the phasing line, feedline, and balun.

Fig. 5. NOAA 4 picture readout as received with the omni antenna system and displayed on the author's CRT monitor (the latter is described in the 73 Weather Satellite Handbook*). The portion of the pass photographed extends from Hudson's Bay in the north, south to the central United States. Lake Superior is faintly visible in the lower left of the picture with the lower Great Lakes covered by a massive frontal system that wraps around from the central U.S. up the east coast of the U.S. and southern Canada. Extremely heavy rain was falling as this picture was received, indicating that the antenna performs effectively under adverse weather conditions. The satellite signal remained full quieting until it reached the latitude of central Mexico.*

drill another with the same orientation as the first. Two inches below this hole, drill another at right angles to it (same orientation as hole #2). The driven elements are mounted at the first two holes using Fig. 2(d) as a guide. One reflector is mounted at hole #3 parallel to the unbroken side of DE #1. The second reflector is mounted at the fourth hole, parallel to the unbroken side of DE #2.

Fig. 4 shows the details of the feedline, phasing line, and balun. The feedline and balun are made up from good quality 300 Ohm foam cable. The feedline may be any length and connects to the feedpoint of DE #2 (the lower DE). The 21.5" phasing line has one end connected to the feedpoint of DE #2 with the other end connected to the feedpoint of DE #1 (the upper DE). The feedline should be routed to the shack using good installation practice, i.e., twist the twinlead, use standoffs, and avoid paralleling metal objects such as nearby gutters. The balun is a standard type and should be located right at the receiver. If it is inconvenient to run the 300 Ohm line around the shack, the balun can be used where the line enters the wall or window and the foam cable can be run to the receiver. The 50 Ohm cable should be kept as short as possible, however.

There is no tune-up — simply start using the system. I think you will be very happy with the results. ■

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VHF Noise Snooper

- - track down annoying pulses

Are you quite sure that nothing can be done about that noise level at your QTH? Just one of the problems with noise is its frequency content. I had a noise which affected the FM broadcast band and even wiped out 6m, but only contributed 1/2 an S unit on 75m. So I was forced to look for some special device, and found it sitting right in front of me. Here is a new approach to noise tracing, using a piece of equipment you most likely already have.

Simply cut or unsolder one end of either of the FM detector diodes in an AM/FM portable, and you have an ultra portable, ultra sensitive noise detector. A schematic is usually unavailable for these Japanese sets (there oughta be a law!), but you can usually spot the diodes sitting side by side between the last i-f cans and the audio transformers. Shorting one diode will probably work as well, but I didn't try it.

In use, my detector worked amazingly well. First find a blank spot between stations and start out. I tried using a bicycle, but tire noise drowned out the noise I was trying to locate, so I walk now. As you move, the noise will go in and out like airplane flutter, slowing down and getting steady when you are very near. Then you can point the end of the whip at the noise source for a null. One noise was found so accurately that the vertical position on the pole was pinpointed for the power company linemen.

Of course there are other problems. When you rid the neighborhood of all those power leaks, you really notice the cars. ■

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Muntinlupa
Rizal
Republic of the Philippines

Understand Your Pet Rock

-- tips on crystal oscillators

This article explains in basic detail how to construct two crystal tester oscillators, how crystals work, the difference between a "fundamental rock" and an "overtone crystal," why you should have a different circuit for each, and what you should know to start with if you are going to do any serious experimenting and/or building at all using crystal frequency control. This subject demands both *experimental work and basic knowledge of sound waves in "rocks" (crystals). Because of the increasing use, worldwide, of "overtone" crystals (such as, for example, "45 MHz" ones for the two meter band which are actually ground for 15 MHz, as you will find when working with them), it is becoming more and more necessary to have a good circuit and to know how it works.*

There has been for some decades a strong push towards ever-higher frequencies due to the space available there, and this force upwards in frequency must of course accelerate as populations and countries develop further.

The lad who plugs a 146.5 MHz rock into an already working *two meter rig does not necessarily need to read this article, but the amateur-experimenter who intends to build his own and wants to* know *what is going on should read it, because that little piece of quartz may be operating with either three or five half waves of* sound *inside its little tin can. Or maybe even seven!*

The use of quartz crystals for controlling the frequency of your transmitter or receiver, and for calibration, is an absolute necessity today even in the most economical types. Even a tunable receiver for amateur use on, for example, the six meter band, should have at least one crystal position for "calling in" for special emergency or net use. These little slabs of quartz operate on the basis of piezoelectricity, in that they expand and contract physically under the influence of electricity, and also *produce* electricity if made to contract and expand mechanically by external forces. A crystal may also act as an "electrical flywheel" or a weighted resonant spring when set in motion at its mechanical resonance frequency, expanding and contracting by an alternating current and/or voltage. There is an ultrahigh frequency sound traveling back and forth through the quartz material, associated with the contraction and expansion, so that the resonant frequency corresponds to the crystal thickness. At 7 million oscillations per second, for example, the crystal thickness is thus paper thin.

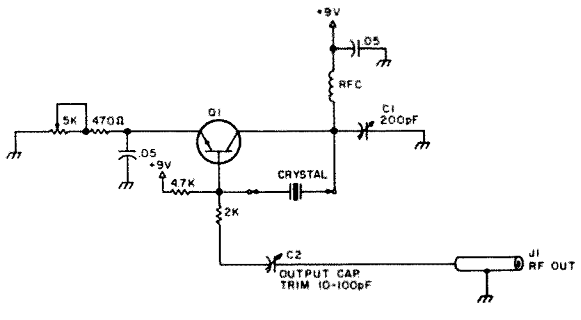


Fig. 1. Untuned crystal oscillator circuit.

When ac (rf) is applied to a 7 MHz crystal, nothing much happens until the frequency reaches 7 MHz. At that time the crystal will oscillate, both mechanically with internal sound waves and electrically with rf waves (these latter rising to several volts if L1 and C1 of Fig. 2 are tuned to 7 MHz). This will tend to hold your transmitter very close to the desired frequency inscribed on the crystal case. Also, if the crystal is used in the local oscillator circuit of your VHF receiver, it will allow your receiver to be tuned to a net or calling in frequency when this crystal is switched in.

Phase Reversal

A little known fact is that

a piezoelectric crystal, generally of quartz for good frequency control, reverses the phase of an rf wave "going through it." Just remember that the Curie brothers, almost one hundred years ago, demonstrated the piezoelectric effect by hitting quartz crystals with a hammer with visible sparks as a result! *Not* recommended at the present price!

At any rate, when the quartz is compressed, positive (+) voltage appears on one side and negative (-) on the other. This feature has a very important and vital usage in the circuits of Figs. 1 and 2.

Fundamental and Overtone Crystals

In order to write this article, I got out my crystal box, which contains over 100 of these little gems representing some 40 years of experimenting with and operating crystal control from 160 meters to X-band (three centimeters).

Going from low frequencies in the HF region around 1.8, 4, and 7 MHz up past about 14 MHz to 18 MHz, crystals change radically in their operation. You will find that from here on up there will be three, five, or even seven half waves of sound inside the quartz material. As I look at the row of crystals I picked out as representative for this article, I find in front of me the following frequencies engraved on their tin or plastic cases; 1.8, 3.9, 6.1, 7.1, 8, 12.5, 14, 18, 21, 26, 28, 29, 45, 50, 60, and 75. Some of these are from before World War II, and some are of the type now sold for as low as 41 cents (U.S.). This latter price, however, only applies when one million are sold at *one time* and on *one* frequency, such as, for example, the color burst frequency near 4 MHz used in TV receivers.

Various "cuts" and types of "optically active" crystals are made which need not concern us here, but we do need to know what kind we should buy and how to use them once acquired. A crystal marked "21 MHz" on the case and plugged into the circuit of Fig. 1 showed plenty of power on 7 MHz, 14, and 21! And quite rightly, too, for this one is ground to 7 MHz and is intended to be used with a tuned circuit of 21 MHz. When on 21 MHz, however, it uses three half waves of "sound" inside, instead of just one. However, do *not* use this for operation on the air with the circuit of Fig. 1, except to learn how it works! To get to *only* 21 MHz output, use the circuit of Fig. 2, which has a tuned circuit on 21 MHz. Going through my crystal samples, another, inscribed 18 MHz, works in both Figs. 1 and 2, because it is cut and ground to 18 MHz and is working on the fundamental. A 14 MHz one does the same, as well as the rest from there on *down* to 1.800. That is, they work in the circuit of Fig. 1. But now let us go higher. A 26.9 job, used in the CB band, shows up right away as being ground for 9 MHz, with power out also on 18 and 27 (roughly). And, continuing upwards and still using the circuit of Fig. 1, just for testing, mind you, and just to show you the principle of multiple half sound waves inside, the next crystal, labeled 30 MHz, shows up with a fundamental of 10 MHz (with power on 20 and 30 as well). Note that the existence of the three half waves (of sound) is due to the extreme thinness of crystals around 15 MHz, and that trying to go further would not be practical. So from there on up we find three, five, or seven half waves inside. The fact that only odd numbers can be used is due to the arrangement of the sound waves inside.

The Circuit of Fig. 1, for Fundamental Crystals

The Fig. 1 circuit is basically an old one souped up for transmitter use. It is quite a reliable one, with the rock between the base and collector of Q1, using the aforementioned phase reversal to maintain correct drive on the base. However, not having any tuned circuit other than the crystal itself, care must be taken with the component values, current and voltages, output coupling, etc., to get good drive out for transmitter use. Even if you are just going to use it for calibration purposes, you need a "good" oscillator for stability, protection against aging of parts, low battery voltages, and the like.

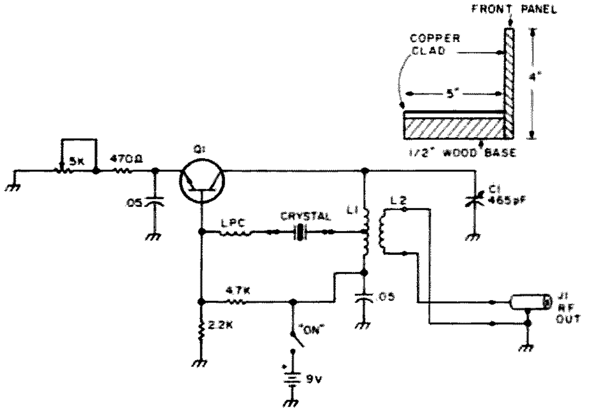


Fig. 2. Tuned crystal oscillator circuit. LPC — phase correction coil (see text). Q1 — see text. C1 — two gang variable, two sections tied. L1 — 6 turns #14 bare copper, ½" o.d., 7/8" long (xtal tap 3 turns from collector end). L2 — 1 turn, semi-adjustable in low end of L1.

Construction

I always use copperclad material for the baseboard, because it is easy to cut, solders easily with a 25 Watt iron, and is an excellent ground. Q1 can be almost any good VHF transistor. The one I used was an SE 3001 by Fairchild, priced at less than P2. The crystal "mount" was a pair of alligator clips, because no less than five different kinds of enclosures, all with different pins (and even one with wires for soldering), were among the crystals I tested (some 16 of them, from 1.8 to 75 MHz). You can, of course, use sockets, if you can find the ones needed for the crystals you have.

The choke can be most anything, but should have plenty of small size wire and plenty of inductance. I used a 16 mm o.d. PVC form 8 cm long, with about 200 turns of coil wire wound single layer. C1 should run up near 450 pF for testing (because power output for different crystals and frequencies is helped), but for an oscillator designed for one band only, a mica compression trimmer will do for C1. You will find it very handy to vary R1 for peaking up the power output and tuning up a good oscillator. The 1k pot is in series with a "safety" R2 of 470 Ohms. Don't forget: Transistors do *not* like to operate without some self-bias in the emitter circuit. The output capacitor, C2, can be a trimmer also, such as a 10 to 100 pF.

After assembling and wiring, check with an ohmmeter for proper values of resistors and possible shorts or opens, and then turn on.

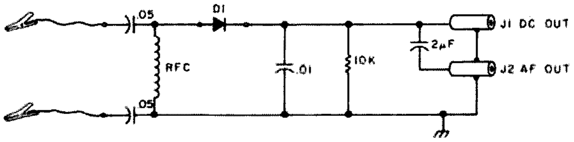


Fig. 3. Untuned diode rf voltmeter.

Using a 7 MHz rock and a 9 volt battery, I found 2 mA of current from the battery with R1 at 3k total and .6 volts rf output into the TD (see Fig. 5 for the tuned diode). A maximum of 2 volts dc from the TD was obtained with an R1 of 1k and 3½ mA of current. Some other crystals gave up to 5 volts or more with everything "peaked." Note that, with only a small value of C2 into the TD, frequency determination is the goal rather than maximum rf voltage indication. In general, for control of a transmitter, do *not* use maximum output. First determine the value of C2 for maximum output, and then *always* operate with *less*. Always run a check on the *minimum* dc voltage with which the crystal will oscillate. This should be *several* times less than the operating voltage.

After checking my fundamental crystals (which all worked well and gave good output in the Fig. 1 circuit), I went up through the 12.5, 14, and 18.3 MHz ones until I hit the one labeled 21.3 MHz. This one immediately showed strong power out on 7, 14, and 21 MHz, indicating that it was an overtone unit. Putting it into the circuit of Fig. 2 resulted in an output of 21 MHz only, the frequency for which is was designed, with the internal presence of those three half sound waves.

Note that output coupling in Fig. 1 is obtained from the low impedance side of the crystal, that is, the base side of Q1. Of course, you can use an emitter follower if you want to be fussy.

Again, remember that the Fig. 1 circuit is for fundamental crystals only, and not for overtones (except to increase your basic knowledge).

The Circuit of Fig. 2, for Overtone Crystals

The same type of copper-clad baseboard and arrangement as in Fig. 1 can be used, with only slight changes in the schematic – but these are quite vital. The use of tuned circuit L1, and the tapping down of the crystal on L1, results in operation on the inscribed frequency, provided, of course, that L1 and C1 are tuned to that frequency.

Operation is as follows. Q1 acts as an amplifier with 50 MHz (assuming you have plugged in the 50 MHz crystal) energy from L1 and C1 feeding back through the crystal to the base, where the desired 50 MHz energy is again amplified by A1, again appearing in amplified quantity on L1, etc., etc. This of course constitutes an oscillator, and a very stable one at that, compared to a non-crystal controlled one. The 50 MHz energy predominates in the output when the proper circuit is used, as in Fig. 2, and care is taken in the tune-up and operation.

Operation

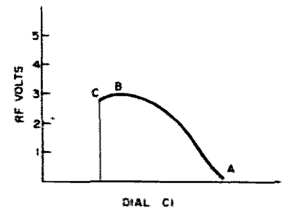
This circuit is for use with crystals of the overtone type, in which the quartz is ground for operation with more than one half sound wave (which makes the presence of a tuned circuit on the inscribed frequency an absolute "must").

Referring to Fig. 2, when assembled and wired, and tested with an ohmmeter for proper resistance values and possible shorts, a milliammeter may be shunted across S1 or put in series with the battery. Some 2 to 5 mA should flow. This will vary with the strength of oscillation, due to the positioning of the FB (feedback) control tap on L1, the setting of C1, and of course, Re, the resistor emitter. I generally connect a 1k variable resistor, known in the trade as a "pot" (potentiometer), in series with a 100 Ohm "safety" resistor to the emitter, and then, after suitable tests to determine the current and overall action desired, I wire in a fixed resistor. However, in this case, for an oscillator designed for experimental testing over a wide range of crystals and frequencies, the potentiometer proved so valuable that it was left in circuit. The Fig. 2 oscillator should now be working.

Two home brew pieces of test equipment are shown, the aperiodic (untuned) diode rf voltmeter in Fig. 3, and the TD (tuned diode) voltmeter and frequency meter in Fig. 4. Both figures contain enough information to enable you to build at least experimental models of these test units. The TD in particular is quite valuable for checking the frequency of an oscillator and the relative powers in the harmonics. Don't forget that almost all oscillators are operating class C and therefore may have strong harmonics. The second and third harmonics are also particularly useful in getting crystal control up beyond 50 MHz. These harmonics are picked out, amplified, and filtered, and then the higher harmonics of the first frequency multiplier are picked out, amplified, etc., etc., resulting at last in crystal control on the radar frequencies (and higher). This requires frequency multipliers, of course.

Referring again to the Fig. 2 circuit, actually the most important of this article, the tuning of C1 and L1 should be done with care. When operating correctly, C1 is not critical, but as you are going

Fig. 5. Tuning curve of C1, Fig. 2 (without LPC).



to use and test several crystals, or maybe a lot of them, and thus be checking widely separated, it is important to get acquainted with just how a good crystal oscillator works. Don't try to figure out how an oscillator starts! Just assume it is running, and it will be if you follow all details and proceed from there. Insert an overtone crystal, 21 MHz for example, and tune C1 and L1 back and forth through the 21 MHz range. I found good oscillation starting at 2 mA, with about one volt dc showing on the TD connected to the output J1 by a cable of 50 Ohms. "Pushing" the oscillator, by lowering R1 to 470 Ohms, with a total battery current of 4 to 5 mA, caused 3 volts to show on the TD. You can push it even more, to 7 mA, and some 5 volts will show on the TD. However, I just checked the Q1 I was using because it did not start easily, and found that replacing it with an "FCS 9011 H 209" led to much better reliability. So, don't push these little semiconductors too far in power! Note that this type of tester is also useful for testing transistors. Indeed, I generally test out three or four and label them "good 50 MHz osc." or whatever they may be.

Voltmeter readings showed B+ of 8.5; on E there was 1.6, and on the base, 2 volts. Note that the "regular" type of tuning showing on C1 causes gradual rising output as you approach maximum from the higher C side, and an abrupt cutoff of oscillation as you pass the maximum peak on the low side. Fig. 5 shows this curve, which is the

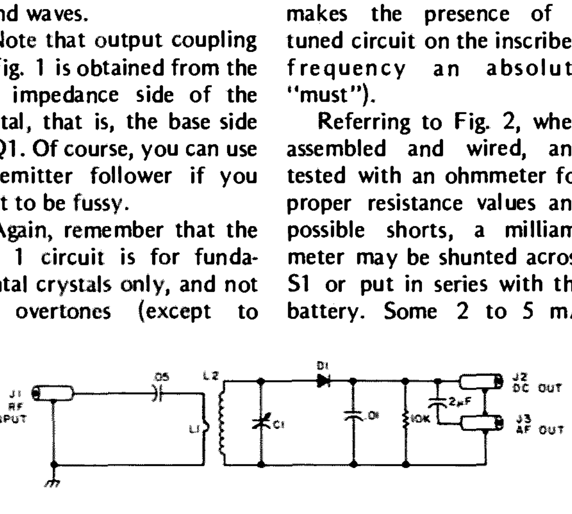
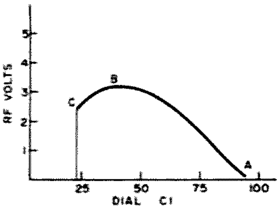


Fig. 4. Tuned diode rf voltmeter. L1 – 1 turn. L2 – to suit frequency. C1 – 465 pF.

Fig. 6. Tuning curve of C1, Fig. 2 (with LPC).



normal and correct type for an overtone oscillator. Get used to it, and note that for reliable starting you should not operate on the peak at C. Use some position near B, as you will find in a short session of trials by turning the battery switch on and off and watching the output. Note that Fig. 5 is just one curve that I found here using a 45 MHz rock designed for two meter (146 MHz) work, and different crystals and transistors (and different feedback taps on L1) may show somewhat different curves.

A very interesting addition to Fig. 2 can be made as follows. A small coil of fine wire, some 40 turns on a matchstick, 4 mm long by 2 mm diameter, can be added simply in series with the crystal, on either the base side or the coil (L1) side. The effect of this coil (labeled "LPC") is quite interesting. It corrects the phase shift through the collector-L1-crystal-base path, and results in stronger oscillation and easier and more reliable starting. It also shows up in a much more uniform curve when plotted as in Fig. 6. The tuning will no longer show an abrupt drop on the low C side. Trying out several sizes of these "phase correction coils" will show you quite a bit about phasing in oscillators.

Checking out the rest of my VHF crystals, the operation was similar, although on 75 MHz oscillations did not start until I used some 2½ mA on the oscillator. ■

TTL Techniques

- - bypass those glitches

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TTL logic is one of the most popular of all logic families. One reason for this is that it will almost always work even when the circuits that are in use are of poor engineering design.

If you saw some of the experimental circuits that I have put together, it would be obvious why I like this feature. But TTL, like all electronic devices, will at least be more reliable if proper engineering design is used.

What is proper design for TTL? I wondered this same thing for a long time. If you would like to know some of what I found out, read on.

The (Vcc) supply voltage for TTL is +5 volts and should be well regulated, with ripple of less than 5%. If you are using a large system, a low inductance power busing system is recommended.

Every circuit board should have decoupling capacitors — at least one for every 5 to 10 TTL ICs, and one for every flip-flop. These should be .01 uF to .1 uF rf bypass capacitors with short leads. There should also be at least one 2 uF to 20 uF on each board. For a general rule, the more capacitors, the better.

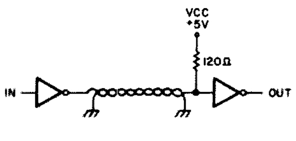

Fig. 1.

A good ground bus should be used whenever possible (essential for large systems). Better yet would be the use of a ground plane. Stay away from using open wire connections for grounds.

Use printed circuit board construction for all circuits, and stay away from hand-wired construction. IC sockets are fine most of the time, but they may cost more than the ICs that they hold.

Don't follow the common practice of leaving unused inputs floating. Though they do normally assume a logic 1, they also act as an antenna for noise and the floating input may go to a logic 0 at any time. You may tie inputs to ground for a permanent logic 0, or to Vcc through a 1k Ohm current limiting resistor for a permanent logic 1. One current limiting resistor can be used for up to 50 inputs.

If you have any unused gates, it is recommended that the output be forced to a logic 1 by tying of the inputs. This will give lower power dissipation and you can use the permanent logic 1 for the tying of other gate inputs.

When open wire connections become necessary, they should not be routed together. They should be kept as short as possible. If long runs of wire are required, it is best to use twisted pairs. One possible way to drive a long run of twisted pairs is shown in Fig. 1.

The next time a TTL project does not seem to work right, or works right only part of the time, check it for the engineering design. You just may find the problem.

If you are doing design work yourself — and what project-building ham doesn't? — just eliminate some of the possible problems to start with. ■

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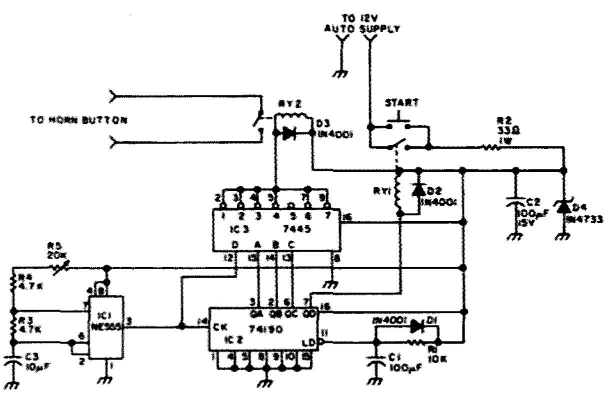
Sending HI

-- on the hooter

Remember the good old days when hams would toot HI, in Morse code, on their automobile horns when spying one of their cohorts? Why don't they do this any more? Is the dastardly rumor true? Don't hams know the Morse code or has that esprit de corps, peculiar to hams, gone the way of home brew rigs and sunspots? The little goody described herein won't bring back the sunspots but will put you on the road to home brew rigs and will allow you to send HI on your automobile horn with just one push of your pinky. This unit utilizes electron flow to accomplish this worthy purpose. You remember electrons, don't you? They're some of that electricity stuff.

This circuit can be divided into four main sections: an oscillator (IC1), a counter (IC2), a decoder (IC3) and a power supply latch and regulator. The oscillator rate and the rate at which you send HI can be adjusted by R5. I found that after I had used the unit for a short while, I didn't want to adjust the rate any more, so R5 might just as well be a trim pot hidden out of sight. The start pushbutton is the only thing that needs to be accessible.



When the start pushbutton is pushed, 12 volts from the car battery is dropped through R2 and regulated to 5.1 volts by the zener D4. C2 keeps any noise from the automobile system from causing problems as well as providing a low impedance power source for the ICs.

When 5 volts is applied to the ICs, the network of R1 and C1 causes the voltage on pin 11 of IC2 to rise more slowly than the supply voltage, and thus performs the function of clearing the counter to all zeros. The diode D1 causes the capacitor C1 to discharge rapidly when the power is removed so that the circuit will be ready for a new cycle of operation very soon. With the output Q_D in a low state, the relay RY1 is energized and the 12 volt power is maintained to the circuit even though the start push-button is released. The oscillator performs two functions. It advances the counter every time the oscillator output makes a low to high transition, and it enables the decoder whenever the oscillator output is high. Since the oscillator output spends half of its cycle time high and the other half of its cycle time low, the counter retains a particular count for a complete cycle of the oscillator while the decoder IC3 is enabled for only half of the cycle time. This provides that each dot will be followed by a space of equal duration. As the counter starts counting up from zero, the decoder outputs go low one at a time. The output corresponding to the count in the counter activates relay RY2 and the relay contacts toot the horn. Only the first three bits of the counter are decoded and the outputs 1 through 7 are the only decoder outputs used to activate RY2. Output 5 is not used and this is the space between the H and the I. When pin 12 of the decoder goes high with the oscillator output, the decoder interprets this as a number greater than 7 and none of the outputs connected to RY2 can go low. When the counter goes to a count of 8, output Q_D goes high, which releases RY1 and removes all power from the circuit. This means that you can leave this unit connected to the car battery all the time since it only draws power when it is in actual operation (which means this design is ecologically sound, whatever that means). If you hold the button down, you will send HIs ad nauseam. ■

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Build a DDRR for Your Mobile

- - this one won't blow off

When I moved to a new mobile home park a few years ago, a new and formidable kind of antenna problem faced me. The park rules forbade my normal array of antennas. After sitting around lusting for forty meter phone for a while, I decided forty meters wouldn't be the same without me, and I had to do something to get back on the air.

I tried the usual non-working, "invisible" wire antennas with 10:1 swrs, and a home brew joy stick that was tricky to load and produced rf burns at the microphone (it is hard to enunciate with Band-Aids on the lips), but it was obvious – there had to be a better way. There was. I discovered, in a June, 1970, *73 Magazine*, the DDRR (Discontinuous Directional Ring Radiator) antenna.[1]

The first thing I had to consider was what size DDRR would be needed for forty meters. My calculations produced a height of twelve inches and a diameter of nine feet. Just right for my twelve-foot-wide mobile home! And I had another bonus: The home roof was metal and would make an ideal ground plane for the antenna. I had only to supply the radiating element, and bingo – on the air!

The next thing I had to do was convince the park officials that an antenna only one foot high sure wouldn't look like an antenna. Subsequent conversations with the park manager produced permission to put it up, since, "It sure wouldn't look like an antenna." We had reached an understanding. Construction proceeded at full speed.

I had lots of ½ inch copper tubing left after setting up my home in its new location, but not enough to make a complete antenna. A trip to the hardware store produced a few more feet of tubing, an in-line coupler, a tee-coupler, and a deep appreciation for the similarity between the price of copper and gold. I put all the copper under lock and key until the antenna went up.

Since the antenna radiator wasn't self-supporting, I had to design a framework to hold it in position. PVC tubing is rather cheap, and since I am too, another trip to the hardware store produced a PVC four-way connector, several ten foot lengths of ½ inch i.d. PVC tubing, and four right angle PVC connectors. The four-way connector was the center of the support structure. The PVC pipes, cut to 4.5 foot lengths, were inserted into the connector. Holes were drilled through the connector limbs and pipe, and 6-32 screws were inserted through the limbs and pipe. This prevented the pipes from twisting in the connector. The right angle connectors, after being mounted on the four pipe sections, were squared vertically and drilled through. 6-32 screws were inserted.

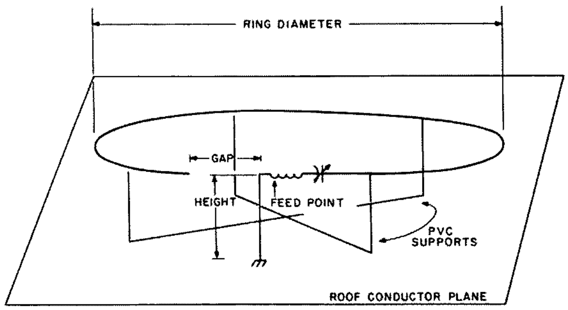

Fig. 1. Schematic layout of the final antenna and support parts. The PVC four-way connector is located in the support center. The right angle connectors form the upright bends.

The PVC uprights, twelve inches long, were cut with a hacksaw to form slots on the end to hold the radiator while the other end was pushed into the right angle connector. The antenna was now ready for final assembly.

All the parts were collected on the roof after the copper tubing sections were joined and bent into a first order approximation of a nine foot circle. On the ground, the tubing measured 27.2 feet with a one foot discontinuity, but after carrying it up the ladder, the roundness became more approximate. A copper tee-section was soldered to a copper tube with a flattened section bent at a right angle to the rod. The distance from the bend to the tee-section was twelve inches. The radiator was placed on the supports and re-rounded to take out the strain on the supports. The whole arrangement was centered on the roof. The copper upright was soldered to the main radiator, and a hole was drilled through the flattened section on the upright and the roof. The contact area of the flange and roof was cleaned carefully on both metal surfaces, and a large sheet metal screw run through both. The connection site was caulked and covered with putty and painted with some roofing paint.

Nylon lines extending from the center of the support frame (the four-way connector) to some convenient tie points on the roof held the assembly in place. The wind wouldn't blow this project away, and where I live you have to think seriously about such things.

A variable capacitor of about 100 pF was placed on the end of the radiator at the discontinuity, and the other plates on the capacitor were grounded. An SO-239, mounted near the base of the copper upright, was connected to the antenna via some solid copper wire. Last of all, the rig was brought up on the roof, along with some power, lights, and a real sense of anticipation. Now was the moment of truth.

An swr meter was inserted in the line close to the antenna, and the rig was turned on. There was a little noise coming from the speaker, but not much to cheer about. I tuned the capacitor, and suddenly I could hear good, loud signals coming through. The tuning was sharp, but boy did it work!

I loaded the rig into a fifty Ohm dummy load, connected it to the antenna again, and inserted some carrier. The roof lit up like Broadway, with a bluish cast. My capacitor was a beacon in the night as rf buzzed between the plates. The capacitor was the correct value, but the voltage rating was far too low.

I started a search into every junk box I was privy to. No dice. Seems no one uses high voltage capacitors any more. With transistors and two meter FM, high voltage capacitors are joining the dinosaurs in extinction. The alternative was to make one.

Choosing the sturdiest-looking peanut butter jar in stock (I save such things), I mounted a long screw through the lid, put a foil-covered paper cup on the screw head, and dropped the whole thing inside the jar.

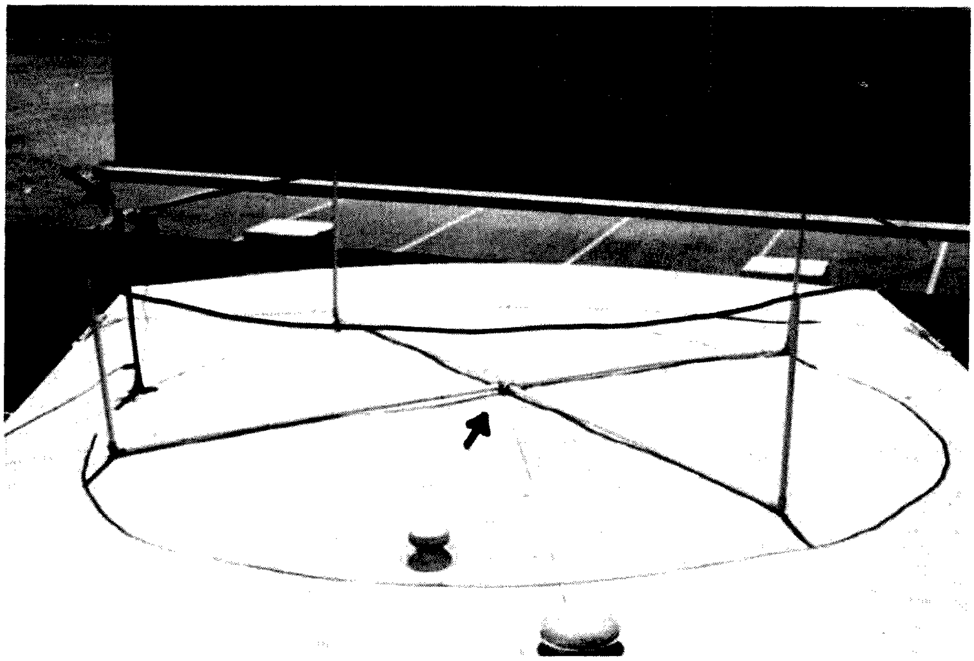

Fig. 2. Final DDRR positioning on the roof. The antenna is two feet high. The tuning capacitor and coil can be seen on the left. Nylon lines run to the PVC four-way connector in the center.

The outside of the jar was covered with foil, and connection to the foil was made with some copper wire twisted around the foil on the jar. I mounted the capacitor, tuned it, and, joy of joys, it worked! A great sense of foxiness overwhelmed me, and I bragged wildly to my XYL for fifteen minutes or so before returning to my triumph on the roof.

I tuned up the transmitter, and applied a little power to the antenna again. The swr was about 10:1, but that could be adjusted later, I thought. However, I had second thoughts about it and brought the swr down to 3:1 by changing the tap point on the antenna. At about fifty Watts into the final amplifier, the whole thing cracked like a rifle. I ducked and headed for the power switch. The capacitor was shattered as if it had been hit by a hammer. As I looked at my broken success story, it started to snow, and it really became imperative to get off the roof before the rig and I both slid off. The moral of this short story is that a lot of voltage appears at that discontinuity, so have a healthy respect for it. Capacitors at the discontinuity had better be able to handle 3 kV or more.

Fortunately, my reference for this project didn't let me down. It described another loading technique, and, since I had put more than my weekly allowance into the copper tubing, I wasn't about to quit now. Besides, I was getting questions from the neighbors about my new solar heating unit on the roof. I smiled knowingly and talked about heating the world.

Meanwhile, my junk box yielded some three-inch-diameter B & W stock, and a call on two meters produced a nice 200 pF variable from a very disbelieving ham. I disconnected the tee-section from the radiator and inserted a PVC section into the gap for support. The coil was soldered to the tee-section and the variable capacitor, after the capacitor had been mounted to the radiator with some machine screws. The combination formed a series-tuned circuit and provided a handy tap point for the coax. This technique isn't as efficient as the one which lighted the sky, but the tuning capacitor sees smaller voltages which are more manageable. The final arrangement is diagrammed in Fig. 1.

The resulting combination tuned easily, with the characteristic sharp increase in noise at resonance. The coil was then stepwise shorted, and the capacitor tuned to provide the highest C to L ratio with a little room for tuning. Some ten turns of coil remained unshorted.

The final tuning process was a combination of tuning for minimum swr and moving the tap point until the returning energy was minimum. I ended up with no measurable reflected swr at resonance. It pays not to hurry through these adjustments.

Set the resonant point at your favorite spot on the band (you are building one, aren't you?) and don't expect to stray far beyond that. The

	10	15	20	40
Ring Diameter	28″	40″	54″	108″
Antenna Height	3″	4.75″	6″	12″
Discontinuity (Gap)	2″	2.5″	3″	5″

Table 1. Dimensions for other bands.

the roof. The PVC support system can be easily seen. Fig. 3 gives an idea of how the antenna could appear on your home. In case you are interested in other bands, some suggested dimensions are shown in Table 1.

In the December, 1975, *QST*, John Belrose analyzed this kind of antenna, and, from the analysis, he has suggested a new name for it.[2] I ignored the name (apologies to John) and moved to a very instructive graph that plotted the height of the antenna in degrees versus radiation efficiency. That graph, plus some thinking on my part, produced another antenna party on the roof, this time to raise the whole thing another twelve inches. Doing that, according to the graph, would (could) raise the radiation efficiency some 4-plus dB. Everything went up a foot. The results have been gratifying, with fewer CQs and calls in the log that have a "no QSO" notation.

For those hams who live in mobile home communities with antenna restrictions, this kind of antenna might get you back on the air. I can vouchsafe one product of building and tuning such an antenna: You will end up knowing a great deal more about antennas than when you started the project. ■

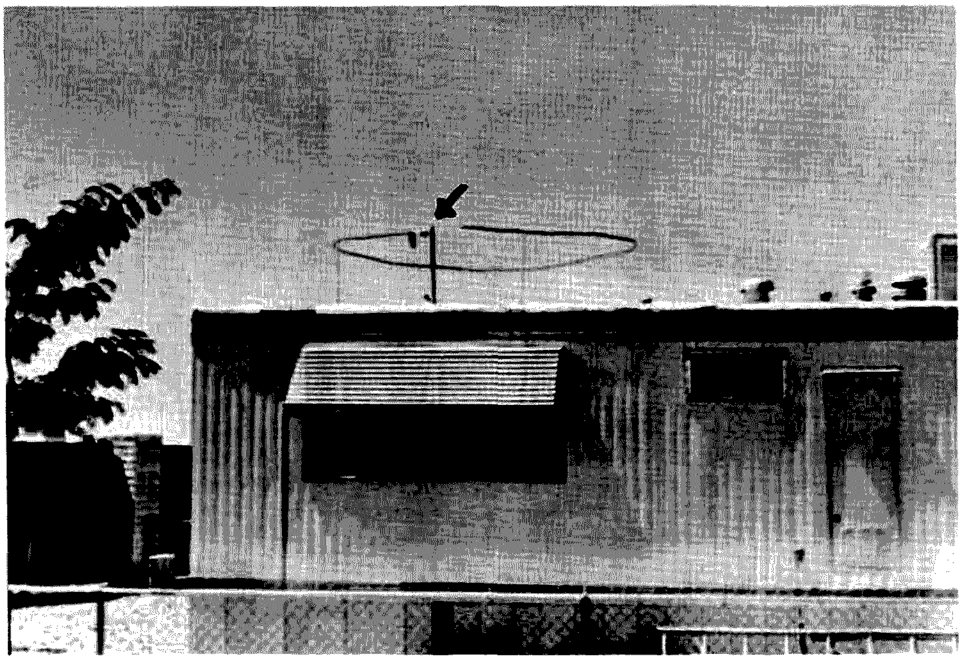

Fig. 3. The elegant look of success: the DDRR on the roof. Vertical portion of the radiator and tuning section are quite visible. Call it a solar heater.

final adjustment provided about 40 kHz of operation around 7250 kHz for a vswr measured at 2:1 or less. Considering the alternative of no operation, I viewed this as only a minor annoyance.

The antenna has operated at this QTH for over a year and a half and has satisfied the objective of keeping me on the air. Plus, it has proved to be quite a stimulant to conversation during QSOs. There is always the suspicion, with any antenna you build, that it's really just heating the air rather than radiating electromagnetic energy. This antenna, too, has fallen under that suspicion, but every time my doubts have risen, the DDRR comes through with a nice solid contact into eastern Canada, or Puget Sound, Washington.

I recently put up a temporary vertical for forty meters and tuned it for an swr measured close to 1.1:1. Switching between the two antennas produced a real surprise. The DDRR worked as well as the vertical for getting the signal out, and reported signal strengths for both of them were indistinguishable. However, the DDRR proved to be exceptionally quiet! A noise level of S5 or S6 on the vertical was S1 to 2 on the DDRR, but the received signal levels were identical.

I have worked both coasts with 5/9-plus reports, with 60 to 100 Watts PEP at the antenna. I have worked mobiles others cannot hear because of the QRN. On my vertical I can't copy them either, but they are Q5 and S2 on the DDRR.

My vertical sits in the corner a lot of the time now, awaiting portable or emergency use. The DDRR sits on the roof at dc ground potential (no static electricity buildup from the wind) and won't blow away, and if I get a little more inventive, remote tuning will let me walk all over the forty meter band.

Fig. 2 shows the final positioning of my little gem on the roof.

References

[1] English, W. E., "A Practical DDRR Antenna," *73 Magazine*, issue 117, page 20, June, 1970.

[2] Belrose, J. S., "Transmission-Line Low Profile Antennas," *QST*, page 19, December, 1975.

Headphone Jack Adapter

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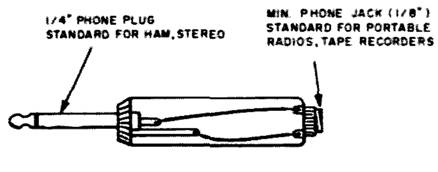
Have you ever bought a good pair of headphones for your ham set that work with your AM/FM radio or tape recorder, only to be confronted with a monstrous ¼" plug? Well, here is a setup that may help.

This is also a handy adapter to have lying around for that "once-in-a-lifetime" chance that you won't have a speaker or headphones and want to get on the air.

That happened to me as I came home from college, but forgot to bring home a speaker or 'phones. I used this adapter in conjunction with some 2,000 Ohm earphones that I had used with an old Japanese transistor radio. ■



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Automatic Taping Unit

- - for repeaters, logging, etc.

This unit has been developed for sticky-beaking on selected FM channels. It has a number of useful functions for the experimenter.

Basically it is a unit for turning on a tape recorder whenever an input signal is received by the receiver and turning the tape off again when the signal goes off — after recording the audio from the transmission. Applications are many. The local repeater can be monitored unattended. Information such as daily usage rate, overnight use, callsigns of all users and so on can all be analyzed. It enables an experimenter while out mobile to hear his signals replayed when reaching home. Other stations can leave messages for you with this system.

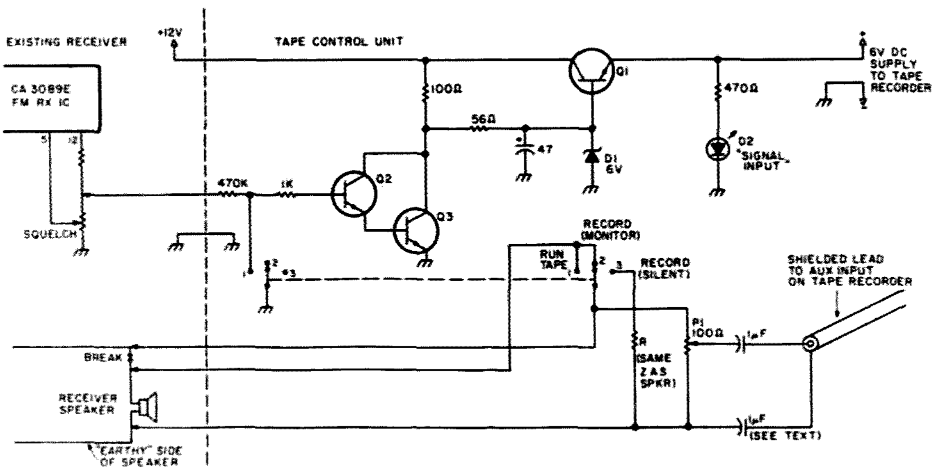
The tape recorder used is a cheap cassette with autostop. The autostop is a desirable feature so that the recorder turns itself off when the tape has run out. The circuit could be adapted to other types of recorders. A 6 volt dc supply is necessary for the recorder used in the example described here. This supply is obtained by a series regulator Q1 and zener diode D1 from the 12 volt receiver supply.

Transistors Q2 and Q3 are a Darlington pair which, when conducting, effectively remove the base supply for Q1 and turn the tape off. If the base of Q2 is positive, the tape is off. If the base of Q2 is at earth, the tape operates.

The receiver in use has a CA3089E in the i-f tail-end. Connection to the mute (or squelch) circuitry is as shown in the diagram. Other receivers could be connected up in some similar way. The 470k resistor and Darlington connection of Q2 and Q3 ensure negligible loading of the squelch circuitry. No mechanical relays are necessary.

The control switch in position 1 enables the tape recorder to be run for rewind and replay. The LED gives visual indication of an input signal entering the system. This is of use when recording in the "silent" position of the control switch.

Audio from the receiver is taken from the speaker circuit and fed to the input of the recorder. A resistor (of the same impedance as the receiver speaker) is switched into the circuit when the control switch is in position 3. This keeps the shack silent during unattended recording. In positions 1 and 2 of the switch, the receiver speaker is active. The receiver speaker monitors receiver activity



during rewind and replay to ensure that nothing is missed!

Potentiometer P1 sets the audio to a suitable level for the recorder input. The receiver audio gain control must have already been set for comfortable room listening. The two capacitors in the audio leads to the tape recorder input are necessary to ensure complete dc isolation of the receiver from the recorder. Some recorders are positive earth, while most receivers are negative earth. Provided that this problem is recognized and investigated with appropriate steps taken if found to be necessary, then no difficulties should arise. My recorder is positive earth, but it is in a plastic case with few metal protrusions, so the whole thing "dc floats" quite acceptably.

This monitoring system has been running successfully for some years now and has been useful for keeping up-to-date with current happenings on the channel and for testing purposes. It is much more acceptable to record your own signal when testing or developing transmitters and hear it later yourself than to rely entirely on verbal assessments from other operators.

Transistor Q1 is an NPN power transistor. Q2 and Q3 are NPN small-signal types. There are so many suitable types of transistors available for these applications that no type numbers are quoted here.

This tape control system is also useful when out mobile. It can be run quite conveniently in a car. When the vehicle is parked, it can be set operational, and you can soon learn if someone has called you during your absence.

Construction is not critical in any way and any suitable board or box or chassis will be suitable. Junk box parts will invariably be found to be appropriate!

Good luck and good listening!■

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Let's Use English

-- for a change

CBers are known for their CB lingo, the jargon they like to use. They use a handle – a nickname that they use only on the air, like "Red Baron" or "Big Breaker." Their language is colorful: "18 wheeler" instead of "truck," "10-4" instead of "OK." There are even dictionaries of CB slang being published.

As far as I am concerned, this is foolishness. CBers are people talking to other people – why shouldn't they use the same language as everyone else?

We hams are almost as bad. Our peculiar language includes such things as "What's your QTH?" or "Thanks for the fine Q sew." Most of our contacts involve a lot of jargon, but we manage to get some English in, so listeners can at least tell what language we are speaking.

There was a time when ham talk had its place, on CW. Abbreviations and short cuts are the order of the day on CW, but to carry them over into speech is silly. The only reason we keep using a peculiar form of talking is that it sets us apart, it makes us a select group, with our own practices.

I propose that we stop using oddball terms like QTH, QRMary and XYL, and stick to terms that we have understood since childhood, like hometown, interference, and wife. As a group we have nothing to set us apart. Oh yes, we all managed to pass a code and theory test that wasn't that much of a challenge; then we went out and bought our rigs, set them up, and started talking. We're not really into this radio thing too technically. If we were, I could understand us talking shop, using technical terms.

Why did we get into ham radio at all? To join a group that is set apart by its strange practices, or for the thrill of being able to talk with some one across the state while seated in our car, or across the world from the home station? I think you know why. So what happened? When we first became hams we wanted very much to join the group and be like everyone else. So we imitated what we heard. We adopted the practices we heard on the bands. We learned to say "The QTH here is . . .", "The handle here is . . .", "See you further on down the log." That gave us a feeling of belonging, and made us feel like old pros on the band.

Now that CB has become the latest national fad, and its weird ways of talking are being heard on the streets and on TV, many of us hams have seen how silly it is and how little we need our own peculiar jargon. We can make sense to each other by using everyday English, the same language we use everywhere else. So how about it? How about going up or down in frequency instead of QS whying? "Further on down the mike cord" should become "Some other time." Let's lay QRMary to rest, alongside QRNancy. No more talk about XYLs or Q sews. Come on, hams, let's hear it for good old standard English! ■

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The Ham Radio Classroom

- - sure beats study hall

I shoved the key in the lock and twisted. Then I put my shoulder against the panel and kicked the bottom of the door with the heel of my shoe. It opened with a groan. That door, like everything else at Riverside Vo-Tech High School, was badly in need of repair.

Heels clicked on hard tile. I paused, turned, and gazed as the chic YL figure passed.

"Hi," she tossed a breezy greeting.

"Evening," I managed to get out.

She continued on down the hall, hips swaying provocatively. I pursed my lips in a soundless wolf whistle, and fumed at myself for acting like a high school freshman.

I was there that evening to get my ham rig set up and checked out for class demonstrations the next day. I had no idea what Leigh Wainright was doing in the building. For that matter, I had never been able to figure out why a dish like Leigh was teaching Home Ec in a crummy school like Riverside.

I turned back toward my room. It was hard to realize only two months had passed since I accepted the job as electronics instructor, and had my name, Kenneth Cook, inscribed on a cardboard tab over the door.

My eyes took in the familiar scene. Tables and chairs in the middle of the room, where students were supposed to study and take notes. A bench down each wall with a few test instruments, mostly government surplus. Junk TVs and radios, which should have been scrapped years before. And a green portable chalkboard, covered with illustrations and basic formulas.

Maybe, just maybe, I thought, I could get those kids interested in Ohm's Law or how to make a good solder joint, if I showed them how much fun ham radio could be.

So far it looked as if trying to teach them anything was a waste of time. The school was practically an armed camp, where keeping a semblance of order was the major task each day.

Although teaching jobs were not plentiful, I could have been working elsewhere, either as an instructor or technician, for more money than Riverside paid. But I had chosen to hunt a position in an urban poverty area school where I felt I could be of service – maybe help some of those less fortunate find a better life.

And what career was more wide open than electronics, in this day of integrated circuits and microprocessors.

As I thought, I kept busy, securing the coax I had strung the evening before from a dipole on the roof, along the wall. I had decided to set up on 40. A 2 or 6 meter rig would not impress the kids as much as talking to someone at a distance. 20 was too crowded with no beam. 40 looked like the right compromise between distance and reliability.

I made the final connection between my transceiver and home brew linear, plugged in the mike, and flipped a switch. I found an open spot on the band and checked the swr.

A "5" called a short CQ. I went back to him.

My cares and worries dropped away. No matter how down I was, I could fire up a rig and forget my problems. It had always been like that, even when I was a kid playing with crystal sets and code practice oscillators.

I had my General before I was fifteen and nothing, absolutely nothing, had ever come ahead of hamming. This included girls, which was probably the reason I was still single at the ripe old age of twenty-four.

I was right in the middle of a long-winded explanation of what I hoped to accomplish at the school when my door rattled violently.

"Wait one, Joe," I spoke into the mike and across three states.

A lift and pull at the door was necessary from the inside, before it opened. I looked into a pair of blazing violet eyes.

"Mister Cook," Leigh Wainright exclaimed. "We're trying to watch a slide presentation, and all we can hear on the sound system is you!"

"Sorry."

I had learned long ago there was no use arguing with anyone, especially when they were angry, concerning TVI, BCI, or any other kind of interference. "Just give me a minute and I'll sign off."

She nodded and I ended the QSO briefly.

"I'll have to work on the sound system," I told her. "I'm planning on a club station and we won't want to be interfering."

"Nothing wrong with the PA," Leigh insisted, "except when you have that thing going."

Again, there was no use arguing. I changed the subject.

"What kind of slide show are you watching?"

"Presenting," she corrected me. The expression on her perfectly molded face was incredulous. "You really don't know?"

I shook my head.

"Teachers Association," she said tersely.

I decided her complexion wasn't perfect. She had two freckles on the end of her turned-up nose.

"Oh, the union thing."

Violet eyes blazed again. "Yes, the union thing. If you

want to see how underpaid and overworked you are, and how our educational system in this state compares with other states, why don't you come and watch?"

"Might as well," I grinned, "since you've put me off the air."

The Home Ec department was at the other end of the building. I had to walk faster than my usual ambling gait to keep up with her. I didn't tell her the reason I agreed to attend the meeting was because of her, not the union. I didn't have anything against unions. I knew they had done a lot of good, but I always had the idea they were for truck drivers, carpenters, and other trades, not for teachers.

"I'm surprised you're allowed to hold a union meeting in the school building," I made conversation.

"Mr. Higdon's on our side," Leigh replied, "even though he can't say so. He just conveniently looks the other direction."

Higdon was the principal. As far as I could see, he always looked the other direction when anything came up. Especially anything that required spending any money, like parts I needed, or books, or test equipment.

I sat through the slide presentation and listened to Leigh Wainright's perfectly modulated voice cite reams of facts and figures. A lot of what she said made sense. It was ridiculous that the lowest paid sanitation worker had take-home pay greater than a beginning teacher.

But I confess I was more interested in the curve of Leigh Wainright's slender throat, silhouetted by the projector light, than by the cause she espoused.

Finally the presentation was over. Bright lights flashed on.

"Well," Leigh Wainright concluded, "are we willing to do whatever we have to, to see these injustices are corrected?"

A chorus of "yeahs," "Yesses," and "You tell 'em, Leigh," rang out.

A man I recognized as a science teacher jumped to his feet. "Strike," he yelled. "I say, let's strike."

"Not so fast," Leigh shot back. "A strike is the last resort."

They wrangled for several minutes. There was no doubt about the sentiment. 90% of the teachers were 100% activists.

It was also very apparent that Leigh Wainright was Miss Big in the Teachers Union.

Slowly the room cleared. I lingered until only Leigh, I, and two burly men were left.

"Mr. Cook, I want you to meet Mr. Summers and Mr. Cannon," Leigh introduced them.

"Jake Summers," the older of the two stuck out his hand. He was fat and bald. "Pleased to meetchu."

"Likewise," Cannon said. He would have been handsome, in a swarthy kind of way, if it had not been for a white ragged scar across his left cheek.

"These gentlemen are from headquarters," Leigh explained.

Both were impeccably dressed, but I though they could have passed as fugitives from a chain gang. But the union men were of little interest to me.

I was tuned to resonance on Leigh Wainright's wavelength. I screwed up my courage. Nothing ventured, nothing gained, I told myself.

"Miss Wainright – Leigh," I finally stammered. "Could I – that is – do you need a lift home?"

"I have my car."

I knew she did. My heart's S-meter dropped to zero.

"But if you want to follow, we could stop for a Coke," she added.

Did I want to? You bet your sweet one and only 4CX1000 I wanted to!

A short time later, facing Leigh across a table, I listened for the second time to her union sales pitch. "And we *will* strike if we have to," she concluded.

"What about the kids?" I objected. "Is a strike fair to them?"

"As fair as what the city fathers are doing to us – and to them."

I still didn't agree, but I was willing to discuss it all night, just for the privilege of sitting and watching the sparkle in her violet eyes, and the bounce of her blond hair. Finally the subject of the union was exhausted. We really began to get acquainted. Before we parted I had a date for the next evening.

The following morning I had the attention of the entire class, at least for a few minutes, when I fired up the rig. I caught a "4" in Florida who was willing to rag chew. I explained what we were doing and even let some of the students say a few words, after explaining this was permissible, as I was actually operating the equipment.

The students seemed to be fascinated as much by the VOX as by the QSO itself.

"Well?" I queried, after I signed and turned down the receiver gain.

"That was really somethin'," one of the two girls in my class exclaimed. "'Specially the way your voice turns everything on and off."

"Yeah," Russell Allen, a boy who had been even more of a problem student than others, interjected. "But how you make any bread, man, outta just talkin'?"

"You don't make money," I explained. "In fact, it is against the law to use amateur radio for commercial purposes. But you can learn – how to build, adjust, and maintain radio transmitters and receivers. There are millions of jobs in related fields: police radio, taxicabs, broadcast, TV . . ."

I waxed eloquent, "Why, hams have always been pioneers, opening up frequencies once considered worthless."

I stopped, knowing he would not understand about frequencies. "I learned most of what I know working with ham radio," I finished. "I could hold down almost any kind of electronics job, and be making a lot of money."

Russ pounced on my words. His brown eyes danced and his chocolate face displayed an insolent grin. "Then how come you're here, teach?"

There was nothing stupid about Russ Allen. I desperately wanted to reach him, to help him, but I felt frustrated.

"Money isn't everything," I finally replied. "I'm here because I want to do something useful."

"If you ain't here for the bread, how come you gonna strike?"

So the strike talk had got back to the students.

"Nobody said I was."

"You gonna scab?"

I knew the conversation was going far beyond the area where it should have been allowed, but I had let it go too far to stop.

"I'll be here to teach any day the school is open," I told him. "Now, how about you? Are you going to take advantage of your opportunity for an education?"

"I be here," he said, "if you be."

That night my date with Leigh Wainright went as smooth as a local 2 meter QSO. For the first time in my life, I found myself more interested in a girl than my radio equipment.

It happened sooner or later to most good hams, I excused myself, judging by the number of XYLs and junior ops.

I went to a number of union meetings with Leigh, at various locations throughout the city. Each was a repeat of the one at Riverside, although the teachers at Riverside were by far the most militant. At each meeting the two organizers, Jake Summers and Art Cannon, were present. But I could not see that they took

any active part.

Once I tried to explain ham radio to Leigh. She echoed Russ Allen's thoughts.

"But Ken, what good is it?"

I repeated all I had said to Russ and added:

"Hams handle all kinds of emergency messages during floods, tornadoes, ice storms, and so forth. Many have emergency power. Countless lives have been saved and literally millions of messages have been handled for the Red Cross or branches of the military. The Army, Air Force, and Navy all recognize the value of hams and have their own ham organizations – The Military Affiliate Radio Service – MARS."

She may have been impressed, but she failed to show it. However, I knew she was uptight over the union thing.

"We have this local net right here in the city," I went on. "We meet every Friday night . . ."

"Meet? Where?" she interrupted. "Would they be interested in seeing my slides?"

I laughed. "We meet on the air for an emergency drill."

"Oh," she said, "just a bunch of radio nuts."

For the first time, I was angry with her. "Ham radio operators include some of the finest and best-known people in the world," I snapped. "People like Arthur Godfrey and Barry Goldwater. Doctors, lawyers, teachers, politicians, businessmen, policemen – you name it. I'm new in this city, but I'm willing to bet you'll find every profession I named on the net!"

"Sorry," she said, "I didn't mean to rile you."

"Would you like to listen when it's my night to call the net?"

She nodded, but without enthusiasm.

I continued seeing Leigh Wainright almost every evening. Thoughts of a home and family life were very much a part of each day.

Strike talk waxed hot. I helped Leigh draw up a list of demands. Truthfully, nothing asked was unreasonable, except perhaps the dues check-off – whether a teacher chose to belong to the union or not. And even that was a matter of opinion.

The list was duly submitted to the School Board and passed up to the Mayor and Commissioners.

In the meantime, I moved more of my personal equipment into my room at school. I set up my two and six meter FM rigs. Beams were not necessary because of the repeaters. Both rigs were VOX controlled. I had always been a nut about that, so I could keep both hands free to solder or wire while operating.

Finally, it seemed, I was at last creating some student interest. I didn't know if the ham demonstrations deserved the credit, or if I had, somehow, at least partially, won their trust.

In spite of dating, I still managed to meet the net. Leigh Wainright or no Leigh Wainright, I had no intention of abdicating this responsibility. On several occasions I found Russ waiting for me outside the school. He puttered in the shop, soldering on a code practice oscillator and listening as the net progressed.

Then negotiations began to break down between the teachers organization and the School Board.

Leigh Wainright was totally committed to teachers' rights.

I found out she had chosen a position at Riverside because she wanted to expose the conditions there, which were worse than they were in any other school in the city. I could see she was becoming more and more frustrated.

One afternoon she told me, "I'm sorry, Ken. I can't be with you tonight. We have a showdown meeting with the School Board. The way it looks now we'll be on strike tomorrow!"

I hadn't thought much about the possibility of a strike. I figured they would work something out. And if the worse came to worst, those who wanted to strike would stay home and those who didn't, wouldn't.

I seldom watched TV and nothing prepared me for the scene outside the school the next morning.

The crowd was immense. Students, parents, police, reporters, TV crews, and teachers milled about. The teachers moved in a circle, carrying placards which proclaimed their grievances. Leigh Wainright headed the marchers.

She saw me and waved a hand in greeting.

The din was intense. Parents shouted obscenities. Teachers replied. Students, looking forward to a holiday, agitated by throwing an occasional rock or bottle from time to time at the cordon of police who stood between them and the teachers.

"You goin' in, teach?" I heard a familiar voice inquire. The arrogant smirk I remembered was on Russ Allen's face.

I had not known until that minute what I would do.

I squared my shoulders. "I'm going in."

"Wait," Russ instructed.

He moved about swiftly and was back in a couple of minutes with three of my students.

"This is all," he said.

I led the way. We moved toward the cordon of police. Two stepped forward to meet us.

"I'm a teacher," I said. "I'm not striking. We're going in."

"We can't guarantee your safety!"

"We're going in," I repeated.

Their ranks parted slowly. We moved forward, up to the line of marching strikers. I met Leigh Wainright, face to face.

"Ken," she gasped.

"I'm going in," I told her. "The children's education is more important than anything else."

The look on her face told plainer than words how she felt.

Police parted the marchers. We slipped through onto the school grounds. I noted a couple of other teachers and a dozen students followed us.

Then I spied Summers and Cannon. They stepped from the line and moved quickly alongside of me, one on each side.

"Friend," Jake said, "ain't you makin' a slight mistake?"

Cannon seized my arm. His hand was like a vise. "Breakin' a picket line could be downright unhealthy, friend."

"Besides, what will your little woman think?" Jake added.

I shook them off and trudged ahead. Now I knew the function of the two: muscle men, when the going got rough.

The day was a washout as far as any actual work on lessons was concerned. But I sensed a new respect from Russ Allen and the other three students. Once he put his thoughts in words:

"You really ain't here just for the bread, teach!"

"I need money to live same as anyone else," I replied. "But educating America's future citizens seems more important to me than the size of the salary."

He nodded, solemnly.

That afternoon, getting out of school was as much an ordeal as getting in. The police surrounded us completely and escorted us through the crowds.

The next day we knew what to expect, and took our lunch. Six teachers and maybe fifty students crossed the picket lines with us. And the day following, more than 100 students and several additional teachers.

The contempt in Leigh Wainright's eyes was almost more than I could bear. But there was nothing I could do.

She thought she was right. I felt I was.

That afternoon things appeared even more hectic. Boos were plentiful and obscene gestures the order of the day as our little band, encircled by police, started across no man's land, away from the school.

Then shouts and yells arose. Several people surrounded a police car and began rocking it. More swarmed around and the car was turned onto its side.

Our escort rushed toward that mob, and the striking teachers headed for me. I felt a blow in my stomach, and caught a glimpse of Cannon as I went down. Then feet were tromping. I realized the people had gone mad as blackness closed around me.

When I awoke, it took seconds to realize who I was, minutes before the wail of a siren and the motion of a vehicle penetrated my mind. I was flat on my back on a stretcher.

Then I thought it had to be a dream as part of that dream spoke:

"Ken. Thank God, Ken. Are you all right?"

"I am now," I told Leigh Wainright. "That is, if I'm even here." Then memory hit me. "The kids? Other people? How many were hurt?"

She shook visibly. "Too many. Maybe I've been wrong, Ken. I never knew people could go crazy."

"Not people," I said. "Mobs."

"When I saw you — all hurt like that ...," she choked. I reached for her hand.

At the hospital they checked me over, patched me up and checked me in. I had cuts and bruises, and a lump on the head, but no broken bones. But they insisted I remain overnight for observation.

Leigh stayed until they ran her off.

"See you in the morning at school," I told her.

"Ken, no," she remonstrated. "Haven't you had enough?"

I shook my head.

She kissed me before she went out the door. Once again I slept with visions of a blond, violet-eyed XYL and six junior ops running through my dreams.

They released me early the next morning. I went directly to the school. The scene was much subdued from the day before. It was as if the mob had run out of steam after blowing a pop valve.

A few teachers still marched. Leigh Wainright was not one of them. I looked about for familiar faces and was relieved to see the bushy Afro and intelligent brown eyes of Russ Allen. He wore a bandage on one cheek and one arm was in a sling.

"Ready, teach?"

"Ready," I said.

The students bunched behind me as we walked toward the picket line. No words were spoken as we crossed the street. As we approached the picket line, I heard Leigh cry out from behind me:

"Ken! Wait!"

She joined us and I reached for her hand.

"I-I'm still for the teachers," she said, "but I can't be a part of violence."

"You wanted to call attention to conditions here at Riverside," I told her. "And I guess you've done that."

"The wrong kind of publicity," she said bitterly. "People who saw those news films on TV will think teachers are a bunch of wild animals."

That morning, almost a third of the teachers and student body entered the building. It was my guess the strike was all but over. And little, or nothing, had been accomplished.

But one good thing had come out of it. I had gained the respect of my students. Russ Allen was the prime example. He listened to every word I spoke, and I knew he was convinced I was sincere in the work I was doing.

Leigh spent most of the day observing my class, since none of her students were present. She was impressed at the eagerness Russ and the other students displayed.

That morning and again in the afternoon, I fired up the rig and we talked to people in six different states.

"Tonight's my night to call the 2 meter net," I told Leigh. "Want to sit in?"

"Here?"

I nodded.

"Can we get in the building?"

I shrugged. "Why not? I get in every day, and the picket line is only during school hours."

"I'd love to," she agreed.

That night I picked Leigh up early and we drove slowly to the school. There was no indication a strike was in progress. But as we parked, a police car cruised by, circled, and came back. We identified ourselves. In a couple of minutes Russ joined us and we proceeded into the building.

A school security guard intercepted us at the door, but he knew us and we exchanged greetings as I reset the lock.

"Better keep everything locked," he advised. "We ain't takin' no chances."

"I think the strike's about over," I replied.

"Me, too," he agreed. "And I'm plenty glad. My old lady's scared to death I'll get hurt or somethin'."

"I was, too," I confided. "And then I was."

We laughed together. I invited him to join us for a while when he made his rounds.

The door to my room, after the usual sequence, opened. I snapped on the light and fired up the 2 meter rig. It was not quite net time, and the usual pre-net chitchat was in progress.

I explained the VOX system to Leigh, and told her how autopatch worked.

Russ made the necessary entries in my log book. I opened the net and began roll call. I was about a third of the way down the list when my door rattled violently.

"Wait one," I said into the mike. Habit caused me to rotate the receiver gain to "0" before I went to the door. I lifted and pulled, expecting to see the security guard.

"Well, ain't this a party?" Jake Summers snarled as the door swung open.

He pushed past me. Cannon followed. The younger man's hand closed in a vise-like grip around my arm. "Friend, didn't we tell you crossing a picket line could be unhealthy?"

"Jake! Art! What is the meaning of this?" Leigh demanded.

Both men laughed. "Now, sister. You didn't think we could let you welsh on our deal, did you?" Jake sneered.

"You'd better leave," I tried to make my voice firm. "The security man will be here in a few minutes."

"He ain't likely to be nowhere for a long time, friend."

Out of the corner of an eye I saw Russ move toward the transmitter. I thought I knew what he was trying to do. I began struggling. I had to keep the thugs' eyes off the boy.

Cannon's hand found my throat, and Jake landed a kick in my groin. But I had seen Russ's hand turn up the mike gain before he glided away.

"What we gonna do about the boy?" Jake demanded.

I heard a faint click as I doubled over. The VOX relay had kicked in. I prayed they hadn't noticed.

"We got no choice," Cannon snapped. "We ain't gonna leave no witness."

Russ's eyes were wide and round. "I don't hear nothin'," he said. "I don't see nothin'. I don't say nothin'!"

"W-What do you intend to do — with us?" Leigh asked.

They didn't answer.

"Listen," I shouted, before the delay unlatched. "You can't break into River-

side Vo-Tech and kidnap us — maybe murder us — and get away with it. People know where we are. They'll be here in a hurry. Jake Summers, you tried to kill me yesterday. You didn't make it. You won't get away with it today!"

"Shut up," Jake growled.

"Come on," Cannon snarled. "Let's get out of here."

He hauled out a snub-nosed revolver from beneath his coat and waved toward the door.

"You, too," he told Russ.

"Please, Mister. Don't make me go. I ain't gonna say nothin'."

Again, Cannon waved the pistol toward the door. Russ dropped to the floor and began yelling.

"Help, somebody, please! They gonna kill us. They gonna take us away and kill us, right now!"

Russ was the picture of a genuinely terrified boy, and I couldn't blame him, for I wasn't exactly comfortable about the situation. But he knew he was "on the air," and no actor ever gave a better performance.

Jake landed a solid kick in the boy's side. Russ quieted as suddenly as he had begun. He staggered to his feet and lurched out the door.

Cannon twisted my arm behind my back and forced me forward into the hall. Jake prodded Leigh, who was sobbing softly.

I knew how terrified she was and I longed to comfort her. But there was no way I could let her know we had been telling more than fifty ham radio operators what was happening.

We moved down the hall, not toward the front of the building, but in the direction of the Home Ec department.

"Look," I said. "You need Miss Wainright. She hasn't quit the union. Let her go. She just came in this morning to watch me operate my ham rig."

"Shut up, punk," Cannon growled.

We reached Leigh's room. Jake opened the door with a key he took from his pocket.

Leigh hung her head. "I let them have my keyring one night to come after a projector. They must have had duplicates made."

So they had simply unlocked a door and walked in, I thought. I remembered the security guard, and how he had met us at the door. Then what Cannon had said.

They herded us across the room toward a window. Jake raised it, listened, shoved a big foot against the rotting screen, then climbed through.

"All right, sister," Cannon ordered.

Russ was next and I followed him.

The grounds were dark. We moved slowly, past the cafeteria, in the direction of the football field.

Had I miscalculated? Had the net members decided the real life drama relayed by our two meter repeater was a hoax?

I couldn't believe it, yet where were the police?

Then I heard something. Cannon heard it too.

"What was that?" He stopped.

"Garbage pail," I said. "Probably a dog."

After a long moment we moved forward again.

All at once I heard a welcome sound. The whoop-whoop and wail of a siren. Faint, but building. Then it sounded as if half the police force was approaching.

Two things happened almost at the same time. Cannon and Jake turned to run. I stuck a foot in front of the fat man, and he tumbled to the ground. Several figures popped up from behind the garbage cans.

"Stop or I'll shoot," one yelled.

Cannon swung toward the man, the revolver in his hand. A slim figure hurtled past me and into the thug's side.

Russ knew how to tackle.

Flashlights came on and a policeman got handcuffs on the two muscle men. Then the officer turned to me.

"Hi, Ken," he said. "I'm WA9———. I was just coming off duty and caught the excitement on my mobile rig."

"Boy, am I ever glad to see you," I said, and added, "this is Leigh Wainright. Leigh, this is Bob, one of the net members. You didn't realize it, but the VOX circuit kept my transmitter on all the time we were in my classroom.

Others crowded around, introducing themselves. Police began arriving by the dozen. Bob explained he had used the autopatch in his car to call them while en route.

Somebody said they had found the security guard, trussed up, and with a lump on his head, but otherwise OK.

The police took Summers and Cannon away, after telling us to report to police headquarters and give our statements the next morning.

By that time there were at least a couple of dozen hams milling about.

"What say we go to the radio room for an eyeball?" I suggested.

Everybody agreed.

Leigh Wainright had recovered her poise completely. She detoured through the Home Ec department and picked up a coffee pot. Soon, one would have thought we were at the end, or the beginning, of a big hamfest.

Hams kept coming until the room was overflowing.

Somebody fired up my rig and soon the word was passed to the shut-ins and distant net members.

Of course I had to go over what had happened several times, including Russ's cool and shrewd thinking.

One thing led to another. I began to tell them what I had accomplished with the students by using ham radio. Then Leigh took over and was soon conducting a tour of Riverside, pointing out all the glaring deficiencies.

I noticed one of the hams taking notes, and I remembered the boast I had made to Leigh about finding people from all walks of life on our two meter net.

When we got back to my classroom I conducted a poll. We had one newspaper reporter, seven doctors, one man who was an aide in the Mayor's office, four druggists, two plumbers, three policemen, fourteen people connected with radio and TV stations (mostly engineers), five lawyers, four teachers (two college level), forty-one who were businessmen or worked at various other positions, and, believe it or not, one *School Board member!*

"Just a bunch of radio nuts," I whispered to Leigh. "Do you think you could ever learn to love one?"

"Oh, Ken" was her only comment. But the look on her face gave me the answer I wanted. That was three years ago.

We now have one junior op and another on the way. Leigh got her ham ticket a year after we were married.

I wish I could say the ham School Board member and the ham newsman gave us enough publicity that all ills at Riverside Vo-Tech were cured.

But it didn't work that way.

True, we got good publicity, and the support of the media. Some improvements were made, and we got a small raise in pay.

As usual, everything in life was a compromise.

One interesting thing came to light.

Jake Summers and Art Cannon both had felony records, and were not official representatives of the National Teacher's Organization. They were part of a wildcat, militant union and had lied to Leigh, intending to use the union as a base of operation to further some nefarious scheme.

Russ Allen graduated from Riverside with honors, and most of my classes are now there to learn.

I give ham radio the credit. Wouldn't you? ■

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CB to 10 -- A Legal Alternative

-- part I: bandplan and crystal info

For some time now, there has been an ever-growing concern over the outcome of the ten meter band. The ham use of the band has dropped over the past several years due to sunspot activity to a point where other services, mainly Citizens Band, feel that the frequencies could be put to better use. I remember when I used to work into Europe daily with five Watts and a dipole on CW and AM, and even into ZL and VK land after I got up a 3 element "plumber's delight" beam.

The sunspot cycle, though probably not as good as the one back in the late 1940's, is about to open the band up again. Many groups are presently getting ready for better activity on ten with the establishment of nets and even new repeaters.

The above is the whole idea behind this article: an easy way to get back on 10 meters with low power with a small outlay of cash.

When the FCC announced that they were increasing the Citizens Band from 23 channels to the current 40 channels effective January 1, 1977, the prices started to drop on the 23 channel units. If indications here apply to the country as a whole, a lot of hams started picking up these cheap rigs with the idea of first going on CB in their cars to keep track of traffic, and secondly, someday converting the CB rig for use on other bands, namely 10 meters.

Also, there seems to be a large influx of former CBers giving up the ranks of CB and going on to amateur radio. Over 80% of the new hams in the Mobile, Alabama, area are former CBers who wanted to get away from the QRM on 11 meters. Most of these former CBers still have their old CB rigs stored away in their junk boxes. They have picked up the ham habit of never throwing away anything that might be usable some time in the far distant future. Now is the time to drag out that old 11 meter rig and convert it to 10 meters on crystal controlled channels that could become standard all over the country.

The first thing that has to be done to make the whole idea of getting low power transceivers to work is to establish some simple ground rules. If every person converting a CB rig for 10 meters picks frequencies at random, very little activity will result. I would like to therefore suggest some standard blocks of channels (frequencies) that could be used to increase the effectiveness of these low powered rigs. With both the Novice and Technician class license holders on 10 meter CW, it can be seen that there

		Converted Ten Meter Frequencies		
Channel	Original Frequency (MHz)	Novice/Tech Frequency (MHz)	AM Phone Frequency (MHz)	SSB Phone Frequency (MHz)
1	26.965	28.005*	28.705	28.505
2	26.975	28.015*	28.715	28.515
3	26.985	28.025*	28.725	28.525
4	27.005	28.045*	28.745	28.545
5	27.015	28.055*	28.755	28.555
6	27.025	28.065*	28.765	28.565
7	27.035	28.075*	28.775	28.575
8	27.055	28.095*	28.795	28.595
9	27.065	28.105	28.805	28.605
10	27.075	28.115	28.815	28.615
11	27.085	28.125	28.825	28.625
12	27.105	28.145	28.845	28.645
13	27.115	28.155	28.855	28.655
14	27.125	28.165	28.865	28.665
15	27.135	28.175	28.875	28.675
16	27.155	28.195	28.895	28.695
17	27.165	28.205*	28.905	28.705**
18	27.175	28.215*	28.915	28.715**
19	27.185	28.225*	28.925	28.725**
20	27.205	28.245*	28.945	28.745**
21	27.215	28.255*	28.955	28.755**
22	27.225	28.265*	28.965	28.765**
23	27.255	28.295*	28.995	28.795**

*Fig. 1. NOTES: * = Channels 1 through 10 and channels 17 through 23 in the CW segment are not authorized at this time for Novice or Technician class use. ** = Channels 17 through 23 in the SSB segment are the same frequencies as channels 1 through 6 and channel 8 of the AM segment.*

28.505 MHz Output Used To Show Example of Crystal Frequency

Transmit Crystal Frequency		Transceive Crystal Frequency (Both Transmit and Receive)	
F	28.505 MHz	F - 5010	23.495 MHz
$\frac{F}{2}$	14.25250 MHz	F + 5010	33.515 MHz
$\frac{F}{3}$	9.5016667 MHz	F - 10000	18.505 MHz
$\frac{F}{4}$	7.126250 MHz	F + 5995	34.500 MHz
		F + 6200	34.705 MHz
		F + 10635	39.140 MHz
		$\frac{F - 3456}{2}$	12.52450 MHz
		$\frac{F + 8750}{3}$	12.41833 MHz
		$\frac{F - 10700}{3}$	5.935 MHz

Receive Crystal Frequency

F - 265	28.240 MHz	F - 455	28.050 MHz
F + 455	28.960 MHz	F - 1365	27.140 MHz
F + 1650	30.155 MHz	F - 1650	26.855 MHz
F + 1680	30.185 MHz	F - 1750	26.755 MHz
F - 1755	26.750 MHz	F - 2310	26.195 MHz
F - 3580	24.925 MHz	F + 4000	32.505 MHz
F + 4300	32.805 MHz	F + 4224	32.730 MHz
F - 4455	24.050 MHz	F - 5500	23.005 MHz
F + 6000	34.505 MHz	F - 6000	22.505 MHz
F - 6500	22.005 MHz	F + 6685	35.190 MHz
F + 7500	36.005 MHz	F + 8000	36.505 MHz
F - 10000	18.505 MHz	F + 10700	39.205 MHz
F - 20635	7.870 MHz	F - 23505	5.000 MHz
31955 - F	3.450 MHz	$\frac{F - 455}{2}$	14.025 MHz
$\frac{F + 455}{2}$	14.480 MHz	$\frac{F - 455}{3}$	9.350 MHz
$\frac{F - 455}{4}$	7.0125 MHz	$\frac{F + 1650}{2}$	15.0775 MHz
$\frac{F + 1640}{3}$	10.048333 MHz		

Fig. 2. NOTE: With this many different i-f combinations being used, it is necessary that exact specifications of the transceiver to be converted are known.

must be a block of channels that they can use when they convert a CB rig to CW operation. There is unwritten use of SSB only on the low frequency end of the 10 meter phone band, so the SSB CB rigs that are converted should have a block and, of course, the bulk of the converted CB rigs, being inexpensive AM rigs, will need their channel allocations. Fig. 1 lists all three of the groups of 23 channels that could be used.

The very nature of the basic CB transceiver makes this type unit one of the simplest to convert to ten meter operation. In the case of other types of low power surplus equipment that has been available in the past, the tunable stages have been fairly narrow, but in the case of the CB rig, the tuned stages are fairly broad. To fulfill the requirement of being channel selectable without being tunable by the operator, most CB rigs on the market today will give close to 4 Watts output at both extremes of frequency, that is, at channel 1 and channel 23.

After reviewing the crystal requirements of over 1200 different CB transceivers, I was able to arrive at the common configuration for both transmit and receive crystals. Every transceiver reviewed fell into one of the configurations shown in Fig. 2, where "F" indicates the output frequency desired.

The frequency combinations shown in Fig. 2 are for CB transceivers that use a single crystal for each transmit channel and another crystal for each received frequency. This type of transceiver can be modified for use on 10 meters, but the expense would probably be more than buying or building a simple 10 meter transmitter and simple converter for use with an existing receiver. The possibility of building a simple VFO to replace the crystals in the transmitter and receiver sections of this type of transceiver would solve the problem of the large numbers of crystals needed.

There are two other

PART II
ORIGINAL CRYSTAL FREQUENCIES FOR CB OPERATION

Crystal	Crystal Frequency (MHz)	Channel Numbers
A	23.290	1-2-3-4
	23.340	5-6-7-8
	23.390	9-10-11-12
	23.440	13-14-15-16
	23.490	17-18-19-20
	23.540	21-22-23
B	37.600	1-4
	37.650	5-8
	37.700	9-12
	37.750	13-16
	37.800	17-20
	37.850	21-23
C	11.705	1-4
	11.755	5-8
	11.805	9-12
	11.855	13-16
	11.905	17-20
	11.955	21-23
D	8.159	1-4
	8.209	5-8
	8.259	9-12
	8.309	13-16
	8.359	17-20
	8.409	21-23
E	11.740	1-4
	11.790	5-8
	11.840	9-12
	11.890	13-16
	11.940	17-20
	11.990	21-23
F	14.950	See Note 1
	14.960	See Note 2
	14.970	See Note 3
	14.990	See Note 4
G	10.595	See Note 4
	10.615	See Note 3
	10.625	See Note 2
	10.635	See Note 1
H (LSB)	7.4585	See Note 1
	7.4685	See Note 2
	7.4785	See Note 3
	7.4985	See Note 4
I (USB)	7.4615	See Note 1
	7.4715	See Note 2
	7.4815	See Note 3
	7.5015	See Note 4
J	11.0035	See Note 1
	11.0135	See Note 2
	11.0235	See Note 3
	11.0435	See Note 4
K	7.4225	See Note 1
	7.4325	See Note 2
	7.4425	See Note 3
	7.4625	See Note 4
L	11.275	Transmit (TX)
	11.730	Receive (RX)
M	10.140	See Note 4
	10.160	See Note 3
	10.170	See Note 2
	10.180	See Note 1
N	7.8015	LSB
	7.7985	AM and USB
	7.3435	RX Oscillator
O	7.8025	All Frequencies

PART I

Manufacturer	Model Numbers		Shift	TX/RX	Main OSC
			See Part III for Crystal Formula		
B & K (Cobra)	19, 21 & 29		L	F	A
B & K (Cobra)	130, 131 & 132	LSB	N	H	C
		USB	N	I	C
B & K (Cobra)	138 & 139		O	J	D
B & K (Cobra)	132A & 132B	LSB	N	H	C
		USB	N	I	C
Pace	123A		M	G	B
Pace (SSB)	1000B, 1000M		O	K	E
Pace	CB-143, CB-144		M	G	B
Midland	13-880B, 13-885	LSB	N	H	C
		USB	N	I	C
Midland	13-895		O	J	D
Realistic	TRC-23B, TRC-40, TRC-49		M	G	B
Robyn	T-123B		L	F	A
Robyn	T-123C, K-123 AMGT-VII		M	G	B
Royce	I-602		M	G	B

PART III
CONVERSION FACTORS FOR 10 METER OPERATION

From Part I Key Letter Sequence	Lowest Frequency for Channel 1 (see Fig. 1) 28.005 MHz	28.505 MHz	28.705 MHz
L F A	L=10.235 MHz TX	L=9.735 MHz TX	L=9.535 MHz TX
	L=10.690 MHz RX	L=10.190 MHz RX	L=9.990 MHz RX
	(Frequency groups A & F remain the same)		
	TX = 38240 - Freq. of low end.		
	RX = 38240 - Freq. of low end + 455 kHz		
N H C LSB	H=8498.5 kHz	H=899.5 kHz	H=9198.5 kHz
	(Frequency groups N & C remain the same)		
	H = Low end frequency minus 19506.5 kHz		
N I C USB/AM	I=8501.5 kHz	I=9001.5 kHz	I=9201.5 kHz
	(Frequency groups N & C remain the same)		
	O = Low end frequency minus 19162.5 kHz		
M G B	B=38640 kHz	O=39140 kHz	B=39340 kHz
	(Frequency groups M & G remain the same)		
	+ 1040 kHz	+ 1540 kHz	+ 1740 kHz
	The above is the frequency "B" must be raised for each frequency group for operation in the 10 meter band.		
O K E	O=8842.5 kHz	O=9342.5 kHz	O=9542.5 kHz
	(Frequency groups K & E remain the same)		
	O = Low end frequency minus 19162.5 kHz		

Fig. 3. NOTES: 1 = Channels 1, 5, 9, 13, 17, and 21. 2 = Channels 2, 6, 10, 14, 18, and 22. 3 = Channels 3, 7, 11, 15, and 19. 4 = Channels 4, 8, 12, 16, 20, and 23.

groups of transceivers available on the market at the present that could be modified. First of these is the synthesized units which use combinations of a small number of crystals to obtain all of the transmit and receive frequencies desired. The second class of transceiver available is the phase locked loop or PLL type that uses very few crystals and digital frequency generation to obtain the frequencies needed.

The combinations used for the synthesized units are almost without limit. When converting a transceiver of this type, it would be of necessity to obtain a complete schematic and parts list for the unit from the manufacturer or one of the CB service type books on the market listing your transceiver. Though the synthesized type is cheaper to modify than the type using crystals for each frequency, there could be problems in obtaining the necessary information to determine the crystals needed.

In Fig. 3, I have listed several of the more common synthesized units available and crystal data necessary to convert the units to 10 meters. Fig. 3 is divided into 3 parts for ease of understanding.

The crystal combinations listed in Fig. 3 are examples of some that will be encountered when trying to shift an eleven meter CB transceiver to the 10 meter band. I have found that the simplest way to calculate the frequencies needed is to use only channel 1 to determine a simple formula. Once a formula is obtained, each crystal frequency can be found. The best way to select which oscillator you want to shift is to select the one that requires the least number of crystals to make up the greatest number of frequencies.

The Cobra 138, Cobra 139, Midland 13-895, Pace 1000B, or the Pace 1000M should prove fine choices for conversion to 10 meter SSB. In each of these, the original 7.8025 MHz crystal is the only crystal that needs to be changed. It seems logical that a multiple deck crystal switch/socket package could be used. This arrangement would allow several 23 channel arrangements over the 10 meter SSB segment. For example: Selection of the lower end frequencies of 28503 kHz, 28505 kHz, 28507 kHz, and 28510 kHz would require only 4 crystals for a total of 92 channels between 28503 kHz and 28800 kHz.

There are several linear amplifiers on the market today which are smaller than most CB transceivers and have output of 50 to 100 Watts. Of course, most of these units are rated as 3 to 30 MHz "ham" amplifiers which actually only work well between 26 and 30 MHz. These small amplifiers could be used to increase the mobile or fixed capability of the converted transceiver.

The final type of CB transceiver that can be modified for 10 meters is the PLL type. These are more expensive than the other two types for several reasons. The PLL is the easiest to modify by the CBer for operation on frequencies other than the 23 or 40 channels for which the unit was built. This type of unit is the easiest for the manufacturer to convert to 40 channel operation. This ease is, of course, the major reason that this type of transceiver lends itself to modification to the 10 meter ham band.

I have selected 8 different models of PLL transceivers that are available to show what can be done to modify this type of transceiver for 10 meter use. Fig. 4 lists the PLL transceivers and the crystals that are presently used for generation of the necessary signals for 11 meter CB operation.

By referring to the original frequencies of the CB trans-

Manufacturer	Model	Crystal Frequency	Oscillator Use
Pace	CB-166	10.240 MHz	All Frequencies — Reference
Teaberry	Stalker One	44.73 MHz	AM OSC — RX
		13.1325 MHz	SSB OSC — RX
		7.8025 MHz	USB Carrier OSC
		7.7975 MHz	LSB Carrier OSC
		10.00 MHz	REF OSC
Teaberry	Stalker Two	Same as the Stalker One	
Standard	Horizon 29	10.24 MHz	REF OSC
		5.575 MHz	Transmit
SBE	SBE-26CB	10.240 MHz	All Frequencies — Reference
Palomar	Digicom 100	12.803 MHz	USB REF OSC
		12.800 MHz	AM/LSB REF OSC
		10.7 MHz	AM/LSB Carrier OSC
		10.697 MHz	LSB Carrier OSC
Royce	I-601	1C 24 MHz	REF OSC
		10.695 MHz	10 MHz OSC
		36.38 MHz	37 MHz OSC
Realistic	TRC-57	13.1325 MHz	13 MHz OSC
		44.73 MHz	AM RX OSC
		7.8025 MHz	LSB OSC
		7.7975 MHz	USB OSC
		10.000 MHz	PLL REF OSC

Fig. 4.

ceivers as listed in Fig. 1, various shifts in oscillator frequencies can be obtained. The intent of this article is not to give a step-by-step conversion of CB transceivers to 10 meters, but instead only to tell what can be done with the available units on the market.

In the case of the PLL transceiver, it will become a matter of experimentation to determine the exact frequencies needed. I recommend that anyone attempting to convert a PLL transceiver become very familiar with PLL circuits in general. In the type of transceiver requiring only crystal changes to change the output frequency, the processes are simple. In the case of the PLL circuit, the problems that can be encountered in digital development of the frequencies needed are best solved by the more expert in the ham ranks. The conversion of a PLL transceiver is not a project that should be tackled by the new ham or one with little or no knowledge of solid state devices.

There are several things that must be taken into account before you attempt conversion of any CB transceiver for operation on the 10 meter band. Mainly these can be grouped into a few simple questions:

1. How much do I want to spend if I have to buy a new or used CB transceiver?
2. Does the CB transceiver I presently have lend itself to easy and cheap conversion?
3. How much electronics knowledge do I have to solve the problems I will encounter?
4. Do I feel that 10 meters is worth all the effort to convert a CB rig to that band?

If all of these questions can be answered in such a way to indicate that your next project is to be the conversion of a CB transceiver for 10 meters, then get started before the band starts to open up for some rare DX. ■

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Save Your Old Speakers

-- how to remove the beehive

In the old days, service technicians did a lot of speaker cone recentering to clear up annoying rattles, which was at the time a tedious but possible job.

Current speakers generally make speakers throw-away, due to their modern design, so they're "go or no go" devices. There is, however, a possible cure if the rattle is due to an off-center voice coil and it's a fast repair.

Remove the speaker. Hold it close to your ear and gently, with fingertips, alternately press and release the cone about an inch from the rim toward the voice coil and listen for scratchy sound. Rotate the speaker while doing this. If the speaker is capable of this fast cure, you will find the noise limited to one point on the circumference. Carefully note that point. Lay speaker on a solid flat surface, with magnet up. Then use a heavy rubber mallet to strike the magnet end a sharp blow or two at a point directly opposite to point where the scratch was heard. Don't get over-ambitious with pounding. A few lighter raps are far better than one hefty wallop. In effect, you are recentering a misaligned voice coil. Result is usually a clear-up of the rattle. ■

Beware the Compressor!

- - some pitfalls to avoid

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Speech compressors really work! Using one on 10 meters with a friend about 8 miles away, I found that the average level nearly equaled the average level obtained when switching on and off a 1200 Watt amplifier. The objection is that a) The background noise may be excessive unless some care is exercised in adjustment; b) Enough distortion is introduced from the compressor that it may even be objectionable or unpleasant to delicate or sensitive ears (again, careful adjustment may be the answer); and c) The problem of congestion on the bands is not addressed with a compressor, in fact, it is sometimes made worse by signals being too wide – again an adjustment problem, usually.

The third reason given above is probably the best known by amateurs in general. There is also a small amount of interference noticed by some, that of detecting a portion of the unwanted sideband when using an SSB station. The problem here is usually at the transmitter, but the point is that it exists!

Another form of interference to the SSB operator is that of another station moving into about 2 kHz of your frequency, which is referred to as "Alligator Teeth." Not only is it distracting, you sometimes find yourself attempting to copy both the station you are in contact with and the adjacent station.

Herein I will outline an idea and a concept which the reader and experimenter should be aware of and, perhaps in the not too distant future, the concept will be put into action by some of the more adventurous and innovative amateurs. I will be using it myself, but I believe that when the concept is understood, not only will it be used by amateurs, but also by the military and by commercial communications systems.

In order to understand the idea of band compression, some background preparation is in order. No doubt there are some readers with insight and experience who could proceed at once to the block diagrams and read the conclusion. Others could probably say they thought about something similar in the past and may have surpassed me in the initial design. This is encouraged. In fact, I hope and expect to see specific diagrams and schematics in the future that will enable anyone to duplicate the circuitry.

Unless the reader has had some experience with linguistics, foreign language, or has had extensive English study, the vital parts of communication must now be covered.

In the English language, as well as many others, the S and Z sounds (voiced and unvoiced hissing sounds) contribute the most to the *understandability* of verbal communications. These sounds lie in the frequency range above 1 kHz, and below 1 kHz are the explosive sounds such as B, T, D, M, N, L, K, G, F, and P. There exist languages in the world that are made up of the explosive sounds alone, and the frequencies above about 1 kHz are not vital to verbal communications. Granted, the upper frequencies are necessary for providing depth and naturalness to the human voice, but as far as communications are concerned, we can get along without the upper frequencies. However, we must have some way of signaling to our ears when the high frequencies (the S and Z sounds) are part of the verbal communication.

Moving right along, a glance at Fig. 1 will now give the reader a preliminary understanding of the band compression concept. Following the signal from the antenna through the receiver, a frequency splitter using active filters will pass the frequencies from 300-1000 Hz, but will attenuate the frequencies above and below. However, the frequencies *above* 1 kHz (with a cutoff of about 2.5 kHz) will signal or gate a white noise generator. This white noise will be adjustable for naturalness and will signify the S and Z sounds by a hissing sound.

The combination of the white noise generator's output and the 300-1000 Hz frequencies are made in the mixer where the strength or relationship of the two signals is effected. The audio amplifier rounds out the receiver system.

By this time, the idea should be firming up. The transmitter block diagram is shown in Fig. 2 and is nothing but the reverse of the receiver's signal processing.

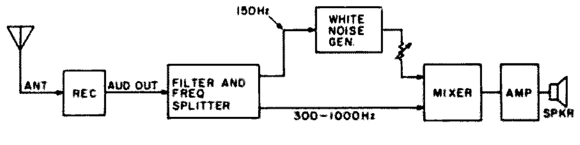


Fig. 1. Receiving block diagram.

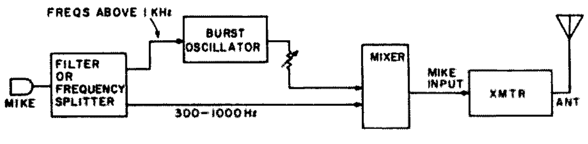


Fig. 2. Transmitter block diagram.

Fig. 3. Rough spectrum representation.

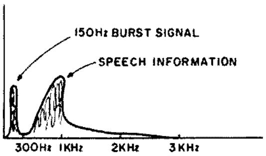
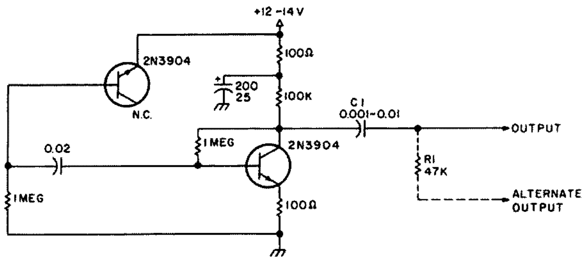


Fig. 4. Noise generator circuit. Note: Values of output components will be selected during breadboarding (C1 and R1).



The frequency splitter passes those frequencies between 300 and 1000 Hz and senses those frequencies above 1 kHz (with a cutoff at about 2.5 kHz). The signal sensing frequencies above 1 kHz trigger or gate a burst oscillator which I've arbitrarily chosen to be set at 150 Hz. The mixer then combines the two frequencies and the microphone input will have a signal roughly conceived and shown in Fig. 3, with a 150 Hz triggering signal and those frequencies between 300 and 1000 Hz being transmitted.

Now, before you say this will give an effective bandwidth of 1 kHz, it must be noted that due to combining the two signals and the inherent mixing processes, the total effective bandwidth is closer to 1 kHz plus 150 Hz, or approximately 1.2 kHz, to be safe, could be considered the overall bandwidth. It should be understood that we would not be using pulse modulation, since those frequencies above 1 kHz have been merely attenuated and could be recovered by amplification of the upper frequencies. Also, since the usage of S and Z sounds is so entirely random in natural conversation, band compression would not detract excessively from the usually less than ideal conditions on the bands using single sideband.

My reason for not being specific with schematics, printed circuit board layouts, parts list, etc., is that not only am I plowed under with projects, but I also believe that there are many fertile minds in amateur radio that not only could conceive the project, but also could breadboard and build it. I have included a white noise generator circuit which is known to work; however, the gating and level setting circuitry will have to be designed. All experimentation could even be done by using two tape recorders, but it must be remembered that this will not be high fidelity. If high fidelity is desired, go to 2 meters (where, coincidentally, I've noticed some use of speech compressors, much to the detriment of the inherent quality of voice communications).

Conclusion

In the history of radio communications, there have been repeated cycles of refinement and improvement. First, we had spark or "noise generators," which were replaced by vacuum tube oscillators and tuned circuits, making them cover a smaller frequency spectrum. Then came voice communications. Amplitude modulation was, and still is to some extent, a good means of communication. With congestion beginning to build up, other means of communication were sought, however, and with wire communication pioneering, double and single sideband transmission were studied as an alternative. The state of the art was refined as oscillators became more stable, materials became available, and construction methods were standardized. The military demand for the best available communications equipment produced unequaled models for others to follow, when considering the period in which they were designed.

The world of communications is again at a turning point. Amateurs are able to "make do" by using maximum usable frequency techniques and by selective listening, but this only serves to refine one's operating. With the congestion apparent at the lower frequencies, an approach allowing less adjacent frequency interference and therefore more effective usage of the amateur bands would seem to be very desirable.

We as amateur radio operators are concerned with "getting the message through." By using band compression, we would not be bothered by adjacent channel interference. However, in the future, another problem will surely consume us if we do not move with the times, and this is super-saturation. More compactness in our frequency bands will be necessary and this is why I use the term "band compression." The challenge is before us and amateurs could find themselves the pioneers once again.

I would like to express my thanks to Ken Frank WB5AKI for his understanding and encouragement in the band compression project. We have intentions of building and testing the concept and may later be able to provide more data, schematics, etc. You would then see them in *73 Magazine*, unless some other fellow amateur beats us to it! ■

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Matching Output Transformers

When installing multi-tapped output transformers, it is often confusing to try to follow charts and, in some cases, an incorrect match is made due to not knowing voice coil impedance. To avoid this, and obtain a perfect match, connect one terminal of the transformer to one side of the voice coil. Connect an output meter across the voice coil. Introduce a 400 cycle audio signal to the detector with enough attenuation to show a low reading on output meter with probe on any lug. Then, with a probe clipped to open side of voice coil, touch each lug on secondary of transformer in turn with the probe, noting change in meter reading.

The combination of lugs giving highest reading is the nearest match and will give maximum efficiency. This can be done with any multi-tapped audio transformer and applies to either primary or secondary. ■

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Stop Timeouts!

-- build this 10 minute ID timer

I would like to say, at the outset, that there is nothing new or original about this timer. All the bits and pieces were stolen from various magazines and books. However, I must modestly admit I designed what I wanted and made it work.

Of all the timers I have ever built before, none really ever satisfied me. I have built the tube type and the solid state type using the RC timing method, but their accuracy leaves something to be desired and they are difficult to adjust to the ten minute time period.

Being LED readout happy, I decided to build a ten minute readout timer that would read out the minutes, recycle after ten minutes, shut off the alarm after two or three seconds, and could be manually reset at any time. This is a lazy man's timer that can be built for less than a thousand dollars.

The problems in building the counter were numerous, because I am a raw beginner and do not pretend to know what goes on inside those little black boxes. Previous to this project, I marked the fronts of all my magazines with IC circuits that interested me, along with the page numbers (e.g., all 555 timer circuits and 4700 bounceless switch circuits, etc.). Then I armed myself with about twenty dollars worth of books, of which the *TTL Cookbook* proved to have the most information in terms that I could almost understand.

I sent away for the ICs and sockets from the ads in the backs of the magazines and bought the balance of the goodies at our local Radio Shack. I had some junk on hand and used that where possible. The Radio Shack salesman asked me what I was building. After I gave him all the glowing details, he said, "How about one of these mechanical timers for $3.50?" I already had about ten bucks worth of stuff between my thumb and forefinger, and thought to myself, "I wouldn't want this character working for me." He said "It's all solid state." Then I knew he was pulling my leg. I told him no self-respecting ham would use a mechanical timer — it isn't sophisticated enough for the state of the art. This sophistication does cost more, but I decided to go first class.

I built the enclosure out of 3/8" thick walnut and copied the metal cabinet design of those cute miniboxes with the slanted overhang in the front. If you decide to build your enclosure, the vectorboard used for the ICs and wiring was 4-1/2" wide by 5-7/8" long, and the 4 spacers or legs under the board were 1/2" high. I kept these spacers as short as possible to keep my nosy friends from getting a good view of the sloppy wiring job. The bottom of the enclosure is 4-5/8" wide by 6-1/2" long, the ends are 4-5/8" wide by 3-3/8" high, the top is 4-5/8" wide by 7-7/8" long, and the sides are 3-11/16" high by 7-7/8" long. I sanded the walnut lumber first with #80 grit paper, followed with #120 grit, and finished with #220 grit. I glued the ends onto the bottom section (using no nails) and kept it in the vise for 24 hours to dry. The sides are glued to the top section in the same manner. After this section dried, I cut the front at an angle to give that overhang effect. The finish on the cabinet is hand-rubbed like the finest furniture.

I used Radio Shack's .1" vectorboard for construction, keeping all components above the board and the rat's nest below. I ran reset, ground, and positive bare buses of solid #20 copper wire as near the ICs as possible, and threaded them up and down through the holes to hold them firmly in place. The readout was fastened to a small piece of vectorboard about 1-1/2" square using an IC socket and fastening all 1/4 Watt resistors on the same board. All wires that leave the board were the stranded type, for flexibility. This makes it easier to fit the readout to the hole in the panel and to hook up the speaker and controls. I left these wires objec-

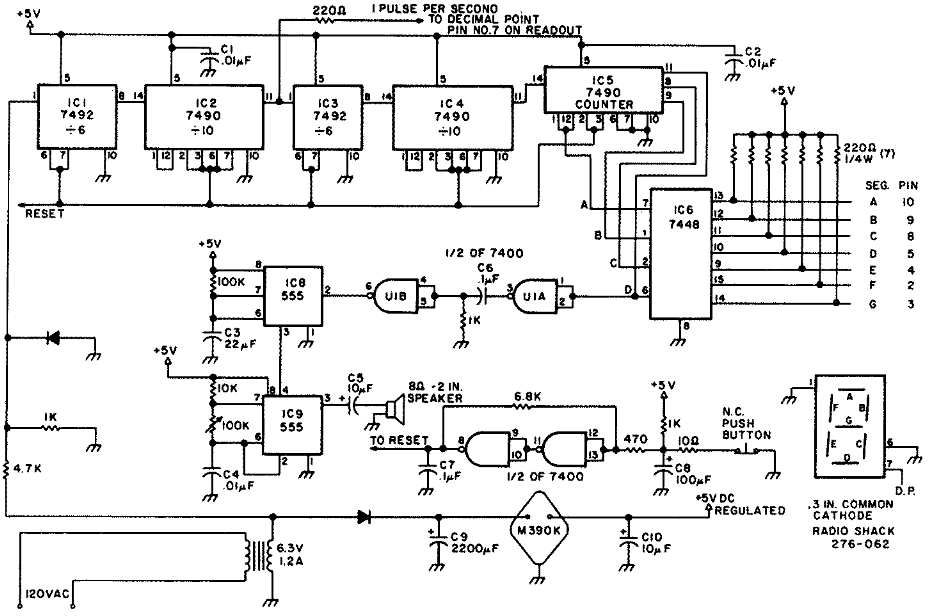

Fig. 1. Ten minute ID timer.

tionably long so I could assemble them out of the cabinet and get the circuit board in and out of the cabinet without a fight. At this time I must admit there was an architectural mistake in the design of the cabinet. The front is too thick to accept the tone control and the push-button switch. I had anticipated this and made the front 1/4" thick, but I still had to chisel out enough wood to make them reach.

The speaker is mounted on the rear of the cabinet with three thumbtacks. It is an 8 Ohm 2" Radio Shack speaker. The voltage regulator is mounted on the left side of the rear cabinet. The heat sink is a piece of 1/8" scrap aluminum with mounting holes drilled to match the mounting holes in the regulator. There was a mechanical engineering problem here, however. The regulator is slightly dome-shaped, and the point of the dome just touched the aluminum when the regulator was drawn down tight with sheet metal screws. I healed this problem by folding some aluminum foil into a thick pad, placing it in between, and drawing it down tight.

The power supply is simple and easy to build. The despiker capacitors are perhaps the most important items in the project. I believe all the problems that I describe later could have been avoided if I had included them in the first failure. The diodes are from my junk box – the bullet type. The voltage regulator is an M390K, but any 5 volt 1 Amp job could be used. The filter capacitor could be increased to 3000 uF as the power supply voltage is at the bare minimum.

The 60 Hertz line frequency is divided by IC1 and IC2 to give a one second pulse. This is connected to the decimal point on the readout through a 220 Ohm 1/4 Watt resistor, and pulses every second to give an indication that the timer is working. This one second pulse is then divided by IC3 and IC4 to give a one minute pulse or, to be more exact, to give a pulse every minute. The one minute pulses are then counted by IC5, and its binary output is fed into IC6, which drives the seven segment readout. I used a 7448 driver and a common cathode readout because I had them on hand. Most circuits use a 7447 driver with a common anode readout, and use series resistors to limit the current in the segments. I tried my readout without any resistors by hooking it up direct, but it wasn't bright enough. I experimented with various pull up resistors, starting at 500 Ohms and working my way down until I was satisfied with the brightness. I settled for 220 Ohms, as I had a lot of them on hand (the segments were drawing 15 mA current with a maximum rating of 25 mA). This is a very nice, clear, bright readout, and not very expensive.

IC7 is a 555 timer wired in the monostable mode with RC values to give a 2.2 second output on pin 3, which is used to drive the alarm circuit. I arrived at these values from the chart that came with the 555 timer. The first try gave me exactly what I wanted. I discovered, when breadboarding this circuit, that it would trigger when I pushed my mike button or flicked the switch on my desk lamp. I learned by reading my various books that the input pin 2 must be held high until the negative pulse arrives to trigger the timer. What a problem! I also needed a negative pulse every ten minutes to trigger the timer. The 7490 goes low at the end of the ten minute period and stays low until the count of eight. What a problem! At this point I needed help and found it by way of ham radio.

Another ham, Jack Sponeybarger (a retired electrical engineer), gave me the idea for the quick pulse and suggested the values that worked on the first try. This circuit uses two gates of the 7400 IC and works as follows: The 1k resistor holds pins 4 and 5 of U1B low, which in turn holds pin 6 of U1B high and keeps the triggering pin 2 of the timer high. At this time, the inputs of U1A pins 1 and 2 are either high or low, depending where the count is at any particular time. If they are low, then pin 3 of U1A is high. When pins 1 and 2 go high at the beginning of the count of eight, pin 3 goes low but nothing happens across the capacitor C6, because the other side of the capacitor is held low by the 1k resistor. Please don't get lost yet, for the real action is about to take place. When the 7490 counter reaches the end of the count of ten, its "D" output, pin 11, goes low, pins 1 and 2 of U1A go low, and pin 3 goes high, causing a brief positive spike across C6.

Now for the thrilling part of the action. This positive spike causes pins 4 and 5 of U1B to go high and pin 6 to go low, thus triggering the 555 delay timer. The only time the 555 is triggered is on the negative going edge of the output from the 7490 counter. I was quite proud of this circuit, thinking it was very original, but I later on found several versions in the *TTL Cookbook* disguised as negative or positive edge triggering circuits. There are other ways of doing this; I tried most of them, but decided to let well enough alone.

The alarm circuit is another 555 timer and is a triggerable astable multivibrator. This was stolen directly from a recent *73 Magazine* article describing a keying monitor circuit. It is almost the same, except that I

eliminated the volume control that was located ahead of the speaker and changed a few values here and there to match my junk box. The 100k pot is the tone control, which varies the tone from an ear-piercing high to an annoying growl. This is a beauty, and is the only one I have ever built from a 555 that worked properly.

Manually resetting the timer to zero was my biggest problem. This takes a bit of doing, especially when using a cheap, normally closed push-button switch. I tried every bounceless switch circuit I could find, but nothing worked 100%. Every time I went to show off my timer, I had to push the reset button a half dozen times to get it set to zero. I would get a count of one, and sometimes as high as an eight. Everything else worked nicely.

The ten minute cycle worked fine, and the alarm sounded for 2.2 seconds. The timer proceeded merrily on its way with the decimal point blinking every second as planned, but she would not reset worth a hoot. They make bounceless switches for a price, but I was determined to make this one work. Finally, I tried a circuit I copied from the *TTL Cookbook*. It consists of the other two gates of the 7400 IC and the associated goodies. This was better, but not perfect, until I added C7 to pin 8 of U1D, which gave me one failure in about ten tries.

I took the little jewel to work to show it off, and Murphy's Law set in. After a short time, the damn thing began to beep every second. I told the fellows I had designed it that way. I brought it home and started to tune up my rig. The alarm went off and it began to count like crazy. After all that work I had the only timer in the world that couldn't be used in a ham shack. My ham buddies were very helpful, making some good and some wise guy suggestions. One fellow said I shouldn't have used a wooden cabinet, so I wrapped the little dud up tight in aluminum foil – but that didn't help. It did tell me, however, that the rf was coming through the line cord. All the while, I was thinking that I could have painted my window sills this summer instead of fiddling with this thing. I was about to hide the thing in the midst of all my other failures and unfinished projects when I decided to try it in another outlet. When I unplugged it, I noticed my line cord was about 4" from my coax on the rig. When I plugged it into another outlet, it worked fine, even when I sat it on top of the rig, right over the finals.

When I reflect back on the last problem, I believe I was thinking like an engineer instead of a technician.

I still was not satisfied with the reset circuit. It was at this point in time that I added the .01 uF capacitors that I mentioned earlier. That was without a doubt the source of all my troubles. We have a computer-controlled milling machine at work, and I noticed that every IC on the circuit boards had a .01 uF from the positive input pin to ground. They were located as close as practical to the IC. I can now plug it into the outlet behind my rig, set it on top over the finals, take it to work where they have loads of line noise, and the little beauty works perfectly. I can now reset it 100 times out of 100 tries.

This miracle of modern digital electronic engineering has been running 24 hours a day since last July, counting and indicating the minutes, blinking the seconds and sounding the alarm every ten minutes. I never unplug it, except to take it somewhere to show it off. My XYL was annoyed a little for the first month or so, but then I would change the tone to another pitch to break the monotony. I guess she finally decided that as long as that thing buzzes, the OM is not working on it. ■

Have You Tried Television?

-- it's easier than you think

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The interest in ATV is due, at least in part, to the availability of reliable 470 MHz commercial surplus gear at very reasonable prices. *73 Magazine* has had RCA transmitter strips advertised for fifteen dollars from DuPage FM, and Gregory has had GE equipment, both transmitter and receiver strips, for twelve to thirty dollars. With the advent of small compact solid state modulators (Tom O'Hara's W6ORG modulator), it has become both simple and cheap to put your ham station on ATV.

Most ATVers are members of a club, even if it only has five or six members, or they work together in groups of two or three. It ain't much fun sending a picture if nobody sees it!

Since conversions of the RCA CMU-15, GE Progress Line, and Motorola T44 have been pretty well covered elsewhere, this part of the job is no longer considered to be in the realm of mumbo-jumbo and we need not go into any detail on conversions as such. Generally, the conversion consists of building a power supply, lengthening the grid lines on the RCA, or just retuning the GE to the correct frequency. The Motorola with its 2C39s is a little different, but it still puts a potent signal on the air. We completed the first rough conversion on our new RCA CMU-15 in four evenings and a Saturday.

Neither do we plan to go into the receiver conversion. The receiver can be as complicated or as simple as you wish. We know of five guys locally who are on ATV. Four of us use RCA CMU-15s and one uses the GE Progress Line. All of us used the same general conversion information for the transmitter strips, but no two of us are going the same route on our receiver conversions. Just use your imagination. Rather than get into the particulars, we are going into customizing your gear after you have it working and putting out an acceptable picture.

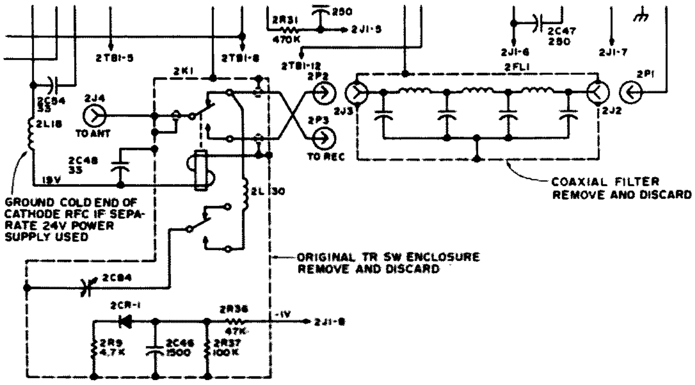

Fig. 1. Partial schematic.

Customizing your gear allows you to take a mass-produced item and convert it to your own uses. This allows your own personality quirks to come through. This thing of personalizing your equipment has become a big thing with the American male. Note the number of automobile speed and customizing shops, even such things as firearms with customized grips, cases, and holsters, or do-it-yourself home remodeling, built-ins, and add-a-room projects. These are all fair game for the avid do-it-yourselfer, so why not your ATV rig?

There are not many appliance operators among the ranks of the ATV fraternity. Until recently, there was just no commercially made ATV available, so anyone on ATV had to be a home brewer. In getting my ATV station on the air, I had a lot of fun and learned a good deal about UHF as well. We now have really effective PTT type operation, and this makes for a lot of fun and satisfaction.

My ATV station is not the quick and easy type. We had been active on ATV for some time when we got tired of throwing two or three switches and waiting for the video to come on, so we decided to make further refinements. We had removed the coaxial filter between the antenna PI tuning section and the antenna switching relay. In this unit the antenna switching relay coil is in the cathode circuit of the 5894 second tripler-driver stage. There is 19 volts available at this point, used to control the TR relay. When excitation and B+ is applied, the second tripler-driver conducts, causing the relay to switch the antenna. The B+ is applied through a relay on the power supply strip on the original chassis. We had considered using the original TR switch; however, when we removed the coaxial filter to

broaden out the bandpass, we were left with about fourteen inches of open space to fill between the output PI section and the TR switch. The TR switch was located on the front of the chassis. After some thoughtful moments, we decided to leave the short four inch piece of coax undisturbed due to the way it was attached to the antenna matching assembly enclosure. Also, this area is rather crowded, and all space saving ideas must be utilized, including mounting the modulator circuit board on the underside of the chassis. Since the original TR switch must be shielded if it is to be used, there just was not enough room for all that had to fit there.

We found that an old TR switch out of a junked ARC-3 would work as well as the original. Mounting it directly on the rear panel within three inches of the PI network output allowed us to solder directly to the cable which was already there. We completely removed and discarded the original TR switch along with the components in the box with the relay. This included the 1N48 diode and the 48k and 100k resistors, which we soon discovered was where the rf came from which was available at pin 8 on the 11 pin metering socket on the top of the chassis. We now use an rf loop coupled directly to the antenna coax line for an rf indicator. This works very well and gives a true indication of the rf power level if properly calibrated. It can also be used to check swr by reversing the leads in the line.

If the ARC-3 arrangement does not appeal to you and you have a 24 volt transformer and relay knocking around the shack, it would work just as well to build up a small power supply for the TR switch. We made everything in the rig straight PTT and mounted our 24 volt relay directly on the chassis of the power supply. We prefer 24 volt control circuitry to 110 volt control for obvious reasons. Holding 110 volts in your hand on a PTT button does not seem to be the best way to go. For those brave souls using 110 volt control, the extra trouble of the 24 volt supply can be eliminated.

Using 19 volts available at the relay end of the RFC in the cathode line saves running another line from the power supply to the transmitter chassis. If it is desired to use an external 24 volt source to operate the TR switch, the cold end of the RFC in the cathode circuit must be grounded, because the coil of the original TR relay was part of the cathode resistance in the 5894.

To mount the new ARC-3 TR switch, drill two 5/8" holes on 2½" centers, remove the RCA plug from the end of the coax cable, and solder the coax directly to the input of the new TR switch. Then retune and you are in business.

One word of caution: When we were originally converting our CMU-15, we had some circuitry underneath the rf cage bottom plate. After a while, a short developed which completely killed the signal. The rig would work with the bottom of the rf cage removed, but not when it was in place. We found that one of the screws holding the bottom plate in place extended through the plate far enough to short one of the grid lines. When we removed the screw and plugged the hole, we had no more trouble.

The small size and potent 15 Watt signal make the CMU-15 a natural for mobile or portable operation, making possible good on-site displays at hamfests and meetings. As soon as the power supply has been completed, we are looking forward to an ATV session with an aircraft mobile. Should be fun! ■

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Quick Vertical

- - for 20 and 40

Verticals have always performed well on the long haul DX contacts that many hams enjoy participating in. The vertical radiates power at a very low angle, enhancing the possibility of a DX contact. The dipole radiates power at a much higher angle.

The antenna I am going to describe was designed for simplicity. It is simple to erect, taking a matter of an hour or so, and will not make a dent in your wallet!

The radiating portion of the antenna is made of #18 wire. Many other sizes may also be used. Cut the wire to a length of 28 feet. The wire may then be held up in a number of ways. A well-used scheme has been to run the wire up a wooden pole.

Once the wire is held up vertically, you can proceed to hook up the feedline. The feedline used is *ordinary speaker wire*, commonly sold at Radio Shack stores. It just so happens that the speaker wire has an impedance of approximately 45 Ohms, and works beautifully as a balanced feeder. Hook up one side of the line to the base (the wire) of the vertical, and the other wire to a ground rod, at least 5 feet long. It is also advisable to have 4 or more ground radials each 33 feet in length connected to the ground rod.

After the feedline has been brought into the shack, it will have to be trimmed to a length that will reflect the least amount of current, as the antenna does not resonate exactly on the 20 and 40 meter bands. A bit of juggling with the length of the antenna feedline will give you a respectable match. If you start by tuning the antenna up on the 40 meter band, the 20 meter band will also have a low swr with the same length of feedline.

This antenna works well on both 20 and 40 meters, with an swr of 1.3:1 on both bands. The antenna is quite broadbanded; it is possible to operate both CW and SSB on both bands. After putting up this antenna, the first station I worked was a Russian. Although this antenna works well as a regular home-QTH antenna, it is especially suited for portable operation and use, due to its ease of construction and erection. ■

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Try
Power Saver Logic

- - a guide to CMOS applications

Appearing for the first time commercially in 1968, complementary metal oxide silicon (CMOS) logic elements have been steadily advancing and are presently competing strongly with other logic families. These devices are monolithic integrated circuits containing P-channel and N-channel enhancement type MOS field effect transistors. The MOSFETs exhibit high input impedance (requiring very low input driving currents) and can operate over a wide range of supply voltages (3 to 15 volts). Also, the complementary arrangement of the two output transistors prevents both from being turned on simultaneously. As a result, there is no direct path for dc current flow and consequently power drain is very low.

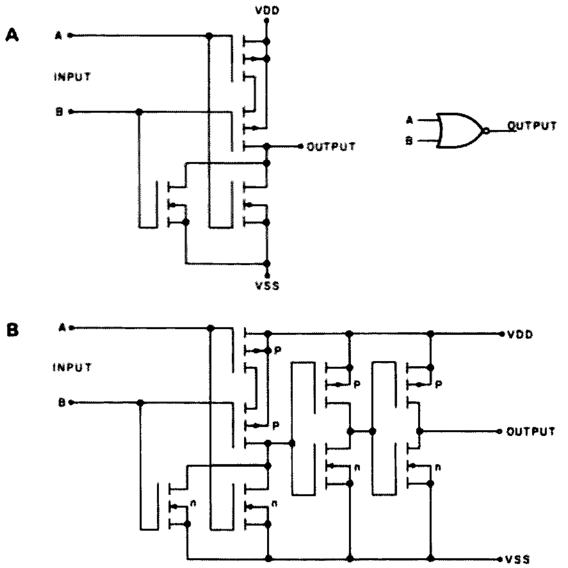


Fig. 1. Diagram showing (a) a conventional 2-input NOR gate and (b) a fully buffered 2-input NOR gate.

CMOS devices also exhibit an almost ideal logic transfer characteristic, meaning that they have exceptionally high noise immunity. As an example, CMOS logic elements have a guaranteed noise margin of about 1.5 volts, while other logic elements (such as TTL) have noise margins of only 0.4 volts.

These main features – the low power consumption, operation over a wide range of supply voltages, and high noise immunity – make CMOS logic easy to work with. However, like other logic families, certain design rules must be followed if successful results are to be obtained. In many cases, the design rules are different from past practices with TTL logic, and these differences will be discussed in greater detail in subsequent sections.

The technology is also improving as more and more manufacturers compete to produce smaller, lower priced chips containing more complex circuits. There is presently a large assortment of medium and large scale integrated circuits to choose from in building communication systems, instruments, and computer interfaces, including microprocessor applications. In addition, you may choose from standard non-buffered logic, or the "B" series of fully buffered gates. Fig. 1 contains a typical diagram of both a conventional NOR gate and a fully buffered NOR gate. The input gate protection circuits, not shown in this figure, will be discussed later.

While there are some differences among the various manufacturers concerning specifications, there are certain definitions that all generally agree on. These basic parameters along with their symbols and definitions are shown in Fig. 2. In working with CMOS circuits, you should become familiar with the various parameters contained in this chart to avoid exceeding the power limitations of the devices and also as an aid in debugging new systems.

CMOS CHARACTERISTICS AND FEATURES

The CMOS family is unique in that it contains many of the same functions found in TTL, while also providing special functions not available in any other logic family. The following is a partial listing of some of the functions available:

1. NOR gates (2, 3, 4, and 8 input)
2. AND gates (2, 3, and 4 input)
3. OR gates (2, 3, and 4 input)
4. NAND gates (2, 3, 4, and 8 input)
5. Inverters and Buffers
6. Complex gates

(exclusive OR, NOR, etc.)
7. Flip-flops (R-S, D, J-K, Tri-State)
8. Counters (BCD, Binary, Decade, Up/Down)
9. Registers
10. Decoders/Demultiplexers
11. Decoder/Drivers
12. Analog Switches

The analog switches are unique and have no TTL equivalent. In addition, there are hex contact bounce eliminators (MC14490), watch/clock circuits (MC14440), oscillator/dividers (MC14450), and tone encoders such as the MC14410.

PARAMETER	SYMBOL	DEFINITION
Input Current	I_{in}	The amount of current flowing into the device at a particular voltage on the input terminal and also a specified V_{DD}.
Input High Voltage	V_{IH}	The range of input voltages that represent high logic level.
Input Low Voltage	V_{IL}	The range of input voltages that represent a low logic level.
Minimum Input High Voltage	V_{IH}(MIN)	Minimum input high level allowed.
Maximum Input Low Level	V_{IL}(MAX)	The maximum low level input logic allowed.
Output High Current	I_{OH}	The amount of drive current flowing out of the device at a logic high level output voltage and V_{DD}.
Output Low Current	I_{OL}	Drive current flowing into the device at a logic low level output voltage and V_{DD}.
Quiescent Power Supply Current	I_{DD}	Current flowing into the drain terminal.
Source Voltage	V_{SS}	Positive potential on the device.
Drain Voltage	V_{DD}	Negative or reference power supply (usually ground potential).
Output High Voltage	V_{OH}	Output voltage for a high level logic.
Output Low Voltage	V_{DL}	Output voltage for a low level logic.

Fig. 2. Parameters, symbols, and definitions for CMOS devices.

Comparison to TTL

In general, CMOS specifications are a bit loose when compared to the rigid parameters of TTL logic. Industrywide, there are variations between devices of different manufacturers, as well as variations between devices produced by the same supplier. However, being aware of these differences should be sufficient for you to overcome any problem areas that may arise. Also, it's important to realize that many parameters such as current, voltage, and ac characteristics are standard for all devices.

As mentioned previously, the primary advantages of CMOS over TTL include low power dissipation, low quiescent current, high noise immunity, high fan-out, and reliable operation over a wide range of supply voltages. These features are summarized in Fig. 3 and will be discussed in greater detail throughout this article.

Quiescent Current and Power Dissipation

In order to understand the low power operation of CMOS devices, let's review the circuit structure of a typical inverter stage. Fig. 4 shows a basic CMOS inverter including input protection circuitry.

In the quiescent state, one output transistor is off while the other is on. For this reason, the only direct path for dc current flow is leakage through the input protection diodes. This current flow is small and is on the order of 1 nanoamp.

Only when the device changes state does any significant current flow occur, and this is due mainly to the charging and discharging of internal and external capacitances. Once these capacitances are fully charged, current flow ceases again. Therefore, most of the power consumption occurs at short intervals during the transition of one logic state to another.

Power dissipation in CMOS devices is therefore directly proportional to the supply voltage, frequency, output load (capacitance), and one other factor – the rise time of the input signal. This relationship is summarized in Fig. 5.

To determine why capacitance plays such an important part in power drain, we must look to the input characteristics of the devices. Since the input stage of one device is usually the output load of the preceding device, the two are usually interrelated. The input of all CMOS gates may be represented as a resistor with a value of 10^{12} Ohms in parallel with a 5 pF capacitor. As CMOS devices are added in parallel, the total capacitance increases as the sum of the capacitances of the individual gates. For this reason,

PARAMETER	STANDARD TTL	LOW POWER TTL	CMOS (5 Volt)	CMOS (10 Volt)
Quiescent Power (per gate)	10 mW	1 mW	5 nW	10 nW
Power Dissipation (per gate)	80 mW	18 mW	5 mW	20 mW
Noise Immunity	1 Volt	1 Volt	2 Volts	4 Volts
Toggle Frequency	35 MHz	3 MHz	5 MHz	10 MHz
Propagation Delay	10 nsec	33 nsec	60 nsec	25 nsec
Input Current	1.6 mA	0.18 mA	±10 pA	±10 pA
Fan-Out	10-STD TTL or 40-74L	10-74L	50*	50*
Input Impedance	5000 Ω	50,000 Ω	10^{12} Ohms	10^{12} Ohms
Output Impedance	100 Ω	10 Ω	400 Ω	200 Ω

*Depends on propagation delays.

Fig. 3. Comparison of standard TTL, low power TTL, and CMOS devices.

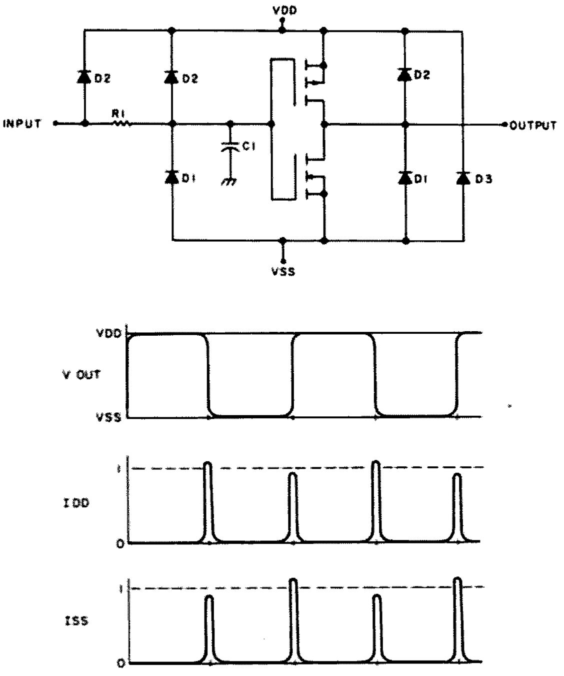


Fig. 4. Basic CMOS inverter with input protection. C1 — 5 pF; R1 — 200Ω; D1 — 25 V; D2 — 50 V; D3 — 25 V; Input: $t_r = t_f \cong 10\ \mu sec$; Output: $C_L = 15\ pF$.

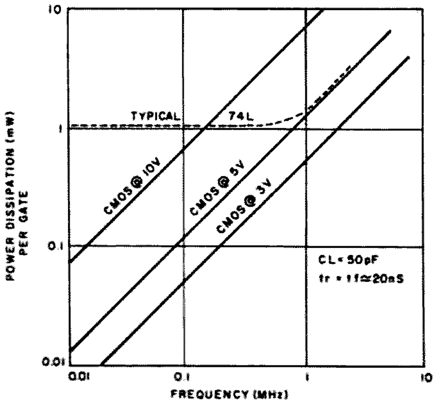


Fig. 5. Power dissipation as a function of the operating frequency.

the propagation delays and capacitance load (not the input driving load) are the factors that ultimately determine the fan-out limits of the device.

Input Current, Gate Protection, and Noise Immunity

As mentioned previously, the input impedance of CMOS devices is extremely high. Consequently, very little driving current is required for the device to change its state, or switch. Typically, the input current is ±10 pA. This low input current requirement is the reason that fan-out for the CMOS family approaches 50 (limited by the propagation delay), compared to TTL with a fan-out of only 10 gates. However, in most applications, the propagation delays will usually limit fan-out to 20 gates or less. There seems to be some discrepancy here, since many manufacturers specify propagation delays at 5 V or 10 V, 20 nsec transition, and a 15 pF load. The problem area is the 15 pF load, which seems to be standard among other logic families. For CMOS, it is somewhat unrealistic and a 50 pF load is closer to actual conditions. Most manufacturers are now beginning to specify propagation delays at output loads of 50 pF; this should help to clarify the situation.

Another CMOS characteristic that requires careful attention is its input impedance. While high input impedance is a distinct advantage in most circuit applications, it can also present problems wherever static electric charges are present. In an effort to protect the input gates, each manufacturer has incorporated some form of diode protection arrangement along with a series resistor to limit current flow. A typical example of this is shown in Fig. 6.

However, extremely high voltages generated during very low humidity conditions will still damage the gates. Because of this, certain handling precautions should be observed which include:

Gounding of all test equipment, tools and soldering irons;
Storing CMOS devices in conductive foam or tubes (never in polystyrene foam); and
Never insert or remove devices with power applied.

Noise immunity is another parameter used to specify logic elements, and one form of noise is related to the speed of the device. Since TTL logic is faster than CMOS, the TTL device will transmit noise while the CMOS device rejects it. This is true for pulses of short duration as well as high frequency oscillations. This characteristic is often referred to as the "ac noise immunity," and it increases as the input pulse width becomes less than the propagation delay of the device.

Another consideration is "dc noise immunity." Due to the complementary action of the CMOS inverter (one transistor on while the other is off), the switching point is midway between the logical 1 and logical 0 states, or 45%-55% of the dc supply voltage. This results in a high dc noise immunity that increases with the supply voltage. This feature is illustrated in Fig. 7 for both buffered and unbuffered CMOS, as well as TTL characteristics.

A discussion of noise immunity would not be complete without mentioning external noise. The higher output impedances (10 to 100 times higher than TTL) exhibited by CMOS devices make them more susceptible to extraneous noise and cross-talk. Capacitively coupled noise immunity is one area where TTL is superior, although CMOS is hard to beat in terms of dc noise margin. Also, good printed circuit board layout practices will overcome any capacitive-coupled noise problems related to CMOS circuit design.

POWER SOURCE RULES

The overall costs of CMOS systems may be lower than equivalent TTL designs due to the lower power dissipation of CMOS devices and their ability to operate reliably over a wide range of supply voltages. Simple low

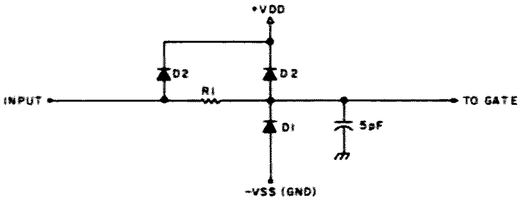


Fig. 6. Typical input gate protection circuit. R1 ≅ 200 to 2000Ω; D1 = 25 volt diode; D2 = 50 volt diode.

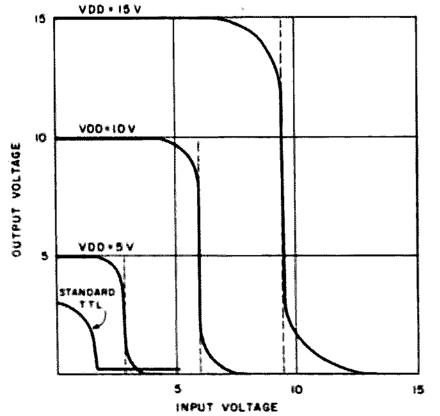


Fig. 7. Noise immunity increases with the power supply voltage as shown by these logic transfer curves.

cost power supplies with a minimum of regulation are all that is required to make the CMOS system operational.

From the comparison to TTL in the previous section, we learned that CMOS devices consume less power than standard TTL by a factor of 10^6. As an example of what this means, consider a system of 20 CMOS packages operated from a 5 volt power supply. At low frequencies, the total current drain from the power supply will be only 1.2 mA for all 20 devices! It is evident from this example that all portable battery-operated electronic systems should incorporate CMOS devices for low power consumption and long battery life.

Absolute Maximum Ratings

As with all electronic components, there are operating range limitations which, if exceeded, will destroy the devices. The maximum ratings are summarized in Fig. 8 for both the "A" series and "B" series devices. Maximum V_{DD} is +15 volts for the "A" and +18 volts for the "B" series. Maximum power dissipation is 200 mW and the maximum operating temperature for ceramic packages is +125° C and +85° C for plastic packages.

Typical Supply Voltages

All CMOS devices will operate reliably with V_{DD} in the range of +3 volts to +15 volts (with V_{SS} at ground potential). For this reason, CMOS is ideal in auto electrical systems, battery-operated instruments, and numerous other applications.

It is necessary to keep in mind, however, that the speed of operation is directly proportional to the supply voltage. Referring back to Fig. 3 in the previous section, at +5 volts, the maximum toggle frequency is 5 MHz, while at 10 volts, it increases to 10 MHz. Also, as the supply voltage increases, so does the power consumption. It is sometimes necessary to compromise between the desired operational frequency and the power consumption of the system at that frequency.

Power Supply Circuits

Almost any power supply will perform satisfactorily in a CMOS system because precise voltage regulation is not a primary consideration. However, it is necessary to keep the supply voltage within the 3 to 15 volt range and suppress any transients that may exceed the 15 volt range. An example of a typical power supply is shown in Fig. 9.

As mentioned previously, CMOS devices are ideal for operation from battery power supplies. Since the supply voltage is not critical, inexpensive dry cells may be used which exhibit large voltage drops as they reach the end of their useful life cycle. As an example of a standby battery system, Fig. 10 shows a rechargeable battery system added to the ac power supply just described.

There are a few power source rules that should be followed when working with CMOS systems. Careful observance of these rules will save you much time and frustration, not to mention reducing the failure rate of the CMOS devices.

Rule 1: Do not apply input signals to CMOS inputs without first supplying power to the V_{DD} and V_{SS} terminals of the device.

Rule 2: Always keep the operating supply voltage for V_{DD} within the 3 to 15 volt range (+18 volts for the "B" series).

Rule 3: Reversing the power supply polarity will permanently damage CMOS devices.

Rule 4: For operation of CMOS buffers from split voltage power supplies, V_{DD} should always be equal to or greater than V_{CC}.

Rule 5: For safe operation, limit the power source current to as low a value as practical for the system.

Rule 6: Transient turn-on of the input protection diodes may result from voltage drops across large resistors in series with V_{SS} or V_{DD}. Such resistors should be avoided wherever possible.

INPUT DESIGN RULES

Due to the high input impedance of CMOS devices, certain design rules should be followed to protect the gates. These rules, including TTL interface and handling considerations, are summarized as follows:

Rule 1: *Unused Inputs Must Be Connected to V_{SS} or V_{DD}.* If this rule is not followed, the device may generate faulty logic or exceed its rated power dissipation. Some manufacturers, in the case of plug-in type circuit boards, recommend that all inputs have some type of shunt resistor (200k to 1 megohm) to either V_{SS} or V_{DD}, whichever is appropriate for the specific logic circuit. This will serve to protect the IC when the board is not plugged into the main frame, or during storage when static charges may exceed the internal protective circuits.

Rule 2: *Input Signals Must Not Exceed the Power Supply Voltage Range of V_{SS} and V_{DD}.* Under certain conditions, however, the gate protection diodes will also conduct during normal operation and attempt to exceed the maximum input current of 10 mA. When these conditions exist, such as in oscillator applications, a series input resistor should be installed to limit the input current to a safe value. Typical series resistor values range from 10 kilohms to 100 kilohms without affecting the electrical characteristics, although the speed is reduced

PARAMETER	SYMBOL	"A" SERIES	"B" SERIES
Maximum Supply Voltage	V_{DD} (+) V_{SS} (-)	-0.5 to +15 V dc	-0.5 to +18 V dc
Maximum Input Voltage	V_I	$V_{SS} \leq V_I \leq V_{DD}$	$V_{SS} \leq V_I \leq V_{DD}$
Power Dissipation (per package)	P_D	200 mW	200 mW
Maximum Temp. Range (PLASTIC)	T	-40°C to +85°C	-40°C to +85°C

Fig. 8. Absolute maximum ratings for CMOS devices.

Fig. 9. Ac power supply for CMOS systems (10 V dc @ 50 mA). C1, C2 — 100 uF @ 35 V dc; D1-D4 — 1N4001; D5 — 10 V zener @ 1.5 W; R1 — 82Ω, ½ W.

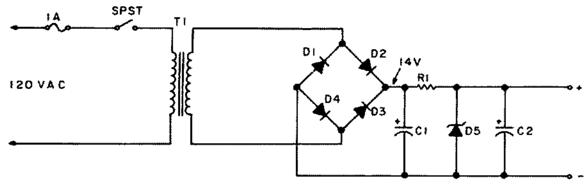
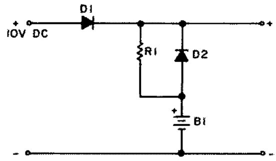


Fig. 10. Standby battery system. R1 is chosen to limit the trickle charging current to the battery during ac operation. When the ac power fails, D2 conducts, while D1 blocks the battery current to the transformer supply, and the battery powers the system.



inversely with the increase in RC delay.

Rule 2 may be interpreted to mean that no input signals may be applied if the power supply is accidentally disconnected or turned off. However, if the proper series resistor is installed in the input circuit to limit the input current to 10 mA, the device will not be damaged under these conditions.

Also, for extremely hostile environments, you may want to consider installing external protective diodes to limit input voltage levels.

Rule 3: When a CMOS Device is Driven by a TTL Device, a Pull-Up Resistor is Required from the CMOS Input to +5 Volts for Open Collector TTL. The value of this pull-up resistor is usually a compromise between speed and power consumption. Typical values range between 1000 Ohms and 10 kilohms, with 2 kilohms providing the best trade-off between speed and power. Fig. 11 shows the relationship between the pull-up resistance and its effects on propagation delay.

Devices with internal pull-up resistors present no problem in driving CMOS devices as long as all devices are operated at +5 volts. In some cases, an external pull-up resistor may be required to insure reliable operation in the high state.

In the case of a CMOS device driving TTL logic, it's best to use a buffer such as the CD4049 or CD4050 operated with the 5 volt TTL power supply. These buffers are rated to drive two TTL loads at 5 volts. Also, unlike the CD4009 and CD4010 that require two power supplies, the 4049/4050 will operate satisfactorily from one power source.

OUTPUT DESIGN RULES

The output voltage levels for CMOS devices depend significantly on the level of V_{DD}. For example, for the CD4001A quad two-input NOR gate @ 25°C, the high level output voltage, V_{OH}, is 4.99 volts minimum for V_{DD} = 5 volts. When the supply voltage is 10 volts, V_{OH} = 9.99 volts minimum, and for all practical purposes, V_{OH} follows the value of the supply voltage.

The low level output voltage is typically zero or equal to V_{SS}. Compared to TTL logic, this is significant voltage swing, which accounts for the high noise immunity of CMOS devices. This V_{DD} to V_{SS} voltage swing is typical for all CMOS devices.

The output drive current (sink current) I_{OL} @ V_{OL} = 0.4 volts is dependent on the type device. For example, a plastic CD4001A will sink 0.3 mA and a CD4009A buffer will exhibit an I_{OL} = 3 mA. These are typical values with slight variations among the different manufacturers.

A few of the output rules and characteristics of CMOS devices are as follows:

Rule 1: CMOS Devices Have a Typical Fan-Out Capability of 50. Since the input current I_I is typically 10 pA, it becomes obvious that CMOS devices with output drive currents of 0.3 mA (3 mA for buffers) are capable of driving many gates. However, due to the high input impedance (10^{12} Ohms), a CMOS driver sees the gate as a capacitor. As more gates are added in parallel, the propagation delays increase due to the increase in capacitance, and the next result is that speed is reduced as the fan-out increases. In this case, the limiting factor is not drive current, but capacitive reactance! Perhaps a more realistic fan-out would be in the neighborhood of 20 gates or less.

Rule 2: Do Not Short a CMOS Output to a Power Supply Bus Greater Than 5 Volts. CMOS devices are not short circuit protected and consequently, for shorts *above* 5 volts, the maximum power dissipation of the device will be exceeded. For operation at 5 volts or less, it is possible that the device may withstand an output short, although this may vary with the device.

Rule 3: CMOS, As With Open Collector TTL Logic, Cannot Be "OR" Wired. The reason for this design rule is to prevent an "ON" P-MOS and an "ON" N-MOS transistor from being shorted directly across the power supply terminals. One solution to this problem is to use tri-state logic wherever practical.

Rule 4: The Paralleling of Inputs and Outputs of Gates is Recommended Only When the Gates Are Within the Same Package. Due to the variations in specifications between the devices, in addition to the non-standardization of devices from the same manufacturer, problems may be avoided by paralleling of inputs and outputs only within the same package. The reason for this is to maintain a proper match and coordinate the various parameters involved.

Rule 5: Output Loads Should Be Returned to a Voltage Source Within the Range of V_{DD} to V_{SS}. Here again, an attempt is made to limit the power dissipation of the device. Also, since output logic levels are directly related to V_{SS} and V_{DD}, returning the load to a voltage higher than the power supply may exceed the maximum voltage rating of the device.

Rule 6: Avoid Large Capacitances (5000 pF or Greater) on the Outputs of CMOS Buffers or High Cur-

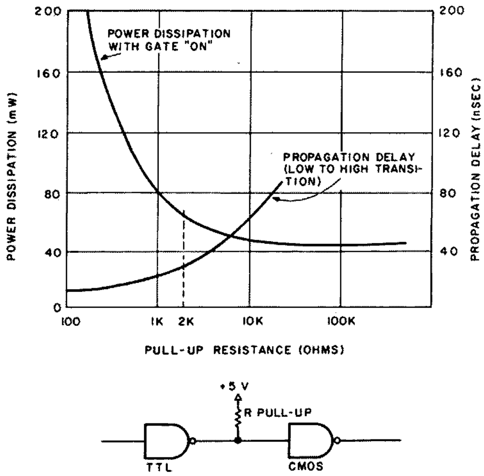


Fig. 11. Typical speed/power relationship for TTL interface with CMOS logic. The open collector TTL gate requires a pull-up resistor.

rent Drivers. Capacitances of this magnitude act as short circuits and may overheat the output transistors.

Rule 7: A CMOS Buffer Will Overheat If Used as a Linear Amplifier. CMOS devices draw maximum current during the transition of states. If these devices are made to operate linearly, current will be drawn for a longer period of time and the device will overheat. This is the reason that maximum clock rise and fall times (usually 5 to 15 secs) are specified for CMOS devices. Longer rise and fall times for devices operated over 5 volts will result in exceeding the maximum power dissipation of the device.

CONCLUSION

Each manufacturer of CMOS devices identifies his device with a distinct part number in which the basic function type can be picked out. For example, the following is a partial list of CMOS manufacturers and their own characteristic device number:

	Type Number
RCA	– CD ----
Motorola	– MC1----
National	– CD ----
Fairchild	– F ----
Harris	– HD ----
TI	– TP ----
Signetics	– ---- (no prefix)

For RCA devices, the suffix letter immediately following the four digit function code usually indicates conventional ("A") or fully buffered ("B") configuration. The second suffix letter indicates the type of package, "E" for dual-in-line plastic, "F" for dual-in-line ceramic, and "K" for the flat pack ceramic. As an example, the CD4001AE is a quad 2-input NOR gate, unbuffered, in a dual-in-line plastic package. ■

73 Magazine *Staff*

HF Bands Expander!

-- eliminate splatter to gain operating room

With many of the speech processing circuits in vogue these days, the SSB operator often operates his rig on the thin line between keeping it fully modulated and overmodulation with its attendant splatter. There are very few devices which can respond instantaneously to the changes in PEP as a transmitter is modulated and so inform the operator when a PEP value has been exceeded, which causes the transmitter to flat-top and splatter. Meters, no matter where they are located in the transmitter or antenna chain, are useless to identify transistory modulation peaks unless they are equipped with somewhat elaborate peak sensing and storage circuits. The only devices which by themselves can respond essentially instantly to voltage/current changes are electron tube display devices (scopes and magic-eye tubes), neon bulbs, and LEDs.

An oscilloscope is, of course, one of the best monitoring devices one can use. But, a scope can be expensive to employ as just a monitoring device, and it is not always easy to hook up a regular bench type scope for modulation monitoring. Also, it is hardly a handy monitoring device for portable operation. This article explores the use of simple and inexpensive neon bulbs and LEDs for the instantaneous indication of different PEP output levels.

The idea of using neon bulbs as an inexpensive PEP output indicator is certainly not new. It was done by many amateurs in the early 1960's, but it often proved to be a problem to get reliable indications on various bands unless the bulb circuitry was located at some point in the transmitter output line where the impedance remained the same on various bands. Today, this is not so much of a problem, since almost all amateurs use coax and also use a transmatch or similar device along with an swr meter between their transmitter and the antenna transmission line. The coax from the transmitter to transmatch is "flat" on every band, and that is the point at which to locate the PEP indicator.

W6GWS came up years ago with the circuit shown in Fig. 1(a). It is simply two neon bulbs connected in series with the voltage dropping resistors arranged so one bulb lights at a chosen *normal* modulation level and the other bulb lights when a *chosen PEP limit* is reached. The circuit can be used across any impedance transmission line. The *total* value of the resistances needed is calculated using Ohm's law, knowing the approximate transmitter power output, the impedance of the transmission line, and using a figure of 1 Watt for the power consumed in the bulb circuitry. The values of R1 and R4 will be 1k or more for any transmitter output of 100 Watts or more, so these resistors, which should be a fixed carbon type, isolate the circuitry from the transmission line so no loading effects are noticed. The resistor directly across the bulbs can be any sort of carbon trimmer pot or regular carbon pot rated at 1 Watt or more.

The ideal way to adjust the ignition point of the bulbs initially is with a monitoring scope. Adjust R2 so the bulb associated with it lights fully when a normal modulation level is achieved with no flat-topping. Adjust R3 so its bulb just starts to glow when flat-topping just occurs. The adjustments may interact a bit, so one has to go back and forth a few times to check the settings. An alternative to the scope method is to insert a carrier so the transmitter draws 80-90% of its normal dc input. Then adjust R2 to light its bulb. Further, reinsert the carrier for the full dc input and adjust R3 so its bulb ignites. The latter ignition point should be checked by some on-the-air checks, if possible, to ensure that it warns when overmodulation starts to cause splatter.

The circuit of Fig. 1(a) works best with linears having about 150 Watts or more PEP output. For PEP output levels of down to 60-70 Watts, the simple circuit of Fig. 1(b) is used. It also uses a NE-17 neon which ignites at a slightly lower voltage (55 volts) than the usual NE-2 (65 volts) and has a larger glow surface. As before, one bulb is set to indicate normal modulation and the other to indicate the danger of flat-topping. 1k isolating resistors are used and the variable resistor calculated on the basis of the

voltage across the line (calculated on the basis of the line impedance and the PEP output) and the fact that the neons use about ¼ Watt of power.

A point to watch when using either neon circuit is that the variable resistors will set the ignition point of the neons, but the extinguishing voltage depends on the characteristics of the neon bulbs. Before finalizing a circuit, check that the extinguishing voltage of the neon used for flat-top warning is the higher of the two particular bulbs used. Otherwise, one can get a slightly confusing indication where the flat-top bulb, once a peak ignites it and the normal modulation bulb, will remain glowing for an instant after even the normal modulation bulb extinguishes.

LEDs can be used instead of neons and present both advantages and disadvantages. The disadvantages are the size of the indicators and that LEDs do not have quite such a distinct or sharp turn-on point as many neons. But, LEDs draw less power and can be used down to quite low power levels. By using a green LED for normal modulation and a red LED for flat-top warning, an interesting display can be created.

The LEDs, being dc devices, require a rectifier circuit as shown in Fig. 1(c). The approximate total value of the variable resistor needed can be calculated on the same basis as before, except that the typical LED will require about .03 Watts for operation (1.5 volts at 20 mA).

Whatever circuit is chosen, it must be properly shielded since one is tapping into the transmitter transmission line. The circuitry required is so small that in many cases the circuitry can be enclosed within a transmitter, an swr bridge, or an antenna matching device. In the case of the LEDs only, they can be remotely located once the sampled rf signal is rectified. So, the rectifier circuitry could be located by the antenna terminal of a transmitter and the LEDs on the front panel. An alternative is to use a small minibox enclosure which has a coax receptacle and use a standard T connector to break into the transmission line.■

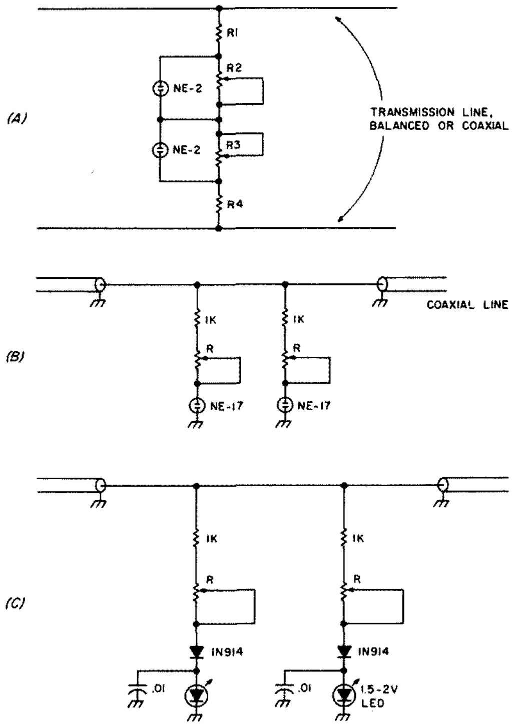


Fig. 1. Various neon and LED PEP indicating circuits.

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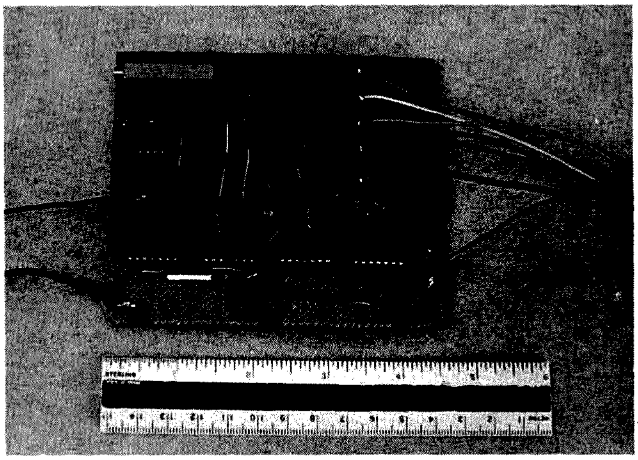
Fight Inflation! Build It Yourself!

-- tips on planning construction projects

Photos by Ira Joffe WA3PTC.



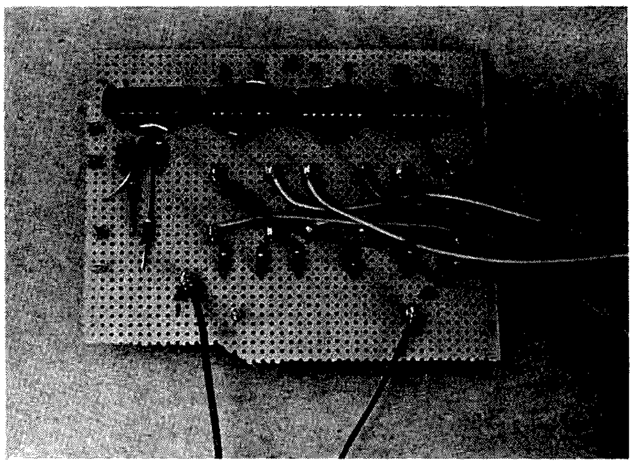
Board which includes timing generator. Trimpot in lower right hand corner is set to 90 Hz for 60 words per minute RTTY machine.

One of the lesser mysteries of hamdom is what makes one ham an operator and another a builder. At one time I monitored an active repeater, trying to sort out from the conversations who might be the operators and who might be the builders. Subsequent eyeball contacts did not confirm my deductions.

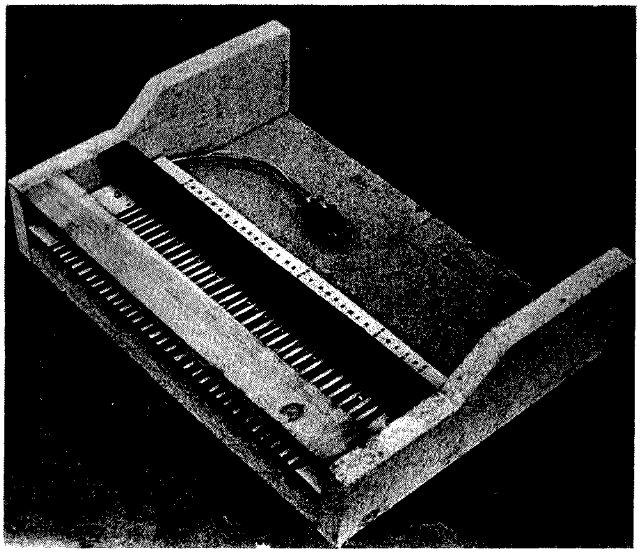
The builders were randomly distributed among the talkers, so the next question was, "Why are there not more builders on the scene?" Certainly there is the small parts shortage, for transmitter projects in particular. There also exists the "mail order lag," which can be discouraging, and finally there is to some degree the "stone wall of solid state." This exists to a degree amongst those of us who cut our teeth on vacuum tubes and still think of the collector as the plate (this includes me).

There is certainly no dearth of good construction articles, particularly in *73*, for both the beginner and the old-timer, although I must admit that if I were starting a ham career today, I might be a bit hard put to tackle some of the most interesting construction articles. With this little bit of soul searching out of the way, I decided to examine closely my mode of attack when I found a construction article of interest.

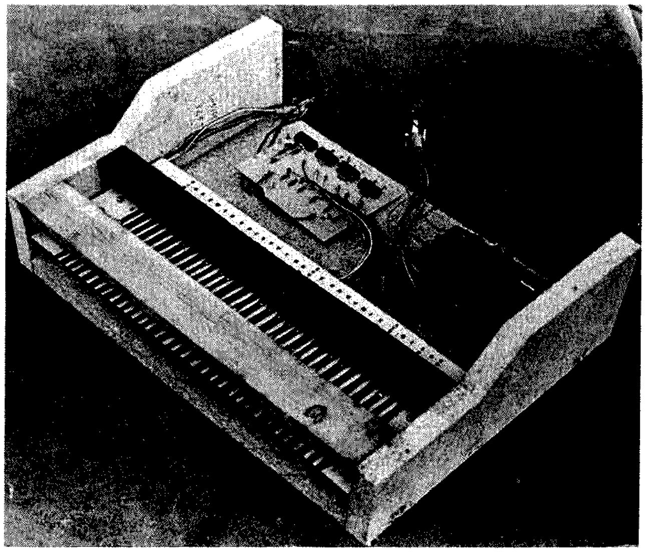
The March, 1976, issue of *73* carried an excellent article by Louis Hutton K7YZZ (page 76) entitled "Build this Exciting New TVT." My basic interest was in Part One, which described an electronic



Memory board.



Basic shell with matrix laid in to show position.



Basic shell with all three electronics packages roughly placed.

keyboard that would run the RTTY printer with which I had been gifted.

What decided me to build the keyboard unit was need, plus the fact that anything with so large an object as a keyboard attached did not have to be micro. This is a large consideration to us who are of bifocal bearing age.

In any multi IC project, there is always this decision: Should you make it up on one big board or separate the circuit into logical chunks that can then be connected together? I always stay away from the "big chunk" theory and try to make the small boards plug together with connectors for ease of troubleshooting.

Most projects somewhere along the line will display the personal foibles and beliefs of first the originator and then the duplicator. Lou had formatted his clock oscillator using a 7400 NAND gate with 2.2 uF capacitors as part of the frequency determining elements. I have a personal hang-up about using such capacitors if there is a way to use a more stable animal such as a mylar or polystyrene unit. I also happen to like the 555 chip for purposes of this kind. Fig. 1 shows the original oscillator and my final version. I further added to the detour from the original article by not adding the switch selected keyboard speed arrangement.

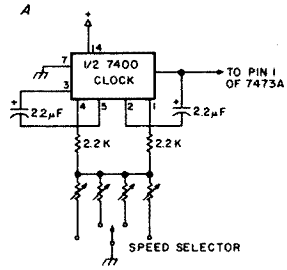
The same capacitor hang-up made me change the configuration of his reset generator. I used the same chip, a 74121 single shot multivibrator, but changed the configuration slightly to avoid use of electrolytics to determine the pulse output. Everything that I have read leads me to believe that this was a reasonable change for the better. Fig. 2 shows the original circuit and my modification.

Lou's article also showed an end of the line counter, which is a great convenience. I omitted this, as I had rigged up a micro switch actuated by carriage movement which dings a bell at me when the last five spaces on a line come into view.

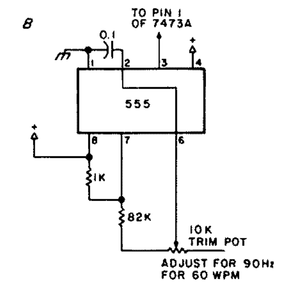
These compromises and adjustments gave me the contents of my first board, namely a 555 for the clock oscillator, two 7473 flip-flop packages, the 74121 single shot, the 74151 data selector chip, and one 7400 NAND gate package. This total of six chips was put on a 4 inch by 5 inch piece of perfboard.

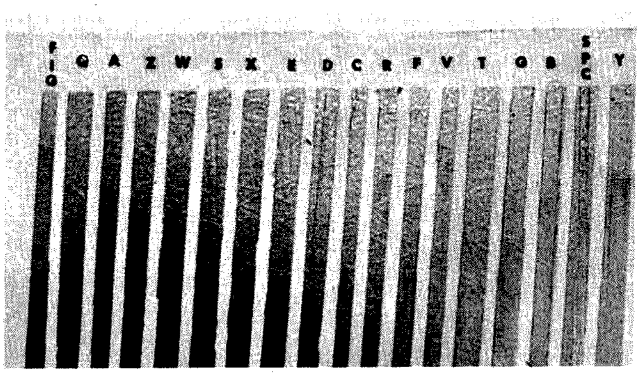
Fig. 1. (a) Original oscillator circuit. (b) Author's revised circuit.

A

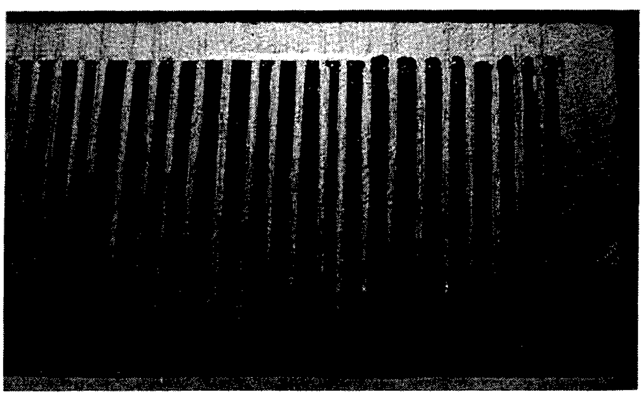


B



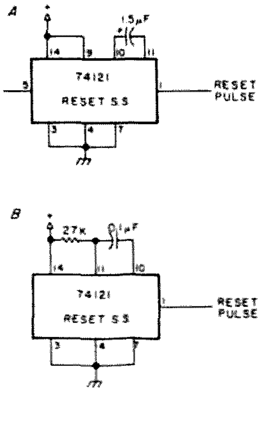


Partial shot of matrix board after *etching and adding identification.*



Matrix board masked out prior *to etching.*

Fig. 2. (a) Original reset generator circuit. (b) Author's revised circuit.



The companion board merely had four 7400 NAND gate packages on it, these serving as basic memory capacity and letters/figures indicator control functions.

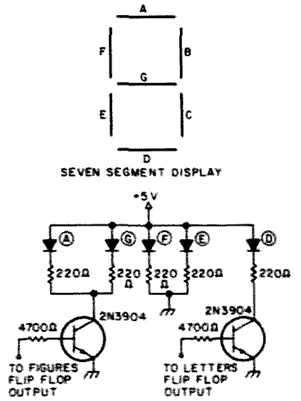
Now we have cut the project down to size by some analysis, elimination, and expression of our personal tastes and opinions. Perhaps if this exercise in technical democracy was practiced more often, those of you who now hesitate to build might do so more frequently.

The single large piece of electrical work left was to create the diode matrix which forms the various character combinations. Again, since the finished product is going to be about the size of a portable typewriter (without encountering scorn), there was no reason to go micro in any way with the matrix. A piece of circuit board 5 inches by 13 inches (copper on one side) was coated with resist. Some 32 circuit stripes were cut into the board running parallel to the five inch dimension. You only need 31 of these stripes, but I always give a bit extra just in case something goes wrong in the etching or the drilling. This is not chicken, but very practical, as disenchantment with one's own etched boards can also turn off the would-be builder.

A finely laid out, closely spaced PC board can give you fits, but an item like this matrix board is just so macro that it can't be a stumbling block. The etching process is self-minding, and the only turnoff here is if you use ferric chloride and get it on you or your clothes. It does not take Perry Mason to spot a careless user of ferric chloride. If you like speedy etching, you borrow the family aquarium pump and allow the airstone to bubble through the etchant while it is working. If you value your fish, use this airstone for etching only! The whole process is so simple that if PC etching was your excuse for not building, that excuse has now vanished.

Sure, you have put all the electronics together; you have even located a suitable keyboard. James Electronics supplied mine and it fulfilled the important requirement that each key have uncommitted contacts that were easy to solder to. When my keyboard arrived, it took the eagle eye of one of my harmonics to spot the fact that where there should have been a "Q", there was instead an "E". A letter to James brought speedy relief for this little problem, which is one of the many reasons that they are a favorite source for me.

Fig. 3. Letters/figures indicator. Common anode MAN 64 7 segment 0.6" LED readout. Source: S.D. Sales.

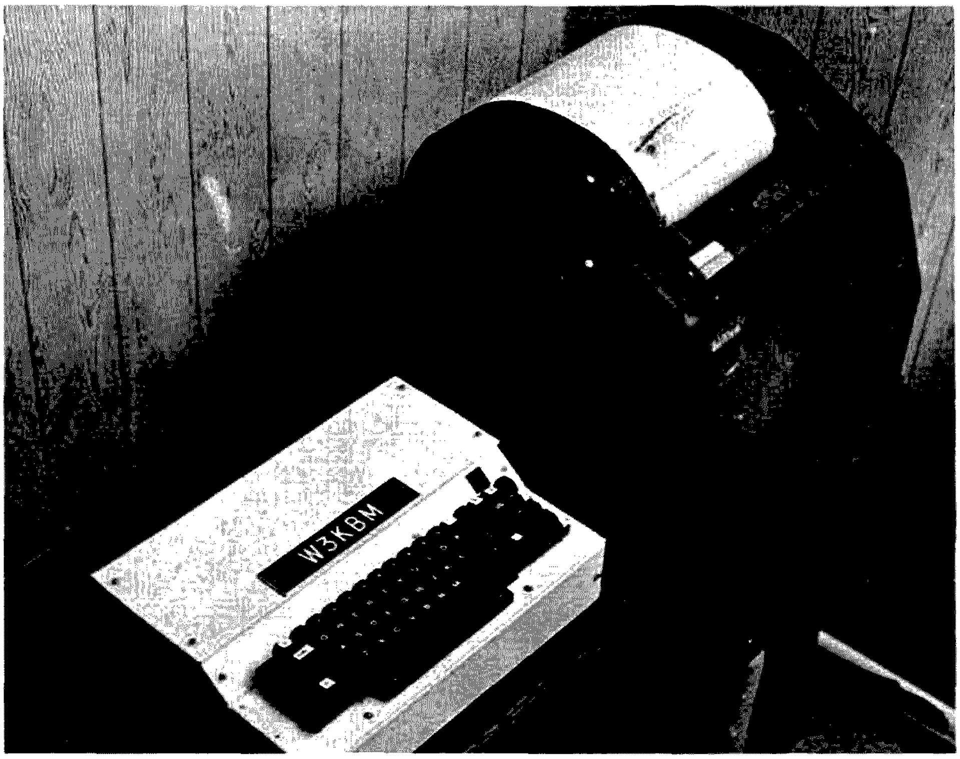


Naturally, you know that the TTL chips use five volts and that a power supply was constructed, but I am not going to bore you with that fundamental other than to say it used a 309K regulator as a matter of good practice.

Now we get down to an emotional problem that we have all encountered. It can be spelled out in one great big word . . . packaging.

This is where the companies that make commercial gear have it over all but the most talented of us. We can put the electronics together, make it work, fix it . . . all those good fundamental things . . . but the finished product sitting in its ho hum housing looks less than aesthetic.

As you can see from the photographs, the bare skeleton foundation is made up of particle board ends, a masonite bottom, and some imagination as to what fitting final shape might be desired. The exact dimensions used are shown in the sketch. Sheet vinyl, a white background speckled with gold splashes, was purchased at the local variety store. Masonite panels were cut to fit the various areas and each panel was carefully covered with the vinyl sheeting using ordinary white glue as the adhesive. The main foundation unit was given similar



The keyboard with the RTTY machine that it serves.

cosmetic treatment. The matrix was mounted in place, as was the keyboard, and the wiring from keyboard to matrix was installed. Care was taken in two areas of this wiring: first, that all wires between matrix and keyboard were long enough to completely remove the matrix without disturbing the keyboard, if and when work might have to be done on the matrix; and secondly, the wire used in this operation was the most flexible stranded wire I could get to avoid putting any strain on the small solder tabs on the keyboard.

The balance of the electronics was installed inside the case, and since the unit is so relatively large in relation to the size of the total electronics packages, space was no problem. The entire power supply was built up on the rear panel of the unit. As you can see from the photo of the finished product, not only was the execution of the electronics passably done, but the finished total package is not something to bring funny looks from the uninitiated.

There is one final bit of show biz that I added to the electronics package. In Lou's original version, there are two LEDs which show the keyboard mode, namely letters or figures. I added the circuit shown in Fig. 3.

Basically, it is a seven segment LED display that shows an "F" when in the figures mode and an "L" for the letters mode. This is both an operating convenience and a bit of pizzazz for the visitor to the shack, who often is more taken with the blinking lights than the actual fact that you can communicate.

To sum it all up: Search out your projects on the basis of need, throw in pocketbook practicality, analyze the unit to see how you can go modular for ease of construction and eventual troubleshooting, and don't forget that an aesthetic package is a valuable detail that is within your abilities. Put them all together and you will find yourself entering the ranks of the builders and enjoying the results. ■

Finished keyboard. Black rectangle in upper right hand corner of small slanted panel is the LED figures/letter indicator. Note that some of the keyboard characters graphics such as the #sign had to be added so they appear on their own key. Also note that, as with most of these keyboards, most of the keys, particularly the numbers row, had upper case symbols above the numbers. They were blacked out with the aid of a resist pen. This accounts for the clean uncluttered look of the keys.

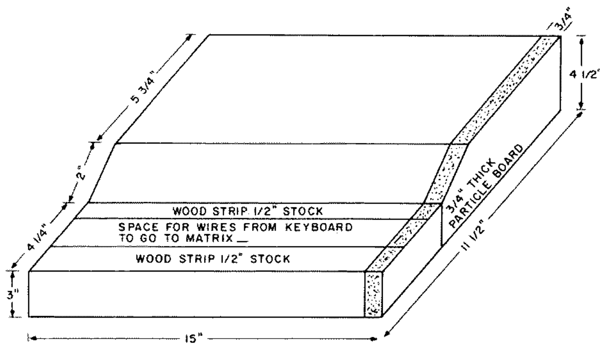


Fig. 4. RTTY keyboard case dimensions.

Wilson HT Mods

- - heavy duty p.s. required

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Arlington VA 22207

In 1972 I got bitten by the two meter FM bug and bought one of the first Genave GTX-2 transceivers in the Washington DC area. I was most impressed with its ten push-button channels and 1 Watt/25 Watt power capabilities for local repeater and simplex operation. Only later did I discover the rig was lacking in adjacent channel selectivity, which only became a problem when I was trying to work 94 simplex within ten miles of our local 91 repeater.

At any rate, I secured the new rig under the dash of my VW with a pair of hinges with padlock hasps and two stout padlocks to discourage would-be ripoff artists. I used this arrangement for four years very successfully and even survived one break-in attempt while the car was parked on the street near my office. At this time, I decided that a less visible and conspicuous mobile installation was needed. Besides, there had been numerous occasions when I could have used a portable rig to help out with local traffic from remote locations during boat races, hamfests, and so on.

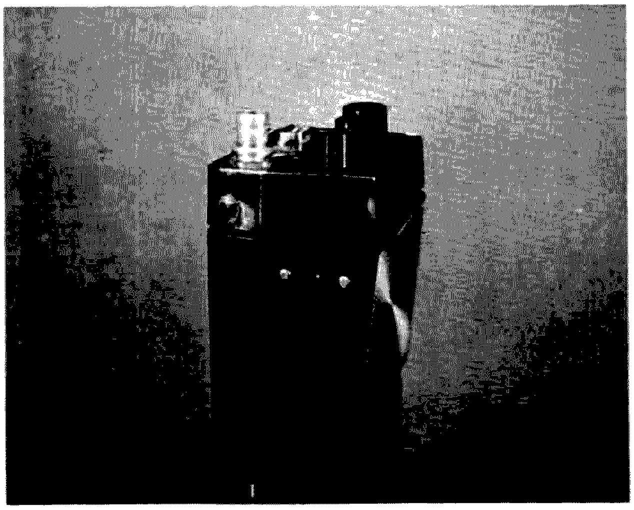

Fig. 1. BNC connector and external power jack.

The GTX-2 is now a base station, and I have a new portable/mobile setup which I consider to be just about the best of all possible arrangements. The rig is a Wilson 1402 handie-talkie that goes with me, mobile and portable.

In the VW I have a 5/8 whip mounted in front of the windshield (total coax length, two feet!) which goes to a 25 Watt amplifier in the trunk. The cable from the amplifier feeds into the glove box of the VW which is the home of the Wilson when I'm in the car. An external power cable and a home brew speaker-mike/touchtone pad complete the mobile installation.

The first (and most difficult) step in setting the Wilson up for mobile operation is to replace the TNC or F connector supplied with the rig with a BNC bulkhead connector. This is so you can quickly and easily remove the rubber ducky antenna and connect the mobile antenna.

I think it took me about a week, after I first looked at the inside of the Wilson, to get up enough nerve to tackle the job. Virtually everything must be disassembled to get to the antenna connector, and I am known to have all thumbs on both my hands when it comes to working on small things in tight places. At long last I undertook the job, and surprisingly enough everything went very well and without mishap. I unsoldered the leads from the original connector and removed it from the panel. The hex-shaped flange on the bottom of the original connector had been filed by the factory assemblers to fit the small space available, so I traced the outline of the flange on a 3/8-32 nut and ground it to the same shape. I threaded a second 3/8-32 nut tight up onto the new BNC panel connector. This nut would later be run down from the outside to tighten the connector to the panel of the Wilson. The D-shaped hole in the panel was reamed out with a 3/8" drill so the BNC connector could be screwed into the ground-off nut on the inside of the panel.

Everything went just as planned, and while I had the unit apart to install the antenna connector, I decided I might as well install a jack to power the rig from the car's electrical system. There appeared to be lots of room just above the push-to-talk button on the side for such a jack. I bought one of those Japanese connectors sold by Radio Shack and Lafayette for just such purposes. I also picked up a package that had a pair of mating plugs for the jack. I learned later that the two plugs were not the same kind, but found how to use

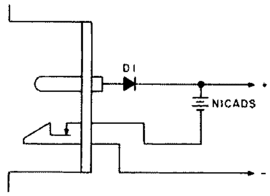

Fig. 2. Power connections.

both to good advantage, as I'll explain.

Fig. 1 shows the newly installed BNC connector and the external power connector jack. If you look closely, you can see the 3/8-32 nut that tightens the BNC connector to the panel. To drill the holes for the power connector, I used a hand-held drill bit to slowly drill the three holes. You don't get much torque or speed this way, but you can drill very clean holes in the plastic. If you try to use an electric drill, even a variable speed type, you'll probably end up scratching, gouging, or melting the plastic case.

Fig. 2 shows in a combined pictorial-schematic representation the connections of the external power jack. D1 is a junk box silicon rectifier and was installed for two reasons: first, to prevent damage to the rig by hooking up the external power source backwards; and second, to give a 0.7 volt drop to the nominal 13.6 volts supplied by the car's electrical system since the Wilson normally operates from 12.0 volts.

When I started to wire up the plug for this connector, I discovered that the two plugs I had bought were not the same type, although at first they appeared to be identical. They were both the same length and outside diameter, but the sizes of the holes in the center were quite different. The jack I had bought had a small diameter pin in the center which fit one of the plugs perfectly. This one I used to supply power from the car, since it would disconnect the nicads in the Wilson.

I made a happy discovery regarding the second plug, which had a much larger diameter hole in the center and fit the jack sloppily. Because of the loose fit of the plug on the center pin of the jack, when this plug was inserted into the jack the nicads were not disconnected, yet an electrical connection was made to both jack connections and thus to the nicads. Thus, by using this ill-fitting plug, I could parallel the nicads in the Wilson with an external power source for charging purposes. This is exactly what I did since I had not bought the Wilson charger. Now charging the nicads is ever so much simpler and handier than with my previous jury-rig of nails and clip leads.

The modified Wilson works beautifully as a mobile rig. It lives in the glove box, and the speaker-mike goes on the dash, right over the broadcast radio. At this point, the only problem I had was that I needed to fit a BNC connector on the Wilson rubber ducky antenna or I had to buy a new one with a BNC connector. The latter did not appeal to my Scotch nature, so I started looking for an F-to-BNC adapter. When I did finally locate one, I found that it cost almost as much as a new antenna and would also add about two inches to the already long antenna. Back to the drawing board.

It was about this time that a friend, WB3AXR, noticed that the internal threads at the rear of the BNC connector just happened to be 3/8-32. This meant that if the mutilated hex flange of the original Wilson F connector were ground completely off or otherwise removed, the connector would screw right down into the standard UG88/U BNC connector. Fantastic! Jim also happens to have a lathe and volunteered to perform the required surgery, although it could have been done with a file or a grinder almost as easily.

Fig. 3 shows the assembly, while Fig. 4 shows the adapter installed on the Wilson rubber ducky. The 3/8-32 nut is put on to lock the F connector to the BNC housing. All in all, a very nice compact adapter at very little cost. Thanks, Jim.

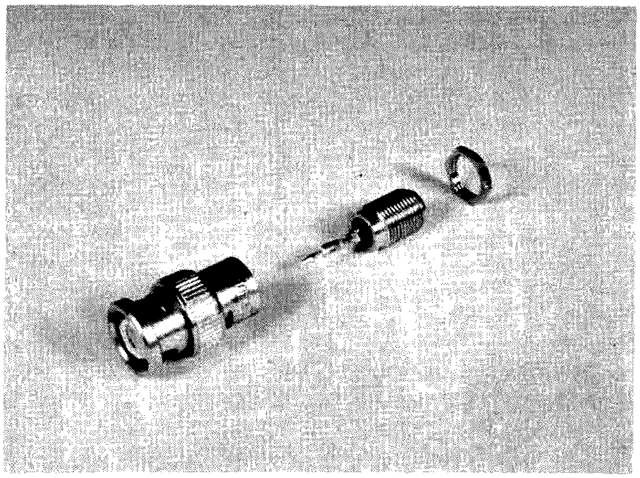

Fig. 3. Construction of the F-to-BNC adapter.

Incidentally, WB3AXR also has a Wilson 1402 and he too hesitated before tackling the job of changing the bulkhead antenna connector, despite his proven mechanical abilities and skills. However, when he saw that I, with my all-thumbs hands, had done it without mishap, he too made the conversion successfully.

The next thing I did to the rig cost me some money. The leather case of the Wilson is very well made, and does a great job of protecting the rig from scrapes and bumps, but it is very inconvenient when it comes to putting the rig on a trousers belt. One has to practically disrobe to thread the belt through the built-in belt loop on the back of the case. I took the case to a local leather goods shop and for two dollars had two male snaps installed as shown in Fig. 5. They do not interfere with the normal closing of the flap, and certainly make it handy for snapping the rig on a belt.

As indicated earlier, there is one more feature that was added to make a truly complete mobile/portable rig. This is a home brew speaker-mike/touchtone pad. I had bought the Wilson speaker-mike, and found it very useful in mobile operation.

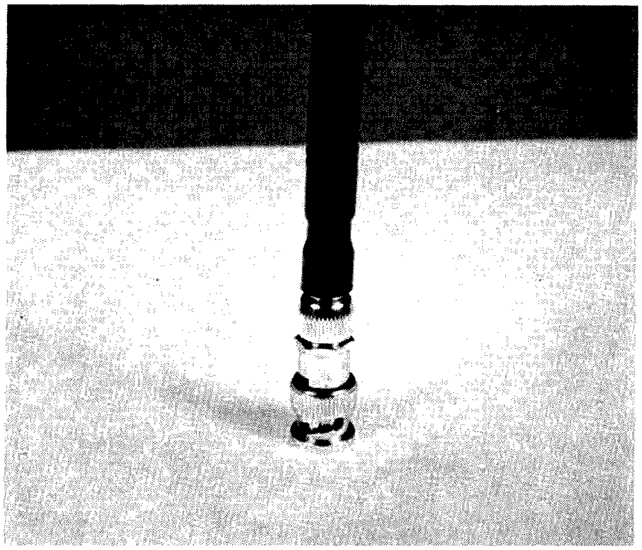

Fig. 4. Finished F-to-BNC adapter.

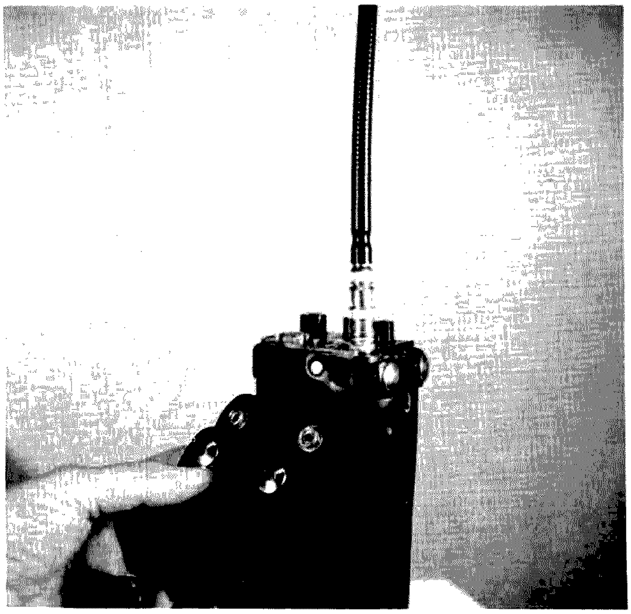

Fig. 5. Added snaps on the leather case.

Adding a touchtone pad to the rig, however, posed several problems. If I built the pad into the front of the transceiver case, it would not be convenient to use in the car. A couple of friends had modified the Wilson speaker-mike to include the touchtone pad on its rear. This method, unfortunately, involves a great deal of surgery on the speaker-mike case as well as a lot of delicate wiring and lots of epoxy to hold the thing together. The end result is very nice, but I'm quite sure I would blow it. Besides, I didn't like the idea of losing the molded mike hanger button on the back of the speaker-mike.

For these and other reasons, I decided to roll my own. I looked around for a suitable enclosure to house the parts, but found that most metal boxes (miniboxes and the like) were just not the right size and shape for the job. Then my roving eye landed on a small transistor radio that I had thrown in the junk box to "fix someday." I think I had paid $2.50 for it at a special sale and it would provide a loudspeaker and battery as well as a hand-size enclosure for the home brew speaker-mike. Not bad!

I had bought the 16 button touchtone keyboard kit of parts from Data Signal* some time ago and, because of my proposed custom design, I had not put the thing together yet. Indeed, I had ultimately decided that I would use the parts but not the circuit board in my custom installation, so it was quite fortuitous that I hadn't put it together. A quick eyeball measurement showed that everything should fit very nicely in the radio case, so I decided to go ahead with my plan.

The first step was to remove the radio circuit board and trace its outline on a piece of paper. The paper pattern was then used to cut out a piece of perfboard (holes on 0.1" centers) to replace the radio circuit board. I used perfboard because it makes no sense to make a printed circuit board for a custom one-of-a-kind project. More time would have been spent laying out the circuit on paper than was needed to complete the point-to-point wiring! I did use IC sockets, however, since soldering multiple leads to IC pins can be harmful to their health – a dead IC in such a situation can quickly cool off enthusiasm for the project.

Fig. 6 shows the final results from the outside. The switch on the right side is an on-off switch that is not at present in use. It was used in the original version only. The small white button near my thumb in Fig. 6(a) is the push-to-talk switch, a microswitch epoxied to the perfboard and extending through the original volume control opening in the case. The microphone, which I bought from Wilson, is located behind a series of small holes drilled in the vertical louvres, about a half inch from the push-to-talk button. The mike is sandwiched between the perfboard and the front of the case, held in place and cushioned by a thin sheet of foam rubber. The cord to the rig exits the unit through the original tuning capacitor opening in the right side of the case. Although the cord looks like a piece of lamp cord, it is actually stereo cable with a vinyl jacket and has two separate shielded cables. The cable is firmly anchored to the perfboard just inside the opening to prevent yanking out the wiring accidentally.

Fig. 6(b) shows the 16 button pad mounted on the back cover of the case. To get a template for drilling the mounting holes for the pad, I used the paper trick again. This time I actually pressed a piece of paper up against the back of the pad to transfer an impression of the four mounting pins and the nine terminal pins to the paper.

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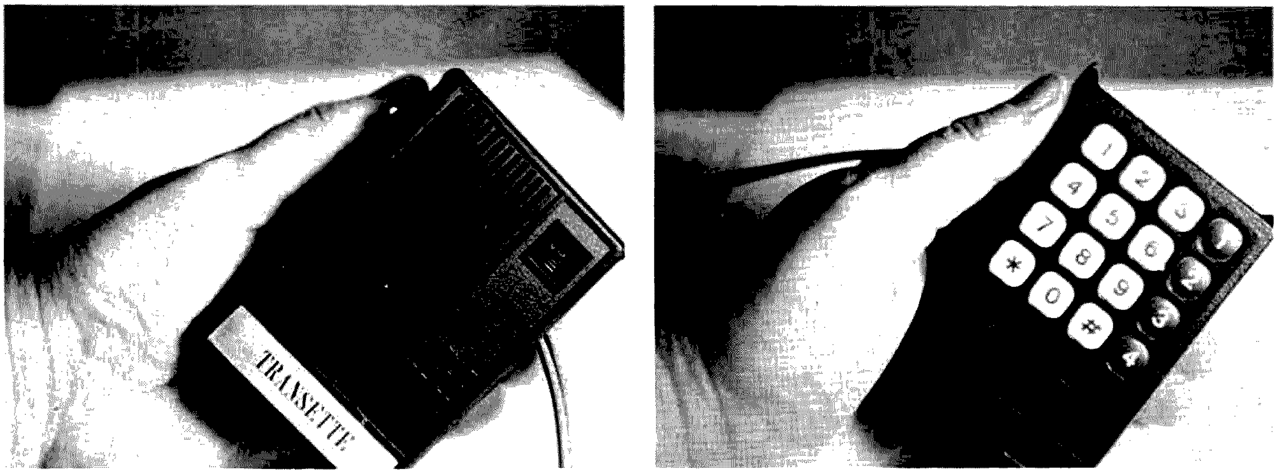
*Data Signal, Inc., 2212 Palmyra Road, Albany GA 31701.



A *Fig. 6. Front (a) and rear (b) views of the speaker-mike/pad.* B

The paper is then rubber cemented to the case while drilling the holes.

Not visible in Fig. 6 is a small hole drilled in the top end of the case for access to the output level control. The output is adjustable from zero to about 900 mV, which should easily drive any medium to high impedance mike circuit.

Fig. 7 is the diagram of the circuitry inside the case. As indicated earlier, the on-off switch was eliminated after the photos were taken. Standby drain is only 20 uA, changing to 4 mA when the circuit is activated by pressing any of the pad keys. The 100k Ohm resistor across the PNP switch transistor, Q2, supplies the standby current to the circuit. When any key is pressed, the 20 uA current is transferred to the common terminal of the pad and to the base of Q1, turning Q2 on to power the circuit.

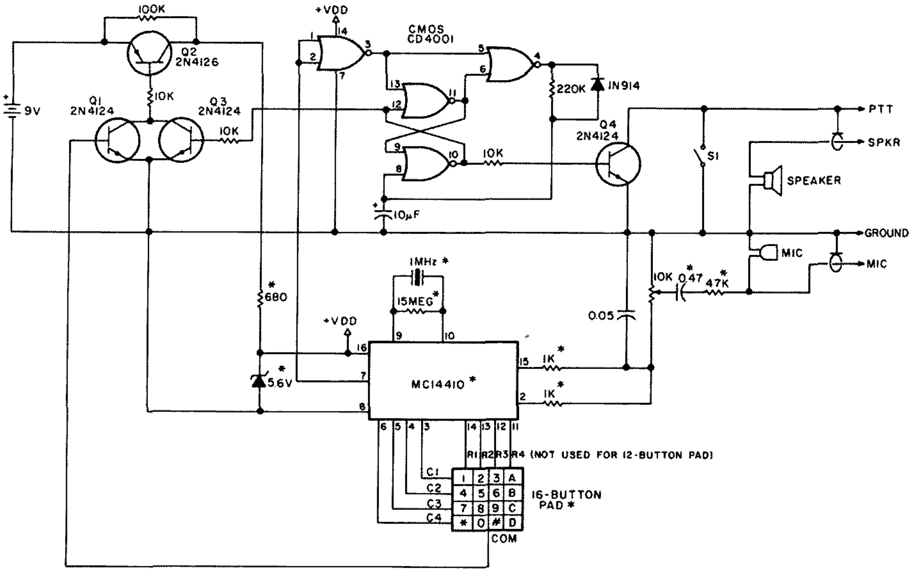


Fig. 7. Schematic of the speaker-mike/pad.

The four gates of the CD4001 IC form a retriggerable monostable to key the transmitter via Q4. The monostable also drives Q3 to keep power on to the circuit at the same time. The 220k Ohm resistor and 10 uF capacitor determine the shutoff delay of the monostable. As shown, they provide about a half second delay when a pad key is released. For a longer delay (if you're a slow dialer!), increase either value – the resistor is easiest.

S1 is the push-to-talk switch and parallels Q4. Notice that the "shield" of the speaker lead is the push-to-talk line and is grounded only by Q4 or S1. The shield of the microphone lead is the only "ground" in the circuit.

And there you have it – the "compleat portable/mobile Wilson." Now if I could only fit a CMOS synthesizer in there some way . . . ■

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Garden Grove CA 92641

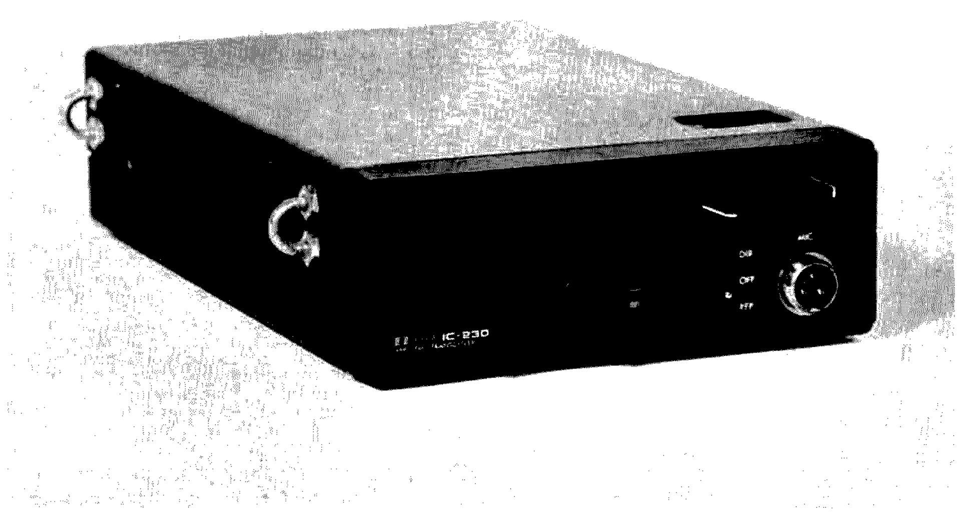
Try These IC-230 Mods

- - improving a popular transceiver

The Icom IC-230 appears to be one of the more popular synthesized two meter rigs on the market today. In its stock form, it tunes from 146.01 MHz to 147.99 MHz in 30 kHz steps, selectable by a 146-147 MHz push-button switch, and rotary switches for the 100 kHz and 10 kHz segments. The power switch is used to select either "direct" or "repeater" operation, and an additional slide switch on top of the rig sets the transmitter to the standard repeater offsets of 600 kHz above or below the selected receive frequency.

Numerous modifications may be applied to the IC-230 to further improve its versatility. This article explains the engineering and construction of 1) an inexpensive method of adding all "split" repeater and simplex frequencies, with easy selection and display; 2) a method for providing automatic repeater offset and simplex operation, so the user need only dial the receiver frequency on the front panel; 3) the utilization of a spare crystal socket, with trimmer, already in the rig, to provide for an additional non-standard repeater offset frequency; and 4) a high/low power switch, with variable low power from about 1/2 Watt upward. In addition, when the switch is in the low position, all front panel lights except the meter light are extinguished, to preserve battery life during portable operation.

All of these modifications are independent of each other, so any or all may be incorporated as desired.



Front view of the IC-230, showing location of the "normal-split" frequency switch. Moving the toggle to the right increases the frequency shown on the front panel by 15 kHz.

15 kHz Step Capability

This modification incorporates an added front panel switch which raises the frequency dialed by 15 kHz. This method covers all split channels between 146 and 148 MHz, and is cheaper and easier to use than adding extra crystals into the "A", "B", and "C" positions of the 100 and 10 kHz crystal bank.

Before going into the procedure for adding the split frequencies to the rig, a brief explanation of the synthesizer is in order (Fig. 1). The heart of the synthesizer is a voltage controlled oscillator (VCO). A crystal-controlled local oscillator (LO) generates a frequency which is determined by the position of the 100 kHz rotary switch. The LO frequency is multiplied by nine and subtracted from the VCO frequency. The resultant is phase compared to the control oscillator (CO) frequency, which is also crystal-generated and determined by the position of the 10 kHz switch. The phase comparator applies an error voltage to the VCO, which remains locked to the desired receive frequency minus the first i-f of 10.7 MHz. The proper transmit frequency is generated by a third crystal oscillator and mixer, which adds to the VCO output 10.7 MHz for simplex operation, 10.1 MHz for a -600 kHz transmit offset, or 11.3 MHz for a +600 kHz transmit offset.

This system has an interesting advantage: All transmit and receive frequencies are independent of possible spurious outputs in the LO and CO, since these are merely control circuits for the VCO.

Circuit Description

Note: Throughout this article, all components added to the IC-230 are given three-digit identifier numbers. Other components originally in the rig are identified in the

same manner as they appear in the IC-230 schematic.

Figs. 2 and 3 show the circuit used to obtain 15 kHz step capability. Each crystal in the LO may be set exactly on frequency by a trimmer capacitor located near the crystal. However, when capacitor C111 is switched in series with one of the crystals, its frequency is raised by about 1.7 kHz, or 15 kHz at its ninth multiple. Capacitor C110 is necessary to swamp out additional capacitance to ground obtained from the added wiring. Otherwise, the range of each crystal trimmer is exceeded before bringing the crystal back on frequency, after these components are added.

Since C111 affects each LO crystal differently, it is probable that a frequency increase of exactly 15 kHz on the ninth crystal multiple will not be obtained with each crystal. For a given value of C111, each LO crystal will exhibit a different frequency "spread" when C111 is switched into and out of the circuit. Ideally, the spread on the ninth multiple should be as close as possible to 15 kHz. To properly align the seven crystals in the LO, it will be necessary to place a capacitor (C100-C106) in series with some of the LO crystals. These capacitors effectively narrow the spread of the LO crystal to which one is attached.

Construction and Alignment

Remember that the 13 MHz LO crystals are switched directly into the oscillator circuit by the 100 kHz rotary switch, so good rf construction practices, such as keeping lead length to a minimum, should be used when working in this area.

Before beginning this modification, connect the IC-230 to a dummy load and attach a VHF frequency counter to display the transmitted frequency. Icom requires that each channel of the rig be within 750 Hz of the correct frequency. Check the CO alignment by reading each frequency from 146.01 to 146.28 in 30 kHz steps, which checks each of the ten CO crystals against one LO crystal. Next, check the LO by reading 146.01 to 147.81 in 300 kHz steps, which checks each LO crystal against one CO crystal. If there are any discrepancies, be sure you know which circuit is out of adjustment before changing the crystal trimmer settings. The IC-230 manual will be of help here.

Now begin construction of the circuit as shown, using the schematic (Figs. 2 and 3) and photographs as a guide. Install all components *except* C100-C106. Instead, leave the wires to P-1 intact. Switch S-100 is installed by removing the front panel of the rig and placing the mounting hole in the chassis above and between the two rotary switches. S-100 is mounted horizontally, and the toggle extends through the front panel between the 100 kHz and 10 kHz display windows. Before drilling through the front panel plastic, place a piece of masking tape on the other side, so a clean hole results. Use a small circular file to elongate the hole to accommodate S-100.

After installing these components, set C111 to midrange and close S-100. In my rig, S-100 is mounted so that when the toggle is facing left, the switch is closed, setting the rig up for standard 30 kHz step frequencies. Now recheck the LO for correct alignment as before, and adjust each LO crystal trimmer as necessary. Each trimmer should be close to its full open position. Record the frequencies obtained with each LO crystal, down to the nearest 100 Hz, in a column.

Now open S-100 and record the new frequencies obtained with each LO crystal in another column. Determine the spread of each LO crystal by subtracting the two frequencies obtained with that crystal. Choose the LO crystal which gives the smallest spread, and adjust C111 to set this spread to 15 kHz. Now the other LO crystals will all yield spreads above 15 kHz. Capacitors C100-C106 will be used as necessary to decrease the spread of the other LO crystals. These capacitors should be silver mica or polystyrene, to insure good temperature stability. A 100 pF capacitor used in this manner will decrease the spread of the associated LO crystal by approximately one kilohertz. The addition of these capacitors also necessitates readjusting the LO crystal trimmers, with S-100 in the normal position, for the correct standard frequency. In my IC-230, five of the seven crystals in the LO needed a 100 pF series capacitor, and the other two required no capacitance here. This combination resulted in all frequencies being within 400 Hz of the desired channel frequency.

Since I spent considerable time and effort obtaining this close tolerance, I recommend being content with the more relaxed 750 Hz standard used by Icom, since no noticeable "off frequency" distortion occurs in this case. This 750 Hz standard allows for a frequency spread of between 13.5 and 16.5 kHz on the ninth multiple of each LO crystal.

It is possible that some of the LO crystals will be difficult to tune in the manner described. In my unit, one crystal stopped oscillating, evidenced by the S-meter light extinguishing, just before its ninth multiple was raised 15 kHz. Another LO crystal required a significantly smaller series capacitance than the others to obtain the desired frequency spread. Replacements from Jan Crystals were installed, and both problems were solved. Remember to follow crystal ordering procedures outlined in the IC-230 manual.

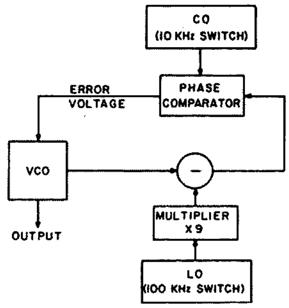


Fig. 1. Block diagram of the frequency synthesizer portion of the IC-230.

Automatic Simplex and Repeater Offset

The circuit described here automatically selects a +600 kHz transmit offset for receive frequencies of 146.01 to 146.37 and 147.00 to 147.39, simplex operation for 146.40 to 146.58 and 147.42 to 147.57, and a -600 kHz transmit offset for 146.61 to 146.97 and 147.60 to 147.99, all obtained with the power switch in the REP position and the repeater select switch in the REP A position. In addition, position A on the 100 kHz rotary switch sets the transmit offset at -600 kHz, and position B sets the offset at +600 kHz, for both the 146 and 147 MHz band

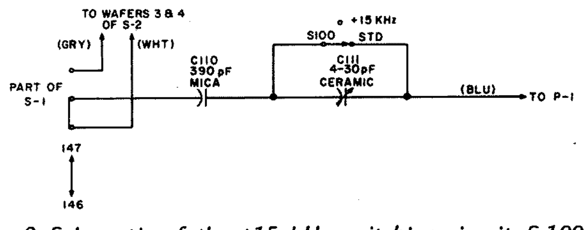
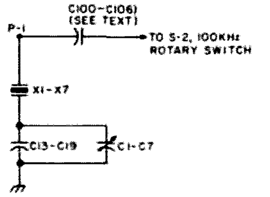


Fig. 2. Schematic of the +15 kHz switching circuit. S-100 is the miniature toggle switch that is mounted on the front panel of the rig. Opening S-100 places C111 in series with the particular LO crystal being used, raising the ninth multiple frequency by 15 kHz.

Fig. 3. Capacitors C100-C106 are mica types placed in series with each LO crystal, as necessary, to equalize the effect of C111. A 100 pF capacitor here decreases the frequency spread of its corresponding LO crystal by about 1 kHz at its ninth multiple, when S-100 is switched between the STD and +15 kHz positions.



segments. This provides for convenient selection of normal and reverse repeater operation, and simplex on the standard frequencies, for both the 146 and 147 MHz bands. Also, if the split repeater and simplex frequencies are added as described before, the system automatically selects proper transmitter offset for either the California or new York plans for split repeater setup. If the power switch is placed in the DIR position, the automatic transmit offset feature is defeated, and all frequencies are set up for simplex operation.

Circuit Description

The correct transmit offset is determined merely by the position of the 100 kHz rotary switch. The offset is +600 kHz for positions B, 0, 1, 2, and 3; simplex for positions 4 and 5; and -600 kHz for positions 6, 7, 8, 9, and A. The circuit consists of two parts, shown in Figs. 4 and 5. The first part wires the front wafer of S-2, which is the 100 kHz rotary switch, along with the power switch S-4, into the logic required for automatic transmit offset. The second part combines some of the 30 kHz spacing of the crystal switching logic, originally utilizing the first two wafers on the 100 kHz rotary switch, into the second wafer alone.

The original purpose of wafers 1 and 2 of the 100 kHz switch S-2 is to switch a regulated 9 volt supply to one of three lines, labeled A, B, and C, which are routed to the 10 kHz switch CO-S-1. This allows the 9 volt supply access to the CO module only when the combination of LO and CO crystals selected corresponds to the frequency shown on the front panel.

The front wafer of S-2 switches the 9 volt supply to lines A, B, and C in a manner consistent with operation on the 147 MHz segment of the band, while the second wafer is set up in a similar manner for the 146 MHz segment. In effect, when operation is changed from 146 to 147 MHz, line A is transposed to line C, line B to line A, and line C to line B. This is also easily accomplished by adding switching transistors Q100-Q105. Each line (A, B, and C) is connected to two transistors, corresponding to 146 and 147 MHz, which is still determined by pushbutton switch S-1. Activating the proper transistor allows the regulated 9 volt supply to pass to the correct line from the second wafer of S-2, which is the only wafer now needed for this switching logic.

The IC-230 uses diode crystal switching for determining the desired transmit offset. This method is simple in that the 12 volt supply is the only thing that need be switched. With the REP A-B switch in the REP A position, +12 volts is switched to the power switch which, if in the REP position, transfers the 12 volts to the rotor of the front wafer on the 100 kHz rotary switch, which diverts the 12 volts to the correct offset crystal switching circuit. With the power switch in the DIR position, the 12 volts is sent directly to the crystal switching circuit that provides simplex operation. If the REP A-B switch is moved to REP B, the 12 volts is diverted to the auxiliary transmit offset crystal located on the LO crystal socket SO-1, if this modification is also incorporated in the rig. The two diodes attached to the 100 kHz rotary switch allow the REPTR indicator light to come on only when a repeater frequency is dialed.

Construction

Although the IC-230 is densely wired in the vicinity of the 100 kHz rotary switch, there should be no problems accomplishing the changes if care is exercised.

Remove the top and bottom covers, front knobs, and front panel from the rig. The mic plug need not be removed from the front panel, if the panel is rotated away from the rotary switches. Remove the 146-147 MHz push-button switch from the top of the rig by unsoldering as many wires (make note of their positions!) as necessary to enable the switch to be moved away from the front two wafers of the 100 kHz switch. Turn the rig over and remove the screws from the two 3-lug terminal strips near the 100 kHz switch. Set the dial of this switch to the zero position, and remove the dial. Slide all obstructing panel lights rearward until they are free of their respective grommets, and move them out of the way. Now remove the control nut holding the 100 kHz switch in place, and slide the switch back about a centimeter to gain access to the front wafer.

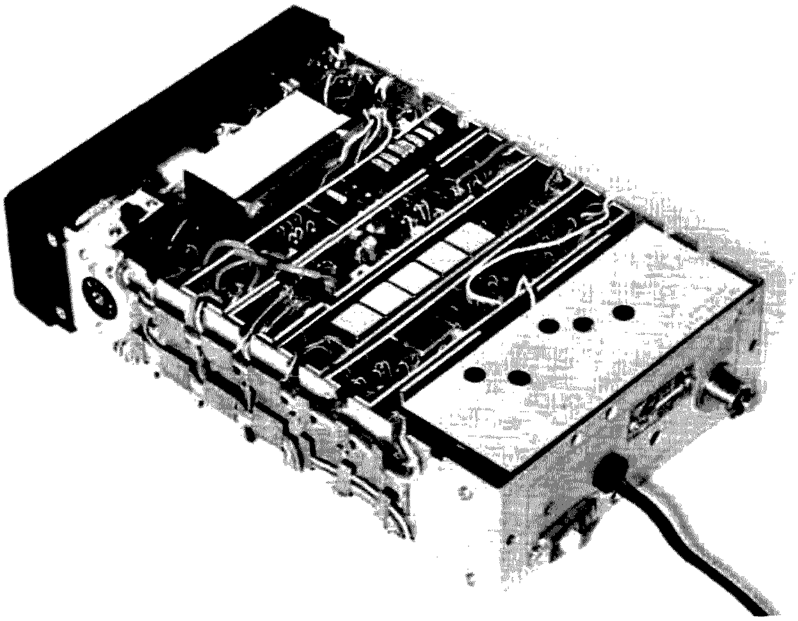
Attached to the front two wafers of the 100 kHz switch are a white and a gray wire from the 146-147 MHz switch, and a line A (orange), line B (blue), and line C (red) wire, which connect the 100 kHz switch to the 10 kHz switch. All of these wires should be removed at both ends, and their positions noted.

Now remove all additional wiring from the front wafer of the 100 kHz switch, and leave all wiring on the second wafer intact. Interconnecting wires between wafers may be cut where they first attach to the second wafer before the portion attached to the first wafer is removed.

On the bottom side of this switch, note that the front and second wafers each had two lugs connected together to a pink wire. These represent switch positions A and B. The other four lugs on this side represent positions 9, 8, 7, and 6. All lugs appear in the same order as the numbers in the selector window when the frequency knob is rotated. Keeping this in mind, connect the 6, 7, 8, 9, and A lugs together, the 0, 1, 2, 3, and B lugs together, and the 4 and 5 lugs together. The pink wire attaches to the A and B lugs of the second wafer only.

Now remove the wires which go to the REP A-B switch, located on top of the rig, and remove the other end of the wire from this switch to the power switch. Attach an extension of the purple wire, which switches the 11.7 MHz crystal, to lugs 0, 1, 2, 3, and B of the 100 kHz switch. Attach an extension of the light green wire, which switches the 10.1 MHz crystal, to lugs 6, 7, 8, 9, and A of the same switch. The 10.7 MHz crystal is already connected by a pink wire to the DIR side of the power switch. Connect a wire from here to lugs 4 and 5 of the 100 kHz switch. Connect the two diodes between the 100 kHz rotary switch and the REP A-B switch, as shown. Connect a wire from the 100 kHz switch rotor lug to the REP side of the power switch, S-4.

Attach a wire to the +12 volt supply, located on pin 3 of the accessory socket, and attach the other end to the center terminal of the REP A-B switch. Connect the REP A side of this switch to the same center terminal of the power switch from which a wire was previously removed. If this modification is used alone, the switch on top of the rig may be left permanently in the REP A position. However, if the non-standard



Top view of the IC-230. C111 is located directly in front of the seven LO crystals, and is mounted on a small right angle aluminum bracket. C100-C106 are attached to P-1, which is located next to C111. The PC board used in the automatic repeater offset modification is shown in place on the lid of the CO module. The additional non-standard repeater crystal is located on the far side of the LO crystal socket, and the three-lug terminal strip is mounted on the side of the rig behind the REP A-B switch.

repeater offset modification is made, as described later, the REP B side of this switch will be used.

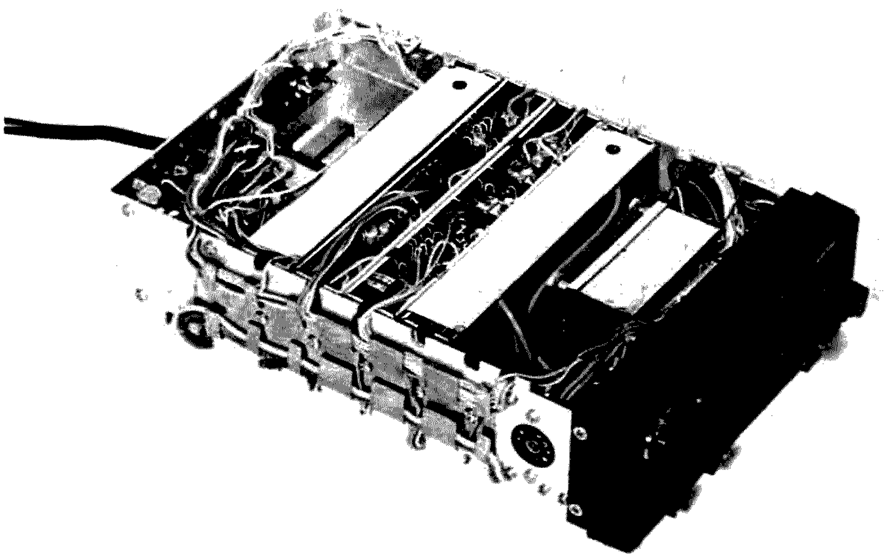
Now remove the lid to the CO shield box, located on the rear wafer of the 10 kHz switch, and cut a piece of PC board the same size as this lid. Etch and drill this PC board to match the schematic (Fig. 5) and photo, and mount it on the lid of the CO shield box after all components and wires are soldered into place. (Since this circuit is elementary, no PC board layout is given here, other than in the photograph. It is recommended, though, that all external wire connections be grouped to one side of the PC board, as shown in the photo, to facilitate installation.) It may be necessary to file the mounting spacers as short as possible so the components will fit next to P-1 on the LO module.

It should be noted that if both the automatic repeater selection and the split frequency features are added, there are two frequency combinations which will result in operation outside the two meter band. Normally, the simplex split frequency of 147.405 MHz is obtained by dialing 147.39 MHz and raising this by 15 kHz with the added front panel switch. However, if the power switch is left in the REP position, the transmit frequency will be 600 kHz higher, or 148.005 MHz. Therefore, for this simplex frequency, the power switch must be in the DIR position for correct operation. Secondly, if 147.99 MHz is selected, with the power switch in the DIR position and the frequency raised by 15 kHz, the receive and transmit frequency will be 148.005 MHz.

Non-standard Repeater Offset

This modification allows placement of an additional transmit offset crystal in the far right socket, which is presently unused, of the LO module. When the switch on top of the rig is placed in the REP B position, this new offset crystal is used by the mix module to determine the transmit frequency. This function operates regardless of whether the power switch is in the DIR or REP position, and when the non-standard offset is being used, the REPTR lamp lights dimly as an indicator.

If this additional repeater offset feature is added to the IC-230 without incorporating the automatic repeater offset modification, a separate switch will have to be used for this circuit, since the REP B portion of S-5 will not be available for this use.



Bottom view of the rig. The high/low power switch is mounted on the back panel of the rig, along with R120 attached directly to the switch terminals. The mix module contains the three standard transmit offset crystals, two of which are visible in their sockets.

Circuit Description

Fig. 4 shows that this new circuit is merely an addition

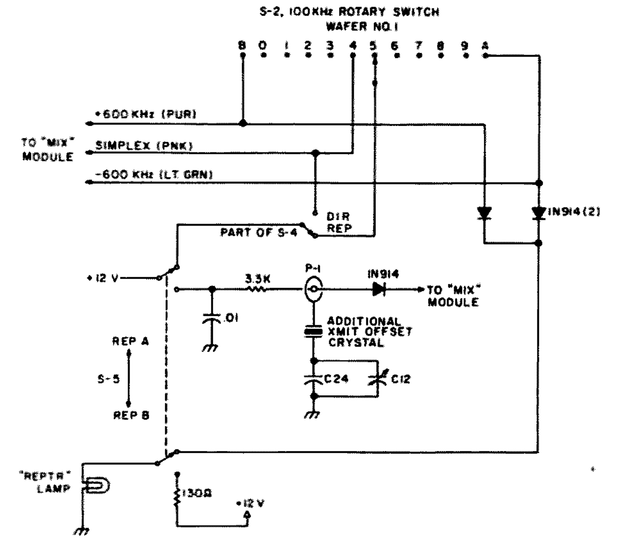


Fig. 4. Automatic transmit offset circuit, with additional non-standard repeater offset crystal. With S-5 in the REP A position, standard repeater, reverse repeater, and simplex transmit offset frequencies are determined automatically. With S-4 in the DIR position, simplex operation is possible on all frequencies. Moving S-5 to the REP B position places the non-standard repeater crystal into operation, and the REPTR lamp lights dimly as an indicator.

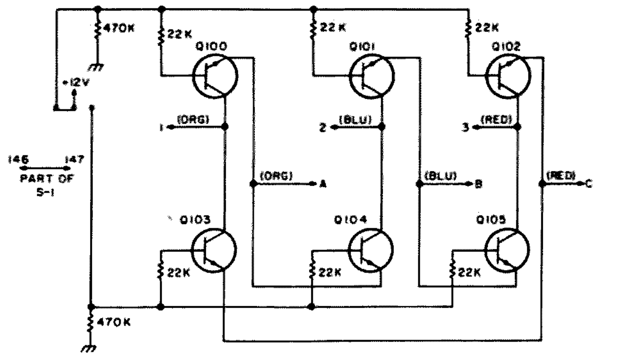


Fig. 5. Schematic of the PC board circuit which combines wafers 1 and 2 of the 100 kHz rotary switch into wafer 2 alone, allowing wafer 1 to be used as shown in Fig. 4. Q100-Q105 are silicon switching transistors. Lines 1, 2, and 3 are from wafer 2 of the 100 kHz rotary switch. Lines A, B, and C connect to their corresponding places on the 10 kHz rotary switch. All resistors are 1/4 Watt.

of one more crystal to the diode switching network already used to determine transmit offset, located in the mix module. When the REP A-B switch is in the REP B position, this non-standard offset crystal is switched into the circuit at the mix module, along with a 130 Ohm resistor in series with the REPTR lamp.

Construction

Begin construction by marking the position of and removing each wire on the mix board. This is the second module from the front on the bottom side of the rig, which contains the three transmit offset crystals. Now loosen the screws located on each side of the mainframe to which the module is mounted, and remove it from the mainframe. Drill small holes for the pin connector (if desired) and switching diode somewhere near the crystal end of the module. Install the diode and connector, and replace the mix module in the mainframe. Install a three-lug terminal strip at a convenient location in the rig, and wire it according to the schematic. The wire which runs between this terminal strip and the mix module should be routed under the bus clips on the side of the rig. Complete the modification by removing the REPTR lamp red wire from the power switch and moving it to the switch on top of the rig; finish wiring this switch by following the schematic.

The correct crystal frequency in this circuit may be obtained by adding the desired transmit offset frequency to 10.7 MHz, and installing a crystal of this frequency in the socket on the far right side of the crystal bank in the LO module. The transmit frequency may be set exactly by adjusting the correct trimmer while observing the transmitter frequency on a counter.

High/Low Transmitter Power Switch

In my unit, the high/low transmitter power switch is mounted on the back of the rig, and the circuit is similar to that used in the IC-22. In the HI position, the rig operates normally. When switched to LO, the transmitter power is reduced to about 1/2 Watt or more, determined by the setting of an added internal potentiometer. In addition, the low power setting turns off all front panel lights except the meter light, and the red transmit light, which operates normally. In this manner, the current drain on receive is cut nearly in half, which, along with the reduced transmit power, extends battery life when the rig is used as a portable.

Circuit Description

The EPS module, located next to the speaker, contains a control circuit which adjusts the voltage to the transmitter driver and final transistors, determined by the swr on the antenna, for protection purposes. In the low power position, a small PC-type pot is placed on the collector of Q1, as shown in Fig. 6, which lowers the voltage to the transmitter in the same manner. Also, the ground return on the 146, 147, REPTR, and the 100 kHz and 10 kHz dial lights is opened, extinguishing those lights.

Construction

Remove the EPS board, located opposite the antenna connector on the bottom side of the rig, and note that a 10k resistor is mounted on the foil side of the board, near the center. One side of this resistor is joined to a 4.7k resistor on the top side of the board. This is the point to which the wire to the high/low power switch should be attached. Find the white (ground) wires on the 146, 147, REPTR, 100 kHz and 10 kHz digit lamps, and connect them all to a single wire, which should be routed via the bus clips on the side of the rig back to the high/low power switch. Exposed connections should be covered

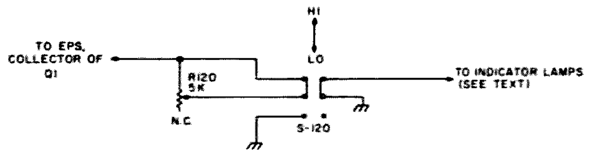
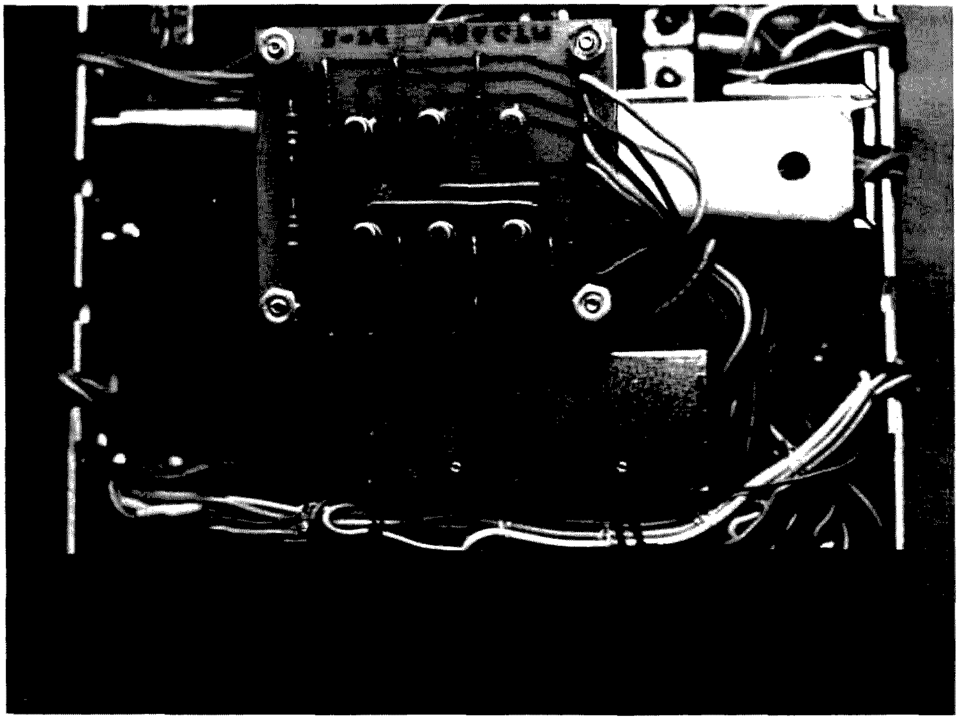


Fig. 6. The high/low power switch mounts on the back of the rig, and incorporates a circuit similar to that used in the IC-22. R120 is a PC mount pot, and may be soldered directly to the switch terminals. S-120 is a standard size DPDT slide switch.



The PC board used for part of the automatic transmit offset modification is shown with all wires attached. From the top down, the wires are: 146 MHz; C; B; A; 1; 2; 3; gnd; 147 MHz.

with heat shrinkable tubing where appropriate.

When setting the low power with R120, key the transmitter and note that the meter still indicates relative rf power. This power can be reduced so that the meter shows a reading between 1 and 2 to obtain the greatest difference between the high and low transmitter power output. Any attempt at a lower power setting may cause the driver and final transistors to stop oscillating.

Conclusion

It is my experience that each modification described here plays a significant part in improving the versatility and convenience in operating the IC-230. In addition, some of these circuit principles could be applied to other rigs as well. For example, each crystal in a discrete channel rig could be raised by 15 kHz, to obtain a limited split channel capability. Some form of the automatic repeater offset circuit could be applied to other synthesized rigs. Finally, a switch which cuts off all indicator lights will prolong battery life on any rig when used as a portable. ■

Social Events

SALT LAKE CITY UT
APRIL 30

The Utah Computer Association announces the Utah Computer Fair to be held Saturday, April 30, 1977 from 1 to 5 pm at Fashion Place Mall. Purpose: To inform the community of the place and value of personal (hobby) computers in our world. Many of our members will be bringing their computers, both home-built and professional systems, demonstrating many different applications. We will also have some manufacturer representatives and local distributors present. This is an informational gathering; there will be no selling! For further *information, contact* Ernie Dixon, Fair Chairman, at home (6-9 pm) at 467-9100; or at work (8:30 4 pm) at 486-7481.

BROWNFIELD TX
MAY 1

The Brownfield Amateur Radio Club will hold a Swapfest on Sunday, May 1, 1977, in Brownfield, Texas.

WEST TRENTON NJ
MAY 1

The annual Delaware Valley Radio Association (W2ZO/WR2ADE) flea market and auction will be held on Sunday, May 1, 1977, 9 am rain or shine at the Villa Victoria Academy in West Trenton, New Jersey (the school is located adjacent to Rt. 29 near the junction of Rt. 29 and I-95). Talk-in on 07/67 and 146.52. Refreshments are available. Advance registration $1.00; $1.50 at gate. For additional information or tickets write: DVRA, PO Box 7024, West Trenton NJ 08628, SASE please.

FRESNO CA
MAY 6-8

The Annual Fresno Amateur Radio Club Hamfest will be held this year at the Airport Holiday Inn on May 6 and 8, 1977. For more information write Fresno Amateur Radio Club, Inc., 4788 N. Safford, Fresno CA 93704.

HERNDON VA
MAY 7

The Potomac Area VHF Society will hold its sixth annual hamfest on Saturday, May 7, 1977, from 8 am to 5 pm at Frying Pan Park on West Ox Road in Herndon, Virginia, which is approximately 15 miles west of Washington DC. Registration of $3 includes flea market or tail gate sales. Professional food and beverage catering and unlimited parking will be available. Talk-in on 146.52 and 31.-91. repeater. This is the hamfest formerly held in Westminster MD, but moved to Virginia because of the recently enacted Maryland traders law. For further information contact K3DUA or WA3NZL.

CORRECTION

On page 158 of the March issue of *73*, we published an erroneous ad for Hamtronics. There is no reward being offered. *73* goofed! Our apologies to anyone who has been inconvenienced.

MEADVILLE PA
MAY 7

The Third Annual Northwestern Pennsylvania Hamfest will be held May 7 at Crawford County Fairgrounds, Meadville PA. Free admission. Flea market begins at 10 am. $2 to display — hourly door prizes — refreshments — commercial displays welcome. Indoors if rain. Talk-in 146.04/64 and 146.52. Details C.A.R.S., PO Box 653, Meadville PA 16335.

SUPERIOR WI
MAY 7

The Twin Ports Two Meter Club will hold its Second Annual Swapfest on Saturday, May 7, 1977, in the hall of the Duluth First Methodist Church from 11 am to 3 pm. Pre-registration and door prizes will be awarded. Admission is $1.00 in advance and $1.25 at the door. Selling space is $1.50 additional — $1.00 with your own table. Food available on the premises. Plenty of parking. Talk-in on 34/94. For flyers and/or tickets, contact Twin Ports Two Meter Club, c/o Libby Welsh WB9MLN, 525 Homecroft Court, Superior, Wisconsin 54880.

BINGHAMTON NY
MAY 7

The 18th Annual STARC Hamfest will be held Saturday, May 7, 1977 at Binghamton, New York. Take exit 71N from NY-17, go 3.8 miles north on Stella-Ireland Road. Flea market, tech talks, hourly door prizes. General admission $2.00/person. Banquet by pre-reservation at $6.00/person. Indoor exhibit space by pre-registration at $5.00 per table. Outdoor exhibit flea market space free. Talk-in 146.22/82 and 94/94. For details and reservations, contact STARC, PO Box 11, Endicott NY 13760.

GREEN BAY WI
MAY 7

The Green Bay Amateur Radio Club will hold its 2nd Annual Electronic Hobby Swap on May 7, 1977 at the Wisconsin Army National Guard Building, 800 N. Military, Green Bay, Wisconsin. Swap runs from 8 am til 4 pm. Admission $2.00; table space $2.00. Food, refreshments, entertainment, prizes, etc. For further info contact David Boyce WB9QYJ, 706 Mather Street, Green Bay, WI 54303, or Bob Heiser WA9SWX, 1547 Foeller Drive, Green Bay, WI 54302.

BIRMINGHAM AL
MAY 7-8

The Birminghamfest Amateur Radio Convention will be held May 7 and 8, 1977 at the Alabama State Fairgrounds, Birmingham and Rodeway Inn, Oxmoor at I-65 and Oxmoor Road. One of the country's largest flea markets, technical and operating forums, huge prize drawing, manufacturers' and distributors' displays, ladies' and children's activities. Booth display area will be offered free of charge to bona fide distributors, manufacturers, publishers, etc., on a first-come, first-served basis. Others may rent space in inside or outside flea market areas at a small charge. No admission charge. Prize ticket donations — $1. Talk-in 34/94, 3965 kHz. For booth display space, information, and reservations, write: Birminghamfest, PO Box 603, Birmingham AL 35201.

KEY WEST FL
MAY 7-8

The Second Annual Key West Conch-fest will be held May 7 and 8, 1977. $12 includes one dinner and admission to many attractions in the Key West area. Door prizes will be awarded. Reservations and room information available from Dennis Farr, 1831 Harris Ave., Key West FL 33040.

SANTA BARBARA CA
MAY 13-15

The 22nd annual West Coast VHF Conference will be held on May 13-15, 1977 at the Miramar Hotel on the beach in Santa Barbara CA. The event opens with registration at 6 pm Friday (May 13), followed by a full day of technical presentations starting at 9 am, Saturday. Pre-registration fee is $2 until April 30. After that and at the door, $3. Registration forms, hotel information, and further details may be secured by writing Dr. Overbeck at the Communication Division, Pepperdine University, Malibu CA 90265.

WARMINSTER PA
MAY 15

The Warminster Amateur Radio Club's "HAMMART," Flea Market and Auction will be held Sunday, May 15 from 9 to 4 at William Tennent Intermediate High School, Street Road (Route 132), 2 miles East of York Road (Route 263), Warminster, Bucks County, Pa. Registration $1, tailgating $2 additional. Talk-in on 147.69-09; 146.16-76 and 146.52. For further information write to Horace Carter K3ZAC, 38 Hickory Lane, Doylestown PA 18901.

IRVINGTON NJ
MAY 15

The Irvington Radio Amateur Club Hamfest, Flea Market will be held Sunday, May 15, 1977 from 9 am to 4 pm at the P.A.L. Building, 285 Union Ave., Irvington, NJ. The P.A.L. building borders the Garden State Parkway at Exit 153. Talk-in 34-94 and 52. Prizes and refreshments. Tables $3. For further information write Radio Club P.A.L., 285 Union Ave., Irvington, NJ 07111 or call Ed WA2MYZ 201-687-3240 evenings.

WEST LIBERTY OH
MAY 15

The Champaign/Logan Amateur Radio Club will hold its annual flea market on May 15, 1977, at the West Liberty Lion's Park, West Liberty, Ohio. Free admission. Trunk sales and tables $1.00. Door prizes. Talk-in on 146.52.

ROCHESTER NY
MAY 20-22

The Rochester Hamfest (combined with the New York State ARRL Convention) will be held May 20-22, 1977 in the Dome Center at the Monroe County Fairgrounds. The show will open at 9 am Saturday; closing will be at 5:30 pm. The show will reopen on Sunday 9:30 am and run until 5 pm. Eight by ten foot booths are available for only $100 each payable in cash only, in advance. Multiple booths are available at reduced rates: double $180; triple $250. For additional information contact E. Ashley Palmer K2EAW, 1776 Hudson Ave., Rochester, NY 14617 or call 716-338-2180 during working hours.

CADILLAC MI
MAY 21

The Cadillac, Michigan 17th Annual Swap-Shop will be held Saturday, May 21st, 1977, at the National Guard Armory, Cadillac, Michigan. Free parking, everyone welcome. Tickets $2.00. Talk-in on 146.37/97.

RAVENNA OH
MAY 21

The Hanna Hills Radio Club located at 5555 Newton Falls Road, Ravenna OH 44266, will sponsor an auction at the Survival Center Saturday, May 21, 1977. Flea market at 10 am; auction at 2 pm. Tickets at door $2. Bring your own flea market tables. Directions to QTH on 146.52 simplex.

LAKE DELTON WI
MAY 21

The 1977 ARRL Wisconsin State Convention will be held Saturday, May 21, 1977 at the Dell View Resort in Lake Delton, Wisconsin. From the south, take the Highway 12 exit, head north to the Resort. From the north, take the Highway 23 exit and go east to the Resort. Talk-in station WB9FDZ on 146.94 MHz. There will be ladies' activities, directional bearing and transmitter hunt, liars' contest, etc. For info and advance registration, contact Ken Ebneter K9EN, 822 Wauona Trail, Portage, WI 53901. This convention sponsored by the Yellow Thunder Amateur Radio Club, Inc.

VANCOUVER WA
MAY 21-22

The Fort Vancouver Hamfair will be held Saturday and Sunday, May 21 and 22 at the Clark County Fairgrounds, 7 miles north of Vancouver

on I-5. Sponsored by W7AIA, Clark County Amateur Radio Club, in cooperation with W7KYC, Portland Amateur Radio Club. Camping, contests, swap & shop, prizes, displays, and many other activities. Registration donation $3. Send registrations to Dorman Stafford W7ZDR, Registration Chairman, Fort Vancouver Hamfair, 3509 E 21st St., Vancouver WA 98661. Make checks payable to Fort Vancouver Hamfair. Talk-in on 2 and 75 meters.

PITTSBURGH PA
MAY 22

The 23rd annual Breeze Shooters Hamfest is Sunday, May 22, 1977 at White Swan Park, Parkway West, near the Greater Pittsburgh International Airport. Western Pennsylvania's largest ham event. Amusement park adjacent to site. Free parking. Contact WA3LUM, 311 Evergreen Ave., Pittsburgh, PA 15209.

TRENTON TN
MAY 22

The Humboldt Amateur Radio Club's Annual Hamfest will be held on Sunday, May 22, 1977 at Shady Acres City Park in Trenton, Tennessee. Flea market, prizes, ladies activities, etc. For further information contact Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt, TN 38343.

EVANSVILLE IN
MAY 22

The Tri-State Amateur Radio Society is holding its annual hamfest on Sunday, May 22, at the Vanderburgh County 4-H Center in Evansville, Indiana. There will be food available, setup space, door prizes, grand prizes, and more. Bring your XYL, YL or OM, there will be fun for all. Talk-in frequencies are 75/15, 19/79 and 52. For further information please write TARS, Steven Harris, R-2 Box 81G, Mt. Vernon, Indiana 47620.

SANDUSKY OH
MAY 22

The Erie Amateur Radio Society will hold their annual Vacationland Hamfest on Sunday, May 22, 1977 at the Erie County Fair Grounds on South Columbus Ave., Sandusky, Ohio. Plenty of flea market tables @ $4 each. 8 acres for trunk sales. First grand prize is a color portable TV. Tickets $1.50 advance, $2 at gate. Flea market vehicles $1 each. Free transportation to Cedar Point Ferry Boat Docks. Call in on 52/52 FM. For further information or reservations write E.A.R.S., P.O. Box 2037, Sandusky OH 44870.

EASTON MD
MAY 22

The Third Annual Easton Amateur Radio Society Hamfest will be held on May 22, 1977, rain or shine, 10 am to 4 pm. This is the only hamfest held on the Eastern Shore of Maryland or on the Del-Mar-Va Peninsula. It's located 5 miles north of Easton, Maryland on US Rt. 50, at the Talbot County Agricultural Center. From the Baltimore or DC area, go across the Chesapeake Bay Bridge and follow Rt. 50 East for 21 miles from the bridge. Exact location is between mile markers 60 & 61. Hamfest signs will be on Rt. 50 both north and south, and talk-in on 52 and 146.445-147.045 repeater in Cambridge. Some tables available, refreshments, and prizes. Donation $2.00 with an additional $2.00 for tables and tailgaters. For further info contact Robert L. Roberts, Jr. K3ONU, PO Box 781, Easton MD 20601 or phone after 6 pm 301-822-0943.

WEBSTER MA
MAY 22

The Eastern Connecticut Amateur Radio Association will hold their 4th Annual Flea Market on May 22, 1977 at Point Breeze Rest., Webster, MA. Time will be from 10:00 am to whenever. Dealer fee will be $5.00, admission $.50 per person. Free parking. Take Rt. 52 to Exit 1 in Webster then south on Rt 193 one mile. Look for signs. Talk-in on 52 direct, 16-76, 10-70, 825-225 channel 14.

WABASH IN
MAY 22

The Wabash County Amateur Radio Club's 9th Annual Hamfest will be held Sunday, May 22, 1977, at the Wabash County 4-H Fairgrounds in Wabash, Indiana. Large flea market (no table or setup charge), technical forms, bingo, plenty of parking and lots of good food at reasonable prices. Admission is $2.00 for advance tickets, $2.50 at the gate. For more information or advanced tickets write Bob Mitting, 663 N. Spring St., Wabash, IN 46992.

DURHAM NC
MAY 28-29

The DURHAMFEST will be held May 28-29, 1977 at the South Square Shopping Center in Durham, NC. There will be a two-day flea market, fantastic prizes, seminars, bingo and shopping held for the family. Talk-in on WR4AGC: 22-82 and 222.34-223.94. For further information contact Durham FM Association, Box 8651, Durham, NC 27707.

BURLINGTON KY
MAY 29

The Kentucky Ham-O-Rama will be held Sunday, May 29 (Memorial Day Weekend) at Boone County Fairgrounds, Burlington, Kentucky. 10 minutes south of Cincinnati, Ohio, 2 miles from I-75 South, Burlington exit. Prizes, exhibits, flea market. Info: NKARC, PO Box 31, Ft. Mitchell KY 41017. Tel. (606) 331-4922.

MINNESOTA
JUNE 4

Amateur Fair '77: Dakota Division's largest Swapfest for amateur radio operators and computer hobbyists. Saturday, June 4th at the Minnesota State Fairgrounds. Free overnight parking for self-contained campers. Talk-in on 16/76 and 52/52. Selling from your car or from our tables. Some "undercover" space available. Presented by the Twin City FM Club. Prizes include: Wilson HT, Bird Model 43 Wattmeter, and much more. Admission $2. For advanced space reservations, tickets or information call Gary at (612) 644-4488.

HERNANDO MS
JUNE 11-12

The Chickasaw Amateur Radio Association, Inc., "CARA," of Hernando, Mississippi presents its annual Tri-State Hamfest June 11-12, 1977 at the National Guard Armory in Hernando, Mississippi, 20 miles south of Memphis, TN on Interstate 55. Plenty of parking area with camping sites. Tables available at $2.00. Doors open 12:00 to 6:00 Saturday, June 11th, and 8:00 to 4:00 Sunday, June 12th. Prizes, food, and beverages. Talk-in on 146.31/91, 146.52, and 3987.5. For further information write CARA, PO Box 2, ATTN: R. Gates, Hernando MS 38632.

NEWBERRY MI
JUNE 12

The Tahquamenon Amateur Radio Society swap and shop will be held Sunday, June 12, 10 am to 6 pm at the Pentland Township Hall, 3 miles south of Newberry and 2 miles west

Continued on page 188

Alan S. Kaul W6RCL
9731 Nevada Avenue
Chatsworth CA 91311

CB to 10 -- A Legal Alternative

-- part II: conversion data

How about a brand new DX transceiver that's rock stable, plugs into your cigarette lighter, and tunes 23 frequencies on 10 phone for less than $30? Of course, there are a couple of drawbacks — power output 4 Watts, and an emission type the sideband guys call Ancient Modulation — but those problems are hardly worth mentioning. Just ask any old-timer who worked the peak of the '46-'48 sunspot cycle. You *can* do wonders with just a few Watts on 10 phone, and the technical specs on the $29.95 transceiver make it a superior performer to what was available in 1946.

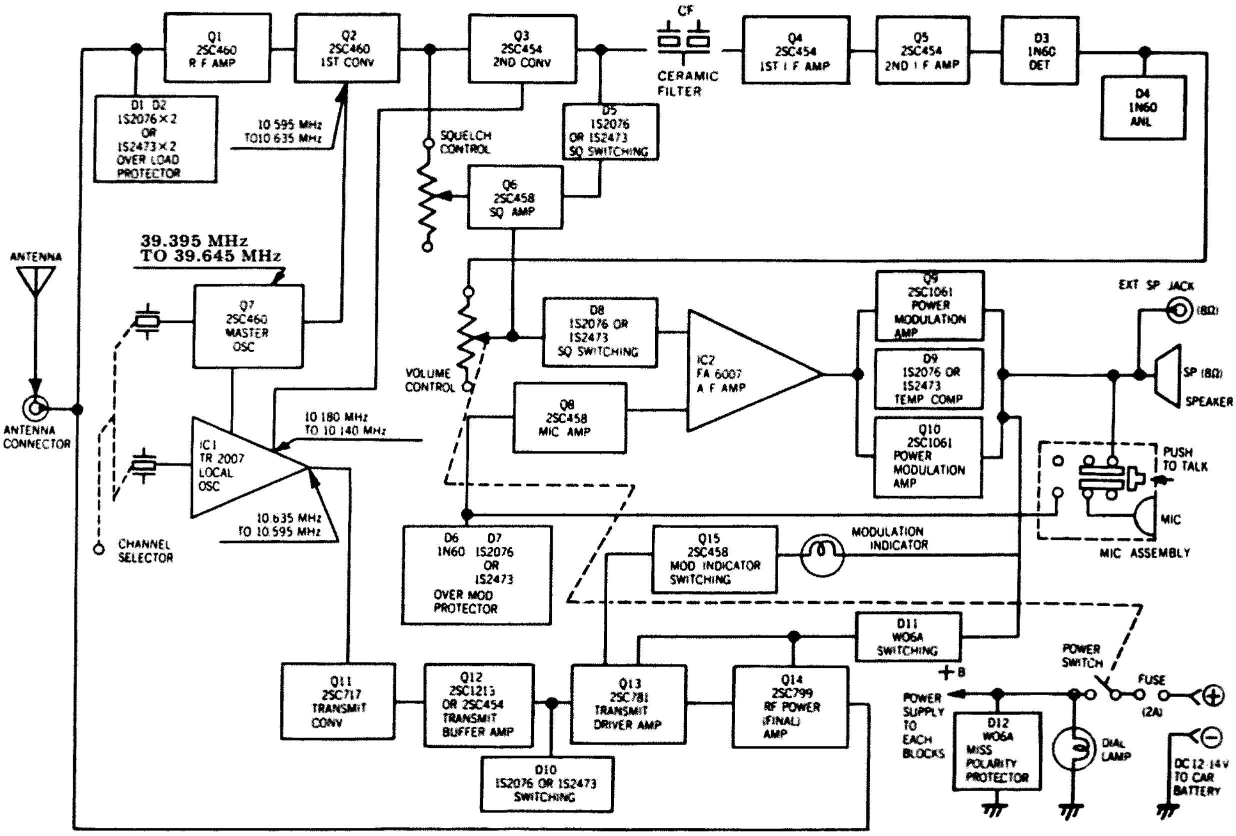
For several years, I've been watching the want ads and going to swap meets in search of the perfect junk CB rig. I had plans for picking up one for just a few dollars, changing a few crystals and — presto — getting on ten phone quick and dirty. I never really found what I wanted for a cheap enough price (CB SSB was always too expensive!) and I soon lost interest. And besides, I was busy getting onto two meter FM, plus I didn't want to give up working the low bands on CW or SSB. All of that was before the FCC approved 40 channel CB for use after January 1, 1977. When a lot of manufacturers started dumping their older model 23 channel sets on the market at bargain prices, I got reinterested in recycling a CB radio up onto 10 phone. I watched the ads and finally bought a J. C. Penney transceiver model 981-6201. It is a quality piece of gear that usually sells for twice the price. There are 2 ICs, 12 diodes, and 15 transistors in a double conversion receiver and AM transmitter configuration. The manufacturer claims 0.5 microvolt sensitivity at a 10 dB signal plus noise to noise ratio. Power output from the 2SC799 rf amplifier is listed at 4 Watts and the spec sheet advertises 90% modulation. Loaded, the transmitter draws 1.4 Amps at up to 13.8 volts (easily obtainable from the cigarette lighter in your car or from a small ac supply). The rig has a built-in squelch circuit, but is not equipped with an rf tuning indicator or receiver S-meter.

10 Meter Channel	Frequency (MHz)	Master Oscillator Frequency
1	28.76	39.395
2	28.77	
3	28.78	
4	28.80	
5	28.81	39.445
6	28.82	
7	28.83	
8	28.85	
9	28.86	39.495
10	28.87	
11	28.88	
12	28.90	
13	28.91	39.545
14	28.92	
15	28.93	
16	28.95	
17	28.96	39.595
18	28.97	
19	28.98	
20	29.00	
21	29.01	39.645
22	29.02	
23	29.05	

Table 1. Frequency coverage of the $29.95 DX transceiver.

When the Citizens Band was created in the 1950's, the early rigs used 23 pairs of crystals to tune both transmit and receive on all 23 channels. Converting one of those rigs to 10 phone would cost a small fortune to crystal up, but I was prepared to pay it until Norm Lefcourt W6IRT mentioned that the newer CB rigs use crystalplex, replacing the old 46 crystals with 14 new crystals and still covering all 23 channels. Norm pointed out that by replacing the six master oscillator rocks, I could cover 23 frequencies simplex on the 10 meter band with just a little tweaking of a few L/C circuits. W6IRT, WA6QPL, K6JUA, others and I all started working on the conversion. K6HY, K6LJJ, and WB6QKF helped with advice.

It sounds pretty easy, but there was a problem — deciding on which frequencies on 10 phone to use. The phone portion of the band is gigantic when compared to the other HF bands, and we wanted to pick a segment where there would be some activity. We didn't want to cause difficulties for other services, yet at the same time we wanted to stay near the low end so that retuning from the CB frequencies would not require a rewinding of coils. After an awful lot of discussing on the landline and two meter FM, we decided to stay away from both the very top end of the 10 phone segment (because of OSCAR) and from the very bottom end, too (because of the SSB DX activity just above 28.5). We finally settled on a starting frequency of 28.76 MHz for channel one, with the other 22 channels tuning upward from there. The decision was based on two practical considerations: First, the pres-



ence of the "10-10 club" net on 28.8 (our channel 4) could tell us very quickly when the band is open, and second, because many home QTH rigs only tune a single 500 kHz portion of the 10 meter band, choosing a frequency outside that segment would mean having to do without a very important piece of test gear – the station receiver.

The first 23 CB channels start at 26.965 and end at 27.255. Channels 1, 2, and 3 are 10 kHz apart, but there are 20 kHz between channels 3 and 4. Channels 4, 5, 6, and 7 are ten kHz apart, but between 7 and 8 there is another jump of 20 kHz. The cycle keeps repeating itself every fourth channel until channel 22, which is 10 kHz higher than channel 21 but 30 kHz lower than 23.

The J. C. Penney rig that I bought and W6IRT's Publicom #1 use six master oscillator crystals (37.600, 37.650, 37.700, 37.750, 37.800, and 37.850), four transmit crystals (10.635, 10.625, 10.615, and 10.595), and four receive (10.180, 10.170, 10.160, and 10.140). On transmit, the rig mixes the master oscillator with the transmit crystal (37.600 minus 10.635 is 26.965 – CB channel one). On receive, the receive crystals are the first i-f conversion frequency and the second i-f operates at 455 kHz. Image problems are minimized by the double conversion i-fs.

The Conversion

To begin with, you need new master oscillator crystals. The J. C. Penney rig uses six – if you want to be able to tune all 23 channels on 10 phone, you have to replace all six. If you only want four frequencies, replace only one master oscillator crystal; if you want to tune eight, replace two, etc. Not all of the crystalplex rigs use the same master oscillator frequencies – some operate in the 16 MHz range – so be sure to check the frequencies in your rig before you go out and buy new rocks. Both Norm and I are just replacing two master oscillator crystals to see how the eight channels work. But, eventually, we both plan to be outfitted with all six crystals and full 23 channel 10 meter coverage. Our new channel designations and crystal frequencies are spelled out in Table 1. Those are the frequencies we are using (along with about 30 other guys in Southern California). When you crystal up, use the same frequencies so we'll all have someone else to talk to. We will continue the CB channel designations (that saves changing the dial) so that our lowest frequency is channel one and our highest is channel 23.

After changing crystals (and a word of warning there – most master oscillator crystals are wire type and must be soldered in; BE CAREFUL!), hook the rig up to a 12 V dc supply and a suitable dummy load antenna. We found the receiver sections worked well enough so that tuning up only required peaking the rf and first mixer stage coils for maximum band noise. Transmitting is a little more complicated, but not impossible. If you don't have a voltmeter, use some kind of relative power output indicator (an swr bridge, a light bulb, etc.). Peak the coils in the transmit stage starting with the master oscillator. You don't have to peak the coil for the transmit crystals, because they still put out in the 10.600 MHz range. Peak each succeeding output stage for maximum indicator reading. If you have a voltmeter, connect it to the output of the transmit driver stage, then peak the lower stages for maximum reading. Then peak the final with some kind of power output indicator. The funny thing about the CB rigs we bought is that they all came with full and complete tune-up instructions – even though CBers aren't supposed to even touch them with a screwdriver.

Antennas: Most of the CB radios are designed for 50 Ohm output and most of the CB antennas sold are vertical-

ly polarized. Polarization probably won't make any difference on the real long haul skip, but for working ground wave with others in your area, it makes more sense to install a vertical antenna. That's what the mobiles are using anyway, and a rooftop groundplane for the home QTH is only 8 feet tall. After seeing what some of those yo-yos on 11 meters are using, I would say it won't take an awful lot to be able to get out.

The $29.95 transceiver is a good club project. If you can't find one on the market, hit the swap meets and check the ads in the local papers; you may even be able to get a better price by buying one from a disgruntled CBer who gave up trying to punch through the QRM. If you are big on modifications, I'd like to hear about them (or see them in print in case I want to try one of them). Here are a few I have in mind: A small VFO that will fit inside the transceiver case and plug into one of the master oscillator crystal sockets; a low cost linear amplifier capable of 15 to 20 Watts output; an alternate conversion for six meters or one for the low power DX guys who want to work 15 CW; a slider for receiver and/or transmitter offset tuning; a BFO; a sideband adapter; or maybe a transceiving converter to other bands.

Look for me on 10 phone. I'll be listening on channel 4 — 28.80 MHz. If I hook up with somebody, I'll QSY up or down to continue the contact. If 28.80 is busy, I'll hang out on channel 3 (28.78). How about you? If we all use the same "channels," it'll make it a lot easier to work 10 phone. If you hear me on though, don't give me any of that "... Breaker, Breaker, this is your old good buddy, got time for a 10-7 ...?" baloney. I heard all of that I could stand while I was waiting for my crystals to arrive!!! ■

All-Electronic SELCAL

- - uses a UART for versatility

Anthony Sperduti WB2MPZ
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Hamburg NY 14075

There have been a few articles on the merits of the selective call (SELCAL) circuit. All of them have been on the use of the Model 28 stunt box. To those of you who are unfamiliar with the 28 stunt box, I will go over it a bit. It is a mechanical arrangement of fingers that are spring-loaded and press against the parallel code bars on the 28 machine. The code bars have slots in them, and when the slots are properly lined up to a stunt box finger, that finger will slip into the slot and provide you with a mechanical function of the machine to perform an operation such as line feed, carriage return, or almost anything you want it to do. It also will operate a switch that you must put on top of this finger. When the finger moves forward, it will operate this switch. The machine has 42 slots for these fingers in the stunt box, which is located between the paper roll and the printer. If you fully load one of these machines up with all 42 code bars, it gets a little crowded, to say the least. It also can get to be very expensive, as these little things cost around 2 bucks each. Now you have to get switches for each one and then run all the wiring to the switches. If you want to do logic with the switches, you will have to build up a heck of a lot of relays to do your logic work for you. For example, if you want a circuit to operate when you have 7 characters in a row, you must first have seven of these bars in your machine that have the characters you want coded on the ends – that is, you either buy them for your callsign or you buy the ones that have all the fingers on them and break off the ones you don't want. Once you set it up, you have had it; you cannot change anything. What I am trying to get over is that it can get expensive and really complicated with a fully loaded stunt box. If you don't have a machine with a stunt box, you can't do it. After playing around with this idea, I decided to come up with an electronic stunt box that could be used with any machine and could also be changed to any character combination that I wanted. Since hams like to have names for these circuits, I will call it the ESB-1, that is, Electronic Stunt Box One. This little circuit will do everything that any mechanical stunt box can do and do it better, faster, cheaper, and easier.

Since by now almost all RTTY people know what a UART is, I will not go into the merits of one and how it works. You will get an added benefit using the SELCAL with a UART, as not only does it enable you to have an electronic stunt box, but it also will help in cleaning up the received signal for better copy. I will go over the circuit to explain how it operates.

The UART is a GI AY5 1013 that converts the incoming teletype signal to a parallel signal. That is, it receives the serial signal and puts the bits out on five separate lines. The UART has been wired to copy a 5 bit code (Baudot). The second half of the UART now converts it back to serial again so that it can drive the TTY machine loop. The five bits are on pins 12, 11, 10, 9, and 8. Pin 12 is the first bit and 8 is the fifth bit. Note that these five lines are wired to a pair of 9311 (74154) one of sixteen decoder/demultiplexers. Pins 20, 21, 22, and 23 of the 9311s are the address lines of these chips. Pins 18 and 19 are the enable pins. Pins 1 through 17, with the exception of pin 12, are the output pins. The outputs are all active low – that is, when they are addressed, they will go low; all other times they will be high. Only one output pin at a time can go low, and then only when that chip is enabled by pulling both enable pins 18 and 19 low. In this circuit, I do not pay attention to what case the machine is in, as it can't really tell. I will assume that it is always in lower case letters. Check the truth table in Table 1 and you will see what lines address the output pins. For example, if pins 20, 21, 22, and 23 are all low, and the two enable pins are low, output pin number 1 will go low. If pin 23 is high, and 22, 21, and 20 are low, and both enables are low, output pin 2 will go low. This is a BCD code, with pin 23 being the least significant bit and 20 the most significant bit. Bit number 5 from the UART is connected to one of the enable pins (18) of num-

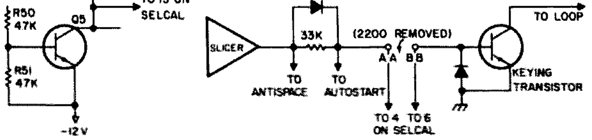

Fig. 1. ST-6 to SELCAL interface.

Pin #

18	19	20	21	22	23	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17
H	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	L	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	H	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	H	L	L	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H
L	L	L	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	L	L	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H
L	L	H	L	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H
L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H
L	L	H	H	L	L	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H
L	L	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L

H = High Voltage
L = Low Voltage
X = Don't Care

Table 1. Truth table, 9311/74154.

ber 1 9311 and then inverted through the 7404 to pin 18 of the other chip. What this does is address chip number 1 when the fifth bit from the UART is low and address chip number 2 when the fifth bit is high. The DAV (data available) output of the UART is connected to the other enable pin (19) of both 9311s.

Now the data is put on the parallel lines from the UART; this addresses the proper chip for which character you want from it. Now the DAV line from the UART goes low, enabling the second enable pin on the 9311, telling it to decode, as data is on the line and it is addressed. This will put a low level on one of the output pins of that chip, depending on which character is being received by the UART.

The DAV line also ties to the 7404 and the 7400, pin 12. The 7404 inverts the DAV signal and clocks the parallel lines into the transmit part of the UART and also feeds back into the UART RDAV (reset data available line). This will cause the DAV line to go high and inhibit the 9311s. Now the output that went low on the proper 9311 will go high. You can see that this gives us a fast pulse out of the 9311s that is just long enough to trigger the 7473 flip-flop that is tied to that line. Table 2 shows the Baudot code that is related to the parallel lines on the output of the UART.

This SELCAL is designed to work with the ST-5 or ST-6 terminal unit. In the May issue of the *RTTY Journal*, Irv Hoff has a circuit of how to modify the ST-6 to use the UART. All it consists of is the removal of the 2200 Ohm resistor that is connected to the base of the driver transistor MJE 340. Fig. 1 is a copy of this circuit modification. Connect the output of the op amp slicer to the input of the SELCAL pin 4 and then the output of the SELCAL pin 6 to the base of the drive transistor. The input to the SELCAL keys the 2N706, gets inverted by the 7404, and drives the UART through pin 20. The pulses always get through the UART and come out pin 25. This is again inverted by the 7404 and tied to one input of the two input 7400 NAND gate. The other input of this NAND gate is connected to the Q output of flip-flop number 4B. This output is low so that no pulses will get out of the SELCAL and the magnets will be held in the mark hold mode. Transistor Q1 is 2N706 and it monitors the autostart relay in the ST-6. Pin 15 of the SELCAL is connected to the collector of Q5 in the ST-6. When the ST-6 relay is not picked up, you will have a positive 12 volts coming in and this will turn on Q1. The collector of Q1 will go low and hold flip-flop number 4B reset. This puts pin 9 of this flip-flop low and keeps the output and gate 7400 from passing any data to the keying transistor of the ST-6.

When the ST-6 autostart relay picks up, the collector of Q5 in the ST-6 will go to negative 12 volts. This turns off transistor Q1 in the SELCAL and the collector of this transistor now goes positive and takes off the reset hold on the number 4B flip-flop. Data will still not get through the SELCAL as the Q output of the flip-flop is still low until it is toggled. You will note that the collector of Q1 was not only holding the reset of flip-flop 4B, but also the reset on flip-flop number 1A through the two 7408 AND gates. Flip-flops 1, 2, 3, and 4 are all connected in series so that the flip-flop ahead of it is holding its reset low and therefore its Q output will be low. When in this mode, no pulses will be able to toggle any of the flip-flops. When transistor Q1 collector goes high, it removes the reset from flip-flop number 1A. The DAV line from the UART cannot pulse the 7490 counter as it cannot get through the 7400 NAND gate, because flip-flop 1A is holding one of the gates low. On the reception of the first FIGS character, flip-flop 1A gets toggled, the Q output goes high, and now will let the DAV line toggle the counter. The Q output also removes the reset from flip-flop 1B, enabling it to be toggled if the next character is an A. The Not Q output of flip-flop 1A is tied back to the K input and prevents it from being toggled anymore if you send another FIGS. It also removes the reset on the 7490 counter so that the pulses from the DAV line will now increment the counter each time the DAV line goes high. Now follow the chain down the flip-flops and you will see that each character in the string of FIGS A, S, I, A, O, and U will toggle flip-flops 1A, 1B, 2A, 2B, 3A, 3B, 4A, and finally 4B. Flip-flop 4B will turn on the LED, showing you the SELCAL is active, and puts a positive on the 7400 NAND gate, allowing the data to get out of the SELCAL, key the ST-6 driver transistor, and print on your machine on the very next character after the U.

Let's go back to the counter. The 7490 counts the characters that come in after the FIGS is received. This is

so that you must make ASIAOU in six characters or the whole chain of flip-flops gets reset via pins 8 and 9 of the counter, through the 7400 NAND gate and the two 7408 AND gates. You must now start all over with the FIGS to get the chain going again. You must send these 7 characters in a row and in the proper sequence in order for the SELCAL to operate. If it were not for the counter, the chain would sit there and just wait for the characters to come through. Whenever it did sense these seven in sequence (even though you had hundreds of characters in between the valid ones), it would turn on. The NE555 timer is just set up for a clock for the UART. It is adjusted for 32 times the baud rate that you want to receive and then flip-flop 5A divides it by two so that it is a symmetrical clock pulsing the UART. The UART wants to get pulsed 16 times the baud rate you are receiving. I run my machine at 100 wpm or 75 baud. 75 times 16 is 1200, and that is my clock frequency at the UART. The simple little power up circuit using diode D1, resistor R4, and capacitor C3 insures that every time I turn the power on the SELCAL, it will reset all the flip-flops. The way it works is that when power is first turned on, all the gates and flip-flops will come up to power before the gate on pin 5 of the 7408 AND gate. This is due to the fact that the capacitor tied to this pin is short circuited until charged and will hold this pin low long enough to reset the flip-flops. You can fool this circuit if you turn the power off and then on again before the 100 uF capacitor has a chance to discharge. Once the SELCAL is turned on, it will not shut off until you turn the power off, push the reset button, or the ST-6 autostart relay drops out. Any one of these will reset all the flip-flops and now you will have to do the whole thing all over again.

A friend of mine asked me if I could come up with a circuit like this that could be easily changed to any 7 characters you wanted, be simple, and above all, be reasonable in price. I looked up the price of all the chips and came up with a fantastic price for everything (including the UART, resistors, and capacitors) – less than $35.00. This does not include the power supply or the board to mount the chips and the sockets for them. I hope to lay out a PC board and make it available for somewhere around $8.00, depending on my costs. The power supply needs a good regulated 5 volts at 300 mA and negative 12 volts at 10 mA. I am sure this will not strain any power supply that you are using for your ST-6. This circuit can be expanded to any amount of characters that you would want by simply adding flip-flops and changing the counter to what you would want to count. A turn-off of 4Ns is incorporated by switching in the other flip-flops and separate counter so that when you get four Ns, you pulse the reset and turn off the chain of flip-flops. I am sure that this circuit will save many rolls of paper that get tossed out of your machines when you are in the autostart mode and not home and some CW station happens to get your machine going with line feeds. I monitor the Navy Marine Corps MARS frequencies and was shocked one time when I came home from work and heard a RTTY station just sending out test pulses; every one of them to my machine was a line feed. I must have

Fig. 2. ESB-1. Parts list: 1 – UART; 2 – 9311/74154; 1 – 7400; 1 – 7404; 1 – 7408; 7 – 7473; 2 – 7490; 1 – 555; 2 – 2N706; 3 – 1N914; 1 – LED.

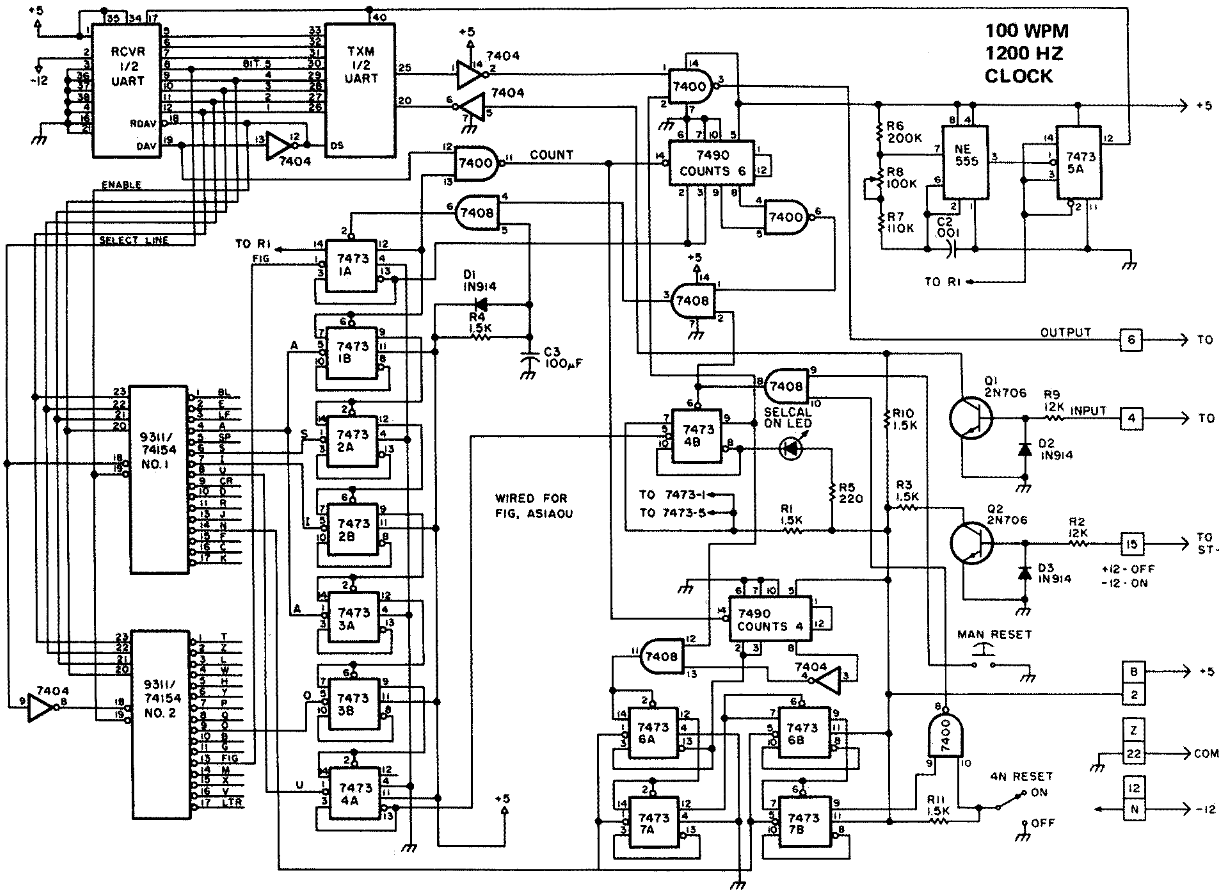

Table 2. Truth table, 5 bit TTY code.

Bit 5	4	3	2	1	Character	Bit 5	4	3	2	1	Character
L	L	L	L	L	= BLANK	H	L	L	L	L	= T
L	L	L	L	H	= E	H	L	L	L	H	= Z
L	L	L	H	L	= LF	H	L	L	H	L	= L
L	L	L	H	H	= A	H	L	L	H	H	= W
L	L	H	L	L	= SPACE	H	L	H	L	L	= H
L	L	H	L	H	= S	H	L	H	L	H	= Y
L	L	H	H	L	= I	H	L	H	H	L	= P
L	L	H	H	H	= U	H	L	H	H	H	= Q
L	H	L	L	L	= CR	H	H	L	L	L	= O
L	H	L	L	H	= D	H	H	L	L	H	= B
L	H	L	H	L	= R	H	H	L	H	L	= G
L	H	L	H	H	= J	H	H	L	H	H	= FIG
L	H	H	L	L	= N	H	H	H	L	L	= M
L	H	H	L	H	= F	H	H	H	L	H	= X
L	H	H	H	L	= C	H	H	H	H	L	= V
L	H	H	H	H	= K	H	H	H	H	H	= LTRS

rolled up 50 feet of paper off the floor back on to the spool. My wife would not go near the machine for a while, as she thought the dumb thing was going to blow up. This circuit should make autostart stations feel a bit more at ease knowing that their machine is not going to print unless it hears their callsign or any other combination of 7 characters that they want to choose. ■

Corrections

I read the article "Have You Used a Triac Yet?" in the October '76, *73 Magazine*.

You seem to have conveyed the wrong notion of holding current.

This current is *not* a gate current. It flows from anode 1 to anode 2.

Once the gate current has triggered anode-anode current, one could cut its gate current to zero (open circuit) and anode current would continue to flow.

The only way to stop it is to increase the resistance in series with the anode-anode supply, until the current flowing drops below a certain critical value. *This is the holding current.*

More usually, one removes the supply voltage by using an ac or a pulsing dc source.

Michael Murphy VK6ZCX
Wembley Downs
Western Australia

I've noticed a few corrections which should be made to my article ("Build a Counter for Your Receiver") in your October, 1976, issue. In Fig. 2, the output of the 8T98B should be connected to the following input and the 1k resistor, but not to ground. In Fig. 8, the emitter of the first HEP15 should be connected to the junction of the 2 1500 pF capacitors, but not to its base. The connection dots indicating +5 V connected to pin 14 of two of the 7490s should be removed. Relative to the power supply design shown in Fig. 9, I found that removing about 7 feet of wire from the secondary of the recommended power transformer allowed the regulators to run much cooler. This seems to be an ideal way of obtaining low cost power transformers for home computers.

Jack Regula WA3YGJ
Freeville NY

Please note the following corrections to "Mobile Smokey Detector" (Holiday, 1976):

1. In Fig. 2, the circuit diagram, the resistor connected to pin 14 of the CD4011A integrated circuit is 100 Ohms. It is a decoupling filter.
2. The location of the detector crystal and modulator diode are in conflict in Figs. 2 and 3. The locations in Fig. 3 are correct.
3. The tips of the diodes shown in Fig. 3 appear to touch the inside wall of the circular waveguide, which is correct, but part of the drawing was left off, to indicate that sleeves which make good electrical contact should be installed. These may be constructed from brass pipe obtained in model shops. The pipe has an inside diameter which tightly slides over the diode tips.
4. Please do not plan on getting on the X band frequency or, for that matter, on any frequency without a license. The implication that a license might not be required was the editors', not W1SNN's.
5. Parametrics 400075 Schottky diodes may be purchased from Parametrics, Inc., of Winchester, Massachusetts, or Microwave Associates, of Burlington, Massachusetts. Both of these manufacturers have a minimum order requirement, and may not be too sympathetic to selling pairs of diodes. K1NAY, 25 Westfield Road, Natick, MA 01701, has a sales schedule for pairs of these diodes, which may help. 1N23E diodes will work well in both places, but care must be used in biasing and with the switching levels. Use them as a last resort.

Stirling M. Olberg W1SNN
Waltham MA

The first two articles read after scanning the January, 1977, issue were: "Dirt Cheap Regulation," and "Behavior Mod for the HM-102."

In the first article, the author did not follow his own parameters for criteria when he loaded the supply to 1.2 A for 30 mA residual ripple. With any kind of Beta on the two transistors, the regulation should be better than that. Also not mentioned is that the emitter of T1 has residual ripple (output ripple) which is in phase with the base ripple and so is degenerative, further reducing ripple. The C to reduce ripple in the regulator would be far more effective and smaller (cheaper) if placed at the base of T1, instead of as illustrated before the isolating resistor. Of course, if current limiting is also used, some isolation from T1 base would be advisable after C. This convenience and security can be easily secured by a small value resistor in the negative return lead and an NPN transistor with collector connected to T1 base. Also, it might be mentioned, since we are going to the junk box, that zeners and conventional diodes, both germanium and silicon, can be combined for precise values. The literature also provides the information so that the combination will be less temperature dependent.

As for the fine article on modifying the HM-102-1, there is an error in the drawing. Some of the boys, quick with the soldering iron, might proceed at once, looking at the manual and the drawing. The new lead (white) to R4 does not go to pin 5 of SW2, but remains at pin 4. The red lead should be shown from B to pin 5.

Frank C. Ruland
Oklahoma City OK

With regard to my article "Digital Autopatch" (April, 1977), I would like to point out the following:

1. "Touchtone" is a registered trademark of AT&T.
2. In the caption for Fig. 6, the following should be deleted: "R5, Q3 not used. Highest R = 31; highest C = 20".
3. On the third page of the article, column 1, line 10, should read, "to 7. The 74193 loads a '1' ".
4. In Fig. 9(b), "17" should read "L1". Please note that the configuration for the 2N3904 transistor was inadvertently omitted (although the pads are shown).

E. E. Buffington W4VGZ
Burlington NC

Ham Help

The Laundale Amateur Radio Club, a newly formed youth oriented organization, seeks your assistance in acquiring equipment. We need all types of usable equipment (VHF antennas, keyers, matchboxes, etc.) to get our members on the air. We are lacking funds, so a nice low price tag or a donation would be well appreciated. Help a young ham and send your info to:

Dennis J. Gazak WA3SZD
President, Laundale ARC
321 Stevens Street
Philadelphia PA 19111

Will be glad to help any County Hunter with Dukes County, Mass. during 1977 on 80-40-20. Just drop me a note for a sked.

Duncan Kreamer W1GAY
Box 637
Vineyard Haven MA 02568

I have an HW-16 CW transceiver and would like to operate it on the twenty meter CW band. I have heard there is a modification to change the 15 meter portion to the 20 meter portion, but am unable to find any info on it. Can someone help?

Alvin S. Koslofsky WB2CUP
2105 Rockaway Parkway
Brooklyn NY 11236

Wanted: a small lightweight QRP transmitter for 40 meter CW operation, 12 V dc or ac line okay. Write giving full particulars. Needed by June.

James Kates WB8TCC
360 North Hubbard Hall
Michigan State University
East Lansing MI 48824

I would like to get in touch with someone who knows his stuff on the Central Electronics 100 V transmitter. I'd like to try for repair advice by mail, or I'll phone. Alternatively, is there a commercial repair outfit who could handle it within a reasonable drive of North Jersey? Thanks much for any help.

Joe G. Koosman K2GFH
54 Brookside Terrace
North Caldwell NJ 07006

Could you show a circuit diagram of an 80/40 meter receiver suitable for CW communications? It should have selectivity.

Benjamin Diaz, Jr. WB4VEZ
2870 SW 123 Ct.
Miami FL 33175

Try "Novice Q & A" for the receiver tips, and January, 73, pg. 160, for a simple transmitter. — Ed.

I would like to appeal to your readers for technical advice on converting a Hammarlund FM 50a commercial transceiver to 2 meters. I am especially wondering about the 1st local oscillator in the receiver section.

Steve Royer
114 Sunset Pt.
Greenville FL 62246

Need help in designing and finding parts (ICs, etc.) for a solid state crystal-calibrated signal generator 3-30 MHz and FM 88-108 MHz and crystal-controlled 19 kHz, 4.5 and 10.7 MHz.

Ford I. Secrist WA3CWZ
355 N. Wash. St.
Easton MD 21601

Tracking the Hamburglar

RIPPED OFF: Motorola VHF-FM Transceiver, "Modar Triton" Series, Model #D23ABA1820A, modified; Serial #LM049T. Serial Numbers & Model Numbers are engraved on the back and inside; also name "W. L. Call," amateur callsign "WA4ZSJ," and driver's license number "KY C-400-887-553-475-6." Unit is distinguished by faded white case with word "SALVAG" scratched into top of case. Inside contains custom modifications. Value $450. Contact William L. Call WA4ZSJ, Box 2740 University Station, Murray KY 42071.

TAKEN: Swan Model 400 transceiver, s/n 100801, grey case, from my car on the morning of February 10, 1977, at my office, City of Industry, California. Neither the 406 tuning head nor power supply were taken; hence, the thief or whoever buys the transceivers might be looking for such items. Ira Bechtold, 17137 East Gale Ave., City of Industry CA. Refer any info to Sheriff's Dept., Detective Bureau, (213) 330-3322, file no. 577-02681-1424-696.

HIJACKED: Clegg FM-3 2 meter transceiver, s/n 750117. Passenger window was smashed on my locked car while at a restaurant in Lowell, Mass., on January 15, 1977. This unit has engraved on upper rear the markings A977. Emile T. Timko W3QHX, 5 West 17th Street, Hazleton PA 18201.

Social Events

from page 161

on highway M-28. Refreshments at the site, ample parking, campsites available at a nominal fee. Reg. $2 at the door. Drawings and door prize. Many free family passes for tours in the famous Tahquamenon area. Many other prizes. Talk-in on 25-85, 28-88 52 & 94 simplex. Correspondence W8GBR.

AKRON OH
JUNE 12

The Goodyear Amateur Radio Club of Akron, Ohio will hold its 10th Annual Hamfest and Family Picnic on June 12, 1977 at Wingfoot Lake Park between the hours of 10 am and 6 pm. The park is located southeast of Akron on County Road 87 near Route 43. Ample parking, rain shelters, picnic facilities, kids' play areas and refreshment stands. The flea market/swap shop space is free with the admission ticket. Gear displays, prizes, etc. Sorry — no overnight parking or swimming. Mobile check-in on 04/64. Family donation $2 advance, $2.50 at gate. For more info contact Don Rogers WA8SXJ, 161 S. Hawkins Ave., Akron, Ohio 44313. Phone: (216) 864-3665.

SANTA MARIA CA
JUNE 19

The Satellite Amateur Radio Club is sponsoring its annual Santa Maria Amateur Radio Picnic and Swapfest Sunday, June 19, 1977 beginning at noon, at the Newlove-Union Oil Picnic Grounds on Orcutt Hill (watch for the sign marking the turn-off one mile south of Clark Ave. on U.S. 101). Swap tables available at $3 each. Santa Maria Style Barbecue to be served at 2:30 pm. Talk-in on 146.52 and 7280 kHz. Many prizes. Tickets $5.00 adults, $2.50 children. For advance orders, send checks to Santa Maria Swapfest, Post Office Box 1031, Nipomo, California 93444. For further info contact Satellite Amateur Radio Club, PO Box 1615, Vandenberg Air Force Base, CA 93437.

PORTAGE IN
JUNE 19

The Lake County Amateur Radio Club's 3rd annual hamfest is June 19th at the Isaac Walton League in Portage, Indiana. (Take I-94 to Ind. 249 exit, then north on Ind. 249 ½ mile.) Tickets: $1.50 advance, $2.00 at gate. Write: Herbert S. Brier W9AD (W9EGO), 409 S. 14th St., Chesterton IN 46304.

JACKSONVILLE IL
JUNE 26

There will be a hamfest held in Jacksonville, Illinois June 26, 1977. Same place as last year. Talk-in 146.40/147.00 WR9ACS. For further information contact (after April 1st) Box 271, Jacksonville, IL 62651.

CUMMINGTON MA
JULY 9-10

The Northern Berkshire Amateur Radio Club Hamfest will be held July 9th and 10th at the Cummington Fairgrounds, Cummington MA. Free overnight camping, tech talks, demos., and dealers. Flea market $1. Admission $3 with XYL $5, advanced $2 and $4. For information write Hildy Sheerin WA1ZNE, 79 Greylock Ter., Pittsfield MA 01201.

OAK CREEK WI
JULY 9

The South Milwaukee Amateur Radio Club Swapfest '77 will be held Saturday, July 9, 1977 at Shepard Park (American Legion Post #434), 9327 South Shepard Avenue, Oak Creek, Wisconsin. Activities begin at 7 am and will run until about 5 pm.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	14	14	14	14A	14A	14
AUSTRALIA	14	14	7B	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7A	14	14	14	14	14
HAWAII	14	14	7A	7B	7	7	7	7	14	14	14	14
INDIA	7	7B	7B	7B	7B	7B	7A	14	14	14	7A	7
JAPAN	14	7A	7	7	7	7	7	7	7	7A	7A	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14B	7B	7B	7B	7B	7B	7	7	7	14B	14
PUERTO RICO	14	7A	7	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7	7	7B	7	7B	14B	14	14	14	14	14	14B
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	7
WEST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	7A	14	14	14	14A	14
AUSTRALIA	14	14	7A	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	14A	14
ENGLAND	7	7	7	7	7	7	7	7	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	14	14	7B	7B	7B	7B	7B	7B	7	7	14	14
JAPAN	14	14	7A	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	7	7	7A	14	14
PHILIPPINES	14	14	14B	7B	7B	7B	7	7	7	7	14B	14
PUERTO RICO	14	14	7	7	7	7	7A	14	14	14	14	14
SOUTH AFRICA	7	7	7B	7	7B	7B	14B	14	14	14	14	14B
U. S. S. R.	7	7	7	7	7	7	7	7	7A	14	14	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	14	7A	7	7	7	7	7	7	7	7	7
ARGENTINA	14A	14	7A	7	7	7	7	14	14	14	14	14
AUSTRALIA	14	14A	14	14	7A	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7	7A	14	14	14	14
ENGLAND	7	7	7	7	7	7	7	7	7A	7A	14	14
HAWAII	14	14A	14	14	7A	7	7	7	7A	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7B	7	7	7	7
JAPAN	14	14	14	7A	7	7	7	7	7	7	7A	14
MEXICO	14	14	7A	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	14B	7B	7B	7	7	7	14B	14	14
PUERTO RICO	14	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7B	7	7B	7B	7B	7B	14B	14	14	14B
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	7	7
EAST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Solar flares

1977			MAY			1977
SUN	MON	TUE	WED	THU	FRI	SAT
1 F	2 F	3 G	4 G	5 G	6 G	7 G
8 G	9 G	10 F/SF	11 P/SF	12 P/SF	13 P/SF	14 F/SF
15 F	16 G	17 G	18 G	19 F	20 G	21 G
22 G	23 F	24 G	25 G	26 G	27 G	28 G
29 G	30 F	31 P				

73 AMATEUR RADIO

JUNE 1977
$2.00

73

#201 JUNE 1977

COVER: Stew Perry W1BB's shack (article begins on page 58). Photo by Stan Miastkowski WA1UMV.

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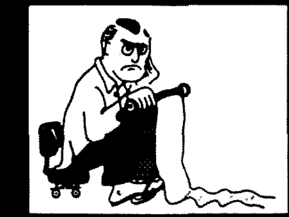


NEVER SAY DIE

... de W2NSD/1

EDITORIAL BY WAYNE GREEN

LOST FREQUENCIES

The Jack Anderson column made a big deal out of how many frequencies amateurs have, while carefully skirting a more realistic evaluation of the situation. We're far enough into the space age now so that it should be clear to just about every active ham that while we can always have fun on the low bands, the opportunities of the UHF ham bands via satellites would make possible a communications system far beyond anything imagined in the past.

A series of synchronous satellites would permit several million hams to make contact at any time with any one or group of other hams . . . anywhere in the world. This, as the space age came upon us, was the real future that we had ahead. We were beginning to think in terms of getting to work on experimental UHF stations with signals strong enough for satellite work up in the GHz bands.

Then came the 1971 ITU space conference in Geneva . . . we were represented there by the ARRL. We went into that conference with about 237,254.77 MHz of amateur allocations for satellite use and we suffered a slight loss. Perhaps you read about it in the fine print in the back of *QST*. The ARRL team came back to announce that we had lost 237,247.27 MHz of satellite frequencies . . . with little hope of ever recovering the lost frequencies in the future. That's right — we went into the conference with 237,254.77 MHz and came out with 7.5 MHz.

When you consider that few of the frequencies above 500 MHz hold much promise for us if we can't use them via satellite, perhaps you can appreciate the magnitude of the loss.

There I go being anti-ARRL again . . . well, maybe . . . but how about you? Is it all okay with you that the ARRL refuses to let anyone else represent amateur radio . . . and then screws up the job they've kept anyone else from taking?

What happened at Geneva in 1971? If you go back and blow the dust off your old *QST*, you'll read the story . . . our "representatives" went to the conference without preparation. They were completely surprised by what happened and had no plan to meet the situation. They found the delegates from the third world countries anti-amateur radio, largely due to not knowing much about it. This is a natural situation and one about which I've been writing for many years.

If the ARRL had spent even a tiny fraction of the membership funds which they are squandering on plush offices to get out there and meet government officials from smaller countries, we might well have the bright prospects of synchronous satellites and several thousand megahertz to experiment with.

So call me anti-ARRL if you want . . . I'm *not* anti-League or pro-League . . . I just am telling you what is what. I don't think amateur radio would do any worse if the League were to fold up tomorrow . . . as a matter of fact, it might be beneficial because then someone might set up a national club which would be run for the benefit of the amateurs instead of a small group of career "hams" in Newington. I put "hams" in quotes because I have little indication that any of them pay much more than lip service to the hobby.

If you are an ARRL member and you have no objection to a bunch of guys in Connecticut spending your money on lovely offices while pretending to serve you, then you have no gripe. If you don't mind losing 99.99684% of your satellite frequencies at a conference where *you* paid the bills to be protected . . . all okay. This is probably a small price to pay for being pro-ARRL.

If you do object to the charade of pretend representation . . . of getting along with no lobby in Washington . . . with losing your frequencies in huge gobs . . . with the damnedest rules being spawned by the ARRL and being passed by the FCC (have you really forgotten "incentive licensing" yet?) . . . if these things bother you, then, dammit, speak up and let that bunch of parasites know you want a change. The next time an election of directors comes up, make sure that someone who is more interested in amateur radio than the power and prestige of being an ARRL official is put up for election . . . and elected. Within two years you could change the League completely, since half of the directors are elected every year. Within two years you could get in a bunch of fellows who could turn the ARRL into a powerful lobby for amateur radio . . . who would make sure that nothing like that Jack Anderson column happened.

As far as saving our bacon at the 1979 WARC conference, it's too late to count on the ARRL. It would take two years to get enough directors elected to turn things around, and the conference will already be upon us. Those third world countries are still anti-amateur radio, and you can bet that when it comes to a choice between frequencies for a bunch of American hams or for their own needs . . . or even remotely possible needs . . . we are not going to get the vote.

This is purely a matter of public relations. Amateur radio is of immense importance to these countries . . . only they don't know it. No one has gone over to visit them and show them what amateur radio can do for them in the way of helping their country to develop . . . getting them technicians and engineers for their communications . . . spreading the word about their country to the people of other countries. As far as I know, this has happened in just one country . . . and I did that. It can be done . . . so why isn't the ARRL doing it?

Okay, so it is too late to get any help from the League . . . what other possibility is there? Sure, I can get out there and visit a country a year . . . which might end us up with two more votes for amateur radio. But I'm already working 100 hour weeks just trying to keep up with what I've got going now. You need some teams out there . . . and this takes money . . . and the only group with a whole lot of money is the ARRL (and they're spending it all on new plush offices). Well, what about the ham industry? Maybe they can get something hung together in time to do some good. I'll talk to them about it, but in the past the League has been able to discourage such industry groups from getting together . . . we'll see.

If the industry can get together and get something started, I think *73* will back them as much as possible. We need to get into contact with third world countries . . . we need a lobby in Washington desperately . . . one which can contact Congress (the ARRL is forbidden by law from lobbying) . . . and can keep in touch with the FCC to help them provide us with the best rules possible.

With the ARRL failing on all counts, I see no other hope than our ham industry.

COWAN PUSHES 220 MHZ CB

CQ's publisher has gone to the newspapers with a CB column distributed by King Features, the main purpose of which seems to be to force the FCC into putting CB on the 220 MHz ham band. A recent column went on to exhaustive length about the joys of using repeaters for autopatch operation . . . and then went on to say that CBers could make all these fantastic free phone calls from their cars at a fraction of the mobile telephone rates if they would force the

FCC to open up the 220 MHz band for CB. Who knows, Cowan may be right ... all it may take is pressure from a few thousand CBers on their congressmen to make the FCC take our ham band and turn it into another citizens band. Congress pulls a lot of weight.

The next time you are thinking of supporting *CQ*, you might just refresh your memory on this one. It wouldn't hurt to bring it up at the next club meeting. Cowan, who publishes the largest of the CB magazines and the smallest of the ham magazines, obviously has his chips bet where the money is ... on CB. *CQ* is small because of neglect ... Cowan tells us this in his own editorials. My understanding is that he is just making time with it until the FCC comes through with the Communicator license, at which time *CQ* will become a Communicator magazine ... in competition with *Ham Horizons*.

LOOKING ON THE BRIGHT SIDE

All these worrywarts who are griping about the ARRL make me sick. Why not look on the happy side of things? Sure, we stand to lose a good part of our low bands at the 1979 WARC meeting in Geneva, but the loss certainly isn't going to be as catastrophic as the 1971 debacle when we lost virtually all of our satellite frequencies ... under ARRL representation. In case you've forgotten, the ARRL went into the conference with 237,254.77 MHz in satellite ham frequencies and came out with 7.5 MHz, a loss of 237,247.27 MHz ... 99.99684% lost.

In most fields a group that provided that quality of representation would be replaced, but not in amateur radio ... the ARRL still has the 100% enthusiastic support of most amateurs despite its total impotence. That's real loyalty and should be applauded.

As I say, it doesn't seem possible that we can get quite the screwing on our low bands that we did on the VHF bands, though there is no one who understands the situation who is in any way optimistic. It does appear that we will lose large parts of the low bands, since even the United States appears to be ganging up against the League on this.

When we lose parts of our bands, we will merely have to economize. Any study of the usage of our bands will clearly show that we can substantially increase our efficiency of operation. Take those pileups of stations trying to make rare DX contacts ... the actual contact takes perhaps 15 seconds ... the calling and interference drags it out for hours for hundreds or even thousands of operators. All that has to be communicated is the call letters and signal strength, something which could be compressed into less than a second with a good fast RTTY system ... perhaps with the help of a computer. DXpeditions could work thousands of stations per hour and still generate virtually no QRM.

How about nets? If you listen much above 14,275 you hear hundreds of nets, many spending hours trying to finish their lengthy call-in procedures. This is another natural for modern techniques ... some fast RTTY with a microcomputer and the net of five hundred stations could be checked in ... in a few minutes.

This is getting exciting ... how about two meter repeater operating? About 17% of the air time on a repeater is used in repetitive indentifying ... a natural for new techniques. Will the 1978 two meter rig have an LED readout to show the call of the chap you are contacting? No reason why not. A quick blip will give the call and handle at the beginning of each transmission.

Perhaps we can go further with this ... since 23% of repeater time is spent by fellows calling someone else who is not there to answer, this could be automated ... and reduced to almost nothing. Calling CQ on the repeater ... yes, I know we don't call CQ, but we do call CQ, only in other words ... could be sped up, too. We're getting places now ... another 8% of the contacts are involved with a description of where the mobile operator is driving at the time ... perhaps we could agree to delete this relatively unimportant data. 11% of the air time is spent describing the gear being used ... and since this comes down to perhaps a dozen different rigs, we could encode that with one single character. Perhaps you see where I'm headed ... with over 99% of the average ham contact strictly routine, why not achieve some real efficiency by setting up an accepted group of abbreviations? This could cut QSOs down to a second or two each and permit far more hams to use what few channels we have left after 1979.

If this doesn't get your vote, then I have an alternate plan. Since the ARRL has done about the worst possible job of representing us that it was possible to do, perhaps we should look around for some other group to step in and do a better one. I think I have a suggestion along this line ... one that will surprise you. The ARRL isn't the only group out there pushing for frequencies ... there are many other groups ... such as the EIA ... but these others are not ham groups, so we might get stabbed in the back if we depended on them ... even so, it might not be worse than we've been getting. Never mind, the one group of hams that has been getting a lot of play recently are those great chaps down at *CQ Magazine*. Dick Cowan WA2LRO is making real progress in his push to get the ham 220 MHz band turned into a CB band ... he seems to be doing a lot better at it than the ARRL is in trying to stop him. And George Jacobs W3ASK appears to be working with incredible success to get choice ham bands for his beloved Voice of America ... George is the *CQ Magazine* propagation editor.

I realize that this is heretical, but how about turning to *CQ Magazine* as our representatives instead of *QST*... since *CQ* seems to be doing far better at what they are doing than *QST*? We have nothing much more to lose.

DRAFTING HELP NEEDED

We're looking for someone to move up here and work at drafting diagrams for *73*, *Kilobaud*, and our books. Most of this work is farmed out right now, which means delays. If you enjoy this sort of work and are good at it, drop me a line.

THE MICROCOMPUTERISTS

Of the somewhat over 10,000 hobby computerists who have their own computer systems up and running, about 2,500 are licensed amateurs. And, judging from the interest in computers shown at hamfests and conventions, the percentage of computerists who are also hams is going to hang right in there.

There are a growing number of hamfests which are combined with computerfests ... a combination which is the best of both worlds because most hams are interested in computers these days ... and vice versa.

Considering the number of amateurs who have been playing around with microcomputers, the number of good articles submitted to *73* has been quite low. I'm most anxious to get all of the information I can on how to interface these gadgets with our ham stations ... I'd like to see articles on I/O devices ... on uses around the ham shack ... on problems you've run into and how you solved them ... on experiments with high speed computer generated and computer decoded Morse Code ... on any experiments with ASCII ... on any of the new hardware being brought out which is particularly useful for hams ... etc.

Despite enthusiastic articles about the microcomputer industry in most of the professional computer magazines and in papers such as the *Wall Street Journal*, the fact is that this is still a very small and fragile business. Most of the firms in the field are much smaller than you might imagine and the sudden appearance of any major firm could be disastrous. There is an interesting and perhaps destructive dichotomy involved ... these small firms have a psychological need to be accepted by their larger and older brothers who make the mini and maxi computers, and so the small firms are forever trying to get promotion which will call attention to themselves in the field ... yet if they succeed in getting the attention, any one of a hundred larger firms could easily put many, if not most, of the micro firms out of business.

The manufacturers and dealers in the hobby computer industry are getting together to form an industry group, and this might give them enough strength to weather an invasion by one of the behemoths. It would be nice to keep this as a field in which a small entrepreneur could put his idea into production and do well for himself ... and that is where it is at right now.

Actually there are a great many ways to turn the computer hobby to a profit and a hobbyist has to be either remarkably lazy or not in need of funds to miss out. Some are doing quite well by keeping track of their adventures with getting their systems to work and writing for the many computer hobby magazines ... there are about nine or so which publish this sort of thing ... make that ten, counting *73*. Other hobbyists are either working for computer stores or opening them ... and they are on the whole faring well. Some are writing programs for profit ... some doing consulting work ... some inventing hardware and selling it to manufacturers ... some are getting into manufacturing.

What about all those magazines? They run the gamut, from *Personal Computing*, which is beautifully done and aimed at the pre-hobbyist, with articles telling of the things you can do with hobby computers, but low on construction projects ... to *Creative Computing*, which is a sort of fantasyland combination of school computing and science fiction ... *PCC*, People's Computing Company, a newspaper type of publication aimed at school use, particularly by youngsters ... *Kilobaud*, aimed at the newcomer to hobby computing, with articles on hardware, software, and systems. *Kilobaud* is packed full of material of interest to hobbyists. *Interface Age* is a fat magazine loaded with new product releases and a few articles aimed more at the OEM market and not too much for the hobbyist. *Byte* is going higher and higher level, aiming at the scientist and advanced computer engineer, and is a bewilderment to the newcomer.

COMPUTERMANIA

Over 12,000 computer hobbyists turned out for the recent San Francisco Computer Fair ... making about 200 exhibitors very happy. The Civic Center was so crowded that you could barely walk around ... and no wonder, for the exhibitors were showing some absolutely astounding devices and systems.

Along the ham line was the new ham board from the Digital Group ... one board with RTTY, SSTV and Morse code on it.

The next big computerfest will be at Atlanta on June 18-19 ... part of the Atlanta Hamfestival. If you are within driving distance of Atlanta don't miss this one.

In July (30-31) the action will be at Seattle, the first big computerfest in the Northwest ... not to be missed.

In August we'll be running Computermania ... the biggest exposition yet of microcomputers. This show will go all the way from advanced calculators, through video games and microcomputers, right on up into small business computer systems. This will be at the Commonwealth Pier in Boston on August 25-26-27th ... Thursday, Friday, and Saturday. The show will be run by *73* and its staff.

We're expecting over 300 exhibitors and 25,000 or more attendees. It will be the biggest and best show yet in the whole field of small computers. If you are interested in looking at what is available in microcomputers and shopping around, this will be the place to go.

Make your plans accordingly.

RTTY Loop

Most active hams have operated on the low bands, chased a bit of DX when it's around, and joined in on the fun on 2m FM. Some have even tried 220 and 432, with a hearty few tackling 1296 and EME. However, if you are like most of the amateurs I know, the day-to-day "routine" of hamming needs an occasional change of pace. Two meters can get old pretty fast when the local repeater group is stagnant, and even the dedicated rag chewer tires of fighting the QRM on 40 every evening.

If you are sick of cranking up on .52 every night, and 75 has you down, possibly a new mode will liven up the time you have allocated for hamming. Let's look at the possibilities: Let's see, there are those OSCAR satellites up there, and SSTV, and what about FAX, TV, microwaves, or RTTY? And, how about those microcomputers, which can be tied into almost every facet of ham radio? There is no excuse for anyone being bored with ham radio, and if one facet of communication is getting old, there is always something new to try. For openers, consider RTTY! Here is a mode that offers just about everything. It does not cost a fortune to get on RTTY; it will be seen that a complete RTTY station can be assembled for under $100! The required printers and keyboard are commonly available, and the electronics can be assembled from readily obtained parts. A radioteletype station can be used on most of our bands, and interfaced to existing station equipment. RTTY also lends itself to state-of-the-art techniques — many hams, myself included, have interfaced computers to existing RTTY equipment, and it shouldn't be long before "quiet" RTTY stations based upon surplus video displays are commonplace.

Interesting things can happen when a group of hams stumble on a new mode. Last summer, a friend with a RTTY station got me interested, and within a matter of days I was on 20m and 2m with a $25 keyboard-printer and inexpensive terminal unit. Well, one thing led to another, and by Christmas a highly active net had formed on a 2m splinter channel. It didn't take long for others to find out what those weird tones were, and soon never-before-heard 2m stations were calling in on RTTY, as it is possible to monitor a frequency all day with equipment that is silent except when a message is transmitted. This "autostart" operation is only one of the special features offered by RTTY. If you're interested, read on!

In response to considerable demand from our readers, *73* is going to provide a monthly RTTY column, the *RTTY Loop*, aimed at present and potential enthusiasts. The idea for a continuing RTTY series has been lurking around for some time, but it took a combination of things to get it going. Several days ago, I received a letter from Marc Leavey WA3AJR, who has written for *73* in the past, and is presently writing a RTTY series for the Baltimore Amateur Radio Club's journal, the *Modulator*. One thing led to another, and the *RTTY Loop* was formed. Marc will provide information for the ham interested in getting started on RTTY in an easy-to-understand fashion. In following months, advanced techniques will be discussed, such as autostart, selective calling, digital control, video displays, and, of course, computer-controlled RTTY. The possibilities are limitless! Your response to this new effort is solicited. Please address any comments, questions, suggestions, and criticisms to "RTTY," *73 Magazine*, Peterborough NH 03458. I will forward all material to Marc, who is responsible for the content of the column. Let's get started, and I hope you like the column!

John Molnar WA3ETD
Executive Editor

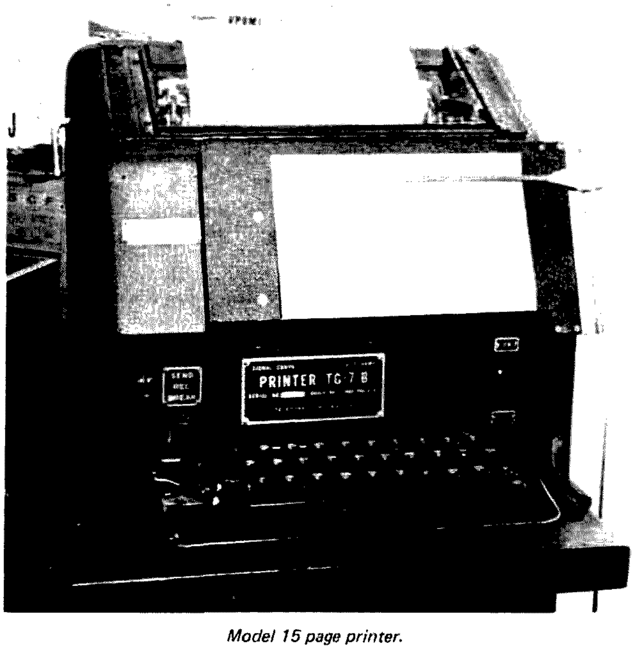
TELE-TIPS 1

This month, and for a couple following months, we will be discussing the principles of RTTY operation. As with any new field, there are a multitude of terms and definitions that must be understood before getting involved in details. Naturally, new terms will be popping up in the months to come, and they will be dealt with when they arise. Be patient — things will fall into place! Presented below is a brief glossary of common Teletype terms. Many of these are familar, and will serve to refresh the RTTY pro. It might be a good idea to save this list, and add to it as the months pass. Each month will have a glossary of new terms, so it will be possible to maintain a complete list. Let's get started, then, with some common definitions:

AFSK: Stands for Audio Frequency Shift Keying and is a means of encoding the Teletype information by changing the frequency of an audio tone.
CHAD: When you punch a hole in a piece of paper, the plug that comes out is called a chad. Paper tape, punched with many holes to serve as a memory, generates tons of these chads.
CHADLESS: Obviously, without chads. If you want to type on the tape with the holes in it, the absence of paper where the holes are makes it difficult. Chadless tape leaves the plugs attached by little lips, to permit it.
DEMOD: Short for Demodulator, this is the electronic marvel that converts the warbling tones of rf into pulsed dc that the Teletype machine can interpret.
FOX TAPE (or KEY): There is a marvelous sentence that contains all the letters of the alphabet — THE QUICK BROWN FOX JUMPS OVER THE LAZY YELLOW DOG. One frequently has a tape to send this for test purposes. Some of the new digital Teletype setups have this sentence preprogrammed at the touch of a key.
FSK: Stands for Frequency Shift Keying. Similar to AFSK, the frequency of a radio carrier is shifted to encode the TTY information.
GOVERNOR: Not the man in your state capitol. Teletype machines are run by motors, and it is important for the motor to be turning at a precise speed. Older machines, or those intended for ac/dc work, used a governor on the motor to set the speed. A special tuning fork is used to set the motor.
LOCAL LOOP: If you hook all your equipment together so that anything you type on the keyboard prints on the printer, kind of like a big electric typewriter, that's a local loop. Essential for testing.
MARK: Spelled differently than my first name, this is the state when everything is running quietly, and loop current is present. Could call it "1" if you're into logic.
MODEL 12, 14, 15, 28, 32: These are different series and styles of Teletype machines. The Model 15 is the "standard," and consists of a keyboard and page printer on a table. The Model 19 is a Model 15 with tape equipment built in. The tape equipment alone might be a Model 12 or 14. The Model 28 or 32 is more recent vintage stuff.
PAGE PRINTER: If the Teletype machine prints on a roll of paper which, when you tear it off, looks like a page, that's a page printer.
PATCH PANEL: One of those can't-do-without things. Usually a jack strip which allows anything to be connected to anything (*anything?*).
PERFORATOR: A keyboard connected to an electromagnetic device which punches tape as you type is a perforator. This cannot punch tape from an incoming signal.
POLAR RELAY: Normal, spring return relays take more energy to make than to hold. This would cause distortion in the Teletype signal, called bias, which will be covered later. A polar relay uses two magnets, one to make and one to break, to overcome this problem. A bias (no relation) supply is needed for one of those windings.
RATT: This is the MARS abbreviation for radioteletype. Don't ask me why.
REPERFORATOR: A tape punch which decodes incoming signals and punches them into tape is a reperforator. Some versions type on the tape at the same time, and are called Typing Reperfs, of course, and are chadless!
RTTY: The ham's abbreviation for radioteletype.
RY: These two letters contain all bits in the Teletype code. Don't worry about it — we will discuss it later — but it makes a fine test signal (RYRYRYRYRY).
SPACE: See also MARK. This is the state without loop strip of paper and reminds one of the stock market ticker; it's a strip printer.
SYNCH MOTOR: Since the motor for a Teletype machine has to be a precise speed, it is nice to synchronize it to the 60 Hz line frequency. Takes the place of governor motor.
TD: Stands for Transmitting-Distributor (which is quite a mouthful). Actually, this is a tape reader.
TT, TTY: More abbreviations for Teletype.
TELETYPE: The whole ball of wax we are talking about. This is a trademark, however, and should always be capitalized.
TU: Stands for Terminal Unit, and is the same thing as a Demodulator.

That has got to be enough to digest for this month! Next time we will cover just how that Teletype machine works.

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133



Model 15 page printer.

LETTERS

CLOSE TO HOME

Dear Jack Anderson,

I've been a fan of yours for years, but one of your recent columns, the one on CB vs. ham radio, struck close to home. The one-sided nature of the column was unfortunate.

Radio amateurs (hams) must pass an examination, which includes knowledge of the international Morse code. By international agreement there is to be *no* hobby use of the spectrum below 144 MHz unless the operator has demonstrated this knowledge of Morse code. Technically, the recent FCC rule change to allow hobby use of CB at 27 MHz is in violation of that agreement.

I believe most CBers are potential hams frustrated by the code requirements. The FCC has proposed a code-free license for frequencies above 144 MHz, but has been unable to implement it due to the crush of CB license applications. It would seem more constructive to support the implementation of this proposal, rather than to encourage the expansion of CB chaos at the expense of hams.

Phillip Nelson WA6PNA
Albany CA

POLITICAL FOOTBALL

I truly believe amateur radio is about to face its toughest hour, which will decide if our hobby will continue as we know it or slowly "pass away." Amateur radio is definitely becoming political football in Washington DC. More and more, it seems that the sides are being drawn up between amateur radio and CB, or David and Goliath. If we are not properly prepared for this fight, we will lose our only national resource forever, i.e., the ham frequencies.

The enclosed Jack Anderson article is filled with half-truths, insinuations, misleading statements, etc., which to the average reader portray hams in a very unfavorable light. Note the quotes from Anderson's article — "The FCC is quietly stifling the millions of voices that jam the CB radio frequencies . . . The Commission has favored the few (hams) over the many (CBers) . . . 300,000 hams have 100 times more frequency allocations than are available to CB . . . ARRL is a lobbying organization" . . . and on and on. But, there is no mention of the purpose of amateur radio, its contributions to public service, national welfare, communications developments, history, service in emergencies, and so on.

I would consider this article to be extremely damaging to amateur radio. Can you imagine the impact this article will have on the US Congress? Please do whatever is required to answer this extremely biased article.

Glenn Packard K3ZOT
Havertown PA

CAHOOTS

Mr. Jack Anderson
c/o *Washington Post*
Washington DC

You had some rather harsh things to say about amateur radio operators in your *Washington Post* column of April 4, 1977. Most of what you said was false. Most of what you insinuated was false. You insulted every amateur radio operator in the United States.

You implied that myself and my fellow hams are in cahoots with the Federal Communications Commission and are in some way depriving the Citizens Radio Service operators of frequency spectrum space that rightfully should belong to them.

Your first mistake was to equate the Citizens Radio Service and the Amateur Radio Service. Both services use radio and there the resemblance ends.

The purpose of this letter is to provide to you some basic information regarding both radio services so that when next you write about ham radio, you will have some facts for reference. I speak for no one but myself . . . and I feel sure, thousands of ham operators. I thank you in advance for your time and attention to what I have to say.

First, examine how the respective radio service licenses are obtained. The amateur radio operator took a series of tests administered by FCC engineers that covered radio theory and practice, rules and regulations of U.S. as well as international amateur radio, and demonstrated proficiency in sending and receiving international Morse code. Failing to pass any one test results in no license.

The Citizens Band operator filled out a simple form about as complex as applying for a social security card. That's all. In fact, under today's rules, the Citizens Band operator gets a temporary license when he buys his equipment. He has that to use while he waits for the FCC office to issue his permanent license.

Look at both licenses. What really do they cover?

Amateur radio operators hold an equipment license that covers the station itself. He also holds an operator's license. The ham is personally identified. Only he can operate his radio equipment. Other people can talk over it but his hands must be on the controls at all times. There are exceptions to those rules, but they involve other licensed amateurs.

The Citizens Band operator does not hold an operator's license. Only the radio equipment is licensed — not the operator. Because there is no operator's license involved, any relative of the person named on the license can operate the station (over age 18 only). The Citizens Band operator is not personally identified.

What is the charter of the two radio services? That is, what is expected of them? Both are utilizing a public property, a resource, the electromagnetic spectrum. It is not infinite. With regard to the Amateur Radio Service, the Communications Act of 1934 put heavy emphasis on ". . . value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications." That language is still in place and is taken very seriously by hams worldwide. Many hams maintain emergency power sources for their stations so that no matter when an emergency call goes out, responses to the call can be made. Citizens Radio Service operators also provide communications for the public good and that is commendable, but the hams have been honing their communications skills since 1913. The hams have the organization, the expertise, the network of stations and, most important of all, the strict radio discipline that results in efficient operation no matter what the situation.

The list of instances of ham radio as the principal and many times the only means of communications is almost endless. Some of the most recent were the earthquake in Alaska in 1964, Peru in 1970, California in 1971, Guatemala in 1976, Italy in 1976, the Dakota floods and the Big Thompson Canyon, Colorado, Hurricane Agnes in 1972, and recently and locally, the Frederick flood in October, 1976.

The charter of the ham operator includes contribution to the advancement of the radio art and electronic advancement, self-training and technical investigation solely with a personal aim and without pecuniary interest of any kind.

The mission of the Citizens Radio Service? To provide private short distance radio communications services for business and personal activities of the licensees. There's quite a difference isn't there?

To address some of your comments in the *Washington Post:*

How can the FCC be stifling the Citizens Radio Service when it just granted 17 additional channels on Jan. 1, 1977?

Why do you say that the Amateur Radio Service should give up spectrum space to the Citizens Radio Service? We gave up the space they now occupy.

The hams don't have a lock on the higher frequencies. Quite the opposite. And those frequencies are *not* interference free.

The hams do not control any frequencies. Only the FCC can make frequency assignments and that task has got to be one of the most difficult and thankless chores in the world to do. It's a no-win situation every time.

The ARRL has put out no "flash bulletin," and it is illegal for *anyone* to transmit on an unauthorized frequency, be it ham, CBer, or ordinary businessman.

This letter is being released to the news media, governmental officials, and the American Radio Relay League.

David R. Halliburton WA3ZOR
Gaithersburg MD

"AIRSPACE"

Editor
The *Washington Post*
Washington DC

The article by Mr. Anderson strongly implies wrongdoing by the Federal Communications Commission (FCC) in its regulation of the Citizens Radio Service ("CB") for the benefit of the Amateur Radio Service ("hams"). Although basic information in Mr. Anderson's article is factually true, it is distorted and incomplete. It reveals both a lack of knowledge on the subject of radio communications and a lack of professional reporting in the art of journalism.

The major issue made in the article is that hams have more frequency spectrum ("more airspace") than the vast majority of CB users, public service user (police and fire departments), FM radio broadcasters, and TV stations in Los Angeles and New York City. This is a true statement. But Mr. Anderson apparently does not understand that radio frequencies differ in characteristics.

At very high frequencies (VHF) and ultra high frequencies (UHF), radio communications are extremely reliable and almost interference-free — necessary traits for police and fire units. But, these frequencies are extremely short ranged. Therefore, it is quite feasible for a small frequency spectrum to be used repeatedly throughout an area as large as the United States. Because of the short range characteristics of these signals, Washington Metro Police cars will not be erroneously receiving instructions from Los Angeles police dispatchers.

Citizens Radio Service (CB) has — and still is — intended to be a short range service also. The low power (4 Watts) was to limit range of these radio sets to just a few miles. But when the service was established in 1958, the FCC took frequencies away from the Amateur Radio Service in the high frequency (HF) band. This range of frequencies — and especially in the spectrum which includes CB frequencies — is especially conducive to long range radio communications. Combined with high powered amplifiers (illegal but widely used on CB frequencies) and directional antennas, radio conversations can literally be "skipped" over thousands of miles.

This is why legal CB operators like myself have so much difficulty trying to talk to someone else just a mile away.

Without illegal use of CB privileges, the service would have almost enough radio frequency spectrum for the near future. In most areas of the US (outside of metropolitan areas), little activity occurs on more than a half dozen channels. The FCC has been experimenting with establishing new CB frequencies in the 900 MHz range which would improve reliability of local communications and prevent long distance communications. Most amateurs would be in favor of this move.

The Amateur Radio Service was established to promote the art of radio communications through experimentation, the development of trained personnel, and to promote international goodwill through radio. All of these goals require access to frequencies throughout the radio spectrum.

Since radio began (Marconi claimed himself to be an amateur), hams have been at the forefront of new developments. Much of the present "state of the art" of radio and television communications is either directly or indirectly the result of amateur radio. Most of the electrical engineers and researchers in the area for the past fifty years became interested in radio as youngsters through amateur radio activities. One of the most significant breakthroughs for reliable long distance voice communications – single sideband – used by the military, civil airlines and ships, and by CBers, was entirely developed by amateur operators.

Also since the beginning of radio, hams have been quick to step in and offer communications assistance during times of disasters. The only communication with the outside world for weeks following the terrible Guatemalan earthquake was by amateur radio. The American Radio Relay League (ARRL) even contributed a VHF radio system for local communications inside Guatemala. The Guatemalan government and the Red Cross have recognized that relief efforts there would have been almost impossible without the reliable communications of hams in the US. Similar examples can be given for any number of disasters here in the US and abroad.

Since the radio frequency spectrum became "managed" in the 1920s, frequency allocations for amateurs have shrunk. Yet the number of hams in the US and worldwide has increased. Not only the CB radio industry (which stands to profit even more by more frequencies being assigned to CBers who would have to buy new radios), but many other radio services covet the frequencies now held by the Amateur Radio Service. It appears to users of those services that there is no opposition to taking frequencies away from hams. Contrary to Mr. Anderson's implication, the ARRL is prevented by law from lobbying. Many amateurs and members of the ARRL, in fact, feel the ARRL is not doing enough to protect the interests of hams. Arrayed against the unprotected hams are the airlines, the boating industry, the broadcasters, and the CB manufacturers. Mr. Anderson acknowledges this when he wrote about ". . . giving the CB *industry* a greater share of the airwaves" (emphasis added). The airwaves belong to the people, not to any industry.

Amateur radio should be viewed as a national resource and protected. Not just because it is a hobby, but because of its continuing contribution to public service and to the development of higher levels of electronics state of the art. It is open to all – even CBers like myself. The only requirement is a desire to learn a little about radio and pass a code test. And if I can do it, anyone can!

Arthur G. Nevins WA4NTP/KGO2773
Sterling Park VA

SENSATIONALISM

Mr. Jack Anderson
c/o *The News American*
Baltimore MD

In your syndicated column of April 4th, a 1977, entitled "Hams Hog The Airwaves," your story seems bent more on sensationalism than in presenting a true picture of amateur radio (ham) or Citizens Band (CB).

You contend that the Federal Communications Commission is quietly stifling the millions of voices that jam the Citizens Band radio frequencies. You further contend that 300,000 hams have 100 times more airspace than is available to the nine million CB enthusiasts and that the hams also have a lock on the higher frequencies, which are free from interference. Let us examine, in depth, your allegations.

First, while it is true that the 300,000 hams of the United States do have more airspace or frequencies than are allocated to the Citizens Band radio enthusiasts, the basic purposes and licensing requirements of the two services are vastly different. It must be remembered that amateur radio is an international service covered under agreements of frequency allocation by the International Telecommunications Union, of which the United States is a member. The Citizens Radio Service is not international and therefore not provided for by the ITU. All that is required of an individual to be licensed in the Citizens Radio Service is merely filling out a form and mailing it to the Federal Communications Commission. On the other hand, for a person to become a licensed amateur radio operator (ham), he or she must first demonstrate to a duly authorized individual the ability to send and receive international Morse code at a speed of five words per minute, along with a written examination encompassing basic radio theory and the rules and regulations of the service. This procedure will entitle the individual to what is appropriately called the Novice or beginner's license. Lest you get the idea this examination is of great difficulty, the youngest person to date to be licensed as a Novice was, in 1976, aged five years. Most hams, however, are between age 15 and 75 and also are truck drivers, teenagers, doctors, lawyers, housewives, etc. We don't, however, lay claim to having a former First Lady within our ranks, but do have many well-known personalities: Senator Barry Goldwater and entertainer Arthur Godfrey, to name two. The licensing requirements do become more difficult, but are commensurate with the privileges bestowed. It is not the intention of the amateur community to exclude any portion of the citizens of this country from obtaining and becoming hams. To this end, the various clubs and organizations, with the help of The American Radio Relay League, conduct free classes to help anyone interested in becoming a licensed radio amateur.

From your article one might infer that sheer numbers is the only requirement for any group to have a larger frequency allocation. I shudder to think what utter chaos application of such a philosophy could have upon the airwaves in a country. You further contend that, should the Citizens Radio Service (CB) be granted more frequency spectrum, it would have to come from the ham radio operators. You fail to mention why this would be necessary, except to say 300,000 against 9,000,000.

To state that personnel of the Federal Communications Commission, because they have traditionally been hams, is like a wolf guarding the flock is irresponsible. The people at the Commission are truly dedicated civil servants.

Your statements about hams controlling more frequencies than all the nation's police and fire departments combined, plus all commercial and educational FM broadcasters, plus all the TV stations on the VHF channels in Los Angeles and New York City is again inaccurate. Had you taken the time to check, you would have found that below 30 Hz, where most of the amateur activity lies, the entire spectrum allocated to the hams encompasses approximately 3.5 MHz. Just one TV broadcasting station occupies 6 MHz of bandwidth, or almost twice the entire high frequency allocation of the entire amateur service.

To state categorically that the hams have a lock on the higher frequencies, which are allegedly free from interference, is again inaccurate. There is still allocated to the Citizens Service a portion of the UHF spectrum in the 460-470 MHz range. The free from interference statement is also incorrect, for no service can be totally free from interference without discipline, regardless of where it is in the spectrum.

It is my objective to attempt to rectify a few misconceptions that you or your staff have about ham radio and Citizens Band. I hope I have been successful. However, should you desire more information, please feel free to contact me.

Barrie L. Schwartz W3ENL
President T-MARC
14413 Ansted Road
Silver Spring MD 20904

see page 215

IGNORANCE

Mr. Jack Anderson
c/o *The Reporter Dispatch*
White Plains NY

I would like to object to your April 4th column, "Hams Quietly Stifling CBers." It is an unreasonable, one-sided presentation which ignores half the facts. Please consider the following:

1. Far from being an exclusive club, amateur radio is a hobby open to all. To encourage newcomers, amateur radio societies and magazines have for decades published books and pamphlets on how to get started. A stepped-up recruiting campaign to entice CB operators to upgrade to amateur radio has, during the last two or three years, included several book/cassette teaching packages (including one from Heathkit, the nation's largest electronic kit manufacturer), three films, local classes, and spot advertisements on local radio and TV stations.

2. Entry into amateur radio is not difficult; five-year-old kids have done it, as well as 80-year-old retirees. The equipment costs no more than some CB equipment. Ham radio is merely a hobby radio service which legally permits many of the practices presently found illegally on CB. There is nothing to prevent those CB operators who desire more frequencies from upgrading to amateur radio. Hams will welcome them with open arms.

3. One of the major reasons why the Federal Communications Commission has not granted more frequencies to CB is that Citizens Band is presently populated to a large extent by unprincipled scoundrels who disobey every rule in the book, abetted by manufacturers and dealers who make and sell CB equipment designed to violate the law. On the other hand, amateur radio is a largely self-policing service where peer group pressure results in virtually no illegal operation. Are you proposing that the law-breaker be rewarded with more frequencies taken from the law-abiding citizen?

4. It does not take a "confidential report" to conclude that radio amateurs control more frequencies than all the commercial radio and TV stations, etc. Had you merely looked at the FCC regulations, you would have seen that amateur radio oper-

ators are assigned an *infinite* amount of frequencies — everything from 30,000,000 kilohertz and up. Traditionally, ham radio has been assigned all the frequencies above the useful range at the time. It is ham radio operators who have always in the past extended the state of the radio art by finding a use for the "useless" frequencies assigned to them. All the frequencies now used for FM broadcasting, TV, CB, shortwave broadcasting, military, police, fire, and mobile communications, were once considered useless, and equipment for using them was developed by the amateurs.

5. Please keep in mind the differences between CB and amateur radio. Originally intended for point-to-point communications for the small business and personal user, CB has degenerated into a vast party line used primarily for yakking. Psychological studies have investigated the effect of unidentified operation — anonymity guaranteed by the use of "handles" — on the psyche of users; interesting trends have been observed. On the other hand, amateur radio is an orderly service which combines operating privileges with technical expertise. In exchange for taking a technical test, ham operators are permitted — even encouraged — to design and build their own equipment and experiment with its use. Many of the pioneers in electronics and radio got their start through ham radio. In time of war or emergency, ham radio operators have formed a pool of trained operators and technicians. Their contributions have been so widely recognized that almost every country in the world has an amateur radio service.

6. Finally, one might ask whether the cries for more frequencies for CB are really justified. By many estimates, over 50% of radio transmissions are *voluntarily* confined to channel 19. Can't the other 39 channels suffice for the other 50%? Perhaps the way to make more room for legitimate CB use is to crack down on illegal and improper operation, rather than to simply allow it to spread over a greater area. When CB is widely used for evading police radar, perhaps it is time to reduce rather than expand CB bandwidth. Moreover, expanding into inherently short range amateur bands which cannot in any way be policed unless the FCC sets up a nationwide grid of monitoring stations every few miles is only an invitation to further improper use.

Please, next time you write on this topic, consult a ham radio operator for the other side of the story. It will do much for your credibility on unknown issues if you present a fair and unbiased story in those cases where a sizable number of readers are familiar with the facts.

Peter A. Stark K2OAW
Mt. Kisco NY

GOT YOUR EARS ON?

Mr. Jack Anderson
c/o United Feature Syndicate, Inc.

I am sure you will never receive this letter, since I am sure your loyal minions would not allow you to receive mail critical of your column. However, I am so incensed over the above-entitled article ("Hams Hog Airways" — Ed.) that I am willing to use my valuable time in order to attempt to contact you. Therefore, with the unlikely circumstance that you are personally reading this, I would submit the following:

Although I cannot dispute your numbers, which you have quoted, you certainly have failed to understand any of the underlying implications. I hope that your other work does not reflect the same lack of understanding that this article exhibits.

For your information, all frequency allocations for the radio spectrum are set by the International Telecommunications Union, whose offices are in Switzerland. The frequencies which are allocated to hams have been approved by this Union, which is composed of every nation in the world. The frequencies which the CB enthusiasts "enjoy" are actually allocated to amateurs on a worldwide basis. The United States has, in fact, violated this international agreement by providing for the Citizens Band radio service. The original purpose for the Citizens Band has been distorted to the point that it is not recognizable as the Federal Communications Commission originally envisioned it to be. Therefore, the Citizens Band mess should not even exist. It appears that the only reason that there is a problem results from the inability of the Federal Communications Commission to enforce its own rules regarding the Citizens Band. If you don't think there is a Citizens Band problem, listen to the obscene language, the threats of abuse, inane conversations, etc., which permeates these frequencies. Also, check with the Federal Communications Commission with regard to the amount of complaints regarding radio frequency interference to home entertainment devices and see what percentage of them relate to Citizens Band operation. At the same time, check with them regarding their proposed rule making which will now ban the manufacture of linear amplifiers even for amateur radio use because the Citizens Banders have been using them, illegally, on their own frequencies. At the same time, you might ask the Federal Communications Commission how many hams they have had to put in jail and how many articles of equipment have been seized as being illegal from amateur radio operators and at the same time obtain the same figures for Citizens Banders. In the same light, also ask the FCC about the term "sliders." You will find that this refers to the illegal practice by CBers of operating on frequencies that have not been allocated to Citizens Banders. These fine people whom you appear to believe should enjoy the good graces of the FCC operate on frequencies assigned to other radio services. Amateur privileges near the Citizens Band start at 28 megahertz. The Citizens Band lies somewhere in the region of 27 megahertz. One megahertz, for your information, is the equivalent distance from the low end to the high end of the commercial broadcast spectrum. Therefore, you can see that there are quite a few "frequencies" available which do not have to be taken from the hams and given to the CBers. However, the CBers have not waited for the FCC to give them these frequencies, since they now proliferate in the region above the authorized CB channels and the 28 megahertz frequencies belonging to the hams. Not only that, these fine citizens are known to occasionally stray onto amateur radio frequencies.

Another item of small import which you have failed to recognize is the theft associated with Citizens Band equipment. In fact, Citizens Banders have so little technical ability that they even steal ham equipment, unusable on their own frequencies, in ignorance, thinking that they are stealing another Citizens Bander's equipment. Of large importance to me is the fact that one of your fine and abused Citizens Banders removed my antenna designed for 144 megahertz from my vehicle just yesterday for his own use. Since it will not operate with his Citizens Band equipment, I hope he has many fine hours trying to find out what is the matter with that "stupid" antenna.

Although CBers get quite a bit of recognition for their "public service" work, that appears to be the only area of justification which they can claim. In addition to allowing citizens to evade police radar, etc., these fine citizens do occasionally notify the proper authorities with regard to stranded vehicles. Hopefully when someone with a CB set reports that they are stranded, the law enforcement authorities appear first instead of their other fellow CBers who come to rape and rob because their victims have identified their location and their inability to escape.

From a historical standpoint, hams have "earned" their frequencies. Although now, because of the sophistication of communication devices and the expenses involved, hams are not as apt to be at the forefront of scientific discovery, a brief examination of the contribution of hams working in their basements on their own time would be illuminating to you, I am sure. From the time of Marconi to the present, many of the pioneers in electronics have been hams. Briefly, Lee DeForest, the inventor of the triode tube, was a ham. Also, the first radio telescope was invented by a radio amateur. It is my understanding that all significant advancements of the state of the art up until the invention of the transistor by the Bell Telephone labs have been made by hams. Hams have pioneered new techniques in television transmissions, bounced radio signals off the moon and have assembled, launched and used their own communication satellites. Hams are also pioneering, today, the field of facsimile transmission, VHF repeater work, and computer-related technology. Hams, because of the licensing structure, must be technically proficient and dedicated. CBers simply have to have ears and a mouth. Quite often the two are not connected. Therefore, as you can see, from a technical standpoint, 300,000 hams have made a significant contribution to the advancement of radio science while your 9,000,000 licensed CBers have since simply caused a pain in the neck to the Federal Communications Commission. Additionally, for your edification, Citizens Banders are not "licensed." Amateurs are. CB operators simply have a permit, which if you bother to check, is quite a significant difference.

In addition to the technical advancements attributable to hams, this pales in comparison to the public service work provided by hams. You have been perhaps too busy to read the newspaper accounts of the communications services provided by hams to Nicaragua, Guatemala, Alaska, and other areas hit by natural disasters. The news services were aware of the fact in the recent Nicaraguan and Guatemalan disasters that for up to two weeks, ham radio operators were the only reliable communications link with these two countries, and the hams were able to coordinate with rescue operations to an extent unmatchable by any other radio service. Don't take my word for it. Check it out. At the same time, you might also contact the disaster agencies responsible for the relief operations in Colorado following the Thompson Canyon flood of last summer and the Teton Dam disaster in Idaho. You will find that hams were at the forefront working many, many volunteer hours to assist in disaster relief operations.

In addition, check with knowledgeable sources as to what the "eye bank net" is all about. You will find that this is an organization of hams who volunteer their own time to coordinate between the agencies responsible for locating donors and recipients for corneal transplants and making sure that the critical time necessary for the removal of the cornea and delivery to the recipient is minimized. In addition, hams maintain contact with the National Weather Service to provide storm warnings for impending hurricanes, aid police departments and provide communications during power outages, and provide many, many other forms of public assistance at times of national disaster. You might also learn, if you take the time to find out, that hams have also spent many hours running "phone patches" from our service personnel in Antarctica, Southeast Asia, and other military installations around the world to their relatives in the United States. All of the above is done without any chance of monetary return, since that is forbidden by FCC regulations.

Additionally, amateur radio operators constituted a vast pool of trained operators for the military during World War II.

By FCC edict, amateur radio exists to promote the communications art, the technical phases of radio, and to provide public service. Please show me, if you can, where CBers are under any compulsion to do anything beneficial to anyone other than them-

selves.

You seem to imply that the FCC has some special love for ham radio. It should, because hams provide so much more service to the public than CBers ever thought of doing. If you do bother to check out the Thompson Canyon flood of Colorado, ask the authorities how the amateur radio operators and the Citizens Banders compared in their ability to effectively assist them in their relief efforts. The news articles we saw in the West indicated that the Citizens Banders were "prima donnas" who got in the way and the amateur radio operators were highly skilled, dedicated, and conscientious in their efforts to assist the authorities.

You apparently suffer from a malaise known to radio aficionados as alligatoritis. You are all mouth and no ears. If you had bothered to do any checking at all regarding the background of the ham-CB question, I am sure you would not have written your article. I would also like to comment that you appear to have been "duped" as you are wont to accuse the federal bureaus assigned to monitor big business. You have been listening to the garbage spouted by the Citizens Band manufacturers and supported by the EIA, all of whom have been pushing to "get *more* frequencies" so they can sell more CB sets. Shame on you.

Although I have been a ham radio operator for 18 years, I must admit I have not "done my share" to justify my license. However, there is a local woman who was able to talk to her brother and family doctor in Sao Paulo, Brazil, when her mother was dying of cancer, to be kept informed of her mother's condition through the use of my radio. I am sure if you asked her whether or not amateur radio was "worth it," she would answer an emphatic yes. After many times trying to reach her family by telephone in Sao Paulo and sending many telegrams, she was quite surprised that in less than half an hour on my radio, I was able to connect her with her mother's doctor in a hospital in Sao Paulo. On several other occasions, I managed to have her talk to the rest of her family and have them visit about her mother. Upon being informed that the many hours which I spent in her behalf were "free," she was amazed.

On *amateur radio* frequencies, the above are daily occurrences. The really extraordinary cases are those involving amateur radio operators in remote parts of the world obtaining rare medicines in the United States and having them shipped to the foreign country in time to save a person's life who is in critical condition.

In 1979, the World Administrative Radio Conference will occur. At that time the entire radio spectrum will be reallocated. The black eye which the United States has suffered by allowing the CB mess to develop will hurt amateur radio operators. If that occurs, thoughtless articles like yours will surely attribute to ham radio's loss and ultimately the people of the world's loss. If you are as concerned about humanity as you claim, you will revert your position and use your considerable influence in Washington to encourage the preservation of the amateur radio frequencies.

From reading your column and that of your predecessor, Drew Pearson, I know that you are "never wrong," so I do not expect to see anything in your column reflecting your erroneous thinking. That would be a shame, since you have so many people believing you speak the gospel.

In closing, I would simply like to say, "Hey, ratchet jaw, have you got your ears on?"

Stephen Guelde W7INH
Wheatland WY

RIDDLED

Chicago Daily News
Chicago IL

The April 4, 1977, article on the Federal Communications Commission and amateur radio by Jack Anderson was so riddled with mistakes and half-truths that I have outlined them in red in the enclosed article. Anderson has done irreparable harm to the good name of the amateur radio operator, *a reputation that has* been earned through over a half century of unselfish service and experimentation.

Anderson insinuates that the FCC is working against the CBers' cause by some secret intent. Nothing could be further from the truth. Since 1971, the Commission has been attempting to help the Citizens Band expand and grow. But the estimated 20 million CBers, half of whom haven't even bothered to get an FCC license, have consistently ignored every attempt at "cleaning up their bands," so that orderly growth can be established. Unleashing these undisciplined, unlicensed radio operators on other portions of the radio spectrum is inviting more television interference, more use of unlawful radio, and an enforcement burden that the Commission cannot possibly handle.

Another Anderson comment: "These (frequencies) would have to be taken from the Ham Radio Operators." This is absolutely false. Megahertz of unused government allocations lie in various portions of the radio spectrum; space set aside for UHF television is almost totally unused.

Anderson: "The Hams also have a lock on the higher frequencies, which are free from interference." I think Mr. Anderson would find it hard to defend his opinion of a "lock" on frequencies by the amateur service, for hams have only 4 megahertz of exclusive use in the entire usable VHF and UHF spectrum, which is 900 megahertz wide. An estimated 150,000 amateurs use this band daily. 79.2% of all usable amateur bands are "shared, on a non-interfering basis" with other services, notably, the government. This sharing arrangement can exist only if both parties are disciplined, state-of-the-art communicators. Sharing was originally tried on the Citizens Band, and it resulted in the "ma and pa" stores and offices, those that could profit most by inexpensive two-way radio, being forced off CB by the personal, illegal hobby user. Would you want to share a band with these people?

And, again, Anderson insinuates that these radio band allocations were all done secretly. Ridiculous! Frequencies are assigned at international conferences after years of negotiations and public dockets. CB interests are represented at these conferences, just as amateur radio is.

None of the FCC commissioners is an amateur, though some of the staff are, but they certainly are not being secretive about it. Most of the FCC hams are CBers, too. And what difference does that make, anyway? If anything, a ham license should be a point in their favor. The amateur radio operator must pass an FCC license exam on radio theory, electronics, and rules and regulations. The fact that some of the FCC staff are hams just proves that these individuals are active in their field of interest. No other radio service allows experimentation and research. Should these individuals be castigated for their interest? Who would you rather have as an FCC radio engineer, a ham or a CBer?

Anderson states: "The opposition to giving the CB industry a greater share of the airwaves has been largely generated by the American Radio Relay League . . . a lobbying organization." Absolutely wrong. The ARRL is not, and never has been, a lobbying organization in Washington. And, in fact, the ARRL has come out repeatedly in favor of orderly CB growth, for many CBers find, after becoming frustrated with the limited range and utility of CB, that they wish to pursue an amateur radio license. Amateur radio wishes CB well, but not at our expense, not at the nation's expense. Amateur radio has turned many citizens on to the world of electronics, has taught them a useful skill, and benefitted the world with more communications breakthroughs than any research facility in the country. And all this has been at little expense to the taxpayer.

Amateur radio is growing by leaps and bounds, and America will benefit from the communications and research skills that are being developed. What new techniques have CBers engineered?

The ARRL indeed has asked its members (through a "flash bulletin"? — be serious!) to prevent the "incursion of CB buffs into their airspace."

The FCC, it so happens, is also quite interested, because thousands of CBers are operating totally outside of their assigned bands, in outright defiance of federal law and international treaty. Amateurs have pledged that CBers will not illegally utilize amateur frequencies, and are working, on their own time, with federal authorities to help track down and prosecute these violators.

Raymond Spence, the FCC's chief engineer, though an amateur, has also made decisions we feel are detrimental to amateur radio too, but we don't hold it against him. He's also a CBer, by the way.

Amateur radio has been the backbone of communications research in this country throughout the twentieth century. This research continues today. Day to day public service is performed by the over one million hams around the world. In emergency situations, hams have often provided the only link with the outside world, via their self-trained and dedicated force of radio operators.

Amateurs are all for CB, but to reassign already crowded amateur bands to "everyman" CB radio, to use as he sees fit, would deal a death blow to the amateur community and in effect reward the CB community for its lawlessness. What a nice way to say "thanks" to what FCC Chief Wiley, who (incidentally) is not a ham, has called "the most disciplined of all radio services."

Mr. Anderson has made a mockery of the term "investigative journalism" and has defaced the good name of the amateur radio service. I only hope that our federal representatives in Washington are informed enough to know that his article is full of half-truths and downright lies, and give it the attention it deserves.

Richard T. Casey WA9LRI
Arlington Heights IL

cc: Jimmy Carter, President of the United States
Sen. Charles Percy, U.S. Senate
Sen. Adlai E. Stevenson, U.S. Senate
Sen. Barry Goldwater, U.S. Senate
Phillip E. Crane, U.S. House of Representatives
Honorable Elliott Levitas, U.S. House of Representatives
Richard E. Wiley, Federal Communications Commission
American Radio Relay League, Newington CT
73 Magazine, Peterborough NH
HR Report, Glenview IL
Jack Anderson, Washington DC

THE UNSAID TRUTH

The *Washington Post*
Washington DC

It is unfortunate that Jack Anderson's column concerning amateur radio is so ill-researched. What is true but unsaid is that the great public service of amateur radio on both a local and worldwide scale takes frequency space, personal and innovative

technology, and selfless dedication. This is in contrast to an untrained, unprepared, and ill-disciplined CB operation which cares not for self-improvement or solutions to its interference and public relations problems. Virtually all of the quarter million amateurs are both able and willing to provide competent, public-spirited, technically clean, and valuable first class service to the public. How many CBers can say as much individually or collectively?

The CB crowd is very vocal about their public service, but what can they really do? By example: On Friday, April 1, I witnessed an automotive accident, radiotelephoned the Alexandria police through the Tyson's Corner WR4ABR autopatch repeater, and had help on the way before an observing CBer could even find somebody willing to pass along the message.

Some research on Anderson's part would have shown a large proposed CB allocation in the FCC's WARC proposal at 900 MHz, a location which does not conflict with valid amateur operations. Perhaps he should do his homework before he writes.

CB is both a valid and valuable means of personal communication, but its services, capability, and reason for existence should not be confused with amateur radio. It is a shame that the *Washington Post* has not informed the public of what amateur radio gave during the Frederick flood, the bicentennial celebration, the recent Cherry Blossom Festival, the Nicaragua earthquake, and the daily accidents on the beltway. Amateur radio is needed both locally and internationally, and before this is forgotten, it may be time for amateur radio to make its voice as loud as its service is strong.

Theodore W. Edwards Jr. W1AJS
Alexandria VA

THE HINT

The *Washington Post*
Washington DC

I would like to comment on the editorial by Jack Anderson and Les Whitten concerning amateur radio that appeared on April 4, 1977. Mr. Anderson clearly distorted several facts and overlooked others in his comments concerning "airspace" allocations for amateur and CB operators. It was claimed that amateurs hold "100 times" the space occupied by the Citizens Band, and that the FCC was refusing to "take the hint" concerning the CBers' requirements for additional frequencies.

Mr. Anderson failed to indicate that the FCC is currently studying the feasibility of additional CB frequencies in the 900 megahertz region — those "interference-free" frequencies referred to in the editorial. Unfortunately, no frequencies remain interference-free when utilized by masses of operators. Mr. Anderson should listen in on the 40 meter ham band some evening, an area rendered almost unusable by foreign high power broadcast stations.

It should be noted that an impassioned plea for additional frequencies by any service, CB included, can only result in the bedlam that exists now on the present CB frequencies. Before opening a new band, a large amount of research into the effects on other users must be conducted. There have been several proposals for new Citizens Band frequencies; unfortunately, most would have resulted in interference to television and other services. There is nothing "confidential" about these proposals and other FCC actions. A simple call to the FCC by Mr. Anderson would have been enlightening.

The FCC does not regulate frequencies arbitrarily. Most amateur frequencies have been assigned by international treaty, and it is impossible for "traditionally ham" commissioners to allocate band space to new services without conforming to international law. A recent proposal for additional CB frequencies was rejected by the Canadian and Mexican government, as interference would have been caused to their services. Unfortunately, radio waves do not adhere to national boundaries.

The FCC *has* taken the hint, and is attempting to find new frequencies for CB use. It is not the CB operator who is harassing the FCC commissioners; it is the manufacturers of CB gear looking for additional profits that will result when new bands are opened. No mention of the operator was made in the editorial. It is this person who will bear the expense of new equipment and antenna systems when new bands are allowed for CB use.

In conclusion, it is important to note that Mr. Spence of the FCC, the American Radio Relay League (ARRL), and the 300,000 hams were powerless to prevent the loss of 99% of their bands when a recent international conference eliminated most of the "interference-free" satellite bands once available to amateur operators.

John W. Molnar WA3ETD
Executive Editor
73 Magazine

ONE SIDE

Enclosed is a column from the *Miami Herald* of April 4th, and, just in case you do not get this Jack Anderson syndicated column, I wanted to forward it to you.

I feel that some knowledgeable individual, such as Wayne Green, should write to Mr. Anderson outlining all the benefits and good that ham radio operators have done for the last fifty years. It would seem that he is getting just one side of the coin from this article.

Personally, I think that the CBers should be given one of the UHF frequencies — and let them have their fun. Maybe that will keep some of them from operating illegally in the ham bands or from becoming two meter technicians and carrying over their poor operating techniques into this operation.

Nevertheless, Mr. Anderson should be rebutted because of the distortion and obvious impact this could have on the general public.

Frank Nankin K4BNZ
President, Palmetto Amateur Radio Club
N. Miami Beach FL

BAD PR

I'm sending along a xerox copy of an article published in the *Rockford Morning Star*, April 4, 1977, written by Jack Anderson, the noted (??) columnist. It shows how much a guy can twist facts and how much he knows about ham radio.

I'm asking *every* ham to let this guy know what ham radio is, the public service that's been done, and how twisted his "confidential report" is.

His address is c/o United Feature Syndicate, 200 Park Ave., New York NY 10017. Give this guy a piece of your mind because this is bad PR for ham radio, especially with WARC coming up.

Tom Carney WB9RXJ
Sterling IL

CROSS POLLINATION

Just a quick note to thank you for the "Briefs" column by WA1GUD and WA1UMV. We have long needed a forum for "cross-pollination" of ideas from various clubs throughout the country. This can only result in a more informed, healthy, and active ham radio fraternity. "Briefs" fulfills a need, and I, for one, thank you for it.

Rich Casey WA9LRI
Arlington Heights IL

TOP BAND

I'd like to see an article on the pros and cons of 160 meters, along with some details relative to the construction of antennas for this band.

L. Lyle Baker K5QJT
Mineola TX

Glad you mentioned that. This issue has a feature article on the King of 160, Stew Perry W1BB. A new 73 book, The Challenge Of 160, *is hitting the presses in a few days. Stay tuned for some great 160 articles in coming issues. — Ed.*

TRIGGERED

Yes, we did receive a refund from Trigger Electronics, the same outfit that we all seem to know about. It wasn't easy. Our problems with them were almost the same as those described by Mr. David B. Hasenick of Springport MI.

We wrote many letters, both to Trigger and then to the Illinois Attorney General's Office. Trigger responded by sending us small lightweight items in large boxes. The airmail postage was almost double the cost of the item. Then after several more letters to the Attorney General's Office with copies to Trigger, we finally received our refund of the balance.

Several months later I received a letter from the Attorney General's Office advising me that the State of Illinois was going to prosecute. The details of the letter were made available to Wayne Green. I had hoped that he would place it in the "Letters" section so all could note the contents and then write to the Attorney General Office and perhaps receive a refund in the coming court action.

Red Stolle W6OHN/MM
Lajas, Puerto Rico

PR THROUGH PS

During the recent East Greenbush-Castleton (NY) area March of Dimes Walkathon, members of WB2YCR, the Amateur Radio Club of Maple Hill High School, were involved with the communications along the walk route and even operated a portable station on battery power.

Actual communications along the route were provided by the Rensselaer County RACES/AREC Association, of which I (the club's sponsor) am a member. I set up communications at one of the checkpoints along the walk route and allowed students to listen to the RACES communications as a means of demonstrating the use of amateur radio in public service, for which the RACES organization is famous.

At the same time, another portable radio station was set up under my direction by student radio operator Geoff Schad WB2EQN. This station operated solely from a 12 volt battery provided by media staffer Stuart Hague. The antenna used was a twenty meter dipole set up on portable supports. Using this simple rig, Geoff was able to talk with several stations, including two in Florida (W1BDF/4 and W4QC), WBØSMK in Lincoln, Nebraska, WBØCHH in Springfield, Missouri, and K4APL in Perry, Georgia, all during the Walkathon.

The Walkathon provided two golden opportunities. One, to provide a public service through RACES, and secondly, to test our club station's portability. It also provided valuable portable operating experience for Geoff and our student operators.

J.F. Kienzle WA2UON
Castleton NY

HELP ABROAD

I just received my March *73* today and noticed in the "Ham Help" section a couple of more articles from individuals requiring help while overseas.

One article asked, "How can I get a license overseas?" The FCC has been coming to Europe (Ramstein AB, Germany, and Mildenhall RAF, England) every six months for the past year. They were here March 21, 22, and 23, and should be back again in September. Most MARS stations and education offices will have the exact information in July or early August as to the dates of arrival.

I have also been asked a number of times, "What kind of American activity is there in Germany?" Answer — "Everything." In Germany all US forces and dependents can obtain a German license very easily. All that is needed is an address (operating location), a valid stateside license, Technician or above, and 39 DM ($16) a year.

Activity within Germany is in almost all modes of operation. As a General or above you will be given a German Class B License. With this license you can operate up to a maximum of 150 Watts plate dissipation on any of the following frequencies — 160m by special permission, 3.5-3.8 MHz, 7.0-7.1 MHz, 14.0-14.35 MHz, 21.0-21.45 MHz, 28.0-29.7 MHz, 144-146 MHz, 430-440 MHz, 1250-1300 MHz and more above. All the above frequencies may be used in the following modes — A1, A2, A3, A3J, F1, F3.

These modes are for the entire band. There are no class or subband allocations. There is a great deal of repeater operation on 2m and 70 cm. Universally within Germany, 145.500 MHz is a mobile calling frequency and 145.525 and 145.550 are simplex.

There are a number of American amateur radio clubs within Germany. I could go into each of them, but a visit to your area MARS station will render you information about clubs in your area. I am a member of the Wiesbaden Amateur Radio Club, so, being biased (hi), I will say a little about it. We meet the second Tuesday of every month at 7:30 pm, and of course everyone is invited. Most club members can be found on 145.550 MHz FM.

Any interested person can write to The Wiesbaden AB, MARS Station, APO NY 09457, or myself, and we will try to answer questions and offer assistance to individuals about amateur radio within Germany.

There are also radio theory and code classes being held on Rhein Main AB and Wiesbaden AB, continually. I would imagine with the amount of American activity, there are many other classes being held. Again, visit your local MARS Station.

Jerry E. Cole DA1JC
Box 4115
APO NY 09057

CT7001 FIX

I greatly enjoyed Mr. Kufchak's article on "The Super Clock" — using the "old" CT7001. I used the same chip in my clock which has been running fine since 1973. Well, actually, there is one minor problem or I wouldn't be writing this!

Every so often, while in the 12 hour mode, the pm bit in the time or alarm register (or even both) gets set. (So, instead of waking up at 7:00 am for work, one sleeps through until dinner time!) I'm pretty sure the problem is in the chip (and, therefore, extremely difficult to correct), but I'd like to know if others who have used this chip have a similar problem, or if this is an isolated case. Any feedback would be appreciated.

Oh, as a suggestion for battery backup, use the "display enable" line to blank the display to conserve energy, and use a blinking LED or something similar to indicate loss of 60 Hz.

Roy Weidig
513 Lamplight Ct.
Middletown OH 45042

THE REAL ONE

When I picked up my first copy of *73* (OSCAR issue, July '75) in Hong Kong, I realized that it had to be the only real "amateur" magazine on the market. The others merely label themselves as such. I don't believe any other magazine has the coverage *73* does. During a recent overseas deployment, I saw book peddlers in Karachi, Pakistan, Subic Bay (Philippines), Singapore, and Hong Kong selling *73* — and they were the current months' editions! Never saw any other ham publications anywhere except in U.S. possessions. In my opinion, *73* has improved steadily since I first bought one. I noted the greatest improvement when the magazine went to the large format in '76.

Most of the time I'm in agreement with your opinions and definitely agree with and appreciate your openness to other opinions.

Keep the I/O section going (I realize you have no intention of ending it). It's great, as is *Kilobaud*. Both serve their functions well.

Thomas C. Johnson WB6NQK
FPO San Francisco

THE SEARS DEBATE

WA4MZL's letter about "Sears and 2M" on page 17 of the March, 1977, issue prompted you to comment, "We're on the case!" Factors to consider in the "case" should also include one or more of the following:

1. The Sears Spring/Summer 1977 catalog, page 967, actually tends to encourage CBers to move up into the ranks of amateur radio with its heading — "Ready to go beyond CB? Enter a new world of communications . . ." The "Important Note" puts the uninitiated on notice that there is a requirement that the user must be duly licensed and further refers potential users to the FCC for further details. How's that for educating the public? Could be better, you might say? Why not help Sears with their later catalog copy?
2. The ownership of equipment is an incentive. A friend recently purchased a 2m walkie and has so far twice failed his exam. He at least has the monetary incentive to push on. Incidentally, he purchased the rig from one of *73*'s advertisers without proof of a license required, and if *73* is not a catalog, mail-order sales operation, I miss my guess.
3. As indicated in "Briefs" in the same issue of *73*, the photography industry benefitted from new markets through mass availability of the products. I agree that "A vastly larger distribution network for amateur products could possibly create enough demand to give amateur radio thousands of new devotees." How about PRing many of them onto 220 and 70 cm?

As you may have gathered, I am interested in encouraging the CB members of our radio family to join our ranks — legally! To that end I wrote this letter.

Skid Schermerhorn
W1TTY/W1IOY
Wellesley Hills MA

P.S. The Sears by Yaesu looks to be functionally the same as my (purchased by mail from an ad in *73*) Wilson WE224 by Yaesu with which I am very pleased. Maybe the Sears should be reviewed in "New Products." Who knows? If Sears sells only a few of these radios, they might have a drastic price reduction and create a great bargain for many of us.

SWIFTSURE

I have been a reader of your "Letters" column for many years, and needless to say I enjoy it very much. Its contents have prompted me to write.

In the Victoria area (southern tip of Vancouver Island), the Royal Victoria Yacht Club holds the Swiftsure Sailing Classic race. As a PR venture, the Amateur Radio Clubs of Victoria and Port Angeles (Washington State) are combining efforts for the second time to handle emergency communications.

The Swiftsure Race is known worldwide and affords an excellent opportunity for publicity. We have close to 100 hams involved in 4 land-located positions, and we also equip 5 power vessels with units for patrol purposes. Communication is via the Victoria Repeater (25/85), with HF used for long haul and backup.

There are usually at least 350 sailboats involved, from both the US and Canada. Their route is west out of Victoria through the Straits of Juan de Fuca to the open waters of Swiftsure Bank, and then back the 80 miles to Victoria. To give an idea of the conditions at sea, the wind at Swiftsure Bank was 45 mph last year, with a 22 foot sea (we have an operator who doesn't get sick). The turn boat is at anchor for at least 24 hours. In closer to Victoria the water conditions change by the hour, sometimes with no wind, other times with wind and rain.

The amateur radio enthusiasm is unbelievable. To give you an idea, last year this year's planning began the day after last year's race!

This year's Swiftsure Race is May 28 and 29, and we hope it will be a success.

A.L. Muir VE7BEU
Victoria BC

SOCIALISTIC CB?

Many CBers advocate that they be given privileges normally associated with amateurs. Maybe I'm old-fashioned, but I was taught that people were expected to earn the things in this life that they wanted to receive — whether it's a pay check, more frequencies, or more power.

I don't believe I'm disillusioned. We amateurs at least partially earned our licenses by diligent study and practice to obtain our licenses. Many times I have heard the expression that no one respects anything given to them. I observe that this is also true in regards to CBers as well as welfare recipients. Neither respect what was given to them and only cry for more.

The CBers who use ham frequencies and run high power, disregarding the law, are the same as someone who is denied welfare and steals because he feels it is owed to him.

Unfortunately, this reflects an attitude sweeping our nation. Until it is changed, our society will continue on a path of socialistic decline.

Harold White WA4CPF
Birmingham AL

CRAZY

I wanted to say that I enjoy reading your magazine. I'm not too crazy about all the computer articles, but I wasn't too crazy about 2 meter FM a few years ago when you were pushing that idea. Now I have two 2 meter FM rigs.

I'm also very glad that you're around to keep people on their toes! Many times, when I read your comments or answers to some of the letters you get, I find they reflect my exact feelings! I definitely do not feel, as I'm sure many others do not feel, your last name reflects your character (e.g., the letter "The Golden Helmet," Jan. '77). I think you hit the nail right on the head more often than many would like to admit!

Also — a special thanks to Don

Jenkins WA6OAZ for the fine article on getting 88 channels with 2 switches on the Icom IC-22S. A fantastic article, as many of the articles in *73* usually are!

Finally, as far as good experience with manufacturers goes, I must put in a good word for Amateur Electronic Supply. I've been dealing with them for about 4 years now, and haven't had anything to complain about. Ray Brenier K9KHW is always very pleasant on the phone and very helpful. Their used equipment has always arrived in mint condition. Great service on new stuff, too.

Dave Buda WA2RYC
Nutley NJ

TVI IS CURABLE!

I am interested in knowing any hams interested in reactivating 6 meter AM (in the metropolitan NY-NJ area). I am 16 and have finally acquired my Technician license (I didn't think I would ever reach the ranks). So c'mon fellas and/or YLs (TVI is curable). Drop me a letter and let me know. There have to be some 6m AM rigs around and I only own an AM rig, so it's only fair for myself. So let's hear it!

Kenn Ramirez WB2KQO
675 Knickerbocker Ave.
Brooklyn NY 11221

Watch out, or Ch. 2 will get you! — Ed.

10M CB

In regard to the proposed 10 meter frequencies published in the "Letters" section, how about moving it up 5 kHz so the converted channel 14 would be 28.715 and now be on the 10-10 net frequency? Perhaps this would encourage 10 meter operators to convert a radio to use from home or in the car on the net. Help promote 10 meter activity!

Douglas Reed
St Paul MN

FREE CLASSES

The Flushing (NY) Radio Amateur Technical Society is sponsoring *free* licensing classes in the Flushing area. For more information, drop us a postcard: FRATS, 62-26 Boelsen Crescent, Rego Park NY 11374.

Stu Weinstein WA2BXJ
Rego Park NY

LLOYD AND IRIS

We have just completed operation as W6QL/VP2A. We made 10,000 QSOs with hams in 126 countries. This is an all-time record for our various stops. The large number of QSOs was due, in part, to participation in the first weekend phone and the first weekend CW portions of the ARRL International DX Competition. We made nearly 4,000 QSOs (before eliminating duplicates) in the 48 hours of operating in the phone contest. This is the largest number of QSOs we have ever made in 48 hours. We remember world-famous contest operator Jim Neiger W6BHY telling us that in one contest he made 4 contacts a minute for an hour. At the time we did not see how it could be done, but we did almost the same thing in the contest just concluded.

Lloyd (W6KG) and Iris (W6QL) Colvin at VP2A.

Band conditions have been excellent. For example, we worked all continents in 30 minutes on 14 MHz SSB on 21 February 1977. Stations worked were UF6VAG, VK4AK, YV4YC, IK7RNH, XE1DPF and ZS6DN.

Lloyd Colvin W6KG
Iris Colvin W6QL
Antigua, W.I.

DVM FEEDBACK

I've been following Wayne's career, through the mags he publishes, for quite a few years. I must say that I enjoy *73* very much, especially the article on VR6TC and the mention of KV4AA. In 1956 I used to be VP2LB, so I know what it is like to be DX. Now I am settled in Canada and just about ready to be a VE3 after many hectic years in this country.

The main reason for writing this letter is to clarify some errors on page 60 (Fig. 1) of the Feb 77 issue ("DVM's Get Simpler"). Seems that Gary McClellan, in trying to straighten out the errors in that schematic (in the April '77 issue, p. 17), has introduced more errors. C3, the .01 uF, should move to pin 10, not 9; also the 10k resistor R3 should be between pin 10 of IC2 and pin 7 of IC3. Also, C2, the 47 uF capacitor, shows the wrong polarity. Positive should be on pin 7 of IC2.

Boris Auguste
Hamilton, Ontario

HORRIFIED

I recently received the April, 1977, issue of *73 Magazine* and was horrified to read "Those Illegal CB Channels" by John Skubick K8ANG. I am appalled that your magazine would condone such illegal activity.

My value system is such that I cannot support any publication which condones and even suggests illegal activities.

Therefore, cancel the remainder of my subscription to *73 Magazine*. I shall expect to receive a prompt refund for the cancelled portion of my subscription.

David A. Deem WA3ZXI
Rosemont PA

Please reread my article again, word-for-word. It is fact-filled objective reporting, written in a somewhat sarcastic vain. We hams, as a group, have always conducted ourselves within the law. (I, for over 22 years.) Yet we are constantly being harassed (such as by incentive licensing), and now possibly by restrictive designs placed upon our low band equipment, due to CB related activities.

Yet, the 11 meter band has been expanded to further accommodate some of what was once illegal. More channels have been added, and the rules are relaxed.

Speaking of that word "illegal," it is used throughout my article, including the title. This is the only word I know of that means "unlawful," "forbidden," and "not condoned." Don't you agree? — K8ANG.

LOOKING WEST

While your "Looking West" column is one of my favorites, I take great exception to WA6ITF's comment that there "was not a repeater to be had" while traveling through our Central Coast area. We do have excellent repeaters with lots of activity. Perhaps the machines are a little bit on the quiet side on a Sunday evening, but the times are rare that you can't put out a call and make a contact. Perhaps he should have tried "kerchunking." "Kerchunk" is the sound of a falling squelch tail brought on by a quick flick of the mike button. Of course, one should identify when doing this. Kerchunking 16/76 in San Luis Obispo would have brought to life WR6ADS, Cal Poly's local machine.

Also in SLO you will find the Central Coast's oldest and widest coverage machine, WR6AEL on 22/82. A little twist of the dial, another kerchunk, and up will come our newest repeater — WR6ASW. Located in Santa Maria, this machine covers from San Luis Obispo to the top of the San Marcos pass near Santa Barbara. As designer, owner, and trustee of this machine, I fought hard to get a good site and the best frequency pair, none other than the granddaddy of them all, 34/94. 34/94 was chosen to make the machine useable to a maximum number of persons, transients included.

Traveling south from SLO, one soon comes to beautiful Shell Beach, and while its excellent restaurants are enough to make most of us forget radio for a little while, an insistent kerchunker will discover Lompoc's own WR6AVI on 72/12 — an excellent repeater with coverage almost to the Gaviota tunnel.

In summary, one with only common channels in his radio will have 3 or 4 repeaters to pick from in this area, while those with full coverage can pick up Nipomo's WR6AHZ on 81/21 or WR6AFI on 60/00 with coverage from SLO to Thousand Oaks. All of our machines are carrier access, on the air 24 hours daily, and fully open to all licensed amateurs. We have open autopatch on three of the machines with exchanges covering Los Osos, Baywood Park, SLO, the Five Cities, Nipomo, Santa Maria, Los Alamos, Vandenberg, and Lompoc.

Regarding operation on other bands, WR6AEL has an open 450 repeater as well as a 450 system that controls a 52.525 radio. By the time Mr. Pasternak makes another trip through this area, WR6AHZ's 220 MHz system will be operational, and two open 450 systems in Santa Maria will be operational, one from the WR6ASW site, although our 450 frequencies will be per the national band plan, not the upside down Southern CA plan. Other things being planned but not presently operational include adding a 6 meter receiver at the WR6AHZ site with a 450 link to WR6AEL's 6 meter transmitter to complete a 6 meter, split site repeater on the most popular 6 meter channel per the national band plan.

While we do have good equipment on the air here, we also have good users. We do not need tight controls. Our autopatches are fully open and the codes are published. A high percentage of the local hams even have the repeater control codes. Most of us are not the "new breed." Many of us were rag chewing on 75 and working DX on 20 before we ever heard of a repeater. Several of us are members of QCWA and several of us are in high

school or college. Q signals we understand, but few of us know the difference in a 10-7 or a 10-8, and we are not interested in learning. We have no jamming, no attempts at long distance calls on our autopatches, and we jump to answer a distress call.

The point of this letter is that the Central Coast is not an rf desert. We welcome and encourage transient traffic on our fine repeaters. If you can't work our repeaters, we will even help you build a decent antenna.

Robert C. Couger
Santa Maria CA

THE POWER DEBATE

My comments may not sit too well with some equipment manufacturers and the "big boys," but perhaps the forthcoming ban on commercial linears is a blessing in disguise. Why does anyone need more than a couple of hundred Watts anyway? The only reason that I have found in over twenty years of hamming is to punch through the other signals, with the result that you are probably being heard not only by the person(s) you are in contact with, but by most of the country as well, and causing unnecessary QRM to boot. If the power limit was, say, 200 Watts pep on the high frequency bands, think of the reduction of QRM. Sure, there would still be the same amount of signals, but the level of QRM would be so greatly reduced that working around it would usually be a breeze. The great power myth is easily disproved by listening on the bands in the wee hours when most U.S. hams are grabbing some ZZZZs and hear the DX stations running one or two hundred Watts roll in. So the idea being put forth by some that all the new rigs would have to be expensive high-powered ones is possibly just a manufacturer's dream.

There would be some spinoff benefits from such a power limitation, such as a reduction in energy use and shifting the frustrations of not being able to compete with the super power from the average ham to the ex-super power ham who in most cases can better afford psychiatric care.

I doubt if such a power reduction will ever take place, but if it should, I wouldn't shed a single tear as I dismantle my trusty linear.

Harl Goodwell K6JQD
Paradise CA

You touched a sensitive point, Harl! I have always been dismayed by the use of excessive power on our bands. Possibly it is because I am not a seasoned DXer — sometime I will get into serious DX and my philosophy might change. However, while in college, I worked WAS minus two with 50 Watts CW, and it didn't take forever. With the abundance of good antenna designs around, it is a shame that more hams don't take the time to erect "superior" systems (apartment dwellers aside!). The same theory applies to VHF and UHF. Recently I have been involved in 432-450 MHz experimenting, and it's amazing what can be done with low power (under 50 Watts) and a good antenna/preamp/transmission line setup! The current crop of 2m transceivers all have fantastic receivers — a fact that reduces the amount of power required for dependable communications. I often wonder what it would be like if there was a universal 250 W power limit on HF communications. It might be interesting! High power is required in certain applications, such as EME, but should be employed only when necessary to maintain communications on HF, and I don't mean when blasting through a pileup on 20. I would like to hear from others on this subject — I'm open to criticism and will gladly open the letter forum to comments. — Ed.

20M QRM

The other day on 20 meters I had been monitoring the Intercontinental Traffic Network, in hopes of being of help to someone somewhere. A W5IH(?) station operating mobile in New Orleans began calling CQ on the frequency. There must have been at least 100 stations listening on that frequency. He was asked to move off and got very indignant about that. He continued to operate and QRM the net.

He said that he was sick and tired of all these nets on 20 and would not QSY, as he did not give a damn. I wonder what he thought we actually are about. I would like to publicly explain to him what we do and accomplish for us and him — yes, him!

First of all, one of the main reasons we hams are licensed and are allowed to be on the air is that we are here to promote international goodwill. When we run phone patches and other types of traffic, we certainly serve to further international goodwill, not only between other hams but to non-ham individuals as well. How much international goodwill did he render to his country by calling CQ and working a W8 station and exchanging signal reports, while people in maybe 20 countries were QRMed? We don't wish to take any fun away from anyone, whether he runs DX, SSTV, CW, mobile, etc. But please, try to cooperate with us, who enjoy running traffic. We have to share the band also. Remember that without a netting frequency to congregate onto, there would be hundreds more transmissions going on by people looking for connections somewhere — resulting in even more QRM on 20 meters.

By running traffic we are fulfilling one of our requirements for receiving our tickets. Please work with us, not against us. Use your energy to improve our bands. Maybe you could start a drive to clean up splatter, or perhaps work together to open more frequencies. There would be less QRM and more enjoyment, as we pursue our pet preferences in this wonderful hobby.

Chet Brown WB2AHK
Woodhaven NY

HOME BREW

As a home brew fanatic, I am constantly involved in those guerrilla wars we have all reluctantly come to accept as a way of life when venturing into the marketplace. It's been more years than I'd like to remember that I've been searching for dependable vendors, and any day now I should be receiving my battlefield commission.

I write up many projects and have had my share of pages in the ham magazines. The point is that a single article can sometimes result in literally hundreds of inquiries from interested readers who, for the most part, want to know where they may obtain parts for a project. I very rarely answer with a specific name, as I've learned from experience that I'd be making more enemies than friends.

Whenever I try a new supplier, I send him a small order just to see how it turns out. If all goes well, I keep this place in mind for the next time I need his kind of merchandise. If my order receives shabby treatment, however, I scratch the name from my list.

The candid "Letters," reporting personal experiences that other readers have sent to this column, are quite helpful and a sorely needed service for the harassed consumer. However, the results are not always consistent. After reading a favorable report on Quest Electronics, I sent my usual "test" order for $8.90. After waiting a month, I wrote a letter canceling the order and requesting a refund. I was not even extended the courtesy of a reply. I wrote again 3 weeks later and subsequently received a partial refund. This meant another letter, inquiring after the remainder of the money I had sent for parts they didn't even have, and which were still being advertised months later. (Too bad we can't claim expenses and compensation for all the aggravation.)

Perhaps we should start a "preferred vendors list." Anyway, I've put in my two cents worth, and with inflation it is worth even less, but I do feel a little better for having done so.

Raymond Megirian K4DHC
Deerfield Beach FL

THE RFI BILL

Senator Adlai Stevenson
United States Senate
Washington DC

Since moving to Illinois I've never written to you, but a bill recently introduced in the Senate is of vital interest to me, and should be to all Americans.

I am writing in vigorous support of S-864, Sen. Barry Goldwater's RFI (Radio Frequency Interference) bill.

I speak from experience, as both an active amateur radio operator for over 15 years, and as a TV and stereo buff for even longer. As a ham, my equipment has always been "clean." Yet, I've faced all sorts of harassment from my neighbors because of interference to their TVs, radios, and stereos.

Repressive local laws against any amateur or CB operation are beginning to appear. It's not our fault, in the main. It is the fault of shoddily built equipment for home entertainment, which all my neighbors own.

Look at it this way — one of the major intents of the present administration is for human rights, as expressed in our Declaration of Independence and designed into our Constitution: "The right to Life, Liberty, and the pursuit of Happiness." If that pursuit of happiness is not at the expense of someone else's pursuit of happiness. In other words, I have the right as long as my signal is clean, to pursue my happiness by operating my amateur radio station, as does my neighbor to watch "Mary Hartman" or the Super Bowl. We really should never know of each other's existence. But (1) when my operating signal destroys his picture or sound, even though I'm operating a properly designed and adjusted transmitter, and (2) when various signals from my neighbors' TV sets interfere with my reception, which they do, then (3) something is wrong.

My neighbor himself is not at fault. But he paid $450-$900 for his home entertainment set, and he expects and thinks that that set should be designed and constructed much better than it is.

And so it should be. It must be, because the home entertainment equipment industry's quest for life, liberty, and the pursuit of happiness, via higher profits, is infringing on my rights and the rights of my neighbor, the consumer, to each do as we wish, because of their cheap design and shoddy construction techniques. It just isn't fair, pure and simple.

I believe that S-864 is a major step, a good start in the right direction to the day when all radio operators and TV/stereo lovers can live in peace in the same neighborhood.

The home entertainment equipment industry is not about to agree with any of this. Through their lobbying group, the Electronics Industry of America, they are expected to greatly oppose this bill. They will claim that the cost of properly designing and shielding their devices against RFI would be prohibitively costly. They said the same thing about the all-channel set law in 1964.

It proved to be a fallacious argument then, and still is, particularly in

Continued on page 42

Briefs

Compiled by Warren Elly WA1GUD

Got a good ham radio news story? Drop us a line, or call it in, and take home the 73 publication of your choice, provided we publish your news tip. Be sure to specify which book you want. OK?

At deadline: AMSAT reported a successful 2m CW contact between KP4AST and YV58UK . . . over 500 miles between Caracas and Ponce. A fourth 432 MHz EME WAC is also reported by K3PGP, who completed the all continents award with ZE5JJ. May 2nd at ARRL headquarters, AMSAT officials were planning their first A-O-D operations meeting since both groups signed an agreement turning control of OSCAR 8 over to the League. Topics to be discussed reportedly included allocation of the new satellite's passband, with many OSCAR users advocating a CW-SSB division similar to OSCAR 7 mode A. FCC license totals for CB (February) were nearly 700,000. Some Russians may be signing U60 in commemoration of the 60th anniversary of the October, 1917, revolution. The Fresno International DX Meeting drew the biggest crowd ever – over 350 DXers from far and wide. And, congratulations are in order to the beloved *West Coast DX Bulletin* (the source for the last three items). At Fresno, the *Bulletin* received two awards, one from the Southern California DX Club and another from the Golden Empire Amateur Radio Society. At last report FCC lawyers were still sorting out that cable TV case mentioned in one of this month's guest editorials. One FCC spokesman on the matter of what will happen at the Dayton FCC Forum: "We will be pretty close mouthed until more explicit instructions come from higher up . . . we will discourage discussion on pending proposals, and make a written record of the Dayton Forum for the public files on various dockets."

Jack Anderson's national newspaper column strongly criticized the FCC and left amateur radio with a PR problem under a "Radio Hams Are Favored Over the CBers" headline in early April. Unfortunately it was not an April Fool's joke – Anderson, citing quotes from Georgia Congressman Elliott Levitas, accused the FCC of discriminating against the 9 million CBers in frequency assignments, in favor of only 300,000 amateurs. Anderson's case rested on his claim that important decisions by the FCC have been made by officials who are also amateurs, and therefore biased against CBers. One FCC official termed the report "a frivolous allegation" not worthy of comment. Congressman Levitas, though, is pushing for a House investigation of the FCC. (See Guest Editorial this issue.)

Bob Hope has generously recorded some public service announcements pointing out to the public that amateur radio is valuable to the nation, inviting those interested to "join in." These will be distributed to radio stations, adding to those already being heard which were made by Dick Van Dyke. Thanks to WBNAZ.

Another record month for amateur applications arriving in Gettysburg . . . 22,927 received during March, topping the January record of 21,553. However, the backlog is growing, instead of falling. At the beginning of March the number of licenses awaiting processing was about 38,000. By the end of the month, the backlog was up to 42,000. The waiting period, meanwhile, had grown beyond 10 weeks in some cases, with the average wait somewhere near 8½ weeks.

The ARRL has filed in opposition to RM-2830, that proposal to permit rebroadcasting of amateur transmissions for traffic and emergency purposes over commercial stations. ("Briefs," May '77, *73*). In its response, the League argues that road, traffic, or weather information could not be of benefit to a commercial audience without a two-way system for clarification of the information being filtered into the studio. That, of course, would take a licensed amateur station at the broadcast studio, a requirement broadcasters would be hard-pressed to meet due to commercial considerations. The League also points out that amateur transmissions would be used in heavily commercial time periods, so-called drive times, when broadcasters not only have their largest audience, but also their highest advertising rates. Backing the WBEN plan was the National Association of Broadcasters (NAB). The League response noted that the NAB was not familiar with amateur operations, and sought to exceed reasonable limits for questionable benefit, in backing RM-2830. Buffalo area amateurs, meanwhile, were upset by the League opposition. Said one local (heard on 75m), "This isn't the time to split hairs when ham radio so badly needs better access to the public for PR . . ." As pointed out, however, in the League petition, unusual circumstances (such as disasters and so on) do allow rebroadcast of amateur transmissions, with the permission of the district FCC engineer-in-charge.

It will probably be some months (as of this writing) before the total scale of amateur operations in spring floods and tornadoes will be known. Virginia, West Virginia, and Kentucky were hard hit by floods and mudslides. Local communications went down quickly, especially in WV, where amateurs set up a communications center at the state capital, operating on a 24 hour a day basis. It took as much as 48 hours in some areas before National Guard units could arrive, and amateurs were reportedly working closely with local police using HTs and those repeaters that could be coaxed back onto the air. At Williamson WV, residents were warned of the flood by the local fire whistle, the only form of communication left as the waters crested. In another WV town the mayor was carrying a pistol to discourage looting, he told NBC News, since it would be days before help arrived. In Alabama, tornadoes tore through Jefferson County, three years to the day after the last killer storm there. Amateurs in Birmingham operated W4CUE continuously, handling traffic from the disaster areas.

There were some new developments on the FCC's proposal to ban the manufacture of linear amplifiers covering 24-36 MHz and type accept amateur radio equipment (dockets 21116 and 21117). At issue is the need for point of sale constraints on the sale of equipment to non-licensed persons (a concept the FCC had rejected). ARMA, the newly formed manufacturer's association, reacting to a counterproposal from the San Antonio Repeater Association (see "FCC," this issue), argued that the Texas plan would probably violate federal restraint of trade regulations. ARMA's proposal differs from the San Antonio plan in one key area – it puts the onus on the manufacturers, not the dealers.

The ARMA plan would require all manufacturers and importers of rf generating devices to affix permanent serial numbers and provide affidavits. The affidavits would be presented to the buyer by the dealer, who'd have to see a valid amateur license (or photocopy) prior to closing the deal. The seller would witness the signing of the affidavit, which would include the type of gear, serial number, call letters of the buyer, his name, and a statement of intent covering the subsequent use of the gear. A willful violation of the agreement would carry a $1000 fine on the buyer, dealer, or manufacturer if the FCC found any party in violation. A copy of the agreement would go to the FCC, dealer, manufacturer, and buyer, and, just like a station license, the affidavit would have to be presented upon inspection by FCC personnel. As an ARMA spokesman put it, "this plan offers fewer loopholes than the FCC's type acceptance plan, and would meet the constraint of trade regulations of the Federal Trade Commission.

One importer, in a letter to its dealers, argues against type acceptance as harmful to amateur radio. "Experience with type acceptance in other services is illuminating. A typical amateur transceiver in the 250 W (PEP) class today lists for between $575 and $900, depending on options and manufacturer. A comparable marine transceiver, type accepted, lists between $2000 and $5000, and lacks many of the technical advances found in current amateur transceiver." It

may be assumed then, that type acceptance of manufactured amateur equipment will increase its cost to the consumer, and that innovative changes will be much slower in being produced, just as in other services." The dealer's letter goes on to conclude that "since type acceptance is now desirable only as a solution to a Citizens Band misuse problem, it is beyond our understanding as to how the Commission can expect to keep high powered, illegally converted transceivers from such use, by inspecting them for purity of emissions."

A 90 day delay was announced in early April, extending the comments deadline for both dockets until August, thus opening the door to more amateur comment.

As this issue went to press, ARMA, the Amateur Radio Manufacturer's Association, was delivering an 11th hour appeal to the FCC . . . hoping to soften the first rule and order growing out of Docket 20777 (bandwidth). Effective April 15th, new harmonic and spurious emissions limits were to take effect for amateur transmitters. The 40 dB limit below 30 MHz/60 dB above 30 MHz standards replace the "according to good engineering practices" wording of the amateur regulations. They have widespread implications for amateurs and manufacturers alike.

The FCC's intention, according to a spokesman in the Chief Engineer's office, is to find a new way to crack down on illegal CB amplifiers. But, as the spokesman put it, "the net catches a bit more than we bargained for, "including several popular ham transceivers. (That's based on published specifications, not any actual testing at the FCC lab.)

The regulation covers marketing and advertising of equipment as well, and, as our source put it, "if the gear is advertised you can assume it will meet the specifications." Specifics were hard to come by at deadline, but one thing is sure — amateur stations, upon inspection, will be checked at the antenna output, thus including antenna tuners, low pass filters, and so on. It is the whole operation the Commission will be concerned about, not the individual pieces of gear. A quality low pass filter then, should put most stations in compliance at HF.

The manufacturer's reaction was about as you'd expect. One importer suggested he would no longer be able to advertise or sell gear to dealers; another warned that he'd probably go bankrupt, if forced to take back gear that wouldn't comply from dealers who couldn't sell it. ARMA President Dennis Had of Dentron Radio visited Washington with a message from the manufacturers — "We applaud the proposal because at long last we will have a concrete definition of what good engineering practices means . . . but we feel the FCC has committed a grave oversight in not grandfathering some of the equipment affected by this regulation."

Had told *73* ARMA was asking for a grandfather clause on transmitters and transceivers (not linear amplifiers) built by legitimate manufacturers, who'd be forced into bankruptcy if forced to take back dealer's inventories. ARMA also asked for grandfather clauses covering used gear that would be deemed non-salable by the new regulation. Had argued that the grandfather compromise would lessen the injustices brought by pseudohams operating illegally with amateur equipment, and strengthen the bond between amateurs, the FCC, and the manufacturers. A decision was expected prior to the April 15th effective date.

A Federal Court judge has ruled that 5 dirty words should not have been banned from the airwaves by FCC regulations. And, no, as Morton Dean reported on CBS News, "We are not going to" (list them here).

As expected, *QST*'s ad rates will jump over 40% with the July edition of the League publication. That puts one full page of advertising in *QST* at $1300 (one time), instead of the old rate of $912.

Contesting may never be the same again! In early April, at a meeting attended by 80 contestors, Murphey's Marauders and the North East Contest Club merged by majority vote, thus ending a dynasty that lasted decades. The new club, named the Yankee Clipper Contest Club, unifies the northeast, and is expected to challenge west coast and mid-Atlantic clubs for national leadership through aggregate scores in Field Day Sweepstakes, ARRL DX, and CQ WW.

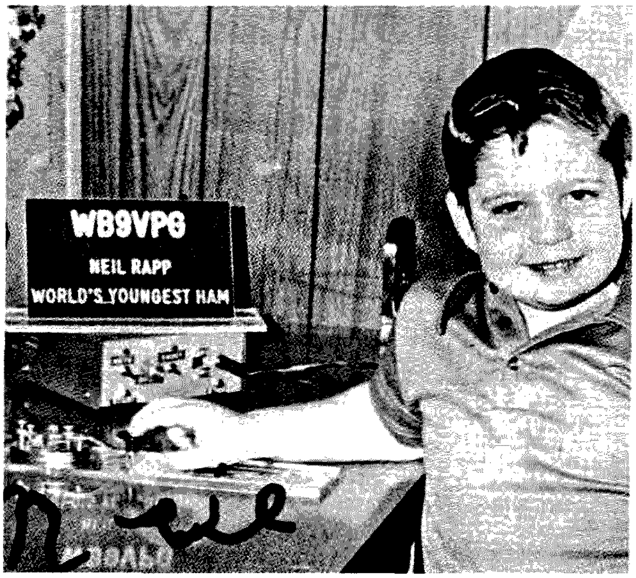
Here's an update on our "Briefs" report last month on the stolen repeater in Minneapolis/St. Paul MN. The 16/76 repeater there was vandalized and QRTed March 2nd, with several hard-to-replace items stolen. A temporary repeater was on the air within 24 hours, with a new installation scheduled to go on the air April 10th. Meanwhile, the club's rental agent has agreed to provide a safer location for the machine, including a security officer. Donations made the new installation possible, according to *The FM Scanner*, monthly bulletin of the Twin City FM Club, Brooklyn Center MN.

Neil "Rusty" Rapp WB9VPG, the world's youngest licensed amateur, has probably passed his Technican exam by now. According to Rusty's mom, the General CW may be a bit too quick for him to write down, so the General will have to wait. Mrs. Rapp herself has probably passed her Novice by now, while Rusty's dad is, by now, a General. As for the theory, six-year-old Rusty is plugging along, according to Mrs. Rapp, who says she doesn't see how he can pass . . . but she says she didn't think he'd pass the Novice either. Rusty has been getting plenty of CW practice with his new birthday present — a TS-520 transceiver from Kenwood.

As the WARC is coming up in 1979 to discuss frequency allocations, it is worth reading the report on the 1937 Frequency Allocation Conference in Cairo, Egypt. "The amateur interests were represented by the IRAU delegates, led by the ARRL's Mr. Warner. The three month long conference was not too good for the European amateurs. The reason was that most delegates of the European countries did not sympathize with the amateur movement. There were delegates who were expressly hostile to the amateur cause. Mr. Warner included the names of these delegates in his report. There have been some delegates who supported amateur aims, first of all, the USA delegation. The result was that all amateur bands were left intact for the Americas, while the Europeans lost large parts of the 80 meter band, and most of the 7 MHz band to be occupied by broadcast stations. The 5 meter band was completely taken away" (*Shortwave Review*, June/July, 1938, Budapest, Hungary). With thanks to W1PL.

A good WARC dialog between Japanese and Australian amateurs was reported at the JARL (Japan Amateur Radio League) 50th anniversary celebration last year. At a commemorative dinner party held in Tokyo Michael Owen VK3KI, an immediate past president of the Australian Wireless Institute, urged the Japanese to look ahead to the next 50 years of amateur radio. "In 1979 in Geneva, the representatives of all the countries of the world will meet and review the bands allocated to each service. There are two very important things that we should remember. The first is that each country has only one vote. Japan

has one vote. Australia has one vote. But so also has Tonga and Nauru." (Both are small Pacific Island countries of 78,000 and 5,000 populations, respectively — Ed.) "The second thing that we should remember is that there are over 300,000 amateurs in your country. The next largest amateur population in our region is in Australia, where there are only 6,000 licensed amateurs. Perhaps we should also remember that our region, which has 37 votes at the conference in 1979, extends from Iran to Tonga — half the globe." Owen went on to assess the future: "Our future is not secure. The amateurs of the world are not the only people seeking to preserve and indeed expand their bands. We must justify our position. We face particular difficulties in our region — we must remember that there are some countries where there are few amateurs and other countries where, perhaps for security reasons, amateur radio is not permitted. Indeed, in some countries it is treated with the greatest suspicion." Further on in his address Owen proposes a way amateurs in the Japanese/Australian corridor can argue amateur radio's case for the future. "The amateur service is global; the needs of amateurs cannot be judged by any country looking only at the narrow confines of



Neil "Rusty" Rapp WB9VPG, current record holder as the youngest licensed amateur, and working hard on his General at age 6.

that country. The unique contribution of the amateur service to international goodwill, training, and education is at the heart of its contribution to both the national and international interest ... The amateurs of the world must speak with one voice." Reprinted from *Amateur Radio*, Journal of the Wireless Institute of Australia.

On March 1st, the FCC extended permission for amateur ATV transmissions (fast scan) in the 420-540 MHz band. This was to allow for further experimentation unless changed by bandwidth docket 20777. Bruce Brown, operator of WR4AAG, the Washington DC ATV machine, gets much of the credit for the FCC action, which grew directly from his comments in response to 20777. Thanks to the *RF Carrier*, bulletin of the Dayton (OH) Amateur Radio Association.

ATV is on the air in California, according to *ATV Magazine*. The site is just north of San Francisco at Auburn, with coverage from San Francisco to Sacramento. The frequencies are 437.25 MHz in and 427.25 MHz out. Meanwhile, in Los Angeles the locals are reportedly building a 434 MHz in, 1240 MHz out ATV machine. Back east, Ed Piller W2KPQ, the Long Island Mobile Amateur Radio Club (LIMARC) ATV chairman, reports he's still working out the bugs on the club's ATV machine. Operating frequencies on LI are 439.25 MHz in, and 427.25 out.

The extra effort separates the "serious" from the "enthusiastic." Here, the Dallas Amateur Radio Club effort illustrates the easy way to clamp a tribander onto a crankup tower. Thanks to the DARC.

The Personal Communications Foundation, a legal aid clearinghouse set up to advise attorneys representing amateurs in tower cases and RFI/TVI disputes, has received some substantial contributions. Yaesu and Wilson both donated $10,000 to go with $5000 from the ARRL, as reported here previously. PCF is still seeking legal briefs from lawyers involved in communications cases. PCF's address is 915 W. Lancaster Blvd., Lancaster CA 93534.

AMSAT has arranged Bank Americard and Master Charge for contributions and membership dues. Be ready with the information embossed on your charge cards when calling AMSAT at 202-488-8649.

In other AMSAT news, the battery situation on OSCAR 6 was status quo as of deadline. Three cells are apparently dead (of the 18 aboard), and telecommand stations have been instructed to turn the satellite off after each orbit for recharging purposes. Both current satellites will be coming out of 100% sunlight now, forcing some changes in operating schedules. Work on A-O-D continues in Washington, now with the help of two ARRL staffers dispatched to AMSAT headquarters through the League's agreement reported in our last two issues.

AMSAT sources say that A-O-D is progressing on a tight schedule, with the launch date now on a call-up basis. At the earliest, that puts the launch at the end of the year, or early next year. Lloyd's of London is underwriting the launch (a stipulation of the AMSAT-ARRL agreement) for $50,000, in case the launch fails or a suitable orbit is not obtained. A similar arrangement was set up for OSCAR 7, according to AMSAT.

Finally, AMSAT headquarters says there are still some 1st day covers available from the OSCAR 7 launch. They go for $1 each or six for $5, by writing (or calling) AMSAT in Washington at PO Box 27, 20044.

An interesting note from England, via *Radio Communication*, Journal of the Radio Society of Great Britain, February 1977:

The severe interference emanating from the Soviet Union continues to cause problems to many services from time to time. It is reported that some European administrations have received the following message from Moscow: "Radio installations operated in HF bands are being experimented with in the Soviet Union and these experiments could possibly cause interference of short duration to your radio facilities. We are now taking actions in order to decrease eventual interference. Your reports will be attentively studied by Ministry of Posts and Telecommunications of the USSR. Regards. Minsviaz."

On a number of occasions, items of news from *Radio Communication* have appeared in the Soviet publication *Radio*. They have included extracts of information on RSGB affairs which have been distorted to place an unfavourable light on western society, and it is hoped that criticism by that same society of the present illegal activity by the Soviet Union on international frequency allocations will also receive due publicity in the same place.

How do you handle the many unsavory and questionable conversations and activities occurring on the amateur bands; The FCC says *ignore it*! Don't try to contact the people to reason or quarrel with them. Don't try to jam them. If they break into a net, and won't move, wait them out. But — do a lot of listening. Get specific information on calls, dates and times. Write down exactly what you hear. *Don't* send tapes to the FCC or make phone calls. Write down all the pertinent information and then mail it. The staff has limited time for these problems, but they are willing to pursue a good hot lead if it is well documented with enough background information. Reprinted from *The Printed Circuit*, Great Lakes Repeater Association, Detroit MI.

Another Federal Court decision, prompted by broadcasters, will affect ham radio. A US Court of Appeals panel, in throwing out some of the FCC's cable TV rules, severely criticized the Commission's rule making practices. As a result, FCC attorneys are warning Commission spokesman in decision making positions not to accept informal (verbal) comment on pending rule making proposals. It could affect "bull sessions" at hamfests and conventions, but the full impact was unclear at deadline. An earlier case brought by broadcasters resulted in the suspension of all license fees, and a Mexican standoff of sorts, as the Congress blames the Commission, and the Commission blames the Congress for the fees dispute.

As we were putting this edition of "Briefs" to bed, the word in club bulletins from one end of the country to the other was Field Day. It looks like another record-breaking year for participation, if the bulletins are portraying an accurate picture. One point to remember is that the ARRL has made the CW rule a permanent fixture of Field Day ... that is, CW contacts count twice a phone contact, so get those keyers and bugs ready!

According to the *West Coast DX Bulletin*, the Southeast DX Club (Atlanta) ran a poll of their membership on the needed ones. The following is the head of the list, notable for the listing of most of the usual "desperately needed" ones.

1. Iraq
2. China-BY
3. Clipperton
4. Khmer-Cambodia
5. Bouvet
6. Heard
7. Saudi/Iraq Neutral
8. Burma
9. D6-Comoroes
10. South Sandwich
11. Albania
12. Spratly
13. Okino Torishima
14. Kamaran
15. Bhutan
16. Laccadives
17. Bangladesh
18. Cocos-Keeling
19. Annobon
20. Geyser
21. Andamans
22. Qatar
23. Central African-TL
24. Chad
25. ZS2-Prince Ed and Marion
26. Auckland/Campbell
27. Malpelo
28. Aldabra
29. Willis
30. Mellis

Clubs across the country continue their search for new ways to relate ham radio to their communities. The Central Michigan ARC has an interesting PR-Public Service approach — a remote base setup for emergency weather alerts aimed at the general public. According to the CMARC bulletin (*The Scope*), police, fire departments, schools, and hospitals monitor

the 147.10 MHz warning frequency 24 hours a day. Hundreds of homes are linked to the system as well, since local supply shops are stocking scanner crystals. The remote base is controlled through the club repeater system, with a link to the Lansing Weather Bureau. The 147.10 MHz warning frequency is repeated through the Lansing system on a priority basis — any station on either repeater is overridden by the warning broadcasts. As John Hackman WB8QPE put it in a recent *Scope* article, "Emergencies come up quickly and without two weeks advance notice . . . ops who get the word off the air are those who help, not those who have to be reached by telephone . . ."

Two members of the North Shore Repeater Association (MA), operating on 28/88, March 4, at 11:35 pm, joined in a successful effort to prevent a tragedy, when Ed WA1LRL/M came upon a disabled car on the Cabot St., Beverly, railroad crossing, with an approaching train coming down the track.

Dick W1FAW phoned the Boston & Maine tower in an attempt to have the train stopped, but it had advanced too far down the track.

On being notified of this fact, WA1LRL grabbed several red flares he had with him and placed them on the track, stopping the train in time.

Then he and the train conductor pushed the car off the crossing, and in doing so discovered two youths who were quite ill lying across the tracks. They were assisted to safety. Reprinted from *QRA News*, bulletin of the Quannapowitt Radio Association, Lynnfield MA.

Contrary to some recent rumors and quite possibly to the hopes of those few who would like to see amateur radio's reputation for self-discipline destroyed, the second 1977 meeting of the Ohio Area Repeater Council was neither a flying circus nor a dogfight. The Council met at the Delaware County Historical Society in Delaware, Ohio, on Saturday, April 2, with representatives of 44 of its 82 supporting member repeaters in attendance (plus 16 guests).

The committee assigned to examine the use of the lower portion of the two meter band by Ohio amateurs reported that most of those SSB operators whose licenses permit operation below 145 MHz use frequencies below 144.5, and the Technician Class licensees now operating just above 145 MHz would move down if given an opportunity. Having already voiced its opposition to unrestricted repeater operation in all parts of the amateur bands, the Council voted to support the Iowa proposal to establish a new repeater band between 144.5 and 145.5 MHz and to authorize Technicians' use of 144 MHz.

Conflicting claims to priority on the 146.34/94 repeater pair in northwestern Ohio and southeastern Michigan by WR8ACT in Toledo, Ohio, and WR8AJV in Belleville, Michigan, were reviewed. The Toledo repeater was originally established in 1969; the Belleville repeater was sanctioned by the Michigan Area Repeater Council at a time when it appeared that Toledo had relinquished the frequency pair. After examining available records and hearing statements by both parties, the Council members concluded that Toledo had a legitimate claim to the frequency, and reaffirmed its earlier coordination of WR8ACT without a dissenting vote.

A strong plea was made to all present to write their senators and congressmen, urging them to support S-864, Senator Goldwater's bill that would require manufacturers of household electronic equipment to install adequate RFI protection. Thanks to W8GRG.

The Illinois Repeater Council took action at the February meeting on the issue of 15 kHz repeaters — and whether they should be "right side up" or "upside down." Illinois voted to adopt the so-called "California plan" which follows the "reverse" principle. This is the same plan followed by western Pennsylvania, Ohio and Indiana (and Michigan is reported to be studying such plan). Reprinted from the Lake Erie ARA *Repeater Newsletter*, Lakewood OH.

Malaysia has apparently acquired its first 2m repeater. Via *Amateur Radio*, the official journal of the Wireless Institute of Australia, comes the news that a frequency coordination committee has approved 147.90 MHz output and 147.30 MHz input for the system. It's to be located at Ulu Kali, with maximum power of 50 W. *Amateur Radio* also reports that Malaysian amateurs are now authorized to use RTTY.

With A-O-D in the offing, AMSAT is anxious to help club groups interested in demonstrating the satellites. A-O-D, which will become OSCAR 8 after launch (and is to be controlled by the ARRL), will be set aside primarily for educational purposes, due to its low orbit and short acquisition time. Contact AMSAT for more details.

The winner of the 1976 Amateur Radio Biting Bug Award is Anthony R. Curtis K3RXK of State College PA. The award, given to the writer of the best amateur radio article published in a US non-ham publication, is a $50 prize and plaque.

Mr. Curtis' article in the February, 1976, issue of *Popular Mechanics* was judged the best of over 50 submitted in the competition. Entitled "New Satellites Make Ham Listening More Fun," the article was accurate, well-written, and attracted a large non-ham audience to amateur radio. Mr. Curtis is an assistant professor of journalism at Pennsylvania State University.

There will be no 1977 competition for the Amateur Radio Biting Bug Award. However, competition will resume in 1978 in two categories. A plaque and a $200 prize will be awarded to the writer of the best article about amateur radio in an American nationally-circulated non-ham publication during 1978. To the writer of the best ham article published in a regional or local publication, there is a plaque and $100. Articles will be judged on how well they attract non-hams to ham radio. Writers do not have to be amateur radio operators.

The judge is Ray Collins, a professional writer and ham operator. Judging will be based on an article's subject matter, style, accuracy, accompanying illustrations, and the mention of where a reader may obtain more information about the hobby.

Photostats of articles with the name and date of the publication should be sent to Ray Collins WA2GBC, Harter Road, Morristown NJ 07960. Please enclose a self-addressed stamped envelope. All entries must be submitted by Jan. 31, 1979.

Kansas State Police officials have decided to do away with the traditional "10" code, in favor of simple words and phrases. "10-4" is now "okay," and "10-13" is "help, policeman in trouble." Officials report that the changeover is going smoothly, although some officers still forget and use the "10" code from habit. Reported by the AP.

FCC licensing figures released by the ARRL indicate a total of 293,655 amateurs in the states. The breakdown, as of the end of January, was: Novices — 38,365; Technicians — 61,359; Conditional — 22,483; Advanced — 71,360; and Extra — 15,732. Whether we can break 300,000 by the end of the year remains to be seen, but if current application rates continue, the chances seem good.

L.A. area repeater owners and users alike are angered by the content of RM 2844 submitted by Jones P. Talley W5JTE, which requests that the FCC place a blanket ban on closed repeaters. The majority of those opposed feel that Mr. Talley's pro-

At the March meeting of the United Radio Clubs in San Pedro CA, Dr. Norm Chalfin K6PGX spoke on AMSAT/OSCAR programs past and future. Here, as the group listens to OSCAR 7 mode B, he points out where the spacecraft is at the time. Thanks to K6SWD for the photo.

posal is an infringement upon their right to own and use personal property as they see fit and fear that once all repeaters are made open and available to any amateur, the next logical step would be to make all amateur stations legally available to all amateurs at all times. This they cite as a direct violation of the Constitution and have vowed to defeat the RM.

receive such calls may use them until they receive new calls mailed automatically by FCC. However, they are advised not to order QSLs with the WCØ call, as it will not be their permanent callsign. From the ARRL *Bulletin*.

One hundred years ago this year the

"breaker four." Gary again responds, and learns that "Main Squeeze" had blown a fuse the night before. His CB power supply couldn't quite handle the 20 Watt input radio. Fuse replaced, he is now able to enjoy the peace and quiet of the new FM-CB rig, as it is described by Gary. Gary then pretends to be interested in "Squeeze's" Cobra-200, and asks if he

was only to leave the radio beacon on the island and then continue on to Capetown. No extra effort was planned in case of poor weather . . . they would just continue on. The schedule was to be in the vicinity of Bouvet around February 24th or 25th, and this was reported when they were in Antarctica. They were early arriving at the island and were there

BE MY GUEST

visiting views from around the globe

OM Winter-East

Since the birth of radio communication, amateurs have always been there to lend a helping hand wherever and whenever disaster struck. On the last weekend of January, 1977, a different kind of a disaster struck western New York State. For the first time in history, a disaster was officially declared due to excessive snow! At the first glance, it might almost seem funny, or that people have turned soft, to be so affected by the white stuff. However, when you consider that snow fell in one amount or another every single day for over a month preceding the storm, and that, for the country as a whole, this was the hardest, coldest winter in all recorded history, it begins to take on a different proportion.

Friday had dawned dismal, like a great many days before it. Temperatures ranged from slightly below zero to five or ten above. A light dusting of snow was added to the foot or so of powder already on the ground. The weather remained stable until just after lunch. Then the storm hit. In the next eight hours, over a foot and a half of snow fell. Winds rose to 40 mph or so, with gusts over 55, and the temperature plummeted.

Before and after digging out. This house, located near the author's home, was completely buried in snow. Snowmobiles ran over the roof, the chimney (at the right end of the house) was covered over, and rescuers had to tunnel down to the door in order to evacuate the family. (Photos courtesy *Albion Advertiser*, used with permission.)

In less than an hour, the New York State Thruway became impassable. The expressways in and around Rochester were closed by the police — too hazardous to attempt any kind of travel. Other highways in the region quickly became parking lots. These were the conditions in Rochester. Further west, they were worse. My home is in Albion, the hardest hit area east of Buffalo, which of course got the worst.

Between the two cities, Rochester and Buffalo, Lake Ontario curves so that a wide bulge extends north several miles further than the rest of the lake shore. Being just on the edge of the favored intercity route, and not conveniently handy to either city, the land is mostly farmland — flat, open, and completely at the mercy of the wind. It is called Orleans County, and Albion is in the middle.

It took me four hours of creeping past stalled cars, detouring around accidents, and clawing my way through snow drifts to reach Orleans County, and I thought I'd made it. Old Man Winter second-guessed me. Five miles east of Albion, a tiny village called Fancher can be found (if you don't blink on the way through). There the State College of Brockport NY maintains a rural property for ecological research and conferences. It was just a mile west of that property that I was told to turn back. Scores of autos were bogged down ahead of me, and there was simply no passage.

I turned down a side road toward the college property, hoping to work my way around this last obstacle, and there I bogged down in a large drift. It was half a mile from my car to the

stopping in another building halfway there.

It would have been a pleasant place to be stranded, and I had good company — four cute young school teachers. Five miles away, however, trouble was starting to pile up. The XYL was stranded with a pair of stir-crazy four-year-old twins. The house is an old one (one of the oldest in Albion), and the brutal winds were forcing cold and snow in so violently that a pile of snow had gathered in a room which was separated from the outside by another room. The water in the bottom of our washer froze.

My hopes of getting out Saturday faded with the day. The snow had stopped, but not the wind. As fast as a pathway could be plowed on the roadway, powdery snow which had collected since Christmas had blown in to close it up again. Highway crews were fighting a losing battle.

Throughout the county, every high school, every recreation hall or other suitable building became an emergency shelter for the hundreds of people stranded by the storm. The CD director had to coordinate his efforts through the sheriff's office, as the CD center was all but inaccessible in the storm. All over the region, amateur radio nets were being called into emergency session. At home, pipes were freezing and bursting. Barb was thinking of evacuating to the high school.

> "With winds as high as they were, the windchill factor could freeze exposed flesh in a matter of seconds. . . "

Sunday morning I said, "To hell with this!" and started walking. The snow had packed so hard you could walk over the drifts without sinking in. My car was buried up to the window. I later heard that after one car was removed from atop a snowdrift, another was found buried three feet beneath it, the driver inside frozen to death.

I was lucky. Less than a mile from the college property, a car picked me up. The driver felt two would have a better chance of making it through than one. We zipped through one of the temporary openings in a half-mile long drift, and I saw the top of a tractor-trailer sticking out. Occasional hints were visible of cars buried in the walls of the ravine of snow. On the other side was Albion and home.

To the towns east of Orleans County, the storm was over. Highway crews trying to clear the roads had their work grind to a screeching halt as sightseers came in from adjoining Monroe Country and found themselves stranded. The sheriff finally cracked down, ordered *all* roads closed, except for official emergency traffic, and imposed a thousand dollar

chapters! I checked into the New York Public Operations Net on 75, and then notified the sheriff and the Red Cross that I was finally home and available.

The net manager, K2KQC, was stranded in Buffalo, far from her rig. W2PZL and WA2SYR were holding things together. Of course, there were plenty of others taking their shifts as net control, but these two stand out in my mind, especially WA2SYR. He's blind, but the best organized net control I've ever heard.

Fortunately, the telephones managed to hang together. Otherwise the already busy nets would have been bedlam. Throughout the day, however, I was asked to originate a few messages out of state for stranded motorists. I even managed to get some of the pipes fixed. Once again we had water running, and the wife felt better.

The CD headquarters for the entire western New York region is in Batavia, 20 miles south of Albion. There an especially energetic group was working through the 04/64 repeater. They were under the guidance of WA2AIV, who stayed several days

"The brutal winds were forcing cold and snow in so violently that a pile of snow had gathered in a room which was separated from the outside by another room. . ."

at the center, and became the first person to sleep in the bunk room since the place had been built. Bad as things were in Orleans County, we had a picnic compared to Erie, Niagara, and Chautauqua counties, which had a lake upwind which manufactured an unreal amount of snow. In Buffalo, K2DWI and others activated the station that had been installed at Salvation Army Divisional Headquarters after the 1972 floods. But I didn't keep track of them. I had troubles of my own.

Sunday afternoon the Red Cross at Medina called. A young man was in critical condition in the hospital there. The telephones were log-jammed, and they were trying to reach his kin in Rochester. For the first time in 25 years of hamming, I listed emergency traffic. I wanted a phone patch to Red Cross Divisional Headquarters, but at that moment there was nobody aboard in Rochester. One of the guys cut up to two meters and W2QYT responded, getting me through to Jim Cross, the disaster coordinator. Within the hour, the family was on their way.

Roads were still closed Monday, and were destined to remain that way through Thursday. By Wednesday, most of the nets were deactivated to a standby condition. Maybe I shouldn't admit it, but in all my years as a ham, this was the first time I had figured directly in a genuine emergency situation. Even then my contributions had been minimal — a mere drop in the bucket. I wish I could list all the guys who worked shift after shift as net control, or served as internet liaison, those who passed reams of traffic, and those who stood by and waited, but were not needed. They also serve who stand and wait.

Six days after the storm had begun, Orleans County opened the roads. Buffalo didn't open for a week or more after that. Even though I got off as easy as I did, it is easy for me to understand the bewildered, almost unreal feeling folks out this way have over the whole affair. Most of them still don't quite know what hit them. When I drove to work Thursday, it felt like I was driving down a gully, and I felt a bit uneasy. It started snowing again Thursday afternoon, and everybody beat it home. We were all scared.

Once my car was dug out of the snow, the AAA paid the tow. Getting it going again was another matter. That cost over $160. This, plus the loss of three and a half days pay, made the storm a bit expensive, but I still think I got off easy — especially in comparison to Buffalo. I guess I was little more than a bystander, but you really never know just how you'll act until the thing happens, and then, just like everybody else, you muddle through the best you can. It's only a matter of how the cards fall that decides whether you'll play a key part, or just be another drop in the bucket. Just remember — it takes an awful lot of drops to put out a fire, but they all help out.

W. Edmund Hood W2FEZ
Albion NY

OM Winter-West

SERVCOMM, a short title for service communications, is a group of about 100 amateur radio operators who live along the eastern front range of the Rocky Mountains from Cheyenne, Wyoming, in the north, to Raton Pass on the border between Colorado and New Mexico in the south. Recently organized (and within the American Radio Relay League public service emergency communications function), SERVCOMM has aided a remote community during a serious fire, participated in various mountain terrain rescues and, more recently, fully aided in a regional search and rescue operation occasioned by the 10-12 March 1977 gale force blizzard that struck El Paso County, Colorado, with full fury.

Amateurs answered a call for help when authorities had trouble establishing communications vital to search and rescue operations. SERVCOMM responded and filled the gap.

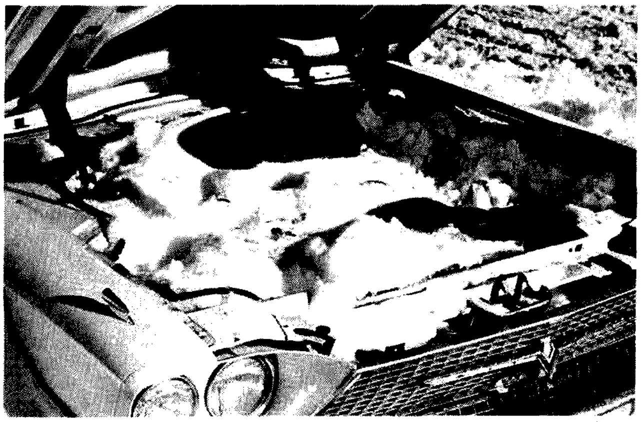
Ninety-three rescues were made by El Paso County Search and Rescue teams in close cooperation with ground and air units based at nearby Fort Carson. Amateurs rode with the various ground and air units. Equipped with battery powered two meter handie-talkies, they relayed rescue mission information to and from units in the field to a base station (WAØHFJ) set up in a motor home and parked next to the El Paso County Sheriff's office. US Army, El Paso County Sheriff, and El Paso County Search and Rescue authorities sat side by side in the "Sheriff Central" command post and directed a successful operation that saved lives and greatly reduced suffering in the afflicted areas.

The Colorado Springs two meter repeaters carried most of the emergency traffic. Primary repaters 37/97 and 16/76 were backed up with the facilities of 19/79, 27/87, and 03/63 repeaters together with thirteen SERVCOMM RTTY stations who stood by in the event the situation mushroomed.

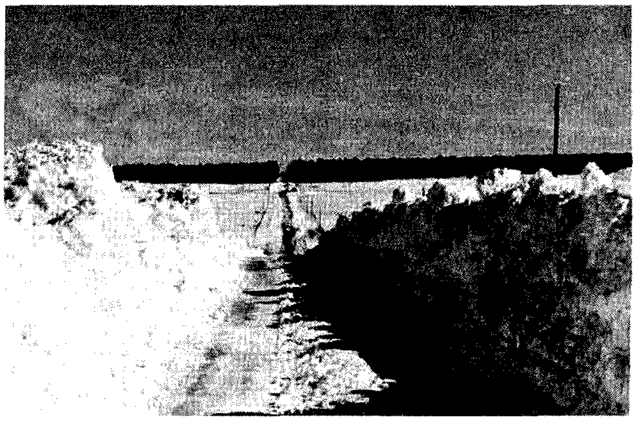
Four wheel drive vehicles were provided and operated by radio amateurs in neighborhood assistance missions. This action reduced the overall emergency problem. Among the 4 WD teams were: WA7HKS/Ø, WBØKDN, WAØLRK, WØMBZ, WBØMHP, WØMQE, WØNR, WØOQI, WBØPNX, KØROL, WBØSDW, WBØUIX, WBØWQI, and WØWYZ.

A local surgeon, WAØRGA, needed to be at an operation scheduled across the city. KØROL and WØWYX hooked up a 4 WD tandem and essentially tobogganed WAØRGA in his own 4 WD and got him to the scheduled operation in time. At the same hospital was WBØEFU, who had given birth to a fine daughter the day before. WBØEFU operated a battery powered TR-22 from her bedside and served as liaison between the SERVCOMM nets and the hospital. Various missions of transporting medical personnel to and from several facilities were completed.

WØOXR left work early as the storm rolled into the Colorado Springs area. Bound for Falcon, Colorado,



The raging blizzard penetrated everything. Those at home for days couldn't get to work.



Search and rescue operations continued after the storm, because scores of missing people, cars, and livestock had to be accounted for.

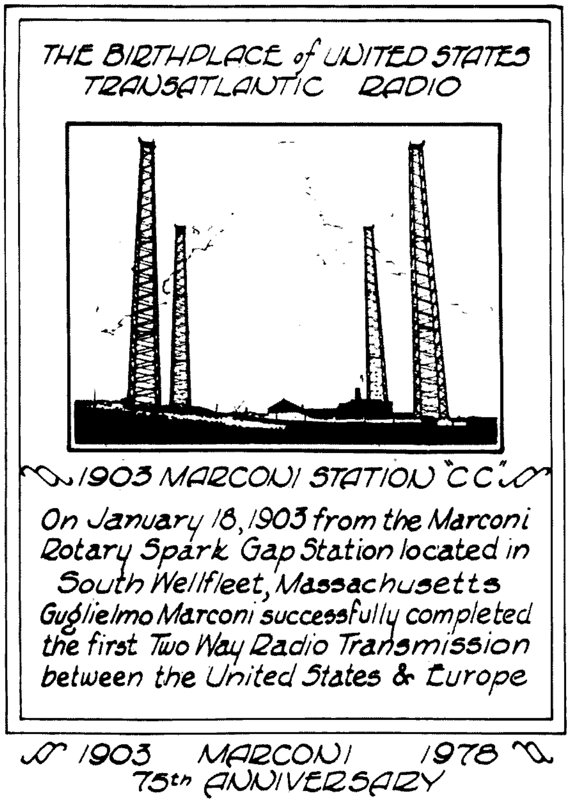
about twenty miles east of Colorado Springs, he could not see well enough to drive due to high winds and driving snow. Even the slowest speed as he groped along did not prevent him from bumping into yet another car stranded in the road. Some 35 hours later, WØOXR and eight others in stranded vehicles near him were rescued. They came through the ordeal without sleep or food by rationing fuel and maintaining two meter status reports. During the long night hours they signaled to each other with interior car lights, as head lights and tail lights were buried in snow and car doors were frozen shut. Rescuers, guided by SERVCOMM, had to battle long stretches of 15 to 20 foot snow drifts in almost zero visibility to reach them. This rescue was typical of the overall operation that employed five US Army half tracks, each carrying an amateur radio operator equipped with two meter equipment. During the last phase of the operation, when sector sweeps were made with various ground and air units, SERVCOMM continued the emergency communications service. Almost all of the emergency communications activity was captured on tape for historical record.

During ensuing days, two debriefing meetings were held with representatives of the El Paso County Sheriff's Office, Colorado State Highway Patrol, El Paso County Search and Rescue Group, US Army, and SERVCOMM present. The meetings produced 27 suggestions for improvements in the SERVCOMM operational plan so that the next time SERVCOMM is called upon, it may be in a better position to serve.

Behind all of SERVCOMM's emergency capability and potential to serve is the farsighted dedication and expertise of the Pikes Peak FM Repeater Association that has for a decade built, sited, and maintained two meter repeaters at altitudes that often provide severe lightning and arctic environments for equipment and those who voluntarily maintain them. Without this group, the loss of human life and suffering would have been much higher. Doing this, of course, is what each amateur everywhere knows to be a good measure of what amateur radio is all about!

D.A. Bartol WØPT
Colorado Springs CO

75 Years



Guglielmo Marconi came to Cape Cod, Massachusetts, in 1901 to establish the first transatlantic wireless station in the United States. The station was constructed on the sand dunes of South Wellfleet and was completed in late 1902. The transmitter was of about 30,000 Watts power, consisting of a three foot diameter spark gap rotor supplied with 25,000 volts from a kerosene generator. The aerial wires were to be supported by 200 foot masts. The masts, 20 in number, were placed in a circle 200 feet in diameter in the sand dunes. The Cape Codders were skeptical of the masts being erected in the sand dunes, and as they predicted, the masts were blown down in a northeast storm in November, 1901. Marconi then erected four 200 foot timbered towers and in late 1902 the station went on the air for tests.

On the night of January 18, 1903, Marconi attempted to send the following transatlantic wireless message from the then President Theodore Roosevelt to the King of England, Edward VII: "His Majesty, Edward VII, in taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting a system of wireless telegraphy, I extend on behalf of the American people most cordial greetings and good wishes to you and to all the people of the British Empire. Theodore Roosevelt."

The message was received at the Marconi station in Poldu, England, and for the first time the United States had been linked with England by wireless. A return answer was received at South Wellfleet from King Edward VII and was delivered to the President through the South Wellfleet Railroad Telegraph station.

In 1907, the engineers realized that they had built the station too near the ocean, and by 1917 the sand dunes had eroded close to the tower bases. The station had to be abandoned soon thereafter. Today approximately one half of the site has been claimed by the Atlantic Ocean. In its 15 year history of operation, the station had three callsigns: CC, MCC, and WCC. Old "CC" was a prime press outlet to ships at sea and to this day WCC, now located in Chatham, Massachusetts, is the busiest commercial radio station on the east coast. The station handles worldwide traffic to and from ships at sea, and is still communicating by international Morse code as used by Marconi in his day.

During the week of January 14-22, 1978, the Town of Barnstable Radio Club will celebrate the 75th anniversary of Marconi's first two-way transatlantic radio transmission. The club will recreate this event with a multitransmitter amateur radio station operating from the original location in the Cape Cod National Seashore Park in South Wellfleet, Massachusetts. The station has received a special event callsign, "KM1CC", from the Federal Communications Commission, and will be manned by members of the Barnstable Radio Club. "KM1CC" will be capable of worldwide communications. The station will be open to the public and we hope you will come to visit us.

Frank Caswell W1ALT
Brewster MA

Jack Anderson-Nuts!

"The story charged that CBers haven't gotten a fair shake at the FCC because CB radio has traditionally been regulated by hams. . ."

The headline, from coast to coast, read: "Radio Hams Are Favored Over the CBers." National columnist Jack Anderson had scored with another hot story, and ham radio was clearly the loser.

The story charged that CBers haven't gotten a fair shake at the FCC because "CB radio has traditionally been regulated by hams." Representative Elliott Levitas (D-GA), quoted in the Anderson column, called the situation at the FCC like "the wolf guarding the flock." Figures that raised many an eyebrow also appeared, like Anderson's assessment of the frequency allocations held by 300,000 amateurs being "100 times more than available to the 9 million CB enthusiasts," plus his statement that "hams also have a lock on the higher frequencies, which are free from interference." At another point in the column, Anderson reports that "according to one confidential report, the hams now control more frequencies than all the nation's police and fire departments combined, plus all commercial and educational FM broadcasters, plus all the TV stations on the VHF channels in Los Angeles and New York City."

Anderson's column, which ap-

peared the first week of April, went on to accuse the ARRL of opposing the CB industry's attempts to gain more frequencies. And FCC Chief Engineer Ray Spence drew the biggest barb – "The Federal Communications Commission's Chief Engineer, Raymond Spence, is a lifetime member of the League. He denied that his membership is a conflict of interest."

In an interview with *73*, Spence dismissed the article as "just another Jack Anderson column." In the Personal Radio division, an aide to chief Johnny Johnston termed Anderson's conflict of interest charges "just a frivolous allegation, a typical Jack Anderson column." The aide added that he doubted that there would be any official response. As FCC sources tell it, the story got started with some of Congressman Levitas' constituents who had complained about the FCC's lack of action on Class E CB (220 MHz). The constituents, representing an unnamed Georgia CB manufacturer, wrote that they were prepared to build a plant to turn out 220 CB rigs, which would bring new jobs to the local economy. The FCC spokesman added that it was understood the EIA (Electronics Industries Association) was also lobbying Congressman Levitas on the Class E issue.

Michael Vollmer, an aide to Congressman Levitas, told a slightly different story about how the Anderson column came to be written. According to Vollmer, a constituent in Atlanta, who runs a CB factory, requested the Congressman's assistance with "an FCC problem." Vollmer refused to name the firm, or the constituent, but added that the thrust of his request was for the Congress to investigate a conflict of interest at the FCC. Several times during our *73* interview, Vollmer emphasized that his boss is not concerned with amateurs, not out "trying to get them." "Congressman Levitas," said Vollmer, "is well aware of the fine service hams have done both at home and abroad. What bothers him the most is whether a conflict actually does exist at the FCC . . . a conflict that may deny all segments of the personal communications industry an equal voice in decisions affecting it."

Vollmer, in response to a question, said that Congressman Levitas was responsible for only a small portion of the Anderson column . . . but he added that the Congressman believed most of the allegations contained in it are true. Vollmer says his boss remains open-minded on the subject, however, and is anxious to receive some feedback from amateurs. (Address those cards and letters to Congressman Elliott Levitas, 329 Cannon House Office Building, Washington DC 20515.) Levitas had already received some comment at the time of our interview, mostly from amateurs, who reportedly appealed for a chance to get ham radio a bit more credit than the Anderson column gave it. Vollmer told *73* his boss planned to deliver a speech on the House floor praising amateurs for their service, but dumping on the FCC as an ill-run bureaucracy. (Congressman Levitas has requested a formal investigation of the FCC by the House Interstate Commerce Committee.)

> "The Federal Communications Commission's Chief Engineer, Raymond Spence, is a lifetime member of the League. He denied that his membership is a conflict of interest. . ."

> "The Anderson column came at a bad time – right after a critical Federal Appeals Court decision . . ."

The FCC, meanwhile, had other problems. The Anderson column came at a bad time – right after a critical Federal Appeals Court decision that may stifle the kind of informal discussions many of us are accustomed to having with FCC personnel at hamfests and conventions. It was a cable TV case concerning siphoning, a practice that's been restricted by FCC rules. The regulation had limited cable TV operators' use of new films and sports events on their own channels, thus siphoning the programming from commercial broadcasters. The Federal Appeals Court not only threw out the anti-siphoning rule, but gave the FCC a real going-over on its rule making procedures. At issue are so-called *ex parte* contacts, discussions between FCC officials in decision making positions and parties interested in proposed rules. The court found that the FCC had violated its own rules, since the so-called *ex parte* contacts are not recorded for the public record. In future, FCC attorneys say, staff members with have to submit written summaries of their informal discussions on pending rule makings. That could mean a lot of paperwork, but more important, it could stifle the kind of "let your hair down" meetings FCC staffers like to hold at ham gatherings. Another byproduct of the court ruling is that the FCC will have to end the practice of accepting late comments on its proposals. Current procedures allow for comment after the deadline as a practical matter, since the staff rarely gets to the mail until after its own deadline.

FCC lawyers are considering a US Supreme Court appeal, but in the interim the Personal Radio Division is faced with a sticky problem – the largest hamfest in the US at Dayton. Dayton, in the words of one staffer, "is our biggest effort of the year," with five or six FCC officials planning to attend. At press time it was unclear what effect the appeals court ruling would have on the Dayton FCC Forum . . . but as the same Commission staffer put it, "at this point we can say anything we want about pending proposals, but we can't listen."

Warren Elly WA1GUD
Assistant Editor

De WA3ETD

We have been getting a number of letters here at *73* concerning excessive QRM, jamming, music, etc., on the low bands, especially on 75m. Several readers complained about nets being intentionally jammed. I have not been especially active on 75, so, armed with a new linear that needed reviewing, I proceeded over to a friend's QTH for the evening. In a few minutes we were ready to go, but it required fifteen minutes to find a spot to tune up without bombing someone. Yes, the band is crowded! However, still no music or excessive QRM, and I began to wonder if the letters were a bit far-fetched. We had a few enjoyable QSOs, giving the linear a pretty good test. Then, while talking to a station in New York, I noticed someone tuning up dead on my frequency – annoying, but not interfering with the QSO. I informed the other station that "the frequency was in use," and that did it. The character proceeded to "tune up" for the next ten minutes, and it appeared that his procedure required continuous whistling into the mike while tuning. Interesting. I also noted that the higher in frequency I went, the more acute the jamming problem was. Well, I'm a believer now, and I can assure you it will be awhile before I subject myself to the "enjoyment" of 75 in the evening.

Let's face it, ham radio is in trouble. We were lucky to escape with our frequencies when the ITU met several years ago, but only a fool can hope that the upcoming WARC will leave the ham bands unscathed. Remember, the USA has only a single vote which can be countered by *any* third world country (see the "WARC Disaster" special report in Feb. *73* for details). I can imagine what an unenlightened foreign ITU representative must think when he tunes in on our low bands.

Not only is there international pressure to trim our bands, but we are also under attack from within. The CB manufacturers would love some extra spectrum space to provide equipment for, and they have an ear in Washington. A day or two ago syndicated columnist Jack Anderson (of Watergate fame) provided the media with an attack on amateur radio. The essence of his report indicated that the hams hold much more frequency space that our numbers justify, and why should three million CBers be confined to a few kHz while we hold choice "interference-free" VHF spectrum. Mr. Anderson's sources obviously are not concerned with the future of ham radio!

NEW MODES

Lately we have been swamped with articles on power supplies and mods for the new Icom 22S transceiver. These things run in spurts; next week it will probably be quad antennas or something. Unfortunately, the people most involved in tinkering have the least time to write articles. It really doesn't take a Master's degree in English to write a good technical article for *73*. If you have a pet project cooking, especially something involving the special modes such as SSTV, RTTY, or microwaves, pass along your enthusiasm to those ready to try something new. An SASE will bring a copy of Wayne's "How To Write for *73*." This document outlines manuscript requirements and provides info about photographs, diagrams, etc. Do a fellow ham a favor and "turn him on" to a new facet of amateur radio. *73* is willing to publish almost anything relating to the special interest areas of radio, so let's hear it! A point to remember: A single article can relieve the financial bite of your latest project. The other night I was talking to a well-known EME enthusiast who indicated that writing for amateur publications had just about paid for his station – think about it.

WHAT'S COMING IN *73*

Check the new RTTY feature by Marc Leavey in this issue. RTTY is a fast-moving mode with plenty of room to experiment and tinker, and if you have been hesitant to tackle teletype for want of information, try *73*.

Marc's column will provide monthly info for the beginner, as well as advanced techniques for the RTTY pro. Some good articles are coming along in future issues. A comprehensive look at active filters for RTTY is coming, written by Pete Stark, for those requiring the ultimate in terminal unit performance. SSTV will be covered in two upcoming articles, as well as an update on Stirling Olberg's "Smoke Detector" microwave system. If you need a cheap alternative to today's expensive transceivers, try 10m with a converted CB radio – coming in future issues. The new 10 GHz "Gunnplexer" microwave transceivers have been getting a workout at *73*. Watch for technical details in the next couple of issues. Tell a friend about *73*, the home of special mode articles. I'm looking for YOUR article, so get writing.

John Molnar WA3ETD
Executive Editor

Continued

Fireworks

So you feel safe after you have disconnected or grounded the antenna feedline? Not necessarily! If you have a rotatable beam or quad, there is usually an 8 or 4 wire cable connecting the rotor mechanism with the rotor control box. This cable leads down the mast or tower into the control or operating room. Unless there is some form of disconnect between this cable and the rotor control box, part (usually too much) of the lightning surge at the antenna or tower will find its way into this cable. Very often this cable runs parallel with the coax used as an antenna feed or transmission line. This enhances the chance of capacitive pickup from the braid of the coax, since the rotor cable is usually unshielded.

In a recent case, nature added to a July 4th local fireworks display by lightning which struck the upper tip of a fiberglass quad spreader holding the 20 meter fed element of a quad at K4NE. The last six inches of the spreader disappeared, leaving a "puff-ball" of fiberglass resembling a feather duster or cotton cone such as one finds at carnivals. The eyebolt holding the antenna wire was unharmed, but dropped down since its support was lost. There was no damage to the antenna or coax transmission line.

All the antenna feeds were disconnected and grounded outside the shack. Yet the lightning surge entered the house through the rotor cable, burned out the CDR control box, entered the stripline 120 volt ac connection strip through the control box ac cord, passed into the receiver and exciter which had their ac cords plugged into the stripline, and caused considerable damage to the receiver and exciter. Some of this could have been avoided had the ac cords been disconnected. But the best preventive measure would have been to disconnect the rotor cable.

There is an eight-pin Jones plug disconnect in the rotor cable outside the shack now which can be connected to a grounding plug, all eight connections strapped together and wired to a ground rod. Truly a few ounces of prevention are worth a few pounds of replacement parts!

I just walked across the room and checked my CDR and a few other cables on various antennas, such as coaxial inverted V, etc., and boy, do I need to get busy on some protective grounding. I advise all readers to go now to your ham shack and check for proper grounding.

Lewis Sieck K4NE
St. Petersburg FL

Thanks to Mike and Key, *bulletin of The Greater Cincinnati Amateur Radio Association.*

Bandwidth

The widely publicized FCC docket 20777, the "bandwidth" docket, was recently commented on by the ARRL. The ARRL felt that the docket was a step too far in the "deregulation" of amateur radio, and that a "wait and see" attitude should be adopted on many provisions in the docket, such as not yet outlawing AM, and that many problems with modulated CW (MCW) in the phone bands, RTTY in the phone bands, etc., would crop up if the docket were adopted as written.

There are certainly some problems in the docket as it stands written, such as the (I think unintentional) exclusion of amateur TV from 450 MHz. But does the ARRL seriously believe that people are going to start transmitting RTTY in the phone bands, or use MCW in the phone bands? RTTY in SSB channels would be just as much of a problem to reception for the RTTY people as for the voice people. And MCW might be run occasionally for experimentation, but would be no real big problem. Has the League forgotten that there are gentlemen's agreements throughout our bands that make mutual habitation possible? How often do you hear a RTTY station outside of 14070-14105 on 20, or outside of 3600-3630 on 80? (Unfortunately, some CW stations do break this gentlemen's agreement and do intrude, but more are considerate and there is no tremendous problem.) How often do you hear SSTV outside of 14225-14235? If we receive more flexible regulations regarding the type of emissions we use, will we suddenly forget these important agreements? Will 40 years of learning go down the drain? I say no. The League has shown little faith in its own life blood, the amateur.

I don't think that the League decision rose entirely from mistrust in hams' ability to govern themselves. I think that the directors who, as a whole, formulated the League response, are long-time hams who have not been involved in the majority of the innovative new things happening in our hobby. To them the status quo is just fine, so "don't rock the boat," let's just wait and see, and join our buddies for a rag chew on whatever mode. The experimenter has been left out in the cold!

The League is us, it's the greatest thing going for us in amateur radio, and the League is concerned about the members' views. That should be obvious from the Docket 20282 survey, which also shows that the members are concerned about League policy. If you agree with me that this issue needs another look, the first step is to be sure you are an ARRL member. Then let them hear your ideas, whether they agree with mine or not, so that they can adhere to member wishes. The League is us.

Bruce Frahm WAØTAS
Colby KS

Reprinted from the Trojan Harmonic, *newsletter of the Trojan ARC, Colby KS.*

Insurance

Listening on 2 meters during recent months, I have heard numerous discussions about the problems of insuring amateur gear, particularly with regard to 2 meter mobile and hand-held equipment. There seems to be much misinformation going around, especially since there are numerous ways an insurance company may look at equipment and its situation in the mobile.

Radio gear may be insured in several ways. First of all, equipment which is permanently installed in the home is considered as household contents and should be insured against such perils as fire, extended coverage, vandalism, and theft, along with other personal property under the well-known homeowner's insurance policy. It is, in fact, automatically covered by this policy, usually subject to a $50 or $100 deductible clause.

Other equipment, such as mobile rigs, hand-helds, or otherwise portable gear, is best insured through Inland Marine Insurance.

The National Association of Insurance Commissioners has ruled under what is known as the Nation-Wide Marine Definition that ham radio equipment in automobiles and otherwise not permanently located in a structure qualifies as a subject for Inland Marine Insurance. Such coverage provides protection against all risks of physical loss or damage except for specified perils such as war, nuclear explosion, infidelity or damage while being worked on, and a few others, wherever located, worldwide.

Insurance may be provided by endorsement to your homeowner's policy just as your cameras, jewelry, furs, or musical instruments can be insured under a personal articles supplement. The rates are generally the same as for musical instruments or cameras. Should you not carry a homeowner's policy, you can purchase an Inland Marine policy known as a Personal Articles Floater on the same basis and providing the same all risk coverage.

It is well to have purchase invoices or other documents to verify values and, as the prices of equipment go up, your insurance should be likewise increased to reflect replacement value. Even though replacement at the time of the loss may be on a depreciated basis, depreciation is based on replacement cost at the time of loss and not on original cost.

The third possibility for insuring your mobile gear is as a part of your automobile policy, which may work against you at the time of loss. Should you elect to insure your gear as part of the auto, it would be well to take a Polaroid photograph of the rig installed in the car and have your agent inspect it and give the insurance company a statement along with the photo to the effect that it is a permanent installation.

When insuring your equipment, always use an itemized schedule giving a full description of all items, including crystals, serial numbers, if any, and *current* replacement value.

In spite of the feeling of many who say nasty things about insurance companies, if you insure properly and give full information at the outset, you will be treated fairly when a loss settlement is made. Should there be honest differences, you always have recourse to your state insurance department which is charged with the responsibility of assuring equitable

handling of honest claims. Just don't try to get something you are not entitled to and, by all means, read your policy as soon as you receive it and take up with your agent anything not clear.

There remains one other area of insurance which, in recent years, has become of great concern to some amateurs. This is the area of lawsuits arising from real or imagined intrusion by amateurs into the rights of privacy of others. Much has been written and voiced about the need for such protection, but apparently, few people know that such protection is readily available and some probably already have it.

Insurance companies have, for many years, offered what is known as "Umbrella Liability Insurance" which is catastrophe type protection for a person's legal liability arising from his negligent acts. You are aware of the automobile bodily injury and property damage insurance, which is now a requirement in most states, and the personal liability protection, which is Section II of a homeowner's policy. An Umbrella Liability policy covers above these policies and also covers other areas of exposure above what is known as a Self-Insured Retention, usually \$250 to \$1,000. Areas covered by the Umbrella, which is usually issued for \$1,000,000, include "invasion of privacy," such as might arise from interference by an amateur station with home entertainment equipment, television, radio, or telephone. The Umbrella policy provides cost of legal defense, as well as paying judgments for which the policyholder is found liable, up to \$1,000,000 above the amount of the Self-Insured Retention which he must bear. Such policies are easily obtained and are relatively inexpensive. If automobile insurance is carried with limits of \$100,000 per person, \$300,000 per occurrence for bodily injury, and \$25,000 per occurrence for property damage, and if personal liability of \$50,000 is carried, an individual with one dwelling and one auto can usually obtain umbrella protection for under \$100 per year. Many larger businesses provide this coverage as an employee benefit at substantially lower premiums.

The insurance coverages we have discussed are readily available throughout the US and Canada. Any professional insurance agent should be able to properly insure you as a radio amateur in a short time if you sit down with him and give him the information about your equipment and operation we have discussed here. Who knows, in addition to properly protecting yourself, you may at least get the real story of amateur radio to someone else or find a budding ham.

Leonard Fowler Jr., CPCU, WA3TCE
Bryn Mawr PA

Another Milestone

Although few hams would agree, one of the best things that has happened to amateur radio has been the advent of the Citizens Radio Service, or CB. From the beginning of radio communication, the amateur service was a non-commercial user of radio frequencies and the word "amateur," denoting unpaid, inexperienced, or unskilled as compared to "professional" or full time, most certainly required strict regulations to protect the public interest up and down the radio spectrum. Like the new automobile driver, this amateur must prove to the Federal Communications Commission that he or she has sufficient radio knowledge by personal examination to put a signal on the air. Thus, the various types of amateur licenses have evolved over the years and the ham can even build and operate his own equipment.

On the commercial side, it was later shown that unskilled persons such as police, firemen, taxi drivers, pilots and others could successfully operate communications equipment that was government type approved and both installed and serviced by licensed persons. When the equipment meets quality standards and is adjusted by qualified personnel, it is evident that the technical knowledge and skill of the operator becomes less important. This latter concept could have paved the way for the CBers.

At least for the first time persons over 18 years of age could get on the air without examination merely by application. Even low power handheld units can be operated without any permit or restriction. Without doubt, the success of CB has exceeded all expectations. Not too many years ago, the radio enthusiast was asked, "Are you a ham?" Now, they nearly always say, "Do you have CB?"

The demand for CB equipment has created a bonanza for electronics manufacturers. Many new companies that jumped aboard the bandwagon have also taken a look at the much smaller (but more expensive) amateur market since the same production techniques apply. Competition has probably reduced the price of some ham gear over what it would be with fewer manufacturers. The sheer numbers of builders stand out when comparing the advertisers of 10 or 15 years ago with the present.

It may be a coincidence that the proliferation of CB has prompted the Federal Communications Commission to take a concerned look at the amateur regulations from time to time. Recent changes like elimination of special Novice calls, no advanced notice of extended portable operation, relaxed logging requirements, and others, have reduced paper work for the FCC. When your hands are full and your budget's under review, the only alternative is to look for ways to lighten the load.

Most certainly the spotlight has shifted to another milestone in radio communications. Has the Citizens Service been beneficial to amateur radio? Some amateurs are beginning to think that it has.

Reprinted from SARA News, *a monthly publication of the Schenectady NY ARA.*

Strip Your Shack

In my attempts to recruit people for our hobby, I have met with concern regarding the cost of equipment — fears that people could not afford to venture into ham radio or to convert from CB.

This is a fallacy which must be corrected by our own publications and should be put into its proper perspective. It is high time that our hobby rags publicize, via the media, that ham radio equipment is really no more expensive to the Novice than many CB rigs.

Many wrong impressions are created when we invite a would-be Novice to our shacks, where we may have a fantastic array of gear. Do you confess to him that this or that piece of equipment is oh-so-many-years old? That it has already been robbed of so many parts that it is now useless, and can never be used again except for further pilfering of parts for another project?

Stop this bull! Be honest with yourself and with him. If you cannot remove the excess gear from his sight, then, for goodness sake, at least label it as obsolete. You will feel and he will feel more at ease. For that reason my shack is stripped to the bare essentials.

It is a warm feeling to have a youngster say: "Gee whiz, is this all you really need to work across the world?"

You answer, "Yes. Control yourself, Mister. Sit down and I shall endeavor to show you exactly what I mean. New Zealand is now busy with WA6 on 15 meters but, just as soon as they complete their QSO, I will demonstrate an attempted contact."

Good fortune came my way with propagation, sunspots, and opportunity, and Frank ZL1BDG answered me. Thank you, Frank. I made a convert.

This young man is now asking me, "How quickly, how soon, and . . . maybe I can use the money from my paper route."

Of course he does not understand the CW yet, but, with my persistence and influence, he will.

In most photographs with the proud owner/operator posing in his shack, I see items of equipment which are not really necessary to operate a bona fide station. Remove that excess gear, OM, and enlist a recruit.

Only after we make it a practice to remove excess gear can we hope to initiate or convert people into our ranks. The display of expensive equipment scares the hell out of them. Move out the crap and you will note an immediate and gratifying change of attitude.

I would like to upgrade my equipment, but looking over price indexes I nearly jump out of my pants. How does a prospective Novice feel when he or she perceives the staggering sums demanded by the makers of today's boxes? They are turned right off!

Forty-nine years ago, fresh from radio school, I was escorted into a destroyer force radio shack and was told I had to learn to operate the equipment. I nearly panicked.

But I learned a compatibility with those ten inch high, five inch diameter bottles, which we later learned to call tubes. Those "bottles" though, were Uncle Sam's investment and not mine . . . all I had was patience, and I could afford to learn to live with them, and them with me.

Today's people, though, do not have this patience. Everything must be now! It's something else. More results more quickly, and more demands. I sympathize with them. They are the ones who will invest in the equipment, and if you would help steer more hams our way by stripping your shack of junk in order to show them just how little is needed to operate your station, we'd all be better off.

A. Paul McMonigal WB8VZW
Caspian MI

News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 *or* Kilobaud *in exchange for a spot on your ham or computer club newsletter mailing list. Deal?*

New Products

CLEGG FM-76 220 MHz TRANSCEIVER

Something has got to give on 2m FM. The band is getting so crowded in the big cities these days, that finding a clear pair is next to impossible. Even up here in New England, where terrain has long allowed local repeaters to coexist with their big city neighbors, overcrowding is becoming the order of the day. The reason? There are more amateurs active on 2m FM than all the other ham bands combined!

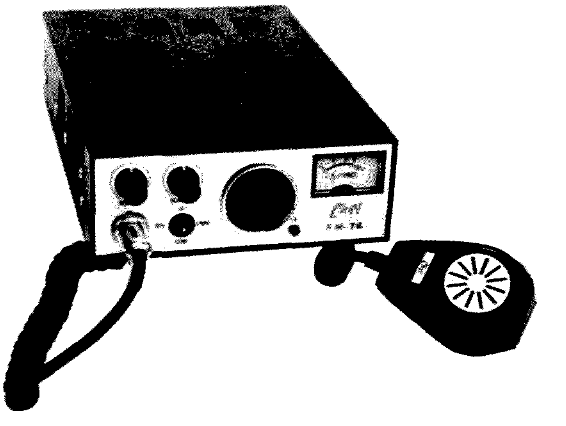
The movement up in frequency hasn't been as fast as many predicted. Repeaters (and simplex use) up on 450 MHz are growing slowly but steadily, fueled by easily modified surplus commercial gear and 2m control links. The growth pattern has been for groups to add 450 repeat capabilities after establishing the 2m system and sorting out a 450 control link. It is only natural, then, to go repeat on the higher band. But for a number of reasons this pattern hasn't happened on 220 MHz, the middle ground between 2m and 450.

"Use it or lose it" was the battle cry when the CB interests first started eyeing 220, and considering recent statements of a few CB manufacturers and coverage in the national media on the subject, it looks like the battle may have only just begun. FCC engineers have tested 900 MHz for CB purposes, and agree that's the place CB ought to go. Getting the whole Commission to agree may be another matter, in view of the 220 CB advocates, but at least the 900 MHz tests are a start. Another positive development is the marketing of low priced 220 MHz transceivers, and the resulting growth in 220 activity.

Activity on 220 is certainly up, especially when you consider a 50 percent increase in 220 repeater listings in the *73 Repeater Atlas* between 1976 and 1977. We are quite far away from having a 220 machine in every state, but few big cities are now without them. Another year of growth on 2m at current rates, and 220 may well become the best alternative for new repeaters. The two bands are pretty similar, with comparable propagation and antenna systems. The major difference is the lack of crowding on 220, and thus the easy availability of coordinated frequencies for repeaters. One interesting sidelight is that New England DXers have joined 220 systems, crossbanding them down to 2m in some cases, to provide a DXalert system stretching from Maine to Connecticut. All those arguments for getting on 220 aside, one of the best reasons is economics, pure and simple. What other band can you get onto for less than $200? That's new, not surplus gear!

An excellent buy, at this writing, is the Clegg FM-76 priced at $165. If your club buys in quantity (from 2 to 40 at a time) the price can go as low as $140. A call to Clegg's toll free telephone number (800-223-0250) will connect you with some more specific information on group prices and related group purchases.

The FM-76 is basic in concept, a feature I'm glad to see after testing so many 2m FM rigs overloaded with buzzers, bells, whistles, and gadgets. The simplicity is a bit misleading, however, when you consider that all the essentials (and a bit more) are there. Clegg has included receive and transmit crystal trimmers, remote speaker jack, power output switching (10 W to 1 W), a transmit indicator, a large illuminated S-meter/output meter combo, a more than adequate built-in speaker (side-mounted, not top- or bottom-mounted), and rear panel inputs for tone burst and output for a discriminator meter. The Clegg is rugged, with a strong and easily-mounted mobile bracket arrangement. Rear panel connectors are standard SO-239 for coax, with a four pin mike connector for the tone burst and discriminator connections. The FM-76 is small, and space was found in my sports car despite the presence of several other radios and a cassette deck. (I even had room for my wife left over!)



The Clegg FM-76 — 10 W on 220 MHz for a moderate price.

The layout, as can be seen in the photo, is simple and clean. Channel numbers are large and well illuminated, and the radio is very easy to operate mobile, day or night. Twelve channels are allowed for, with the 223.50 MHz simplex pair already installed, as standard equipment, at the factory. Clegg nets additional channels for $8 a pair, when ordered at time of purchase. Even here in New England, where we are lucky enough to have quite a few 220 repeaters, I was hard pressed to fill all 12 channels. I ended up with six repeater pairs and the simplex channel.

As this review was being prepared, winter was finally ending here in New Hampshire. So what better excuse for a climb up nearby Pack Monadnock Mountain, the official *73* test site? The mountain comes to just over 2300 feet above sea level and is better known as "Mt. Intermod" because of its uncanny ability to demoralize the best transceivers, turning their receivers into scrambled eggs . . . a maze of cross modulation, intermod, and desense. The mountain is so well located that scores of contests have been won from its peak, the site for several years of the WR1AAB repeater. This mountain, in a word, is a bear.

Getting up the mountain is a lot easier than you'd think. Since the area is a state park, a paved road is maintained during the warmer months. Our test crew was prepared with not only the Clegg FM-76 for 220, but also with some 2m radios, just for comparison purposes.

The comparison was incredible! The 2m band was a mess, with (count 'em) 4, even 5 repeaters on the same frequency in some cases. Not even going down to 1 Watt would cut the QRM. Simplex operation quickly became the only alternative, and 52 got quite a workout.

While the others worked on 2m, I set up on 220 with the Clegg. I used a magnetic mount Antenna Specialists 5/8 wave antenna. Our test rig has been factory equipped with a half dozen repeater pairs. I started out with 224.34, easily raising the Fitchburg MA repeater, and Ed K1SSH. Then we switched off to 223.50, the recognized national 220 simplex frequency. Ed was loud and clear, but soon there was a mini-pileup! (Who says there isn't activity on 220?) Five stations were worked, ranging from Acton MA to Derry NH. I was able to access four other repeaters, including Waltham MA, Quincy MA, and Chester NH. All were Q5, most of them DFQ. Activity, however, was not exactly heavy. It was difficult to get QSOs, despite the noon timing of our trip up the mountain. To say the least, it was a bit discouraging.

I began to feel better, though, as soon as I switched back to 146.52. Bedlam! The boys had quite a pileup going, and some of the stations on frequency were pretty upset — breaking the channel for a "local QSO" only . . . no DX! (It reminded me of a W2 station on 75m who used to call "CQ CQ, no kids, no lids, no space cadets who got their tickets off the top of a cracker jack box!")

Back to 220. I learned from K1SSH, via the Fitchburg machine, that activity there was up, that they were doing even better than the big Boston 220 repeaters. Another station disagreed when I QSYed to Waltham on 223.34, but it was nice to hear an argument about *increasing* activity on 220 . . . instead of the usual "use it or lose it" philosophy.

On the way down the mountain I struck up a simplex QSO with a Manchester NH station, and as I listened on the 2m rig, my companions (in another mobile) were also working a Manchester station. Both of us were running compatible power and antennas, and reports coming back on 2m and 220 MHz were about even, respectively. Interestingly enough, both of us lost our QSOs at the *same* point — just as we drove off the access road. It was a graphic demonstration of the surprising similarity in propagation on the two bands.

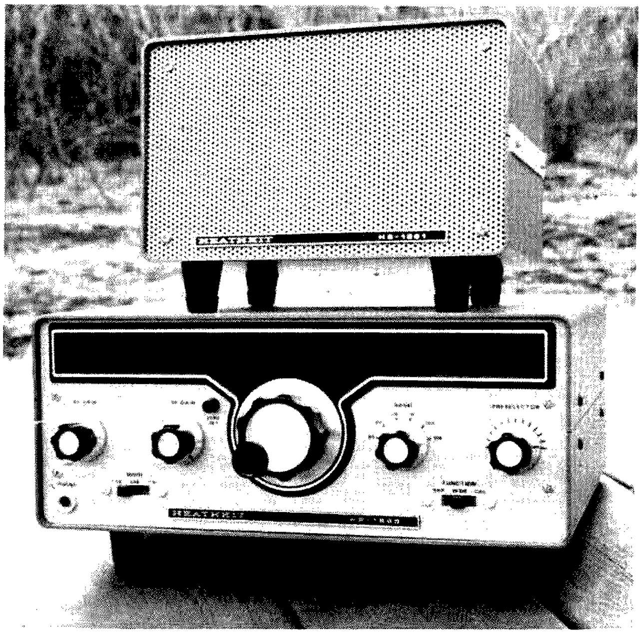
All through this, the Clegg worked flawlessly. The receiver was not affected by the strong rf fields generated on the mountaintop by several commercial repeater installations. It was easy to squelch out overload from my 2m rig, even when running a 70 Watt amplifier, without tightening up beyond the ability to hear anything through the Clegg. And audio reports off air were good, with the comments indicating sufficient deviation and audio gain.

Power output was measured in excess of Clegg's specs, with about 11.5 Watts out in the high power position, 1.5 Watts out in the low power mode. By fooling with the Antenna Specialists 5/8 wave, I was able to get the swr beyond 3 to 1, but the Clegg reacted only by reducing output in direct proportion to the increase in swr. A direct short was then set up, but no smoke! The Clegg, as outlined in the owner's manual, simply refused to transmit.

In the ham shack, the Clegg ran very well off a car battery, and played a key role in gaining several new ones during the late winter DX contests. If you never have used a DXalert repeater system, you're in for quite a surprise — it's really great to know what's happening where, and when. And when it comes to DXalert machines, the movement is growing the fastest on 220.

So, the next time you're driving home in the afternoon rush hour, waiting your turn on 2m, give some thought to 220 MHz. Wouldn't it be nice to actually have a QSO on the way home, instead of finally getting it turned over to you just as you turn into the driveway? You bet! And when you do decide to join the rest of us on 220 MHz, consider the Clegg FM-76. It is small, well built, works without any glitches . . . and the price *is* right. *Clegg Communications Corp., 208 Centerville Road, Lancaster PA 17603.*

Warren Elly WA1GUD
Assistant Editor



The Heathkit HR-1680 Receiver.

The Kenwood R-300 general coverage receiver.

HEATHKIT HR-1680 RECEIVER

With the advent of the HR-1680, the folks at Heath have again surpassed themselves by making available to the newcomer as well as the seasoned operator an inexpensive yet very versatile ham band receiver. It is difficult to believe that a receiver with such sensitivity and design can still be purchased for as little as $199.95.

The cabinet, which measures 12¾" x 6¾" x 12", is in the traditional Heathkit green to blend with your existing station. The dial and S-meter are behind the newer style red dial window so they can only be seen when the receiver is turned on. The knobs are traditional Heath except for the main tuning knob, which includes a convenient finger spinner for fast frequency changes.

Going into the receiver, the construction is completely of solid state design. Four printed circuit boards make up the entire unit and each is inserted into its own socket. These can easily be removed for servicing and during initial tune-up.

Construction progressed in the normal Heathkit style with simple straightforward instructions and easy to understand diagrams. The entire building of the receiver, including tune-up, took approximately four nights of work or a total of about 16 hours. Tune-up is as easy as it could possibly be – no external equipment is necessary. However, the use of a VTVM and rf generator may improve the sensitivity to some extent. I did not notice any appreciable difference in the two methods of alignment.

The receiver covers the following frequencies: 3.5-4.0 MHz, 7.0-7.5 MHz, 14.0-14.5 MHz, 21.0-21.5 MHz, 28.0-28.5 MHz, and 28.5-29.0 MHz. Upper sideband, lower sideband, and CW modes are selected through the use of a front panel slide switch. A 100 kHz crystal calibrator is included for instant calibration of the receiver on any band.

A four pole crystal filter is provided for SSB reception, while audio filters narrow the audio response to either 2100 Hz minimum at 6 dB down for SSB or 250 Hz minimum at 6 dB down for CW. The maximum filter response is 7 kHz at 60 dB down for the wide position and 2.5 kHz at 60 dB down for the narrow position.

The sensitivity is claimed to be less than .5 microvolts for a 10 dB signal-plus-noise ratio for SSB operation. I compared the receiver to the receiver in the popular Heathkit HW-101 transceiver and found the sensitivity to be much greater in the HR-1680 while using the same antenna and switching it from one receiver to the other. The dynamic range is listed at 120 dB or greater.

Operation of the receiver is very simple. Front panel controls include af gain/power on/off, preselector tuning, rf gain, main tuning, bandswitch, function switch (narrow and wide filter and calibrate), and a mode switch (LSB-USB-CW).

The back panel includes jacks for a 4 Ohm speaker, a sidetone input from your transmitter, muting, antenna, and 13.8 volts should the receiver be run from a car battery or external power supply.

The possibilities for a receiver such as this are almost unlimited. Besides its obvious use as a primary station receiver for both the novice and the advanced amateur, it can be used as an auxiliary receiver with a transceiver for split operation. A little ingenuity on the part of the purchaser will also find many other uses for a receiver such as this around the shack.

Also available is a matching speaker, HS-1661. The speaker has an impedance of 4 Ohms and its response is tailored to SSB reception. For the additional cost of $19.95, the speaker is an excellent value to round out your HR-1680. *Heath Company, Benton Harbor MI 49022.*

Rich Force WB1ASL
Publications Editor

KENWOOD R-300 RECEIVER

The parade is on! After a long drought, the electronics marketplace is being provided with an excellent choice of moderately priced communications receivers. For the past few months *73* has been reviewing this new crop of receivers, and this month I had the pleasure of checking out the R-300 by Kenwood.

The R-300 is of "classic" design, as there are no phase locked loops or other devices employed in the tuning scheme. The Kenwood tunes continuously from 170 kHz to 30 MHz, with the exception of a small gap from 410 kHz to 525 kHz. Bandspread tuning is provided for three of the six ranges, starting at 3.0 MHz. Both of the tuning dials are of the drum variety, controlled by large knobs with "rapid-twirl" indentations. A six position bandswitch controls the range, which is indicated by a green semaphore that appears next to the selected range. A combination of push-button and rotary controls round out the available operator functions. Two-position buttons control power, crystal calibrator, and panel lamp, as well as mode, noise limiter, and tone selection. The antenna trimmer, audio and rf gain, and BFO are conventional rotary controls. All functions operate smoothly, and the tuning and bandspread are without whiplash. Back panel options consist of speaker jack, antenna connections, external battery jack, and i-f module adjustments. An S-meter zero control is also provided.

This receiver functioned well on the test bench. A longwire antenna as well as the Kenwood-provided random wire were used during the test. Sensitivity is good on all bands; however, a preamp would be required for serious work on ten meters. On the other end of the dial, the sub-broadcast range was interesting. VLF enthusiasts will be pleased by the R-300, as any number of code, weather, and information stations were copied in the 170 kHz band. The crystal calibrator was most useful when calibrating the main tuning and bandspread. The main tuning can be roughly set to allow bandspread tuning, then tweaked exactly on frequency by listening for zero beat after the 'spread frequency is set. Bandspread scale increments are 20 kHz, and can be easily subdivided by eye. The BFO is stable, and it was easy to tune SSB signals accurately. My impression is that the R-300 could serve as a backup receiver for the advanced ham or Novice operator.

The Kenwood R-300 is priced at $239, a price that should interest serious SWLs and the amateur in need of a second receiver. The battery option makes it a natural for the summer season that is finally arriving. The receiver is a good value, as it is unusual to find a calibrator and full complement of controls on a rig so reasonably priced!

John Molnar WA3ETD
Executive Editor

A GUIDE TO 2M SYNTHESIZERS

When the first repeaters were developed, they were few and far between. Any given area had only one repeater and only the more enthusiastic amateurs modified their converted commercial FM transceivers to provide for a simplex channel as well as the local repeater channel. The first transistorized transceivers designed specifically for the two meter band had provisions for three channels, deemed generous in the early days. Soon, however, the availability of relatively inexpensive transceivers and the multiplication of repeater installations created a demand for 6, 12, and even 22 channels in the transceivers.

With 22 channels (some areas support 22 or more repeaters), the cost of crystals becomes a major factor. At $5.00 a crystal it could cost over $200 just to fill all the positions in the transceiver, and even then you would not have the flexibility needed in some areas of the country. To move to another area could be a financial disaster.

More and more amateurs are turning to synthesizers to solve this crystal problem. The manufacturers have come out with a variety of adaptors and complete rigs which eliminate any need to buy lots of crystals, and which will access almost all repeaters and all simplex channels.

This article is designed to summarize the important characteristics of most of the synthesizers available for two meter FM. Only FM (and not the allmode) rigs are considered here.

Table 1. List of synthesizers and synthesized transceivers.

Equip.	Range (MHz)	Offsets	Stab. (ppm)	Temp. (°C.)	Spurs (dB)	Power	Wt. (lbs.)	Size (in.^{3})	Xceive	Cost
1. Amcomm	143-149	R + S[1]	10	-20 +60	60			187	Yes	500
2. B'stone 144	143-150	S + all	10	-11 +54	70	High	8	313	Yes	480
3. SC 1800 M	145-148	R + S + 3[2]			60	Low		67	No	225
4. CE 2001[3]	146-148	R + S	20	0 -38	45	Low			No	300
5. Clegg FM-DX	143.5-148.5	R + S + 3	5	0 -50	66	High	7	262	Yes	600
6. MFA-22	144-148	R + S + all	5	-10 - ?	?	High		137	No	300[4]
7. Mid 13-510	144-148	R + S + 2						171	Yes	390
8. GLB 200	146-148	R			60	Low			No	260
8. GLB 300	144-148	R + S	5	-10 +50	60	High		79	No	135K[4]
8. GLB 400B	144-148	S + all	5	-10 +50	60	High		111	No	150K[4]
9. WE-800	144-148	R + S				Low	2	102	Yes	390
10. TR-7400 A	144-148	R + S		-20 +50	60	High	6	216	Yes	400
11. VHF SYN II	140-150	R + S + 3	10	0 -50		High	1½	110	No	170K
12. Icom 22S	146-148[5]	R + S			60	High	4	120	Yes	290
12. Icom DV 21	146-148	all[6]			60	High	11	234	No	390
12. Icom IC-245	146-148	R + S + all	10	-10 +60	60		6	200	Yes	500
13. EBC-144 Jr	143.5-148.5	R + S + all	10	0 -55	60	High	6½	245	Yes	530
14. Vanguard	Any 10 MHz	none	5	-10 +60				36	No	160[4]
15. KDK FM 144	144-149[7]	R + S	20	0 -50	60	High	5	104	Yes	390
16. HW 2036	144-148[7]	R + S + 1	15	-10 +50	50	High	6	223	Yes	270K
17. VHF/ONE	144-148	R + S	2	-10 +50	60	Low	4	160	Yes	350
18. Yaesu 200R	144-148[7]	R + S[8]				High	7	247	Yes	450[9]

[1] ± 1 MHz also available.
[2] Special Channel Memory.
[3] For use only with a Motorola HT-220, and fits inside omni case.
[4] Costs less without 5 kHz capability.
[5] Any 22 channels.
[6] Programmable for any split; will automatically scan band.
[7] Will cover only 2 MHz without retuning.
[8] No 5 kHz spacing available.
[9] No longer in production; some units available from Amateur Electronic Supply for $300.

A description of these rigs is given in Table 1.

An explanation of the columns in that table is given here.

Col. 1 – Lists the name of the unit. The number refers to the manufacturer or main distributor, with address and telephone number, in Table 2.

Col. 2 – Lists the frequency range covered by the synthesizer.

Col. 3 – Lists the various offsets available. R stands for plus and minus 600 kHz. S stands for simplex. The number of switch-selected offsets is also given. *All* implies that the transmit and receive frequencies can be independently selected and hence cover any repeater split.

Col. 4 – Lists the frequency stability in parts per million (1 part per million implies a frequency uncertainty of about 150 Hz at two meters).

Col. 5 – Lists the temperature range, in Celsius degrees, associated by the manufacturer in the specifications.

Col. 6 – Lists the degree of suppression claimed for spurious frequencies (not harmonics).

Col. 7 – Indicates the power consumption of the synthesizer. Those labeled low are usually based on CMOS ICs and will consume less than 10 mA.

Col. 8 – Lists the weight of the unit in pounds.

Col. 9 – Lists the size of the unit in cubic inches.

Col. 10 – Differentiates between synthesizers alone and synthesized transceivers.

Col. 11 – Lists the costs of the unit, with a K indicating the cost of an unassembled kit.

If no entry appears in any column, it means that the manufacturer does not establish a value for that quantity or that information was not available when the table was prepared.

There is a lot of information in the main table; however, there is a lot of important information which cannot be given in any table. Quality of construction is one type which is impossible to objectively present. The completeness of instruction manuals and the availability of service has not been considered. Neither have the terms of any warranty or the reputation of the manufacturer. Few companies will tell you how long it takes a unit to lock onto a frequency. If any unit has special features of great significance, a footnote to the table so indicates.

Some of the columns will be of greater interest to some prospective buyers than to others. At the present time, there is not much FM activity below 146 MHz. Hence it is of little importance to most amateurs whether the synthesizer covers 145 MHz or not. But 144-145 MHz coverage is of great importance if the transceiver is to be used overseas in areas where repeater activity is below the US frequencies. Furthermore, if the repeater to be used is a MARS repeater, the synthesizer must cover the frequencies just outside the two meter band.

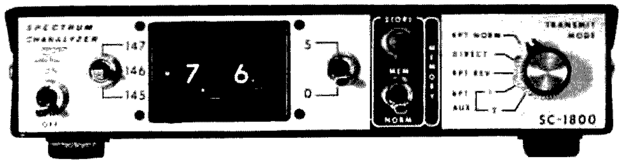
If your area contains no repeaters with an oddball separation, you need not be concerned about any offsets other than the regular 600 kHz up and down and simplex. But, if you travel a lot, the availability of a nonstandard offset might be important.

The next three columns have to be treated with a certain amount of skepticism. Here there is a lot of room for specmanship. The definition of stability at one company may not be the same at another. This difference in definition is particularly important when considering a quantity like spurious output. The Heath company, for instance, lists their spurious output as better than 70 dB down within 20 MHz of the carrier, but only 50 dB down if one goes further away. Another company might just forget about those spurs at the greater distances from the carrier. Heath claims only 40 dB of suppression for harmonics. It is safe to say that most of the other companies could not apply their spurious suppression claims to their harmonics either.

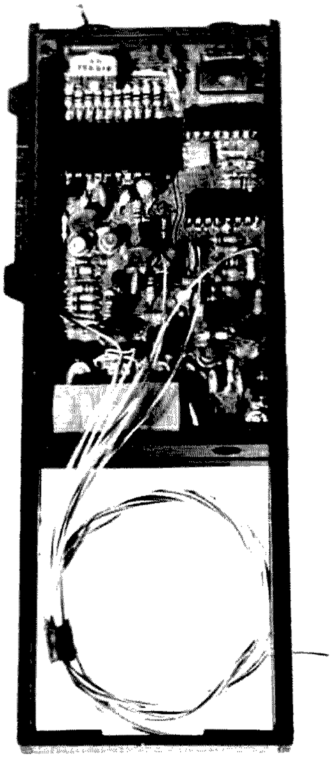
The power consumption will be of interest only to those who contemplate battery operation away from an automobile or other charger – as with

The Icom IC-22S and matching Engineering Specialties Synthacoder 22.

The VHF Engineering Synthesizer II.



Spectrum Communications SC-1800.



Communications Electronics CE2001 synthesizer module for use in the Motorola HT-220 HT.

Table 2. Names, addresses, and telephone numbers of manufacturers.

1. Amcomm
   730 West McNab Road
   Fort Lauderdale FL 33309

2. Tec-Kam Inc.
   2916 Arnold Ave.
   Salina KS 67401
   (913) 823-2235

3. Spectrum Communications
   Box 140
   Worcester PA 19490
   (215) 631-1710

4. Communication Electronics
   Box 1002
   Ann Arbor MI 48106
   (800) 521-4414

5. Clegg Communication Corp.
   208 Centerville Road
   Lancaster PA 17603
   (800) 233-0250

6. RP Electronics
   Box 1201
   Champaign IL 61820
   (217) 352-7343

7. Midland International
   Box 1903
   Kansas City MO 64141
   (913) 384-4200

8. GLB Electronics
   60 Autumnwood Dr.
   Buffalo NY 14227
   (716) 668-0566

9. Wilson Electronics Corp.
   4288 S. Polaris Ave.
   Las Vegas NV 89103
   (702) 739-1931

10. Trio-Kenwood Communications, Inc.
    116 East Alondra
    Gardena CA 90248
    (213) 770-4350

11. VHF Engineering
    320 Water St.
    Binghamton NY 13901
    (607) 723-9574

12. Icom West, Inc.
    13256 Northrup Way
    Bellevue WA 98005
    (206) 747-9020

13. Emergency Beacon Corp.
    15 River St.
    New Rochelle NY 10801
    (914) 235-9400

14. Vanguard Labs
    196-23 Jamaica Ave.
    Hollis NY 11423
    (212) 468-2720

15. Amateur-Wholesale Electronics
    8817 SW 129th Terrace
    Miami FL 33176
    (304) 233-3631

16. Heath Co.
    Benton Harbor MI 49022
    (616) 982-3411

17. Henry Radio
    11240 W. Olympic Blvd.
    Los Angeles CA 90064
    (213) 477-6701

18. Yaesu-Musen USA, Inc.
    7625 E. Rosecrans No. 29
    Paramount CA 90723
    (213) 633-4007

an HT, perhaps. The power consumption is basically a function of the complexity of the circuit and whether the ICs used are of the CMOS (low power consumption) or TTL (relatively high power) type.

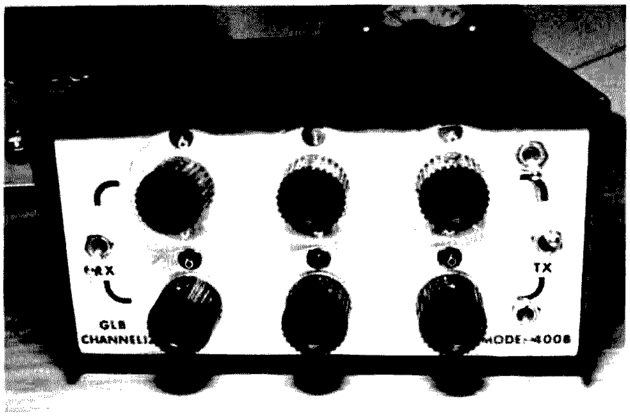
Size may be a limiting factor if the unit is to be added to an existing mobile installation or if the available space is small.

Most of the units listed are complete transceivers, but some are designed to replace the crystals in existing rigs. No attempt has been made to indicate with which rigs the various outboard synthesizers will work. The best way to find out if a given unit is compatible with your particular rig is to write the manufacturer whose synthesizer you are considering.

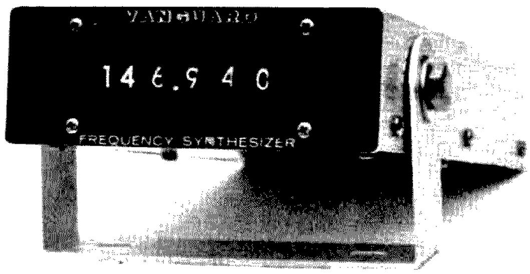
Of course, everybody is concerned with the price. Like calculators, the price has been coming down, and I expect that trend to continue. But I know of nobody who will predict how far down the price of a good rig will go, or how fast the price will fall.

There have been advertised two synthesizer-related pieces of equipment worth mentioning. Engineering Specialties (Box 2233 Oxnard CA 93030, phone 805-486-0817) has offered a Synthacoder for $87.95. This unit is designed to plug into the Icom 22S to permit any channel to be dialed into the Icom by thumbwheel switches. Thus, the owner of that rig would no longer be limited to the 22 channels usually provided by hand-wired diodes.

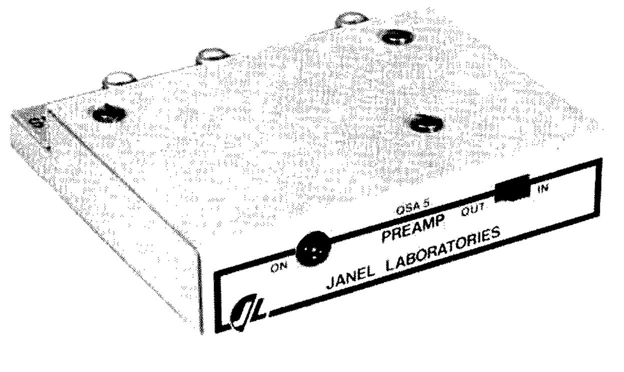
The other interesting unit is offered by Amateur-Wholesale Electronics



The GLB Model 400B.



The Vanguard Synthesizer.



The Janel Labs QSA 5 preamplifier, which can handle up to 30 Watts of transmit power through automatic switching.

(see number 15 in Table 2) for owners of the KDK FM 144. The FMSC-1 Scanner plugs into that rig and permits it to automatically scan a selected 1 MHz portion of the two meter band. Its introductory price is about $170, and it is easily installed.

Of course, this newest segment of the two meter FM market is changing rapidly and new products are coming in faster than old products are disappearing. But the tables presented here should give you a good idea of the variety of equipment presently for sale, as well as some idea of the state of the synthesizer art with which to compare any new equipment that you come across.

Alex F. Burr W5QNQ
Las Cruces NM

EDGECOM SYSTEM 3000

Edgecom of Torrance CA has announced a new microprocessor-based 2m transceiver. The new rig features programmable priority channels, monitor alarms, a built-in scanner, subaudible tone encoder/decoder, variable frequency offsets, and push-button frequency control. Output is adjustable up to 25 Watts from 1 Watt. The System 3000 will sell in the under-$500 price class. *Edgecom Inc., 2909 Oregon Ct. #A3, Torrance CA 90503.*

70 WATT, FM/AM/CW/SSB 2 METER AMPLIFIER

A new 70 Watt, 4 mode, 2 meter amplifier has been introduced by VHF Engineering of Binghamton NY. This new amplifier, the Blue Line BLC 10/70, is designed to be used with the popular 10 Watt FM transceivers and the popular multimode transceivers in the 5-15 Watt class and will deliver 70 Watts output in both the class C mode and the linear mode. A front panel switch permits simple selection of class C or linear mode. An additional model, the Blue Line BLC 2/70, offers the same features as the BLC 10/70 but will operate with transceivers or transmitters in the 1 to 2 Watt class.

The VHF Engineering Blue Line series of amplifiers have been designed for reliability and long life and feature unique broadband, stripline designs, which require no tuning or adjustment during their lifetime. Automatic sensing and relay switching are provided to automatically switch the amplifier into the circuit when drive is applied in the class C (FM) or linear (SSB) modes. The amplifiers offer high efficiency and introduce a receive insertion loss of less than 1 dB. They are designed for 12-14 V dc operation in base station or mobile service. *VHF Engineering, 320 Water St., Binghamton NY 13902.* The BLC 10/70 sells for $139.95 and the BLC 2/70 sells for S159.95.

NEW 80 WATT, LINEAR/CLASS C, 450 MHZ AMPLIFIER

A new broadband, high efficiency, 4 mode amplifier for the 420-450 amateur band has been introduced by VHF Engineering of Binghamton NY. This new amplifier, the Blue Line, BLE 10/80, will deliver 80 Watts output in either class C or linear mode with a nominal 10 Watts input. It is designed as an amplifier to be used with FM, AM, SSB, or CW rigs in the 10 Watt class. A similar amplifier, the Blue Line BLE 30/80, is designed to be used as an amplifier for rigs in the 30 Watt class.

The Blue Line series of amplifiers from VHF Engineering are high efficiency, broadband, stripline amplifiers, which have been designed for long life and reliable operation. Because of their unique, broadband design, they contain no tunable or adjustable components. Tuning or adjustment will not be required during the lifetime of the units. Automatic transmit/receive switching is provided through the use of sensing circuitry which detects the presence of drive power in either the class C (FM) or linear (SSB) modes. They are designed for 12-14 V dc operation in base station or mobile service. *VHF Engineering, 320 Water St., Binghamton NY 13902.* The BLE 10/80 is $289.95 and the BLE 30/80 is $259.95. Both units are wired and tested.

JANEL LABORATORIES MODEL QSA 5 PREAMPLIFIER

A new two meter preamp has been introduced by Janel Labs. This preamp is specially designed to improve the sensitivity of transceivers and includes all necessary bypass circuitry for carrying transmit power through the unit. The low noise figure of the preamp gives excellent sensitivity for weak signals. An adjustable delay circuit (similar to that used in VOX circuits) allows for use on all modes – FM, SSB, AM, and CW.

The gain of the QSA 5 has been optimized for transceivers. The 15 dB gain level is sufficient to improve the sensitivity as much as is practical, but low enough to avoid creating unnecessary overload problems.

A front panel switch is included on the QSA 5 to disable the preamp from the antenna line. This allows one to cut the gain on local signals and also allows for experimentation on weak signals. A LED pilot light is used to indicate when the preamp is in the line. This same LED also indicates when transmit power is being sensed.

The QSA 5 is available from *Janel Laboratories, 3312 S.E. Van Buren Blvd., Corvallis OR 97330.* The unit is available from stock at $39.95 plus postage. A full 1 year warranty is provided.

NEW SIGNETICS LSI CIRCUIT PRODUCES HF AND VHF SIGNAL GENERATION

A frequency synthesizer that uses digital phase locked loop techniques to generate radio frequency signals in the HF and VHF range is now available as a large scale integrated (LSI) circuit from Signetics.

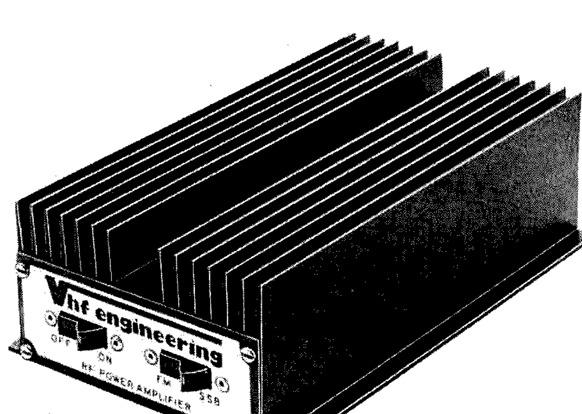
With low power Schottky and emitter coupled logic (ECL) technologies integrated into a single substrate, the new Signetics circuit, designated 8X08, operates at 80 MHz input frequencies with typical system power of 1.6 mW per gate.

As unique design features, the 8X08 incorporates an onboard reference crystal oscillator and an ECL prescaler, according to Dr. John Nemec, Product Planning Manager in Signetics' Logic Division.

Dr. Nemec said the new frequency synthesizer is expected to have major applications in the design of aircraft and marine radio equipment, in instrumentation circuits such as for signal generation in test equipment, as well as in synthesized AM/FM radios.

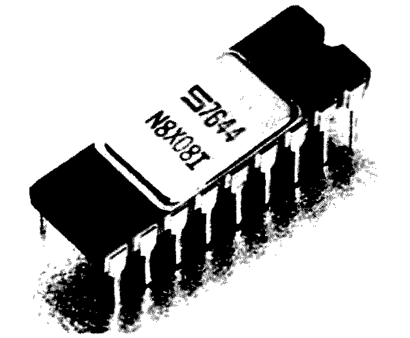
The 8X08 provides the major functional elements of a phase locked loop frequency synthesizer within a single LSI device. A VCO and loop filter are all that are required to complete the synthesizer circuit. The 8X08 contains all other major functional blocks, including a fixed frequency reference oscillator and divider chain, a phase comparator, and a programmable

The Edgecom System 3000 microprocessor-based 2m transceiver.



The new VHF Engineering Blue Line series of VHF/UHF amplifiers.

Heath's new HD-1426 field strength meter.



The Signetics 8X08 Frequency Synthesizer — digital PLL techniques to generate rf in the HF and VHF range.

counter chain for channel selection.

The fixed prescaler for the FM input is a key to the design since it is required in phase locked loops where very high frequencies are to be generated as a means of dividing the local oscillator frequency down to a frequency compatible with the programmable counter, Dr. Nemec said.

In the 8X08, the ECL prescaler is utilized to make possible programmable channel spacing to 100 kHz for FM-receiver local oscillator generation, when using a 3.6 MHz reference oscillator crystal and an external ÷2 circuit. A total of 2000 channels is possible when using the FM input.

Operating features of the circuit include maximum power dissipation of 680 mW and a single 5 V power supply. *Signetics, 811 East Arques Avenue, Sunnyvale CA 94086.*

HEATH HD-1426 FIELD STRENGTH METER

Heath Company, Benton Harbor, Michigan, has introduced a new kit for amateur, CB and marine radio operators. The HD-1426 field strength meter measures the relative field strength of signals from transmitters from 1 to 1000 Watts covering 1.8 MHz to 250 MHz. It can be used to check transmitter operation and to make transmitter and antenna adjustments. The HD-1426 will function with any transmitter having an output from 1 to 1000 Watts.

The HD-1426 incorporates both a built-in printed circuit antenna and a whip antenna as well. It may be used as either a mobile or fixed station device, and is mail order priced at $10.95.

For more information about the HD-1426, send for a free copy of the latest Heathkit catalog. *Heath Company, Dept. 350-23, Benton Harbor MI 49022.*

NEW MOTOROLA HEP CATALOG

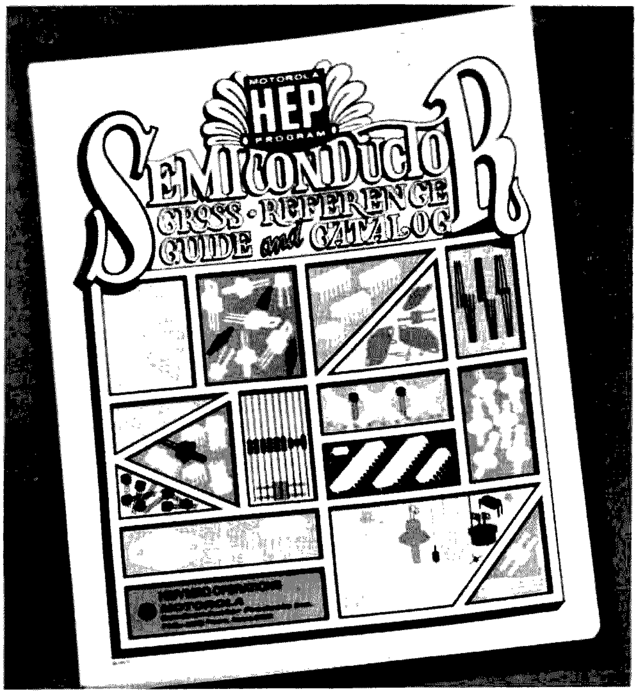
Motorola's HEP semiconductors are offered as replacements for over 60,000 different discrete devices and ICs. Intended for, but not limited to, the hobbyist, experimenter, and the professional service technician/dealer, the HEP products are specified to meet or exceed the important mechanical and electrical characteristics of the replaced device. In many cases, one HEP device will be recommended as the replacement for a large number of components. Because of this one-to-many ratio, the HEP device specifications will often exceed some of the specifications of a number of the replaced devices.

Because Motorola is not responsible for the design of the circuits in which HEP products are installed, and because the HEP device parameters may exceed the original, Motorola Semiconductor Products does not guarantee that the HEP device will perform exactly as the original device. However, the availability of this vast array of potential replacement devices, through a large national network of retail outlets (over 1500), can offer a considerable savings of time or money, or both, to the hobbyist and professional technician alike.

The latest edition of the *Motorola HEP Semiconductor Cross Reference Guide and Catalog* was scheduled for May, 1977. This 184 page book describes discrete silicon and germanium power transistors, thyristors, small-signal FETs and bipolar transistors, CB rf power transistors, zeners, rectifiers, and optoelectronic devices. Digital ICs, in RTL, HTL, DTL, TTL, and CMOS technologies, are also included as well as linear bipolar radio/television ICs, voltage regulators, op amps, etc.

One hundred ninety-eight new products have been added to the *Catalog* — 104 are newly offered TTL functions. Industry popular TO-220 packaged components are also included. A single chip, 3½ digit DVM IC that utilizes CMOS technology to provide both linear and digital circuit functions is also covered. The Catalog also described the Educator II microcomputer and power supply kits.

The unit price of this new *Motorola HEP Semiconductor Cross Reference Guide and Catalog* is $2.00, available from HEP/MRO Operations Headquarters and HEP distributors. *Technical Information Center, Motorola Semiconductor Products, Inc., PO Box 20294, Phoenix AZ 85036.*



GOLD LINE MICROPHONE CLIP

A new microphone clip (the No. 1108) has been introduced by Gold Line Connector of East Norwalk CT. A Gold Line spokesman said that it is sometimes inconvenient, or very undesirable, to drill holes or to rely on a magnet to hold your mobile microphone in position on the dash of your car or truck. The 1108 is backed with a rugged adhesive that gives excellent holding power. It can't vibrate or pull free.

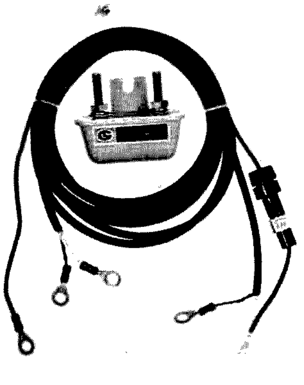
Gold Line designs and produces a complete line of accessories, including noise filters, antenna matchers, coax switches, and wattmeters, to name a few. *Gold Line Connector, Inc., PO Box 893, East Norwalk CT 06855.*

GOLD LINE NOISE FILTERING HOOKUP HARNESS

A new noise filtering hookup harness (the No. 1106) for the two-way communications market has been introduced by Gold Line Connector. A company spokesman commented that noise affecting two-way communications is generated from various sources in your automobile and is picked up by either the radio antenna or the vehicle wiring that supplies power to the communications equipment.

The primary function of the 1106 is to reduce the noise picked up by the wiring. Double barreled filtering action is supplied by heavy-duty coaxial cable for the power pickup which shields against unwanted noise and a ferromagnetic filter that further reduces any remaining interference.

Gold Line designs and produces a complete line of accessories for the two-way communications market, which it sells through a national distributor system. *Gold Line Connector, Inc., PO Box 893, East Norwalk CT 06855.*



The Gold Line noise filtering harness.

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554
Docket No. 20777
RM-1429 RM-2163
RM-2170 RM-2330
RM-2429 RM-2507
RM-2545 RM-2550

In the Matter of

Deregulation of Part 97 of the Commission's Rules regarding emissions authorized in the Amateur Radio Service.

FIRST REPORT AND ORDER

Adopted: March 2, 1977;
Released: March 10, 1977
By the Commission:

1. A Notice of Proposed Rule Making in the above-captioned matter was released April 22, 1976, and published in the Federal Register on April 28, 1976 (41 FR 17789). The deadline for submission of comments by the public was June 23, 1976. Reply comments were due by July 23, 1976. In response to a petition by the American Radio Relay League, the time for filing comments and reply comments was extended to August 4, 1976, and September 3, 1976, respectively.

2. Docket 20777 proposed to revise the amateur rules regarding authorized emissions. Rather than attempt piecemeal reform, the Notice proposed to delete all references to specific emission types and to replace them with limitations on the permissible bandwidth an amateur signal may occupy in the various bands. Additionally, the Notice proposed a purity of emissions standard which would replace the present regulations.

3. A total of 333 persons and 8 clubs filed individual comments. In addition, 23 petitions were filed as comments, adding 625 names. All of these comments are being carefully reviewed. This First Report and Order will address the problem of purity of emissions only. A future Report and Order will deal with the major issue of authorized bandwidths.

4. The present statement of Commission policy regarding emission purity in the Amateur Radio Service is found in Section 97.73 of the Commission's Rules. Section 97.73 states in part that "[s]purious radiation from an amateur station being operated with a carrier frequency below 144 megahertz shall be reduced or eliminated in accordance with good engineering practice . . ." The United States, as a signatory to the International Telecommunications Convention (Geneva, 1959) is bound to the international standards of emission purity. Article 12, Appendix 4 of the Radio Regulations of the I.T.U. requires an attenuation of 40 dB for spurious emissions below 30 MHz, and 60 dB[1] for emissions between 30 MHz and 235 MHz. By this Report and Order, the Commission brings amateur rules into conformity with international standards.

5. Standards for emission purity in the Safety and Special Radio Services are based on the nature of the signal transmitted. The modulation of the transmitted signal produces sidebands needed to carry information to the receiver, plus additional products caused by the modulation and amplification process. It is difficult to suppress completely the undesired emission products without causing unacceptable suppression of the sidebands carrying the information being transmitted. A reasonable degree, however, of suppression of the undesired emissions is needed. This is achieved by a three-step approach. For example, the Land Transportation Services require that for spurious emissions removed from the authorized bandwidth by more than 50 percent but less than 100 percent of the authorized bandwidth, the mean power must be attenuated at least 25 decibels below the mean power (P_m) of the emission. For emissions removed by more than 100 percent but less than 250 percent of the authorized bandwidth, attenuation must be at least 35 decibels below P_m. Beyond 250 percent, attenuation must be either 43 dB + 10 $\log_{10} P_m$ or 80 dB below P_m, whichever is less attenuation. This three-step attenuation is what can most likely be obtained with the usual tuned circuitry of rf amplifiers. Beyond 250 percent is considered a reasonable point to have other additional circuitry which will provide the attenuation we wish for the other spurious and harmonic emissions.

6. The standard proposed for amateur radio in our Notice in Docket 20777 was at least 40 dB for emissions removed from the authorized bandwidth by 250% or more of the authorized bandwidth. In determining a level of emission purity for the amateur service, the 25 dB and 35 dB steps were not proposed since it was intended to have this rule remain simple. The adjacent channels which the first two steps might affect would generally be within the amateur bands and the maintenance of non-interference would be handled on a self-enforcing basis among amateurs. However, beyond 250% there exists an entire range of spurious and harmonic emissions which could create problems outside the amateur bands, and would not be as obvious to the operator until a case of interference occurred.

7. The 40 dB specification was proposed as a first step toward the problem of purity of emission. 40 dB represents an attenuation of spurious and harmonic emissions to a level of 1/10,000 that of the fundamental. This means that for an amateur station which has a 200 Watt output, spurious emissions may be no more than 0.02 Watts. Therefore, 40 dB should provide a degree of protection to operations which would not be affected by interfering signals of 0.02 Watts or less. The effects will vary from location to location, from band to band, and for different emission modes. It is a level of attenuation which the Commission believes can be readily met by most equipment on the market today, and would not require expensive remodeling of equipment by the amateur. It will, however, restrict the use of linear amplifiers which are not meeting what the Commission regards as minimal standards of purity. In a memorandum to the Office of Chief Engineer written November 26, 1976, FCC/OCE LAB Projects 82-025, 82-026, 82-027, 82-028, the Laboratory Division detailed the results of tests of linear amplifiers purportedly sold for use in the Amateur Radio Service which indicate that many such amplifiers achieve harmonic suppression far less than 40 dB, especially in the second and third harmonics.

8. The new rule, as adopted, is a modification of the rule proposed in the Notice of Proposed Rule Making. Because there has been no decision regarding Docket 20777's proposed bandwidth rules, we are unable to enact the rule as proposed. Section 553(a)(3) of the Administrative Procedures Act requires that general notice of a rule contain either the terms of substance of the proposed rule or a description of the subjects and issues involved. Therefore, in keeping with the scope of this rule making, we are adopting the international standards of emission purity which generally relate to the 40 dB level of attenuation proposed by Docket 20777.

9. The International Telecommunications Convention of 1958 requires that all spurious emissions be attenuated by 40 dB when transmitting on frequencies below 30 MHz. When utilizing frequencies between 30 and 235 MHz, transmitters with power output below 25 Watts will be required to attenuate their spurious emissions by 40 dB; transmitters with power output of 25 Watts or more will be required to attenuate their spurious emissions by 60 dB. Amateurs operating near the edges of amateur bands should give due consideration to these attenuation requirements. We consider these international standards to be a minimal level of purity, but to have required higher levels of attenuation would not have been within the scope of this proceeding. The Commission will be instituting a rule making to investigate the need for higher levels of spurious emission attenuation in the Amateur Radio Service. Additionally, upon the disposition of Docket 20777, Section 97.73 will be modified to reflect the docket's final outcome.

10. We received 12 comments specifically addressing the proposed change in emission standards. Of the 12, 2 supported the rule change fully, 2 supported some definite standards, but offered a different standard of emission than the one proposed by the Commission, 5 expressed misgivings over the expense to the amateur and the enforcement of such a standard, and 3 expressly preferred the present standard. Of those who either expressed misgivings or opposed the change entirely, the comments of John V. Durant of Albuquerque, New Mexico, are typical: "From a pure technical standpoint, determination that the emission is at least 40 dB below the peak output power on any frequency removed from the upper and lower limits by more than 250% is a controversial (subject to several interpretations) and a very sophisticated measurement. I do not believe that even 1% of the presently licensed amateur radio operators have the capability or will attempt to acquire the capability to make such a measurement. Further, I doubt that from an enforcement standpoint (presumably FCC monitors) that such a regulation is enforceable." Other comments raised similar issues: the expense of obtaining equipment to monitor the spurious emissions; the resultant lack of adherence to the new rule by the bulk of amateurs; and the difficulty of enforcing the rule.

11. The problem of enforcement mentioned by several comments would be no greater than enforcing any of the standards of Section 97.61 through 97.73. Investigation of interference complaints and normal FCC monitoring will bring the obvious violations to light. However, establishment of a readily measured standard will provide a clearly defined measurement by which to determine compliance. "Good engineering practices," the present standard, has proved to be too indefinite a regulation to enforce effectively. The change, rather than hampering enforcement, should aid it.

12. Finally, we note that two of the comments offering technical criticism of the emission standards as proposed make valid arguments. James E. McShane of Omaha, Nebraska, states, "The proposed section 97.65 and 97.73 bandwidth limitation standards do not take into consideration the range of amateur power usages, from 1/10 of a Watt to the proposed 2.0 kW spread . . . Different regulations should be adopted for low power operation and equipment, or in the alternative, the regulation should be based on a minimum specified power, or actual power, whichever is greater." Gordon Schlesinger of San Diego, California, comments, "I propose that the Commission bring the stated purity standard of 40 decibels of attenuation below peak carrier power more closely into line with the standards existing in the Land Mobile service. A standard of 40 dB + $10\log_{10}$ (peak carrier power, in watts) would establish an absolute standard for attenuation of spurious emissions. Since power delivered to the input terminals of a receiver is proportional to the absolute (not relative) output power level of the transmitter whose emissions are being received, it makes sense to require maximum absolute limits to spurious radiation in the Amateur Service."

13. The above comments are well-taken. As Mr. McShane proposed, we have adopted the ITU regulations with respect to certain low power transmitters. Moreover, the Commission would like to note that the Notice of Proposed Rule Making, Docket 21000, which proposes increased attenuation for spurious emissions in the Personal Radio Services, contains a statement of Commission policy which promises future Notices addressing the matter of harmonic and spurious attenuation for all other services below 1 GHz, including Amateur radio. We would like to reaffirm that statement here and suggest that the above comments are excellent examples of the ideas the Commission will be seeking. Adoption of these present emission standards will not end the Commission's interest in purity of emissions, and we solicit noteworthy comments such as the above in future proceedings.

14. Additionally, the Commission has recently proposed in Docket 21117 type acceptance for commercially marketed amateur equipment. The type acceptance standards proposed would require a 43 + 10 log (mean power in Watts) decibel suppression of spurious emissions, a standard similar to the one suggested above by Mr. Schlesinger. As stated in the Notice of Proposed Rule Making, this degree of attenuation would apply only to amateur equipment which would be commercially marketed. Homemade equipment would be exempt from this standard and therefore adoption of Docket 20777's proposed standards is necessary to bring the entire amateur community into conformity with existing International standards. Until adoption of a Report and Order in Docket 21117, the standards herein specified shall apply to both home constructed and commercially marketed amateur equipment.

15. In view of the foregoing, we are of the opinion that the amended rule as discussed above is in the public interest, convenience, and necessity. Authority for this Amendment is contained in Section 4(i) and 303 of the Communications Act of 1934, as amended.

16. Accordingly, IT IS ORDERED, effective April 15, 1977, that Part 97 of the Commission's Rules IS AMENDED as set out in the attached Appendix. IT IS FURTHER ORDERED that this proceeding IS CONTINUED.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins
Secretary

APPENDIX

Part 97 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

In §97.73, the headnote and text are revised, as follows:

§97.73 *Purity of emissions.*

(a) The mean power of any spurious emission or radiation from any amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency below 30 MHz shall be at least 40 decibels below the mean power of the fundamental without exceeding the power of 50 milliwatts. For equipment of mean power less than 5 Watts, the attenuation shall be at least 30 decibels.

(b) The mean power of any spurious emission or radiation from any amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency above 30 MHz but below 235 MHz shall be at least 60 decibels below the mean power of the fundamental. For transmitters having mean power of 25 Watts or less, the mean power of any spurious radiation supplied to the antenna transmission line shall be at least 40 decibels below the mean power of the fundamental without exceeding the power of 25 microwatts, but, in any event, need not be reduced below the power of 10 microwatts.

(c) Spurious emission or radiation from an amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency above 235 MHz shall be reduced or eliminated in accordance with good engineering practice.

[1] 40 dB for transmitters having mean power of 25 Watts or less.

(d) For the purposes of this section, a spurious emission or radiation is any emission or radiation from a transmitter or any external radio frequency power amplifier which is outside of the authorized Amateur Radio Service frequency band being used.

(e) The above notwithstanding, should any spurious radiation, including chassis or power line radiation, cause harmful interference to the reception of other radio stations, the licensee may be required to take such further steps as may be necessary to eliminate the interference in accordance with good engineering practices.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

In the Matter of

Report and Order Number 20777
Grandfather Clause

To: The Commission

ENDORSEMENT OF REPORT AND ORDER #20777

The Amateur Radio Manufacturer's Association (ARMA) was formed on January 7, 1977, at a general meeting of all manufacturing interests attending the SAROC Convention in Las Vegas, Nevada. The organization is a self-governing body formed in order to encourage high standards and ethics in the Amateur Radio Industry. The basis and purpose of ARMA is to promote the general growth and welfare of amateur radio and to work toward favorable rule making and legislation for the benefit of the industry, as well as to function as a liaison between the member firms and the Federal Communications Commission (FCC). ARMA is also intended to collect and to disseminate market information to the members.

The membership of ARMA generally applauds Report and Order Number 20777: At long last, we will have some concrete specifications from which to engineer our products rather than merely following good engineering practices.

We are aware of the decision-making power which must go into this rule making, but we have also come to realize that there is a grave oversight on the part of the FCC in one area. This is the subject which we wish to follow up with the FCC, in the form of this petition for a "grandfathering" (grandfather clause) of commercially-built amateur radio transmitter and transceivers manufactured prior to April 15, 1977.

The reasons for this petition are as follows:

1) These products have been built by the legitimate Amateur Radio manufacturers who have not violated good engineering practices or the "spirit" of the law. Should these manufacturers be forced to take back the equipment from inventory of their stocking distributors it would be a significant hardship, possibly to the point of Chapter 11 filings.

2) The distributors and retailers would be faced with horrendous inventories of non-salable used equipment on the shelves.

3) The Amateur Radio Operator as an individual would be adversely affected once again with financial burden when he discovers that his present equipment is no longer legally marketable for outright sale or for trade-in on new equipment that does meet the specifications in Report and Order #20777.

4) The legitimate, self-policing Amateur Radio fraternity and industry would be dealt an injustice brought on by the pseudo-Amateur Radio violating the spirit of the law.

We wish to have the present equipment which does not currently cause harmful interference to other services put under this grandfather clause. And, we feel, this action in addition to the Report and Order #20777 would then strengthen the bond between the Amateur Radio manufacturer and the individual Amateur Radio hobbyist with the FCC.

Last, but not least, we must conclude by saying that this grandfather clause would be a positive move in the public's interest, convenience, and necessity.

Respectfully submitted,

Dennis Had
Edward Clegg
George Perrine
Marvin Druskoff
EXECUTIVE COMMITTEE for ARMA

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

In the Matter of

Petition for Rule Making RM-2839 Comments

To: The Commission

ENDORSEMENT OF RM-2839

The Amateur Radio Manufacturer's Association (ARMA) was formed on January 7, 1977, at a general meeting of all manufacturing interests attending the SAROC Convention in Las Vegas, Nevada. The organization is a self-governing body formed in order to encourage high standards and ethics in the Amateur Radio Industry. The basis and purpose of ARMA is to promote the general growth and welfare of amateur radio and to work toward favorable rule making and legislation for the benefit of the industry, as well as to function as a liaison between the member firms and the Federal Communications Commission (FCC). ARMA is also intended to collect and to disseminate market information to the members.

The members of ARMA have studied, with more than a little interest, RM-2839, and find ourselves in agreement with many of the proposals contained therein. We find also, as a representative group, that we have developed a feasible alternative solution to the portion of the ruling involving Type-Acceptance and/or elimination of amplifier equipment in the 24-35 MHz range. We feel that a major change is necessary in this one area.

The organization submits that the legality of licensing retail dealers and/or distributors is not within the jurisdiction of the Federal Communications Commission and, in our opinion, another solution is possible. We propose to the Commission, therefore, this avenue which would enable the FCC to enforce point-of-sale restrictions on *all* parties concerned, whether it be manufacturer or importer, distributor, retailer, consumer, or consumer resaler.

In brief form, for your convenience, we propose that the following data encompasses a viable system:

1) All manufacturers/importers of amateur radio rf generating devices would be required to serial number each and every unit produced and to include a Buyers' Affidavit. The manufacturer would record, in his files, a cross reference of serial number and purchaser data.

2) The Distributor-Wholesaler-Retailer who sells products in the amateur classification would be required to visually inspect a valid Amateur Radio Operator's License (xerox copy acceptable) and to present the buyer with the multi-copy affidavit. The seller would serve as witness to both the transaction and to the actual signing of the affidavit.

3a) The affidavit itself would require the following information: type of product, serial number, call letters of the licensed purchaser, full name and address of the purchaser, and a signed statement of intent that the equipment is for personal use on the frequencies for which the purchaser is so licensed and that he accepts the responsibility for the subsequent use of the equipment upon resale to an individual or group.

3b) Willful violation of any or all of the above stipulations would result in a $1,000.00 penalty fee per occurrence to be levied upon the buyer, dealer, manufacturer, or other party who is responsible in each case.

4) The system would also provide for comparable requirements for mail-order situations. The purchaser would be required to forward the necessary forms and also identification in completed manner prior to the actual delivery of the product.

5) The multi-copy affidavit would be distributed after completion by the purchaser in the following manner: one copy each to the buyer, the dealer, the manufacturer, and the FCC.

We envision this procedure as a more perfectly legal recourse for the FCC to pursue in order to halt the proliferation of illegal CB/pseudo-Amateur products currently on the market. And along these same lines, ARMA feels that the manufacturers should be required to file a separate affidavit supplying the FCC with direct serial number-product description-distribution information.

This alternative proposal, as we see it, offers a path of action with fewer loopholes than the Type-Acceptance route which might well require the elimination of the 24-35 MHz range.

The Amateur Radio Manufacturer's Association remains in total agreement, then, with the FCC's aim to eliminate the illegal use of amplifiers and related equipment. However, we feel that Type-Acceptance in itself is actually an "overkill" and would adversely affect the amateur radio operators as well as the industry itself. Such a limitation would stunt the inventive contributions so often available because of the technical knowledge in the amateur radio world. Our proposed joint effort would form a solid alternative solution which would benefit all parties concerned and would not require more "red tape" or additional enforcement staff at the Federal Communications level.

Respectfully submitted,

Dennis Had
Edward Clegg
George Perrine
Marvin Druskoff
EXECUTIVE COMMITTEE for ARMA

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554
Docket No. 21135

In the matter of

The simplification of the licensing and callsign assignment systems for stations in the Amateur Radio Service.

NOTICE OF PROPOSED RULE MAKING

Adopted: March 2, 1977;
Released: March 11, 1977
By the Commission: Chairman Wiley concurring in the result.

1. In accordance with the Administrative Procedure Act, 5 U.S.C. 553, and Section 1.412 of the Commission's Rules, 47 C.F.R. §1.412, the Commission hereby gives Notice of Proposed Rule Making in the above-captioned matter.

2. During the past two years there has been an unprecedented explosion in interest in personal radio communications in the United States. The popularity of the CB Radio Service has mushroomed to the point where there are now 8.5 million CB licensees, representing an estimated 20 million users of the CB Service. As recently as February, 1975, there were only 1.1 million CB licensees. The Amateur Radio Service has also grown substantially. Although the population of the Amateur Service had remained fundamentally static for several years, the number of licensees has begun to rise, and the number of newcomers to the Service, those obtaining Novice Class operator licenses, has shown particular growth. In December, 1976, for example, there were 36,000 Novice Class licenses outstanding, while in December, 1974, 21,000 operators held Novice Class licenses. The overall population of the Amateur Service is now approximately 293,000. Two years ago it was 255,000.

3. This surge in interest in personal radio commmunications has placed a heavy burden on those members of the Commission's staff engaged in the processing and issuance of licenses for personal radio communications. Although the workload imposed upon the Commission's staff at our Gettysburg, Pennsylvania, license processing facility has increased approximately 1000 per cent over the past two years, the number of permanent staff employees at Gettysburg has increased by only 50%. This has led, in turn, to an increase in the length of time necessary to process and issue Amateur Radio Service and CB Radio Service licenses. Although temporary permit procedures in the Amateur and CB Services allow, in some instances, operation pending issuance of a license, we are very much aware that many amateur radio licensees are dissatisfied with the speed with which their regular licenses are processed and issued, and we are investigating methods by which, assuming no new resources to be forthcoming, service to our amateur licensees might be further improved.

4. The Rules governing the Amateur Radio Service contain licensing and callsign assignment systems of some complexity. At the time these rules were adopted, the size and workload of our Gettysburg staff were such that routine and special amateur application processing could be accomplished without undue delay. As we indicated in the preceding paragraph, however, our resources have not kept pace with the increased demand for personal radio communications. Given these limited resources, we have been forced to assign priorities to our current licensing activities. *We believe our most important task in the Amateur Radio Service to be the processing and issuance of amateur operator and primary station licenses.* We have reached the point at which our lack of resources simply precludes all but the most basic licensing functions. Our regulatory obligations have outstripped our current capabilities. See paragraph 8, *infra*.

5. During most of the boom in personal radio communications, the Commission has been engaged in a program to deregulate the Amateur Radio Service. The proposals and amendments adopted during this period have been intended largely to simplify the licensing and operation of stations in the Amateur Service, and to that extent they complement our desire to improve our procedures in processing and issuing amateur licenses. They have also been intended, at least in part, to reduce the Commission's workload, whenever such a reduction is consistent with the Commission's regulatory obligations. For example, in a Notice of Inquiry and Notice of Proposed Rule Making in Docket 21033, released January 6, 1977 (42 FR 2089), we proposed, *inter alia*, to eliminate from Part 97 of the Rules repeater stations, auxiliary link stations, and control stations. Under the terms of our proposal in Docket 21033, the functions of such stations could be conducted by other amateur radio stations without prior Commission authorization. If adopted, our proposals in that proceeding would afford amateur licensees much greater flexibility in their operations and would also result in a considerable reduction in the workload of the Commission's amateur radio processing staff. Such a workload reduction would, in turn, enable us to redistribute our resources and provide our amateur licensees with better service in other, more vital, areas.

6. We believe the concepts underlying the proposals in Docket 21033 are sound

and may logically be extended to several other aspects of station licensing and operation in the Amateur Radio Service. We are by this Notice proposing revisions of Part 97 of the Rules which, if adopted, would result in a significant simplification of the licensing structure of the Amateur Service and of Part 97 itself.

7. Under the existing amateur radio licensing system, a licensee must obtain both an operator license and a station license. A licensee holds only one operator license and is required by Section 97.40 of the Rules to have, at a minimum, a primary station license, as well. There are several other station licenses available, however, including military recreation, club, special event, Radio Amateur Civil Emergency Service (RACES), and secondary station licenses, and many amateur operators have obtained one or more (occasionally, many more) such licenses. Additionally, many amateur radio operators are eligible for specific station callsigns or callsigns based on particular "preferred" formats.

8. We do not believe that the continuation of the issuance of the various station licenses, other than primary station licenses, listed above or the existence of the current callsign assignment system to be essential to the Amateur Service. The entire system has become extraordinarily burdensome and difficult to administer properly: A disproportionate percentage of our resources must, because of existing rules, be devoted to the processing of special callsign requests and non-primary station license applications. Processing of primary station license applications and operator license applications suffers as a result. For example, as of January 31, 1977, approximately 308,000 stations were licensed in the Amateur Radio Service. Of these, about 95% were primary stations. The other 5% were secondary stations, club stations, military recreation stations, and RACES stations. Yet processing applications for these non-primary stations required resources nearly equal to the resources needed to process primary station license applications. Similarly, Amateur Extra Class licensees comprise only 6% of the amateur population, but processing specific callsign requests from such licensees requires as much (if not more) time as issuing callsigns to the remaining 94%. Clearly, our resources are not allocated in the most effective manner.

9. In this proceeding we are proposing to simplify the basic licensing structure of the Amateur Service by discontinuing the issuance of all amateur station licenses, other than primary station licenses and space station licenses. (Space stations are under consideration in Docket 19852, Notice of Inquiry adopted October 25, 1973, and we are not proposing their deletion.) All amateur radio operators would be limited to one station license. Specifically, we propose to delete from Part 97 of the Rules military recreation stations, club stations, RACES stations (but not RACES itself), and all additional stations, including secondary stations and special event stations. (As we indicated above, we have already proposed in Docket 21033 to eliminate repeater, auxiliary link, and control stations.) Licensees holding the types of station licenses listed above would be permitted to retain them until expiration of the licenses but would not be permitted to renew them.

10. We recognize that the proposals contained in the preceding paragraph would, if adopted, have an impact on certain groups and individuals. We believe, however, that any such impact would be relatively minor and that the Commission and its licensees would realize significant benefits in the long run from the deletion of the station types in question, including the more efficient issuance of operator and primary station licenses. With respect to the specific station types we are proposing to eliminate and the probable effects of their elimination, we would make the following observations:

a. *Repeater stations, auxiliary link stations, and control stations.* Our proposals concerning these stations are fully explained in our Notice of Inquiry and Notice of Proposed Rule Making in Docket 21033, FCC 76-1198, 42 FR 2089 (1977). Basically, the functions now conducted by such stations would be permitted all remaining amateur stations without separate Commission authorization. No one would appear to be adversely affected by adoption of this proposal.

b. *Military recreation stations.* At the end of 1976 there were only 425 licensed military recreation stations, which are amateur stations licensed to the person-in-charge, often a non-amateur, of a land location at which an amateur station has been provided for the use of operators under the auspices of the United States armed forces. We are aware of no need for continuing the separate licensing of such stations. Those amateur operators wishing to operate such stations may do so by operating portable under their own individual station authorizations. We note that one possible disadvantage to portable operation, the requirement that transmissions from stations in portable operation be distinctively identified, was eliminated by the Commission's Report and Order in Docket 20686, 61 F.C.C. 2d 337 (1976).

c. *Club stations.* There are presently 4,500 licensed club stations. Although the elimination of separate club station licenses would have an impact on certain amateur operating programs and traditions, we believe separate licensing of such stations, which may be held by a club comprised of as few as two persons, to be non-essential. Operations now conducted by club stations may be conducted either by club members operating their stations portable or by club members acting as control operators of another club member's station. We are, however, particularly interested in receiving comments concerning the continued usefulness to the amateur community of separately licensing club stations.

d. *Secondary stations.* A secondary station is a separate station licensed to be an individual amateur operator for a location other than the primary station location. Typically, such stations have been licensed for vacation homes or offices. We believe there to be no need to continue to issue authorizations for secondary stations, because, as we noted in paragraph 10(b), *supra*, amateurs may, under the rule amendments adopted in Docket 20686, operate their primary stations at portable and mobile locations without the previous inconvenience of distinctively identifying their transmissions or providing the Commission with advance notification of extended portable or mobile operation. Further, since the suspension of all licensing fees by the Commission, effective January 1, 1977, we have been receiving multiple — and in many instances, frivolous — applications for secondary station licenses from individual amateurs. The applications for secondary station licenses we have received since January 1, 1977, are already beginning to burden our processing staff, and we anticipate a flood of new secondary station license applications as soon as this Notice of Proposed Rule Making is released to the public. For this reason, and to enable the continued efficient processing of other amateur radio license applications, we are hereby declaring, effective with the release of the News Release announcing adoption of this document, a "closed season" on the filing of applications for new secondary stations or special event stations (see below). All applications for new secondary stations received on or after the effective date of the closed season will be returned. Applications for renewal or modification of existing secondary station licenses will continue to be accepted, however. The closed season on filing applications for special event and new secondary station licenses will continue until Commission policy in this area is determined.

e. *Special event stations.* Special event stations are licensed for temporary use in connection with the celebration of an event of either general interest to the public or of particular interest to amateur radio operators, and are intended to bring favorable public attention to the Amateur Radio Service. In 1976 approximately 100 special event stations were licensed. Special event stations are assigned distinctive, unusual callsigns, and it frequently appears that such stations are used not so much to celebrate special events as to enable amateur operation with "exotic" callsigns. We solicit comments concerning the continued usefulness, if any, of special event stations and wish to be provided with specific, concrete examples of special event stations that have brought favorable public attention to the Amateur Radio Service. For reasons outlined above, we are including special event stations in the closed season on the submission of station license applications.

f. *RACES stations.* Radio Amateur Civil Emergency Service stations are stations licensed to civil defense organizations to provide the facilities for amateur radio operators to conduct communications in RACES. Such stations are assigned distinctive callsigns prefixed by the letters "WC". Such stations must in all instances be operated by licensed amateur radio operators, and for this reason we believe such operation can be conducted by amateur operators under their individual station licenses. Functions now conducted by RACES stations and amateur stations participating in RACES would be combined in a form of amateur operation known as "RACES operation." Under this proposal, there would be no change in the basis and purpose of RACES itself, and we believe RACES operations would not be seriously affected if our proposal is ultimately adopted. We do wish to receive comments addressing the utility of separately licensed RACES stations, however.

Deletion of the types of amateur stations listed above would have the added advantage of enabling us to delete the FCC Form 610-B, Application for Amateur Club, Military Recreation, or Radio Amateur Civil Emergency Service Station license.

11. We are also proposing in this proceeding to simplify drastically the system of amateur radio callsign assignment. Under Section 2.302 of the Rules, the Amateur Radio Service is allocated certain blocks of callsigns. Sections 97.51 and 97.53 of the Rules contain rather complex regulations and policies governing amateur radio callsign assignment. Certain licensees are eligible for "1x2" callsigns (callsigns consisting of one letter, one digit, and two letters), others are eligible for certain non-specific "preferred" callsigns, while still others must take the callsigns assigned them by the Commission. We believe there to be no compelling need to continue the complex system of callsign assignment that now exists, a system which, as we indicated heretofore, occupies an inordinate amount of our staff's time, and we are proposing, accordingly, to amend Section 97.51 of the Rules to state simply that amateur radio callsigns will be assigned on a systematic basis. Section 97.53 of the Rules would be deleted entirely. Licensees holding Amateur Extra Class operator licenses would be afforded the opportunity to obtain 1x2 and 2x2 callsigns, but such callsigns would be assigned systematically by the Commission. (Amateur Extra Class licensees would not be permitted, as they are now, to obtain specific 1x2 callsigns of their choice.) Licensees moving from one callsign area to another and modifying their licenses to reflect the moves would not continue to be assigned new callsigns of the same format as the callsigns relinquished. Nor would we continue to issue specific callsigns to former holders thereof. We would not issue any more distinctive callsigns to stations in repeater or RACES operation.[1] Our proposal, if adopted, would result in a much simpler and fairer callsign assignment system and would permit us to concentrate our limited resources in areas more productive for the Amateur Radio Service.

12. The specific rule amendments we are proposing are set forth in the attached Appendix. Authority for these proposals and for the "closed season" announced herein is contained in Sections 4(i), 5(e), and 303 of the Communications Act of 1934, as amended. We invite interested parties to submit comments conerning our proposals on or before June 2, 1977, and reply comments on or before June 30, 1977. An original and five copies of all comments and reply comments shall be furnished the Commission, pursuant to Section 1.419 of the Rules. Respondents wishing each Commissioner to have a personal copy of the comments may submit an additional six copies. Members of the public wishing to express interest in our proposals but unable to provide the required copies may participate informally by submitting one copy of their comments, without regard to form, provided the correct docket number is specified in the heading of the comments. All comments and reply comments filed in this proceeding should be sent to the Secretary, Federal Communications Commission, Washington DC 20554.

13. Individuals wishing to inspect the comments and reply comments filed in this proceeding may do so during regular business hours, 8:00 am to 4:30 pm Monday through Friday, in the Commission's Public Reference Room, 1919 "M" Street, N.W., Washington DC 20554.

FEDERAL COMMUNICATIONS COMMISSION
Vincent J. Mullins
Secretary

APPENDIX

Parts 1 and 97 of Chapter 1 of Title 47 of the Code of Federal Regulations are proposed to be amended, as follows:

§1.922 [Amended]

1. In §1.922, FCC Form 610-B is deleted.

2. In §1.926, paragraph (b)(4) is deleted and designated [Reserved], and paragraph (b)(1) is amended, as follows:

§1.926 *Application for renewal of license.*

(b)(1) Applications for renewal of an amateur operator license, an amateur station license, or a combined amateur operator/station license, shall be filed on FCC Form 610.

(4) [Reserved].

3. §1.951(a) is amended to read as follows:

§1.951 *How applications are distributed.*

(a) Personal Radio Division: Amateur, Disaster, and Personal

4. §1.952 is amended to read, as follows:

§1.952 *How file numbers are assigned.*

(b) File number symbols and service or class of station designators:

Amateur and Disaster Services

Y — Amateur

D — Disaster

5. §1.1115 is amended to read, as follows:

§1.1115 *Schedule of fees for the Safety and Special Radio Services.*

(a) * * *

Amateur Service

Modification of license without renewal ... $3

(b) * * *

(c) * * *

(6) Application for Interim Amateur Permits or Novice Class licenses in the Amateur Radio Service.

6. In §97.3, paragraphs (f), (g), (h), and (i)

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[1] We are aware that in Docket 21033 we proposed to continue in certain instances to issue distinctive callsigns to stations in repeater operation and that our proposal in this proceeding to eliminate such callsigns entirely is, to that extent, inconsistent.

are deleted, paragraphs (j) through (y), inclusive, are redesignated paragraphs (f) through (u), respectively, and paragraphs (c) and (d) are amended to read, as follows:

§97.3 Definitions

(c) *Amateur radio operator*. A person holding a valid license to operate an amateur radio station issued by the Federal Communications Commission.

(d) *Amateur radio license*. The instrument of authorization issued by the Federal Communications Commission consisting of a station license and an operator license.

Operator license. The instrument of authorization including the class of operator privileges.

Station license. The instrument of authorization for a radio station in the Amateur Radio Service.

Interim Amateur Permit. A temporary operator and station authorization issued to licensees successfully completing Commission supervised examinations for higher class operator licenses.

7. In §97.37, the headnote and text are amended to read, as follows:

§97.37 *Eligibility for station license*.

(a) An amateur radio station license shall be issued only to a licensed amateur radio operator.

(b) An amateur radio station license shall not be issued to a school, club, company, corporation, association, or other organization.

(c) An amateur radio operator shall be issued no more than one amateur radio station license. (This paragraph does not apply to an amateur radio operator applying for a space radio station license.)

§97.39 [Deleted]

8. §97.39 is deleted.

9. §97.40 is deleted and redesignated §97.39, paragraphs (c), (d), and (e) are deleted, and paragraph (b) is amended to read, as follows:

§97.39 *Station license required*.

(b) Every amateur radio operator shall have an amateur radio station license.

10. In §97.41, paragraphs (b), (c), and (d) are deleted, paragraphs (e), (f), and (g) are redesignated paragraphs (b), (c), and (d) respectively, and paragraphs (a) and (b) are amended, as follows:

§97.41 *Application for station license*.

(a) Each application for an amateur radio station license shall be made on FCC Form 610.

(b) If the application is for a station license, only, it shall be submitted to the Federal Communications Commission, Box 1020, Gettysburg, Pennsylvania, 17325.

11. §97.47 is revised to read, as follows:

§97.47 *Renewal and/or modification of amateur station license*.

(a) Application for renewal and/or modification of a station license shall be submitted on FCC Form 610. In every case the application shall be accompanied by the applicant's license or a photocopy thereof. Applications for renewal of unexpired license must be made during the license term and should be filed not later than 90 days prior to the end of the license term. In any case in which the licensee has, in accordance with the provisions of this chapter, made timely and sufficient application for renewal of an unexpired license, no license with reference to any activity of a continuing nature shall expire until such application shall have been finally determined.

(b) If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date of the license. During this one year period, a license is not valid. A license renewed during this one year period will be dated currently and will not be backdated to the date of expiration.

(c) When the name of a licensee is changed, or when the mailing address is changed (without changing the authorized location of the amateur radio station) a formal application for modification of license is not required. The licensee shall notify the Commission promptly of these changes, however. The notice, which may be in letter form, shall contain the name and address of the licensee as they appear in Commission records, the new name and/or address, as the case may be, and the callsign and class of operator license. The notice shall be sent to the Commission, Gettysburg, Pennsylvania 17325, and a copy shall be maintained with the license of each station until a new license is issued.

12. In §97.51, paragraph (a) is amended, paragraph (b) is redesignated paragraph (d), and new paragraphs (b) and (c) are added, as follows:

§97.51 Assignment of callsigns.

(a) The callsign of an amateur radio station shall be assigned by the Commission on a systematic basis.

(b) An Amateur Extra Class operator may obtain on request, subject to availability, a station callsign consisting of one letter followed by one digit followed by two letters, or a callsign consisting of two letters followed by one digit followed by two letters. Callsigns assigned under this paragraph shall be assigned by the Commission on a systematic basis. No request for a specific callsign or callsign format shall be granted.

(c) No request for a specific callsign or callsign format shall be granted.

(d) * * *

§97.53 [Deleted].

13. §97.53 is deleted.

14. §97.87(b) is amended to read, as follows:

§97.87 Station identification.

(b) If the control operator of a station is not the station licensee, the station identification required by this section shall be the callsign assigned that station. If a station is operated on frequencies authorized by §97.7 for use by the control operator but not authorized for use by the station licensee, the required station identification shall be the callsign of that station followed by the station callsign of the control operator (e.g., WB6XYZ/W6XY).

15. §97.95(a)(1) and (a)(2) are amended to read as follows:

§97.95 *Operation away from the authorized fixed operation station location*.

(a) * * *

(1) When there is no change in the authorized fixed operation station location, an amateur radio station may be operated under its station license anywhere in the United States, its territories or possessions, as a portable or mobile operation, subject to §97.61.

(2) When the authorized permanent station location is changed, formal application (FCC Form 610) must be submitted to the Commission prior to any operation and within 4 months of the move for the purpose of modifying the station license to show the new permanent station location. Operation at the new location is permitted under the license for the former station from the date the modification application is mailed until the applicant is advised of Commission action on that application.

16. §97.103(b)(1) is amended to read as follows:

§97.103 *Station log requirements*.

(b) * * *

(1) The date and time periods the duty control operator for the station was other than the station licensees, and the signature and station callsign of that duty control operator.

17. §97.112(b) is amended, as follows:

§97.112 *No remuneration for use of station*.

(b) Control operators of an amateur station may be compensated when the station is operated primarily for the purpose of conducting amateur radiocommunication to provide telegraphy practice transmissions for persons learning or improving proficiency in the international Morse code, or to disseminate information bulletins consisting solely of subject matter of direct interest to amateur radio operators, provided:

18. §97.163(b) is amended to read, as follows:

§97.163 *Definitions*.

(b) *RACES operation*. Amateur radiocommunication conducted by amateur radio stations in the Radio Amateur Civil Emergency Service.

19. §97.165 is amended to read, as follows:

§97.165 *Applicability of rules*.

In all cases not specifically covered by this Subpart, amateur radio stations engaging in RACES operation shall be governed by the provisions of the rules governing amateur radio stations and operators (Subparts A and E of this Part).

20. §97.169 is amended to read, as follows:

§97.169 *Station license required*.

No station shall engage in RACES operation unless the station is an amateur radio station licensed by the Federal Communications Commission and is certified by a responsible civil defense organization as being registered with that organization.

§97.171 [Deleted]

21. §97.171 is deleted.

§97.173 [Deleted]

22. §97.173 is deleted.

§97.175 [Deleted]

23. §97.175 is deleted.

24. §97.177 is amended to read, as follows:

§97.177 *Operator requirements*.

No person shall be the control operator of an amateur radio station engaging in RACES operation unless that person holds a valid amateur radio operator license issued by the Federal Communications Commission and is certified by a responsible civil defense organization as being registered with that organization.

25. §97.181 is deleted and a new §97.181 added, as follows:

§97.181 *Station identification*.

In addition to the station identification requirements of §97.87, each amateur radio station engaging in RACES operation shall transmit the following additional information: When identifying by radiotelephony, a station in RACES operation shall transmit the word "RACES" at the end of the station callsign. When identifying by radiotelegraphy, a station in RACES operation shall transmit the fraction bar DN followed by the letters "C" or "CD" at the end of the station callsign.

26. §97.185(b) is amended to read, as follows:

§97.185 *Frequencies available*.

(b) In the event of any emergency which necessitates the invoking of the President's War Emergency Powers under the provisions of Section 606 of the Communications Act of 1934, as amended, unless modified or otherwise directed, amateur radio stations engaging in RACES operation will be limited in operation to the following frequencies:

27. §97.189 is amended to read, as follows:

§97.189 *Points of communication*.

Amateur radio stations engaging in RACES operation may be used only to communicate with the following, upon authorization of the responsible civil defense official for the organization in which the amateur radio station is registered:

(a) Amateur radio stations registered with the same or another civil defense organization;

(b) Stations in the Disaster Communications Service;

(c) Stations of the United States government authorized by a responsible agency to exchange communications with stations engaging in RACES operation; and

(d) Any other station in any other service regulated by the Federal Communications Commission, whenever such station is authorized by the Commission to exchange communications with stations engaging in RACES operation.

28. In §97.193, the headnote is revised and the text amended, as follows:

§97.193 *Limitations on the use of stations operating in RACES*.

All messages which are transmitted in connection with drills or tests in RACES shall be clearly identified as such by the use of the words "drill" or "test," as appropriate, in the body of the messages.

WESTERN PENNSYLVANIA REPEATER COUNCIL

In the Matter of

Deregulation of Part 97 of the Commission's Rules to simplify the licensing and operation of complex systems of Amateur Radio stations and modification of repeatar subbands.

Docket No. 21033

Response and Comments

March 17, 1977

by the Western Pennsylvania Repeater Council

The following response and comments to the docket in question are made in cooperation with a committee of members from the Western Pennsylvania Repeater Council. The contents of this response are approved by the total membership of the council (at this time, thirty-eight trustees).

The council agrees with the general intent of Docket No. 21033, but feels that the extent of the deregulation exhibited by this docket is such that it will be abused. We feel that deregulation without structure is not good. The complete relaxation of repeater subbands would create chaos on all bands and make the voluntary jobs of the frequency coordinators or repeater councils one which would be excruciating. We do realize that amateurs have been, by and large, self-regulating, but there is always that one fanatic who goes to extremes when interpreting rules or the lack thereof and will create havoc on the bands. We feel that structured deregulation is necessary.

To be more specific:

Referring to paragraph six of the docket, we feel that there is a definite need to license repeaters separately from those of auxiliary, control, or remotely controlled stations. Deregulation would permit any amateur to put a repeater on the air without prior exhibition of technical competence which your licensing procedure now requires. The other alternative would be to require the amateur wishing to place a repeater on the air to prove his technical competence and receive a frequency from a recognized area council. Furthermore, delete the word repeater from the following statement and have it read: All amateur station licenses would convey authority to operate as control, auxiliary, link, and remotely controlled stations.

Referring to paragraph seven of the docket, we agree with the wording.

Referring to paragraph eight of the docket, we again state that repeaters should be licensed as a separate entity and therefore should be given a distinctive "WR" callsign.

We therefore disagree with the need for the suffix or prefix "R" or "RPT" or the word "REPEATER," but do see the need in auxiliary operation for a descriptive term.

Also referring to paragraph nine of the docket, the council does not care what length of time should be required for station identification. Trustees of repeaters would set their identification interval at any sequence that they deemed sufficient to let the users know what repeater they are working up to the maximum allowable time anyway.

We agree with paragraph ten and would like to make an additional comment. We feel that deregulation could be extended to the point of eliminating the control operator and making the individual amateurs using the repeater responsible for their actions and words while using the repeater.

We also agree with paragraph eleven.

Referring to paragraph twelve of the docket, the council totally disagrees with removal of repeater subbands as stated in a previous paragraph of this response. We further wish to state that repeater subbands should not interfere with other modes of operation within the same frequency band. We feel that there is no place for repeaters below ten meters and that they should be assigned to specific blocks of frequencies only on or above ten meters. We do, however, agree that monitoring of the frequency used for auxiliary operation before and during operation is necessary and in accordance with good operating practice.

Concerning the request for comments

about power limitations, we feel that these limitations should be continued. The basic concept of repeaters was to provide intra-community communications, and a limit on the amount of power accomplishes this perspective. We do suggest a modification of the power limitation rule as it now reads, and that is to reword it to the effect of measuring power at the base of the antenna (at the antenna end of the feedline) and not the theoretical value required by calculating effective radiated power.

Frequency coordinators or area councils (if they handle frequency coordination) must be given additional power to meet anticipated congestion due to the growing number of repeaters. A mandatory requirement of every group or individual wishing to place a repeater on the air should first be to secure a frequency from a coordinator or council. It should be additionally noted that giving the coordinators or councils official power is not a far-fetched idea or just a whim — the Commission refers frequency coordination for the commercial services to an outside firm.

Respectfully submitted,

Daniel H. Rabinovitz K3ISO
Secretary, WPRC

TO:
THE FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

COMMENTS OF:
Thomas M. Gooding
206 West Maple Avenue
Sterling VA 22170
Licensee of ARS K4LHB and WR4ABR

IN THE MATTER OF: Docket No. 21033. Notice of Inquiry and Notice of Proposed Rule Making Adopted December 22, 1976.

TITLED: Deregulation of Part 97 of the Commission's rules to simplify the licensing and operation of complex systems of Amateur Radio stations and modification of repeater subbands.

1. The following comments are based on my experience of nearly twenty years as an amateur licensee with emphasis on activity in the VHF region. I am trustee for the Northern Virginia FM Association, Inc., for the repeater license WR4ABR and have served since 1970 as an officer and director of that organization.

2. It would appear that the effort to deregulate the Amateur Service is beginning to exceed prudent restraint. While much deregulation is possible without changing the basic principles and traditions of the Service, caution is necessary to preserve those traditions which have made the Amateur Service and the hobby it regulates so valuable to the public interest. I urge the Commission to take a hard look at the disruption that this and subsequent proposals may cause to the overall service and to consider that some restraint in deregulation is necessary.

3. I agree with the proposal to delete the requirement to separately authorize control, auxiliary link, and other remotely controlled stations, including repeater stations. Since it is no longer necessary to submit to the Commission technical showings to obtain a repeater license, it is only logical to make these types of operation an inherent privilege of a primary or club station license. The addition of "/R" or "/RPT" is quite sufficient to identify this activity.

4. It is still necessary to limit the repeater activity to specific subbands, however. Except for isolated cases, the amateur-administered program of frequency coordination has worked well. This program is based on band plans which are formulated on specific subband assignments for repeaters. The continuous use of a particular frequency by a repeater could give an unfair advantage to the repeater station over non-repeater stations, should all frequencies be available for repeater operation.

5. An expansion of the present allocations is certainly appropriate, however. I do believe that the nature of the VHF repeater vs. the propagation vagaries and lack of traditional channelization makes the MF and HF bands a poor choice to even attempt repeater operation. Therefore, I recommend that repeater operation be limited to frequencies above 29.0 MHz and that present repeater allocations be expanded as follows:

29.0	to	29.7 MHz
*145.0	to	148.0 MHz
221.0	to	224.0 MHz
**420.0	to	431.0 MHz
**437.0	to	450.0 MHz

The expansion of the 146-148 MHz band to the limits above (*) *must* be predicated on the expansion of the privileges of the Technician Class licensee to include the band 144 to 145 MHz. This is vital to preserve the non-repeater operation and non-FM activity now in the frequency band 145 to 146 MHz. This move would consolidate the weak signal activity to just above 144 MHz.

It is also necessary to protect the weak signal and Amateur Television activity in the band 431 to 437 MHz (**). The Commission may also wish to protect the satellite activity in the 10, 2, and 3/4 meter bands.

6. I concur in the proposed deletion of the recording requirement of automatic control (§97.111(g)(2)) and agree that satisfactory rules compliance is practical within the provisions of proposed §97.85(e). However, §97.88(e) should be modified to permit radio control via the repeater receiving frequency as a secondary system to the control facility provided by wire-line or other radio frequencies. This would greatly increase the potential for prompt exercise of the control function from portable and mobile units, particularly when the station is being operated under automatic control. It is important that this uplink control be only secondary and cannot relieve the station of maintaining positive control as now set forth in the rules.

7. After noting it in paragraph 3 of the Docket 21033 Notice, the Commission omitted any further reference to the petitioner's request in RM-2780 to delete the requirement for noting third party traffic in the station log (§97.103(b)(2)). The same reasons that make logging under automatic control unnecessary also make this logging requirement unnecessary. The licensee has the option not to initiate or to terminate third party traffic which is contrary to the regulations.

8. Since only isolated cases of significant problems have occurred in the area of frequency coordination, I urge the Commission to make *no* particular statement on repeater frequency assignment. It might be wise to permit the Commission to officially arbitrate disagreements between individual repeater stations where they can show that they are unable to reconcile their differences in any other way. The proposed §97.63 is probably sufficient if any regulation is needed at all. At no time should the Commission designate non-Commission personnel to administer a frequency allocation program. This is best handled by the ARRL or similar groups of Amateurs.

9. I would endorse the provision in proposed §97.84(c) to permit up to 10 minute intervals between required transmission of repeater station indentifications.

Thomas M. Gooding K4LHB

Ham Help

I am at present preparing for the Extra exam and would like a little information. I am a subscriber to *73 Magazine* and enjoy it very much. Also have the *73 Extra Class License Study Guide*, and *73* 20 wpm tape, all of which I find very helpful. However, do you know of any CW magazine that I can subscribe to? By that I mean any magazine devoted exclusively to CW. I thought I read about one in the March issue of *73*, but am unable to locate the article. Thank you for your kind attention to this inquiry.

Frank Travick
2140 Indian Lake Road
Niles MI 49120

I have two pieces of gear that might be salvaged, but no schematics. One is an HP 524B frequency counter, with a 525A scaler. The basic counter is inoperative. Also, I have a Poly-Comm 62 transceiver for 6 and 2 meters AM. Again, no schematic. I would be willing to reimburse any reader for info on the above units.

I am on Social Security disability, and this is the only way I can get on the air within my budget. Anything you can do would be greatly appreciated.

John P. Dieringer W6RVP
9010 Ramsgate Ave.
W. Los Angelas CA 90045

I am very interested in becoming a ham operator. I started reading your fine magazine 3 months ago in my high school library. I eagerly await each new issue so I can check out last month's magazine and I can study it more closely. I really like your columns, and especially your radio construction projects for beginners. I also think your "Ham Help" column is a terrific public service!

Several of my friends and I want to move up into ham radio, but we are having trouble with the code and desperately need help. We would sure appreciate help from anyone in our area. Also, there are many potential hams besides us, and I think a class in amateur radio would go over very well.

Ronald Carnes
PO Box 285
Leitchfield KY 42754

I would like to hear from hams knowledgeable in the solar power field. I want to build nicad chargers, and twelve volt supplies for ham equipment in field use.

I can help those interested in Zepp, random, and other antennas, as well as transmatches and tuners.

James G. Coote WB6AAM/6
6525 Elder St.
Los Angeles CA 90042

Do you know of anyone in the Nuernberg area of Germany who would be willing to help me prepare for my Novice license? I have been interested for a long time and have made many false starts on my own, but need a person to help me with it to succeed.

SP4 Charles W. Espey Jr.
HHB, 1st AD Arty
APO NY 09070

I reside near the Poughkeepsie area in Dutchess County (NY), and would like to take the Novice test. I would appreciate hearing from any ham willing to monitor the test.

F. Cuillo
Box 145
Wassaic NY 12592

I am eleven years old and deeply into amateur radio. I would like to get into a computerized RTTY system on 24 GHz that will send out a signal in microsecond bursts, but I need a transceiver for that frequency that will handle that situation. Can anyone help?

Jim Woodyatt
6646 Moselle Cir.
Yorba Linda CA 92686

Would like to hear from present owners of the Hallicrafters FPM 200 (not 300) with possibility of forming a club to exchange information of interest.

Jerry Swartzlander W8EPI
PO Box 666
Fremont OH 43420

I am a man 84 years old. I received my Novice license on April 7, 1976, and have had 1 contact so far. I have been off the air for 26 years — had a Technician license for over 20 years, and took sick and while sick my license lapsed. Could you put me in contact with some Novices who need help with the code like I do?

Glenn N. Crawford WB0SLV
207 5th Ave. N.
Humboldt IA 50548

I have a problem I think you can help me with. Over the years, I have picked up a lot of very nice equipment at very reasonable prices. Unfortunately, the I/O code is EBCDIC. Many of the boys are handling this problem with software, but this seems an awful waste of RAM.

There are ROMs available, but the quotes I have received range from $58.00 to $72.50 for single units.

If anyone in your very large readership knows where I can obtain Read Only Memories which convert ASCII to EBCDIC and back for $10.00 or less, would they please let me know?

If I can get my hands on one of these chips, I'll put something together and send you a piece for the I/O section of *73*. There must be a lot of good EBCDIC equipment just gathering dust.

Richard Wright
676 Coe Street
Tiffin OH 44883

P.S. Does this problem remind you of the old 400 cycle power supply problem?

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

ANYONE HAVE A SPARE ICEBERG?

A sky so blue it looks as though it were a painting by one of the masters rather than a creation of Mother Nature herself. In the middle of this blue panorama hangs a sun whose white hot rays bring 80° warmth to this scene daily. Nestled below this sky are the mountains, deserts, woodlands and cities that make up the state I call home: California. Only one problem, though. For all her picturesque creativity in building this scene, Mother Nature has gone a bit awry. You see, one would expect to have this scene from mid-June until the beginning of October. However, it's now April, and with little exception the rains we need to grow our crops and provide water to our cities have yet to come.

We are in pretty bad shape out here. At least that's what the TV and the newspapers tell us. Normally our rainy season, approximately mid-October to early June, would bring the water necessary for the rest of the year. However, this year something went wrong, and while most of the nation froze in sub-zero temperatures that were accompanied by heavy snowfalls, out here on the West Coast it was warm and dry. Now the time has come when it looks as if we are going to have to pay the piper for his nice music. Already, a number of Northern California cities have imposed severe restrictions on the amount of water to be used by each person and for each task. Soon I suspect that we here in the Southland will be forced to follow in the same direction. It's a rather heavy price to pay for a warm winter, but it is something that we have no control over. As I said, the time has come when we must pay the price for this winter, unless one of you out there has a spare iceberg or two lying around and wishes to donate same to a worthy cause. Any takers?

When a voluntary coordinating council such as the SCRA administers an area as large as Southern California, it is obvious that the four people who make up the elected directorate along with the members of the two technical committees cannot be everywhere at once. Problems arise, and it would be nice to know when such "brush fires" ignite, so that they can be solved before they reach the "forest fire" stage (as has happened in the past). Then too, when you issue a "90 Day Test Sanction" for a new system, it would be kind of nice to have someone available from the organization to work with those involved, so that they can more easily interface with existing activity. If such is not possible, it would be nice to at least have someone to turn to with a call for help. The evening before the April 2nd SCRA meeting, Jim Hendershot WA6VQP and myself sat in my livingroom pondering just such a problem. It was no secret out here that both Jim and myself were running for elective office within SCRA (Jim for Chairman and I for Vice Chairman), and we wanted to have a few new ideas ready that would enable us to help build even stronger unity within the organization (should it come to pass that one or both of us were elected). The key, we felt, would lie in developing quick lines of intercommunication between us in Los Angeles and the rest of the administrative area. While Jim says it was my idea, I really feel that I must share credit with him for the idea that follows. We call it the "SCRA Area Advisor" – an amateur from each given area recommended to us by his peers who will act as an interface between the people of his area and the SCRA proper. In that way, we felt that any situation that might arise could be handled a lot faster. The fact that such was being dealt with by an area resident rather than a group of "outsiders from the big city" would tend to bring "vibes" of goodwill rather than help fan the flames. We felt that the only proper way to select such people was to let those whom he or she would be working with make the choice, since only in such a way could that person hope to get the support of all amateurs in his or her area.

Both Jim and myself were elected to the offices we were candidates for, along with incumbent Don Root WA6HJW as Secretary and Warren Andreasen WA6JMM as Treasurer. Jim has already opted to reappoint Tom Rutherford W6NUI as 220 MHz Techical Committee Chairman, but as of this moment has yet to pick a leader to handle the same position for two meters. However, we are proud to announce that the first SCRA Area Advisor's position has gone to Paul McClure WA6HGK in San Diego (on the very strong recommendations of that area's representatives present at the meeting). It's only been three days since the meeting, so we are still waiting to hear the recommendations from Santa Barbara, Ventura County, Orange County, the High Desert, and the Low Desert. By next month, we should have the names of those who will be taking on this responsibility for the areas they reside in.

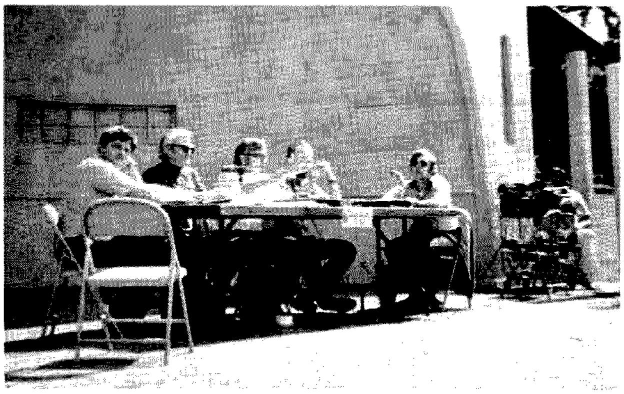
On motions brought from the floor by immediate past Chairman Bob Thornberg WB6JPI, the membership voted to actively seek and implement direct technical committee interface between the SCRA, the Southern California Repeater and Remote Base Association, and the Mexican Coordinating Council, so that each can know what the other is doing and thereby avoid any form of "rf" conflict. The establishment of such an interface only awaits action by these other groups. Fred Deeg K6AEH will be acting as liaison to SCRBBA if all materializes as we hope. A number of people are being considered for the post of Mexican liaison. Again, more on this as it materializes. We also hope to develop direct lines of communication with NARC (the Northern Amateur Relay Council), so that we can work together on any problems common to both organizations. Jim, Don, Warren, and myself have taken on a big responsibility; however, with the help of the technical committees and the overall support of the organization as displayed at the April 2nd meeting, we feel that we can accomplish a lot in building strong repeater and human relations. At least we intend to give it the old "college try."

Special thanks must be given to Bill Carpenter and the JPL Radio Club for the exceptional meeting facilities provided. We met in the Von Karmahn Auditorium at JPL – a place that many of you have viewed on your TV screens during US space missions – and it is, from a technological standpoint, the finest facility that SCRA has access to. There is something special about holding a meeting there, holding a meeting dedicated to the future of amateur relay communication in a place where history was created. A very special feeling of pride.

SUNDAY AND DOCKETS IN THE PARK

21033 . . . 21116 . . . 21117 . . . 21135 . . . RM-2844 . . . RM2839 . . . letters and numbers that hold the future of the amateur service in their collective nomenclature. But, how many hams really know or realize what effect action on any of these will have on his personal amateur career, or on the careers of us collectively. In an effort to educate and motivate interest by area amateurs in just this very thing, a coalition consisting of Alhambra RACES, the Mt. Wilson Repeater Association, and the Amateur Radio Media Workshop sponsored an open format discussion on this topic in Alhambra Park on Sunday, April 3rd. Though hurriedly put together, this meeting was attended by about 70 area amateurs who came to ask questions of such well-known amateurs as Herbert (Pete) Hoover III W6ZH, Bob Thornberg WB6JPI, Lenore Jensen W6NAZ, Al Ogden W6SPK, Don Root WA6HJW, and yours truly. They came because they cared about their own future, and realized that if they were going to air their views on these matters to the Commission, they first had to thoroughly understand exactly what was transpiring in Washington.

They also needed to know what the proper method of filing such responses was, and the intricate why's and wherefore's to include in such responses. They came, they listened to the "experts," they asked questions, and hopefully they went home to file



The panel of experts included (L to R): Don Root WA6HJW, Pete Hoover W6ZH, Chairman Bob Thornberg WB6JPI, Al Ogden W6SPK, and WA6ITF. Not shown: Lenore Jensen W6NAZ. Photo by Chris Williams WB6HGW.

Arriving in style: Pete Hoover W6ZH and XYL with BMW.

Providing audio engineering is the master himself, Bill Orenstein KH6IAF. Photo by Chris Williams WB6HGW.

their own personal views on the pending deregulation and reregulation.

With only two weeks' lead time, it would not have been at all possible to make this a go if it had not been for the efforts of such concerned amateurs as Paul Wirt W6AOP (who procured the meeting site), the ever present and ever available Bill Orenstein KH6IAF (along with his fine Shure Vocal-Master PA system), Orlo Brown K6SUJ (who obtained free use of the dias table and seating), Bob Thornberg (who doubled as event organizer and meeting chairman), and many many others who realized the necessity to both "educate and motivate" amateurs. Although quickly planned, for those in attendance (including a contingent from the SANDRA organization who mobiled up from San Diego, and a duo who flew their Cessna 182 in from up north) it was indeed a success. If they each file a response, it will have been even more of one.

JACK ANDERSON VS. AMATEUR RADIO

Last month I was pretty hard on the ARRL for their failure to act and assume responsibility for the creation of a National Voluntary Band Planning Council. It's now April 5th, and to date I have yet to hear of any positive action in that direction coming from Newington — nor do I expect to hear any in the near future. On this one I hope that I am proven wrong. Come on ARRL, how about surprising us with some positive and quick action on this one!

Now, however, comes an attack upon the ARRL, the FCC and the very structure of the amateur service itself, from none other than the celebrated columnist Jack Anderson. Mr. Anderson writes a widely-read syndicated column for United Feature, 220 East 42nd Street, New York City NY 10067. In this column Mr. Anderson states that in effect it is the amateur service that is holding back the future expansion of the citizens radio service. He goes on to state that from confidential sources and reports, including one prepared for Representative Elliott Levitas of Georgia, he has learned that we amateurs "control" the FCC (ah . . . if only that were true), that the ARRL is a "lobby" for amateur radio (we should only be so lucky), and that we amateurs have "a lock" on the higher frequencies which are interference free (whatever that's supposed to mean). He states that hams control more frequencies than all of the nation's police and fire departments, commercial and educational FM broadcast stations, and TV stations in New York and Los Angeles — *combined!* Well I guess that's true if you count some of the stuff up in the GHz region and light, but tell me, how many QSOs have you had with your flashlight lately, fellow hams? Out here if you stand on your roof calling CQ in CW with a flashlight, the response you get will probably be a police helicopter circling above you with a rather bright light of its own, and a number of police officers on the ground who will want to know why you were up there in the first place and exactly what you were doing.

Anderson claims that FCC Chief Ray Spence has made decisions detrimental to CB. I suppose that if one is in a position of having to enforce the Commission's rules he might be placed in such a position from time to time. However, Mr. Anderson fails to mention that it is the Board of Commissioners, and not Mr. Spence, who makes the decisions around the FCC. In Field Operations, Mr. Spence is only doing his duty to his employer — in this case, the Federal Government in the form of the FCC. Since when is it improper to obey the directives of your superiors, Jack? I'd get fired if I did not follow my bosses' directives!

There is more to this story, but by now it should be clear what the whole thing is about: another attack from CB in the hope of grabbing 220 from us. It was a cruel story, one without any real basis in fact and one that we have heard time and time again. However, I find it a bit hard to hold Mr. Anderson totally responsible, in that I doubt if he has any first-hand experience with either service. I suspect that he thought he had a good story and went ahead with it without bothering to check as carefully into the facts as he should have. Unfortunately for him, this is one that just did not pan out as expected. Even more unfortunately for us, though, this column may well have caused irreparable harm. I sincerely hope that when Mr. Anderson learns the true facts, he will follow up with the kind of story that will punch holes big enough to let all the hot air out of those who would act to discredit the amateur service for the sole purpose of the theft of our spectrum. If anyone can do it, Anderson can. Educate him! The ARRL a lobby for ham radio? We should only be so lucky!

Don't forget to write a letter of education to Jack Anderson. If he gets enough input, and it's the right kind, we just might be able to make a friend of amateur radio out of him — rather than have him as an enemy.

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit		Date (June)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (June)	Time (GMT)	Longitude of Eq. Crossing °W
NA	21155 BTN	1	0138:29	85.8	11630 BQ	1	0030:49	61.0
N	21167	2	0038:25	70.8	11643 8Q	2	0125:06	74.6
NA	21180 BTN	3	0133:21	84.6	11655 BQ	3	0024:26	59.4
N	21192	4	0033:17	69.6	11668 A	4	0118:43	73.0
NA	21205 BTN	5	0128:12	83.3	11680 B	5	0018:04	57.8
N	21217	6	0028:08	68.3	11693 A	6	0112:21	71.4
NA	21230 BTN	7	0123:04	82.1	11705 B	7	0011:42	56.3
NA	21242 BTN	8	0023:00	67.1	11718 AX	8	0105:59	69.8
N	21255	9	0117:56	80.8	11730 8	9	0005:19	54.7
NA	21267 BTN	10	0017:52	65.8	11743 A	10	0059:37	68.3
N	21280	11	0112:47	79.6	11756 B	11	0153:54	81.9
NA	21292 BTN	12	0012:43	64.6	11768 A	12	0053:14	66.7
N	21305	13	0107:39	78.4	11781 BQ	13	0147:31	80.3
NA	21317 BTN	14	0007:35	63.4	11793 A	14	0046:52	65.1
NA	21330 BTN	15	0102:30	77.1	11806 BX	15	0141:09	78.7
N	21342	16	0002:26	62.1	11818 A	16	0040:30	63.5
NA	21355 BTN	17	0057:22	75.9	11831 B	17	0134:47	77.1
N	21368	18	0152:18	89.6	11843 A	18	0034:07	62.0
NA	21380 BTN	19	0052:14	74.6	11856 B	19	0128:24	75.6
N	21393	20	0147:09	88.4	11868 A	20	0027:45	60.4
NA	21405 BTN	21	0047:05	73.4	11881 B	21	0122:02	74.0
NA	21418 BTN	22	0142:01	87.1	11893 AX	22	0021:23	58.8
*	21430 X	23	0041:57	72.1	11906 B	23	0115:40	72.4
NA	21443 BTN	24	0136:53	85.9	11918 A	24	0015:00	57.3
**	21455 X	25	0036:49	70.9	11931 B	25	0109:17	70.8
**	21468 FD	26	0131:44	84.6	11943 BFD	26	0008:38	55.7
N	21480	27	0031:40	69.6	11956 BQ	27	0102:55	69.3
NA	21493 BTN	28	0126:36	83.4	11968 A	28	0002:16	54.1
NA	21505 BTN	29	0026:32	68.4	11981 8X	29	0056:33	67.7
N	21518	30	0121:27	82.1	11994 A	30	0150:50	81.3

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

Tracking the Hamburglar

STOLEN: Heathkit DX40 transmitter, VFI, VFO, SB301 receiver, s/n 6490878, SB401 transmitter, s/n 10346, SB600 speaker. The transmitter was newly constructed and not yet aligned. Taken from my former residence in Lethbridge, Alberta on February 18, 1977. Richard Loken VE4ABV, 1114-666 St. James St., Winnipeg, Manitoba R3G 3J6.

LETTERS

from page 15

the light of all the extra little unneeded gadgets available on present TV and stereo sets. Why not dispense with them and build a really decent set?

The EIA will also say that government is trying to over-regulate the industry. Well, the rules of free enterprise dictate, and quite rightly so, that if a product is not improved, and needs to be, either the public will mandate it, or the government will regulate it. At this point, the public is not sufficiently aware of the significance of this problem. So, we must rely on regulation to do the job. That is why we need S-864.

I said earlier that S-864 would be a "good start." At this point, this bill does not cover such things as TV/FM antennas and antenna amplifiers, both of which are potential RFI sources, not only to the equipment to which they are attached, but to the equipment of neighbors as well – I should like to see S-864 amended to cover such exigencies.

Arthur Reis WB9YUB
Wonder Lake IL

NO CB – ITU

Several of your readers seem worried about the proposed 220 MHz Class E proposal. On page 36 of the January issue of *Wireless World*, a British publication, we read, "As far as the international control of radio is concerned . . . Citizens Band radio does not exist. The countries that operate a service are taking advantage of another agreement made in Geneva that countries may use frequencies allocated elsewhere, provided such use has no effect outside their own borders. It was because of this provision that the FCC had to shelve their plans to introduce a Class E service on 220 MHz. Canada and Mexico said it would interfere with their television services."

This might explain why the FCC is now considering the Detroit-backed plan to use 900 MHz for future CB expansion. It would also explain the extreme actions which the FCC has been considering with respect to linear amplifiers.

I was surprised to learn that the British Post Office controls all the radio communications in England. They have *their own* WARC disaster since the Postmaster General doesn't think that he has to reveal any of his proposals for WARC. If anyone expects expansion of amateur radio frequency allocations, then they should ask, who will make the proposals?

I've been working on my code and hope to go for my ticket soon. It would appear that in the future all amateur radio may be limited to the code, since everybody is looking for more frequency allocations, and you amateurs have such a fine tradition for giving. I can see it now – in 2027, the FCC is permitting microprocessor-controlled SSB slow scan audio with an ERP of ½ kW, except during Family Time, which was only temporarily defeated by the major networks in the late 70s, during which time transmissions shall be limited to 4 Watts input power at 27.185 MHz.

Alan Ames
Quincy MA

WINTER

Whoever coined the phrase, "when the going gets tough, the tough get going," must have had ham operators in mind.

I would like to bring particular attention to the Cuyahoga Amateur Radio Society (CARS, 146.22/.82), of Cleveland OH. I am sure that this past winter will long be remembered by all, and on 1-28-77, winter dealt its final blow, closing airports, roads, and yes, even whole cities. In their homes, vehicles, and at the Red Cross headquarters in downtown Cleveland, were members of CARS, giving their all in an emergency, throughout the long weekend.

The following were active during the 72 hours that the storm whipped through the Cleveland area: K8TIA, WA8EYF, WB8JSC, W8PSX, WA8GEO, WA8YWN, WD8CHL, K8MBV, K8PPZ, K8AJG, WA8DXY, WD8AJJ, WB8LDA, WA8PIW, and WA8NIL. To all others who assisted in the weather emergency, the entire membership of the Cuyahoga Amateur Radio Society (CARS) would like to extend a heartfelt, "Well Done."

William S. Savage WA8GEO
Seven Hills OH

HORSE AND BUGGY

In reply to your request for input regarding use of our HF bands, I would say that I don't have much comment regarding AM because it just seems to have died a natural death anyway. Why forbid horse and buggy rigs after they're gone? There are times when AM is, in my view, justified, even on 20 meters. Take, for example, when a court strips a man of his funds and possessions, and leaves him in deep financial debt and poor health. (Wouldn't such make one at least in mentally poor health?) And don't say that such doesn't happen! I know that it does, from first-hand experience! All after a fellow is too old to make a new start, and too poor in health as well. So if that fellow has some old gear or can scrounge some, AM could be a means of keeping him from going off the deep end, through moping in his troubles. He could get his mind on other matters by yakking with others. Enough of that.

What I would like to propose are a few frequency use changes inside some of our bands. For example, some foreign stations use frequencies above 14.200 for other foreign contacts. The almost universal use of same-frequency transceivers finds many foreign stations above 14.200 in order to work W/Ks (which I don't complain about). But I would much prefer the old method of "split frequency" operation. There seemed to be far fewer pileup situations that way compared to the messes now. I see no way to outlaw transceivers. That is not my thought. My suggestion for a step toward relief is to *ban* US domestic QSOs in certain portions of DX bands, especially when the band is open for DX to at least a portion of the US. Also, because the "foreigns" are allowed in the "US" portion of the bands, why not be reciprocal? Allow W/Ks to use a portion of what is now DX territory for DX contacts only. My example is referenced to 20 meters, but it can apply to 10, 15 or 40m just as well.

Joe Demke W7KCF
Vernonia OR

CA KW

I wanted to tell you about an incident that happened Sunday evening around 4 pm. I have a sick sister in San Diego CA. She is in her middle 30s. I heard a San Diego operator calling someone on schedule. He called for 30 minutes and no contact. This was on 15 meters. I made a quick break-in and asked if he could make a phone call for me in San Diego. He said, "Sorry, old man, I don't have time."

Wayne, I just got my Advanced in November and I do not operate very much, but is this what the amateurs are coming to? This is the type of ham that raises cane when you get 1000 Hertz off his frequency and call CQ. That is what I started to do. I started to wait until he made his schedule, then move 1 kHz and call CQ San Diego. But, I thought, well the ham bands are getting like CB, so I just won't put myself in his class. A typical California kW. By the way, all my folks live in California. When I was there last year when my mother died, I went to visit a ham that had a fantastic antenna setup, but he was too busy to let me see his shack. Probably 6 kW. We sure need some editorials on operating procedures and our responsibilities as hams in emergencies and to our fellow hams. I have been the communications officer for Civil Defense here since 1968 and believe me, it is hard to get enough licensed hams to help. They want the publicity but don't want the work. I bought them all new equipment plus a 2 meter Motorola repeater, Phelps Dodge duplexer, Hal ID, power supplies, you name it. They use the repeater regularly, but where are they when you need them? My CB is more reliable! I now have gone commercial. A complete setup including mobiles and remote base. I intend to get the job done one way or another. I will equip CBers with commercial radios.

I agree this sounds bad, but the hams, of which I am an Advanced class, are bringing it on themselves.

Franklin J. Christian WA4DIU
Johnson City TN

AR VS. CB

Last summer I got a letter from a friend whose husband had just had a heart attack. Because he was temporarily in Calgary, Alberta, her phone number was under another name. It would have taken hours with Ma Bell trying to locate the number.

So I tried amateur radio. A call to the local repeater elicited, "We'll see if anyone has low frequency capabilities." 48 hours later, no phone number.

My own son, 14 and a Novice, was too frightened to originate an emergency message at his minimal 5 wpm. So many kids jumped on him so fast when he first CQ'd that his operating experience had been unpleasant.

So, we joined the local CB club. We are teaching and graduating quality operators into CB, and working road and weather emergencies regularly.

My son and I will be trying for Technical licenses this spring. We won't give up on ham, but it won't be because CB is bad. It will be because we may face our own long distance emergency situation again.

Foncey Taylor KACF8986
Laramie WY

JAMES

James Electronics gives fast service even here in the Western Pacific. I mailed an order to them on the morning of January 9 and I received it on January 16, while at sea, 500 miles from the *nearest* land!

Max Cornell WAØSIG
FPO San Francisco

HOT WATER

The following two letters concern the article "An Automatic Thermostat," by George R. Allen W1HCI, which appeared in the January, 1977, issue. After receiving Mr. John P. McDermott's letter, we asked Mr. Allen for a reply. – Ed.

I just read the article on page 62 of the January issue and must say that it is the biggest mess of error-prone nonsense I have ever seen. The author obviously knows nothing about furnace control systems, and you are

nuts to publish the article without having his ideas verified by a competent furnace installer or technician.

To do what he wants you need two items: a second thermostat identical to the first and a twenty-four hour clock switch that can be isolated from the 120 V ac power line. Most of these clock switches can be dissassembled, and the contact wires disconnected from the line cord and reconnected to bridge the outlet socket. Now you have a clock driven switch through which any reasonable voltage can be passed.

Now mount your new thermostat next to the existing one and wire it in parallel, with one exception. Splice the clock operated switch in one leg of the new installation. The new thermostat becomes the day (or high) controller and the existing thermostat is now the night (or low) controller. Set the "on" tripper for days and the "off" tripper for nights. The furnace will always try to satisfy the highest setting it sees.

Now about hot water zone systems. You need a thermostat and clock for each and every zone. Also watch out with hot water systems. Many use line voltage thermostats. It saves the cost of a motor relay. A word now about what happens in a hot water system.

The wall thermostat controls only the circulator pump, and not the burner. When the thermostat calls for heat, the pump is started. This brings colder water into the boiler bottom as the hot water is pushed out the top. This cooling of the boiler controller causes it to close its contacts and fire the burner. This cycling continues until the wall thermostat is happy and the boiler controller is satisfied.

There are three basic hot water zone types. Two are manifold types and the third is a ring loop. (1) Here the water inlets and outlets are manifolded and each zone has its own thermostat and circulator pump. Quite often these are line voltage thermostats. (2) Here we have the manifolds again, but we use solenoid or motor valves for each zone. This requires a three wire thermostat. The extra wire is used to control the pump. There is only one pump on this system, and it must run as long as there is any demand in the system. (3) This system uses a single pump, a single loop of pipe, and a thermostat and valve for every room. The same three wire requirements apply as in (2) above.

Any three wire system should use DPDT switches to remove the unused thermostat from the circuit. This complicates things, as the clock assemblies for this type of system would have to be handmade. But it could be done, and is probably worth the effort.

John P. McDermott
Stratford CT

Mr. McDermott's comments are in error, with the exception of his description of "three basic hot water zone types."

As a reputable author, I take pride in the accuracy of the articles that I submit for publication. All of the articles that I have submitted for publication over the past ten years have been checked in concept by other authorities prior to submission for publication. This article was no exception. In this case, I checked with a local professional engineer who is knowledgeable in heating systems, and a manufacturer of furnace control systems. Furthermore, prior to installation of the unit on my own furnace, I checked with the contractor who installed my furnace during the construction of my home. These three authorities indicated that my ideas were sound and feasible. They did caution me not to attempt to describe every possible heating system and their resultant variations. They advised me to discuss the two common, simple systems discussed in the article in order to keep the article clear and concise. I therefore must take exception to Mr. McDermott's statement that the article is "error-prone nonsense." Instead, the article was verified by competent authorities.

Mr. McDermott states that, "To do what he wants you need two items: a second thermostat identical to the first and a twenty-four hour clock switch. I suggest that Mr. McDermott reread the article one more time, especially the section entitled "Principles of Operation." Mr. McDermott should also take notice of the schematic in Fig. 1 and the parts list at the end of the article. Upon reviewing the article one more time, Mr. McDermott will surely notice that the clock switch is present (Tork 1101 or Sears models) and is isolated from the power line by the 117 V ac relay. The second thermostat is also present and is referred to as the "night thermostat." Mr. McDermott is in error when he states that the second thermostat must be the same as the first thermostat. The second thermostat must be of good quality, such as the thermostat recommended in the article. In some cases the "on-off lag" of the thermostat may have to be adjusted. The instructions that come with the thermostat will describe any such adjustments if they are required.

Mr. McDermott supplies a sketch and description of an alternate connection for the clock switch. Mr. McDermott's connection will only handle a single thermostat. It will not perform the function as described in the article. Mr. McDermott has supplied this sketch since he has stated that ". . . you need a thermostat and clock for each and every zone." This statement is incorrect. For home heating purposes, only a single, centrally located, "nighttime" thermostat is required. As mentioned in the article, temperature uniformity is not maintained throughout the house when the system is in "nighttime" mode. However, as stated, this is of little consequence.

I regret that the article was necessarily limited to "automatic control" of only two simple, generalized, heating systems. However, time does not permit a discussion of all heating systems and their variations. If the experimenter has a heating system that does not conform to the examples in the article and is unable to adapt the automatic thermostat to his system, he can drop me a note and I will attempt to help via letter.

It should be noted that as of this time there are currently four of these systems operational in my neighborhood. (The first systems have just turned three years old.) All four systems have performed well without problems and have given their owners significant savings.

George R. Allen W1HCI
80 Farmstead Lane
Windsor CT 06095

EXTRA CLASS

I'm taking your advice in the preface of the *73 Amateur Extra Class Study Guide* — drop you a letter when the license arrives! Since instant upgrading is in effect, I don't have to wait.

I'd like to thank you and your technical editors for a truly outstanding study guide. I'm a nuclear submarine officer and have been away from amateur radio for about six years. I picked up a copy of your study guide, studied it over a two week period, and that was that. I especially appreciated your practical examples and informative approach. I truly enjoyed reading the guide — as surprising as that may seem to most.

Also, I just took out a subscription to your magazine. I was impressed by the variety of articles in your January issue. I hope the future issues are as good. Keep up the good work.

Ed Giambastiani WB2CTK
Canasota NY

AMP BAN

The FCC released a Notice of Proposed Rule Making, Docket 21116, on 18 February, 1977. This ominous docket would prohibit the manufacture of any amplifier capable of operation between 24-35 MHz. If adopted as a Report and Order, you will no longer be able to purchase an amplifier with 10 meter coverage. Sunspot activity during the next few years will peak, and the loss of this privilege should be of concern to you, no matter what your license class. Comments must be filed on this docket by 25 May.

In an even more disgusting NPRM released on 18 February, docket 21117, the FCC proposes type acceptance for all amateur transmitting equipment. Type acceptance is an expensive, complicated and slow bureaucratic process. It will increase costs of amateur gear! Costs will double, possibly triple, or maybe even quadruple. Small manufacturers will be forced to close their doors, or abandon the ham market. Comments must be filed by 25 May.

Explaining the need for these new rules, which they acknowledge will punish licensed law-abiding amateurs, the Commission cites increasing abuse of amateur transmitting equipment (currently exempted from type acceptance) by CBers and unlicensed

operators who have taken over the frequencies just below 10 meters . . . or in some cases frequencies in the 10 meter band.

In anticipation of these dockets, the San Antonio Repeater Organization filed a petition for rule making with the FCC before their release. Briefly, this petition, assigned Rule Making No. RM-2839, requests that FCC license equipment dealers of non-type accepted equipment and require proof of a valid amateur operator's license for purchase, with appropriate mandatory fines for violations. Nothing in dockets 21116 and 21117 would stop acquisition of amateur transmitting equipment by non-amateurs. It could then be easily modified to cover 11 meters, or used on our amateur bands by unlicensed operators as it now is. FCC is going to do something about the problem. SARO doesn't want to cause serious loss of privilege or inconvenience to any licensed amateur. Certainly we want new rules to effectively end this problem.

The FCC, in the above dockets, asks amateurs to suggest reasonable alternatives. SARO has, yet pressure is obviously needed so that the Petition RM-2839 will receive the consideration it merits.

Bob Wheaton W5PKK
San Antonio TX

PETITION FOR RULES AMENDMENTS

The San Antonio Repeater Organization, a nonprofit society of amateur radio operators, dedicated to the advancement of Amateur Radio Communications and the preservation of this radio service in the public interest, respectfully requests the Commission to amend Part 97 of its rules to provide for adequate restrictions on the sales of transmitting apparatus and rf power amplifying devices currently exempt from regulation under the equipment type acceptance or type approval programs. We further request that the Commission establish a dealer licensing program for dealers engaged in the sale, lease, trade, shipment and distribution of non-type accepted or non-type approved transmitting apparatus at the retail level, and provide for mandatory penalties for any party, who during or after the original retail sale, delivers or causes to be delivered, any such transmitting apparatus to any individual or group of individuals not in possession of a valid license

authorizing its use.

In support whereof, the following is respectfully submitted:

1. The absence of such regulations has been responsible for the proliferation of variable frequency oscillators, linear amplifiers and other transmitting equipment manufactured and sold as intended for the amateur radio market, and thereby protected by the technicality which exempts such equipment from the type acceptance or type approval programs. Much of this equipment is obviously, by its very design, manufactured and sold primarily for unlawful use outside the amateur radio service bands by citizens band or unlicensed operators. The manufacturers' claims that such equipment is intended for the amateur radio market are a subterfuge to permit circumvention of the Commission's Rules, since it is of little or no value for use by the serious radio amateur.

2. Transmitting equipment manufactured and sold by this devious method of rules circumvention is known, by the Commission and others, to be a primary cause of interference to radio and television receivers operated by the general public, and is known to be responsible for significant interference to lawful users of the citizens band radio service, the amateur radio service and other users of the radio spectrum, notably in the public service, marine, aircraft and commercial services. The vast number of persons using the citizens radio service makes it mandatory that they observe closely the 4 Watt transmitter output, as well as other restrictions in Part 95 of the Commission's rules. Harmful interference to other spectrum users caused by lawful operation of citizens band equipment is almost negligible compared to the disruption to legitimate communications caused by illegal citizens band operators, and the new breed of lawless and unlicensed pseudohams, variously described as HFers, whiskey groups, etc., which utilize both unauthorized frequencies in the 26-28 MHz spectrum and transmitter output levels often in excess of one kilowatt.

3. The Commission's ban on CB linears, effective January 23, 1976, is proof that the Commission is both aware and concerned about the harmful effects caused by equipment intended for illegal use by citizens band operators (Part 95) but manufactured and distributed in circumvention of those rules through the false assertion that they are intended for the amateur radio market, and therefore fall under the protective exemption of the type acceptance and type approval programs. While this ban was intended primarily to end future availability of linear amplifiers for use by citizens band operators, it has been effective only in eliminating the VHF (low band) class "C" amplifiers, marketed by reputable manufacturers, which, due to their non-linear amplification characteristics, were of no value in illegal citizens band use. The manufacturers' circumvention of the rules was made possible through technical advances in amplifier design, permitting them to be successfully broadbanded and therefore outside the jurisdiction of the ban.

4. Clearly, the exemption from the type acceptance and type approval programs of transmitting apparatus designed and manufactured solely for use by radio amateurs has made the job of rules enforcement more difficult. However, in spite of recent statements by Commission personnel, that the Commission intends to investigate the possibility of requiring type acceptance for all commercially manufactured transmitting equipment, we submit that the inclusion of amateur equipment into the type acceptance program would fail to get to the heart of the problem. Conversely, a total ban on all forms of linear or rf power amplifiers, an alternative known to be under consideration by the Commission, would be shortsighted and prejudicial to many lawful and conscientious users, and would also fail to stop the availability of high powered transmitters to unlicensed operators. The amateur transceiver offering a power input of two kilowatts PEP, with 11 meter "receive only" provisions, would simply replace the lower powered versions currently available. Clearly, none of the alternatives mentioned so far would effectively control the problems.

5. Simply stated, the problems are primarily the availability and abuse of amateur radio transmitting equipment, by non-amateurs, for unlawful purposes, and the tremendous interference they cause to other radio services' owners of radio and television receiving devices. Much of this interference must be presumed to originate from transmitters operated by the unlicensed pseudoham operators mentioned earlier.

6. A high level of technical competence is necessary for the proper construction and operation of high powered transmitting equipment. Exemption of amateur radio equipment from the type acceptance and type approval program is evidence that the Commission presumes that amateur radio operators will possess the required level of competence, having so demonstrated by successfully completing technical and operational examinations administered by the Commission. Amateurs have done nothing to warrant a change in the Commission's views on this matter. To the contrary, while few of the citizens band or outlaw pseudohams possess more than a rudimentary knowledge of transmitter operation, and have no reserve of knowledge to draw upon in the event of interference to other services, amateurs have demonstrated the highest level of competence and concern in matters of interference and have formed many interference committees to assist when necessary.

7. To eliminate such abuse by persons not licensed to use amateur radio equipment, to stop unlawful encroachment into the amateur bands, and to secure the amateur's future freedom to experiment and develop new communications techniques while providing valuable public service, we recommend that the Commission abandon all other alternatives, in favor of rules changes which would require a valid operator's license for the purchase of any non-type accepted or non-type approved transmitting apparatus. The licensing of dealers engaged in retail trade, in a manner styled after the federal firearms license, as it applies to retail firearms dealers, is certainly indicated. A point of sale registration should be implemented, with appropriate provisions to make it impossible to circumvent the rules through mail order or export sales. The rules change should empower the Commission with jurisdiction in both the original sale, at retail, and subsequent resale by individuals as used equipment. Mandatory penalties for willful violations are recommended. To preclude continued circumvention, such as the inclusion of a disabled transmitter, sold as a receiver only, and type accepted under Part 15 of the rules, any piece of receiving equipment containing additional circuitry not necessary to perform its stated purpose, or kits of parts for home construction of amateur transmitting apparatus, must be presumed to be operational at the time of sale.

8. We respectfully petition for these rules changes, not because the majority of licensed amateur radio operators are guilty of violating their code of ethics, but as the only effective means to control the commercial greed which has promoted such abuses. It is offered as the only reasonable alternative to the Commission's current consideration of more restrictive rules changes in its effort to resolve these dilemmas. We are convinced that such rules changes would cause a minimum of inconvenience to the lawful pursuits of the amateur radio service, and simplify the Commission's enforcement problems to the extent that new personnel would not be necessary to administer a dealer licensing program. We are hopeful that strong regulation of sales will stop the rash of new state and local laws attempting to deal with the radio and television interference problem, most of which are intended as nuisances only, and usurp the Commission's authority to regulate transmission of radio signals.

Wherefore, the premises considered, the Commission is respectfully requested to issue a timely notice of proposed rule making to amend Part 97 of the rules in the manner petitioned.

San Antonio Repeater Organization

MORE BAN

To the FCC:

This Society of 750 licensed amateur radio operators endorses petition for rule making RM-2839, submitted by the San Antonio Repeater Organization. During board action on 19 March 1977, after hearing reports on Dockets 21116, 21117 and petition for rule making RM-2839, directors voted to endorse petition RM-2839.

In support whereof, the following is respectfully submitted:

1. In consideration of rapid advances in the state of the art, and the amateurs' need to adopt and further develop new communications techniques, it is in the Commission's best interests not to impose type acceptance regulations on amateur transmitting equipment to attempt to control unlawful use by non-amateurs, if more effective means are available.

2. RM-2839 proposes more effective means for the Commission to achieve its goal, without imposing unreasonable restrictions on the licensed radio amateur. The simplicity of enforcing regulations proposed in RM-2839 should appeal to the Commission. Substantial savings in budget and manpower would result, permitting more vigorous enforcement in problem areas.

3. Failure to implement restrictions proposed in RM-2839, or adoption of 21116 and 21117 as reports and orders will perpetuate circumvention by failing to interrupt the supply of equipment easily modified for unlawful use by non-amateurs.

Wherefore, the premises considered, the Commission is respectfully requested to consider RM-2839 as a more effective and desirable alternative for the Commission and licensed amateurs.

Texas VHF FM Society, Inc.
Lawrence S. Higgins W5QMU
President
San Antonio TX

BROADCASTING

Federal Communications Commission
Washington DC

Comments on RM-2830, Rebroadcast of CB and Amateur Transmissions.

As a radio amateur, I am not opposed to the intent of this petition by the National Association of Broadcasters to provide a more direct channel by which radio amateurs and other services may communicate emergency and safety information to the public at large. I am concerned, however, by what I feel is inadequate assurance that such rebroadcasting privilege would not be abused by competitive, commercial broadcasters and their news departments, nor do I see where adequate provision is made to ensure that such rebroadcasts would be made only with the permission of all participants.

I do not feel that it would be in the best interest of the amateur radio service to have broadcast news people monitoring, and recording, our frequencies in hopes of hearing some interesting, "newsworthy" item which they could interpret as pertaining to "public safety and convenience," to be incorporated into a commercially sponsored news broadcast. Neither would it be appropriate, in my opinion, to air a regular "traffic report" or other such regular program originating through amateur radio. Such uses of amateur radio could be construed as commercial, or

pecuniary, in the competitive broadcasting market.

On my second point, I feel that it should be required that a broadcaster obtain consent of all persons whose radio transmissions were recorded or monitored before such transmissions are rebroadcast, keeping in mind that amateur communication usually involves two or more (often many more) stations. In the situation of broadcast personnel monitoring the amateur radio service for news, is it proposed that the broadcaster have an amateur license so that he can operate an amateur station, break in on the conversation, and ask all the participants for their consent to rebroadcast? Or would such rebroadcast privilege be limited only to such communication as emergency traffic networks, where prior consent of the participants could be obtained?

I feel that the NAB petition fails to set forth adequate guidelines for the broadcast industry that would protect the *amateur radio service from* unauthorized or commercial use, and that action to relax the current protection afforded by the regulations should be deferred until such time that the amateur operators have had an opportunity to review and comment on this important matter.

Jerold R. Johnson WA5RON
Austin TX

ASCII

Federal Communications Commission
Washington DC

I have been a licensed radio amateur for over 25 years and have advanced through the ranks from Novice to Extra class. My activities in amateur radio have been of tremendous importance to my vocation. I am Technical Director of a 5 kilowatt directional AM station and a 100 kilowatt FM station with stereo and SCA, and have been recognized as a Senior Broadcast Engineer by the Society of Broadcast Engineers.

I owe much of my success in broadcasting to the opportunities for experimentation and hands-on experience afforded only by amateur radio. One can do very little "experimenting" in the broadcast business; it must be right the first time.

The present state of the art in amateur radio has outmoded the rule allowing only the use of the Baudot code for the transfer of information between amateur stations. Most of the teleprinter machines that use this code are obsolete and repair parts are no longer available from the manufacturer.

The current trend toward the use of microprocessors in amateur radio oriented applications is growing rapidly and appears to be a major step forward. These systems generally use the ASCII 8 level code for information interchange and the use of ASCII on the amateur frequencies would allow greater interchange of experimental information without the necessity for conversion to and from the obsolete Baudot code with the attendant possibility of error.

My position is to support the approval of RM-2771.

Melvon G. Hart WØRV
St. Louis MO

A MICRO OS

I read with great interest the article published in the March, 1977, issue of *73 Magazine* entitled, "Save Time With A Micro OS." The article was submitted by Mickey and Foxy Ferguson of PO Box 11104, Chattanooga TN.

I have put this OS into my system just as it was published. I have checked and double checked to make certain that I have made no mistakes. I find that the block move, the zero memory, the tape write, and the tape read functions all work fine. I have not been able to list a program. I believe that this is due to my not using a PR-40 (I use a teletype located in the control position). The program was written to print out at 800c. I did change this address to 8004 to no avail. I suspect that the PR-40 being a parallel device is the difference. The dump also stops the program, I suspect for the same reason.

Of more concern to me is that I believe that I have found two places that the program jumps to addresses outside of the program. I do not know where they should jump to, and this is the reason for my letter. I believe that as printed the address at location 035F is incorrect, as it jumps to address 0456. Again at address 03B3, the jump is to address 0467.

Could you please advise me of where these addresses should jump to? I would like to use this program, as I think that there is much to be gained from it. I have already used the block move function to advantage in writing some programs. It is very handy when I forget something — I can move the program down and insert what I have left out.

I would also like to encourage the author to write up another article to tell what he did for the PROM that he is using in his system.

Jack A. Inman
Covina CA

May I begin with an apology to Mr. Inman (and all others fortunate enough to have a hard copy device for their control terminal). I should have included the necessary information in the article on moving the dump and list functions to the control terminal. This is quite easy to do, as only a single change to the OS is required Change the three bytes beginning at $01EA to $7E E1D1. Also, if the device that you have at the control terminal can print sixty-four (or more) characters per line, you may wish to change the byte at address $01AD from $08 to $10, as this will print sixteen bytes per line instead of the eight bytes per line required by the short (40 character) line length of the PR-40. I might add that several improvements have been made to the operating system since the article was submitted to 73 (is any piece of software ever really completed?). If anyone cares to have them, send me an SASE and I will send you a copy of these improvements.

I would also like to add that the dump that was published with the article is correct as published. If you have difficulty in getting any function to run, I would suggest that you recheck the contents of your computer's memory against the memory dump in the article. To answer Mr. Inman's question about the program branching outside itself, it does not. In Mr. Inman's first example (adr. $035E, instruction $26 F6), the $26 is a branch not equal instruction and the $F6 is the offset. In the M6800, this offset byte is a signed number, which can perhaps be summarized as follows: If the most significant bit of the offset byte is a zero, then the branch is forward; if the most significant bit of the offset byte is a one, then the branch is backward. So, instead of branching forward by $F6 bytes to address $0456, it actually branches backward by $0A bytes to address $0356. This (branching backwards) also applies to his other example, which is a $26 B3 and branches backwards to address $0367.

In response to Mr. Inman's question about my PROM board, I must admit that I have been too busy to do it as yet — I'm still using the OS in RAM memory. But several good PROM boards for the SWTPC M6800 computer are available from MSI (Midwest Scientific) and Smoke Signal Broad casting. I would encourage all those who have written and called me about this to check these two sources. — M.F.

10M CB

I have been giving some thought to the idea of using modified CB rigs on 10 meters and I feel that if an across-the-board shift of +2.440 MHz were made, it would provide the perfect "band plan."

Some of the benefits I can see for the amateur service through this type of conversion are — (A) make amateur radio more attractive to prospective hams, now CBers, by providing them with a low cost means of getting on the air after they have passed the amateur exam; (B) encourage more prospective hams and Novices to go for the General class as soon as possible and not stagnate (as I did) as a Technician for years; (C) provide relief for the congestion on 2m FM in major metro areas; (D) provide an alternative to 2m FM for "rag chews"; (E) provide effective inner city mobile communications without high rental repeaters; and (F) protect, by use, the upper reaches of 10 meters.

Ralph E. Delligatti
K3CMY/WB3AUM
17651 Amity Dr.
Gaithersburg MD

The response to CB-10m conversions has been encouraging. We presently have several articles in production describing the process with several different types of CB radios. If anyone has completed a conversion, write it up and submit your work to 73. Don't keep all that originality to yourself! I wonder if anyone has modified one of the CB base or mobile antennas for 10 yet. — Ed.

Ten Meter Band Plan For Converted Citizens Band Transceivers

CB Freq.	Channel #	Amateur Freq.*	Notes
26.965 MHz	1 or A	29.405 MHz	1
26.975	2 or B	29.415	1
26.985	3 or C	29.425	1
27.005	4 or D	29.445	1
27.015	5 or E	29.455	1
27.025	6 or F	29.465	1
27.035	7	29.475	
27.055	8	29.495	
27.065	9	29.505	2
27.075	10	29.515	
27.085	11	29.525	
27.105	12	29.545	
27.115	13	29.555	
27.125	14	29.565	
27.135	15	29.575	
27.155	16	19.595	3
27.165	17	29.605	3
27.175	18	29.615	3
27.185	19	29.625	3
27.205	20	29.645	3
27.215	21	29.655	3
27.225	22	29.665	3
27.255	23	29.695	3

Notes:
1 — Shown alphanumeric since many transceivers of six channels are shown either way.
2 — Since many CB sets came with channel 9 or have had it installed, this would be a good choice for a National Calling Frequency.
** — OSCAR enthusiasts should not be hampered nor should any other more exotic modes be annoyed if these converted rigs were to be used without any amplifiers.*
3 — These could be used, via a gentleman's agreement, strictly as local "rag chew" frequencies.

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Nanticoke PA 18634

Two Meter Scanner

-- for the IC-230

After fighting a continuous battle with crystal manufacturers to get delivery of crystals for the local repeaters, I decided to take the big step and go synthesized. A review of the synthesized rigs available at that time resulted in the purchase of an Icom IC-230 which was on display at a ham radio outlet near a hamfest I was attending.

The rig seemed to have all the features necessary for efficient 2 meter operation: coverage of all standard repeater and simplex frequencies, 10 Watts output, plus or minus 600 kHz transmit capability from receive frequency (the receive frequency is set up on the front panel), and helical resonators for increased receiver selectivity. The latter feature proved invaluable when a new repeater came on in the area and the locals began having intermod problems when it and the other strong local repeater were on at the same time. I found that the IC-230 completely solved my intermod problems. The only problem I had now was that with my previous base setup, I had incorporated a scanner built into the rig to monitor four of the local repeaters plus 52 simplex. When I sold it, I lost my scanning capability, which I sorely missed.

At first the thought of a system that would enable me to scan a synthesized rig seemed like a formidable electronic feat. However, upon closer inspection of this little beauty, it seems that Icom has done most of the work needed.

Brief Operation of the IC-230

The received frequency is converted to the 10.7 first i-f by being heterodyned against the sum of the frequencies generated by the LO and CO oscillators in the phase locked loop section of the rig. For example, when receiving 147.21, the LO frequency is 13.916 MHz, multiplied by 9 internally, or 125.245 MHz, and the CO frequency is 11.265, for a total of 136.51 MHz. The difference between the 147.21 MHz receive frequency and the 136.51 phase locked loop frequency is the i-f frequency of 10.7 MHz. Refer to Fig. 1 for determination of LO and CO frequencies for the receive frequencies desired. The black areas are frequencies available. Fig. 2 is a basic block diagram of the receiver and should give you better insight into the operation of the receiver.

Fortunately, in the phase locked loop section, Icom has thoughtfully provided a switch position ("V" on the 10 kHz switch) which disables the internal CO oscillator and uses it as a buffer for an external VFO. The input to this position is available on a nine pin accessory socket on the right side of the unit. This is meant to be used with a VFO between 11.255 and 12.255 MHz and will cover 146 to 147, or 147 to 148 MHz, depending upon which switch position the MHz switch in the upper left hand corner is in. As a matter of fact, of the connections needed for a successful scanner attachment, i.e., rf injection, ground, plus 12 volts, ptt line access, and squelch access, only the squelch access is not already available at the accessory socket. This, however, is quickly remedied by a 10 minute modification to the transceiver which requires no defacing of the unit and is completely reversible in even less time. This will be described shortly.

Armed with the knowledge of how the unit works and what points are available, it seemed the easiest approach was to build an external oscillator which injected the proper frequency into the CO buffer to enable monitoring of the frequencies of my

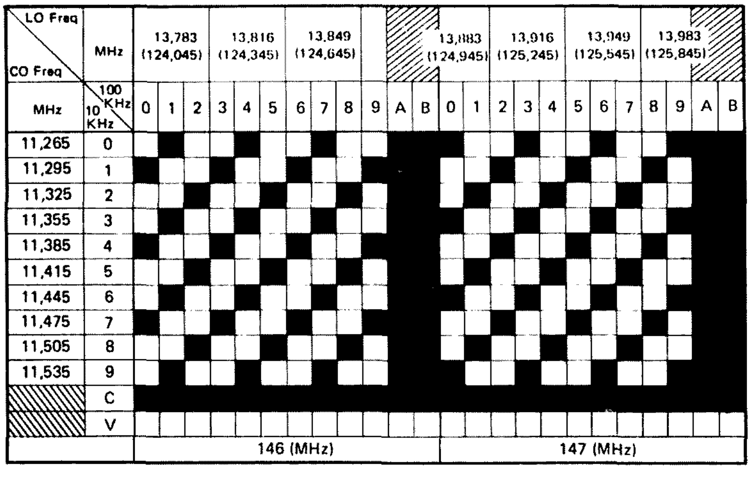

Fig. 1. LO and CO frequencies for receive frequencies desired.

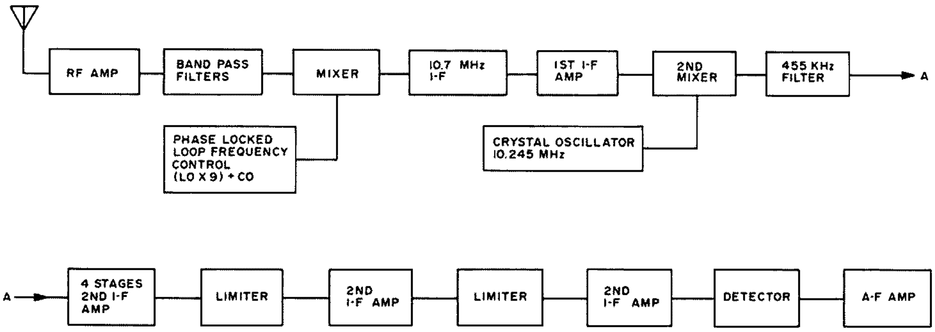

Fig. 2. Receiver block diagram.

choice. With the MHz switch in the "146" position and the 100 kHz switch in the "9" position or, alternately, the MHz in the "147" position and the 100 kHz switch in the "1" position, the LO frequency selected is 13,849 x 9 or 124.945 MHz. To determine the CO injection frequency needed: F = frequency to be monitored minus 124.945 minus 10.7. For example, crystal needed to monitor 146.94 would be 146.94 minus 124.945 minus 10.7, or 11.295. Using one of these switch positions enables you to monitor 146.5 to 147.5 MHz covering simplex and repeater outputs. Using the above formula, the crystal frequency for 146.52 works out to be 10.875 MHz, which is below the 11.255 range for external CO input specified by Icom. However, both IC-230s I own operate very well at 52 anyway.

An added advantage is the capability to scan transmit and receive with a single crystal. There is one thing to watch: When the scanner stops on a particular position, you must notice whether it is a 146 MHz repeater, a 147 MHz repeater, or a simplex frequency, and move the offset switch (located on top of the unit) accordingly or the toggle switch to "direct" for simplex. Transmit and receive scan capability is possible with a single crystal because the CO and LO oscillators are common to the transmitter and receiver.

IC-230 Modification Steps

1. Remove bottom cover of IC-230.

2. Locate two small coaxial cable center conductors connected to pin 9 of the accessory socket, unsolder from pin 9, solder together, and tape. This removes a "CO output" point from the accessory socket.

3. Run a wire from pin 9 of the accessory socket to pin 14 of U4E, the AF board. The AF board is the third compartment from the rear. With the rear of the set facing you, pin 13 can be located just to the left of center and is the only pin on the board without a wire connected to it. It is the squelch test point and will be used to obtain the signal which stops the scanner.

The scanner can be built on a piece of vectorboard and parts layout is not critical, but keep in mind good building practices, including keeping all leads as short as possible. Fig. 3 shows the scanner schematic.

Circuit Description

IC1, a 7414 TTL IC, is a hex Schmitt trigger. Since the squelch voltage of the IC-230 rises and falls relatively slowly, a Schmitt trigger is needed to process that signal to provide an output with a sharp rise and fall time for positive starting and stopping of the scanner. Q11, in conjunction with R1 and C1, provides a time delay to hold the scanner on frequency for a short while after the carrier drops. With the values shown, the delay is approximately 5 seconds. The time delay can be increased by increasing the value of C1 or decreased by decreasing C1.

IC2 is connected as a clock which provides the pulses that tell the scanner how fast to scan. Scan rate can be increased by decreasing the value of C2 or decreased by increasing its value. A word of caution: Increasing clock speed too fast will result in the IC-230 not being able to "lock on" to the externally generated frequency and only sporadic scanning of some channels will be realized.

IC3 is a decade counter which counts the input pulses and presents them in binary form at pins 8, 9, 11, and 12.

IC4 is a BCD to decimal decoder which takes the BCD output of IC3 and converts it to decimal form, bringing the lines connected to pins 1, 2, 3, 4, 5, 6, 7, 9, 10, and 11 to ground one at a time, lighting each LED in sequence and, at the same time, turning on Q1 through Q10.

When Q1 through Q10 turn on, they activate one at a time Y1 through Y10, which generate, in conjunction with Q12, the frequencies needed by the IC-230.

IC5 is a simple regulator which supplies the IC circuitry with 5 volts from a 12 volt source.

If 10 channel operation is not desired, 2, 4, or 8 channel operation can be had by ungrounding pins 2 and 3 of

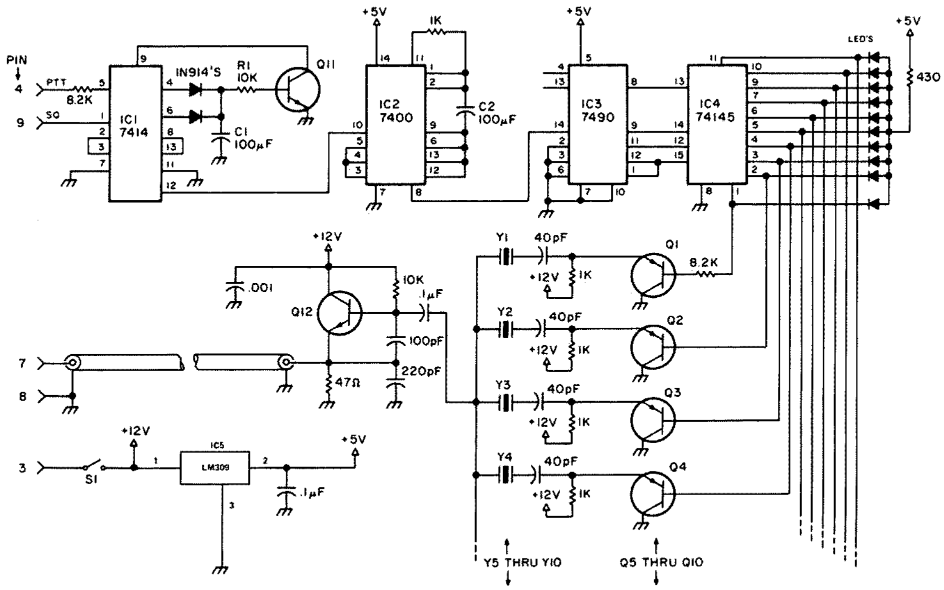

Fig. 3. Schematic. Q1-Q10 — 2N3638 or equiv.; Q11 — 2N2102 or equiv. (any NPN silicon); Q12 — 2N2102 or equiv.; Q13 — 2N3055 or equiv.

IC3 and tying them to pins 9, 8, or 11, respectively. Five channel operation can be accomplished by tying together pins 1 and 6, 2 and 7, 3 and 9, 4 and 10, and 5 and 11 of IC4. Of course, you would only use the amount of transistors and associated circuitry needed to scan the desired number of channels. For example, if only 5 channels are required, omit Q6 through Q10 and components connected to their base and emitters.

Operation

Set "MHz" switch to "146", the 100 kHz switch to the "9" position, the 10 kHz switch in the "V" position or, alternately, the MHz switch in "147", 100 kHz switch in "1", and 10 kHz switch in "V". You will note that the meter light is out, indicating that the IC-230 is not getting a CO oscillator frequency.

Turn on S1; the scanner should now scan and the meter light will be on. If a channel is active, the scanner will stop on that channel. It will begin scanning again after a five second delay when the repeater goes off. If you wish to transmit on a frequency on which the scanner has stopped, simply check to be sure the A-B switch is in the proper position for the repeater you are listening to, or the on-off switch is in "dir" for simplex operation. Simply key the mike button to communicate on that frequency. As stated before, transmit and receive frequencies are scanned simultaneously using one crystal.

Crystal Ordering Information

This circuit will work well with International Crystal Manufacturing Co. catalog #031300 crystal or equivalent. Price is $4.25. The only possible disadvantage might be the physical size. These crystals are the HC6/U type and not the type you normally find in 2 meter equipment. ■

Try the Mini-Timer

-- prevents HT timeouts

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Brooklyn NY 11218

The necessity for a timer on repeaters to limit the length of individual transmissions has generated several circuits that the individual ham can use to avoid timing out. None of those that I have seen, however, were appropriate for my purpose, which was to limit my monologues from the car with my Midland hand-held. I wanted a "time out" circuit that would fit entirely in the HT, draw little current, give a loud warning, and not otherwise affect the operation of the rig. The circuit in Fig. 1 fits all these criteria and in addition is cheap and easy to build.

Circuit Description

IC1 is an NE-555 connected as a timer. C1 and R1 determine the timing length. With the components pictured, the timing cycle is about 90 seconds. A small trimpot would give considerable variation above and below this. With pins 2 and 4 connected together and at ground potential through the 10,000 Ohm resistor, the timer is inhibited. Point A is connected to any part of the T-R switch that goes from neutral or ground potential on receive to 12 volts on transmit. When this happens, the timing cycle begins and, unless reset, will eventually go on to time out, causing pin 3 to go to ground. This in turn activates IC2, which is connected as an astable oscillator at about 1000 Hz. Its output drives the transceiver's internal speaker directly through a capacitor. The output is loud enough to be easily heard within a room or car. The tone will sound until the mike button is released and then it resets.

The circuit draws 7 mils on standby and 50 mils when sounding off. I found that I could eliminate all current draw on receive by connecting the points C and A together, therefore only supplying voltage to the unit on transceive. However, when this was done, the oscillator would occasionally go off when the mike button was pressed. Some fiddling with the circuit would probably correct this if the 7 mil draw is unacceptable.

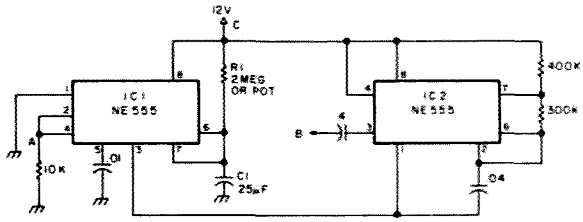


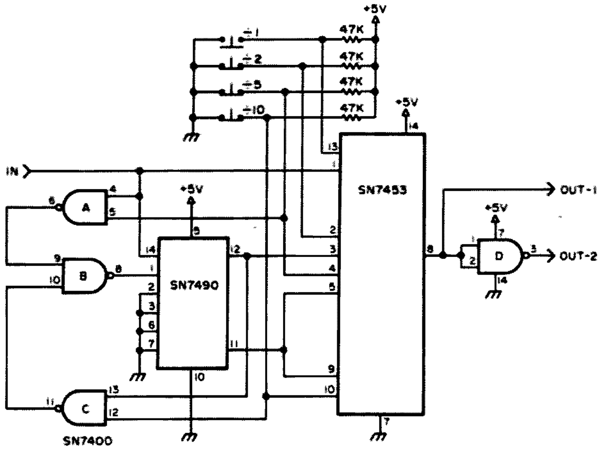
Fig. 1. The Mini-Timer.

Two additional points: The unit will sound for about ½ second when the set is turned on, confirming the operation of the timer. I have also noticed that when my batteries begin to run down, the timer begins to emit chirping sounds on receive. I find this a convenient signal to recharge.

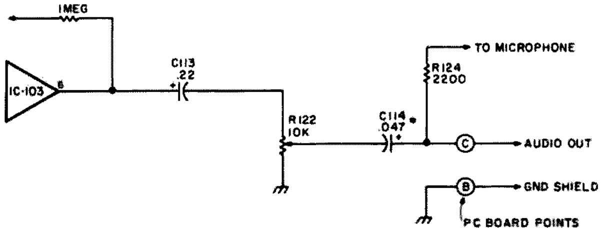
Any construction method will do and none of the component values are critical except the voltage tolerance of the caps. An NE-556 (double 555) cannot be used since both ICs share a common ground and this obviously won't work in this circuit. ■

Circuits²

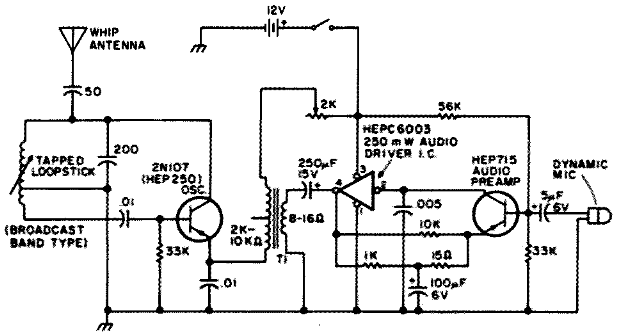
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice. Just be sure to specify which book you want. OK?



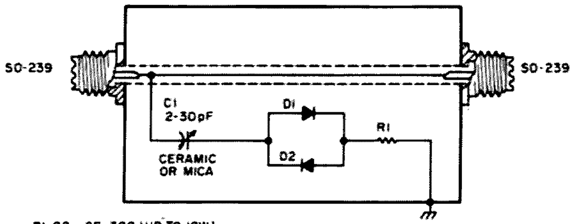
This circuit permits an input square wave to be divided by one, two, five, or ten, depending on which switch is in the open position. The signal at "OUT-1" will be inverted and the signal at "OUT-2" will be non-inverted with respect to the input. Thanks to Eric Grabowski WA8HEB.



Here's a way to match the Heath HD-1982 Micoder to low impedance transceivers. To get around the Hi-Z condenser mike supplied with the Micoder, substitute a 15k ¼ Watt resistor for C114 (.047 uF) capacitor in the audio output circuit. This mod has worked with the Midland 13-505 and Wilson 1402 SM HT. You may have to experiment with different values to find the right match for your transceiver. Thanks to W8FX.



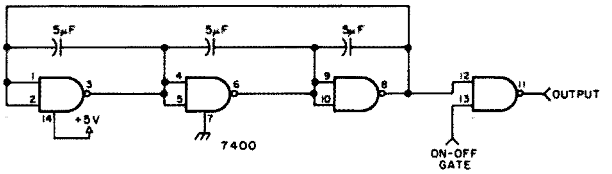
Here's a 1-2 MHz broadcaster transmitter. T1 is a low impedance output transformer, 5000-8 Ohms. Thanks to WA5RON.



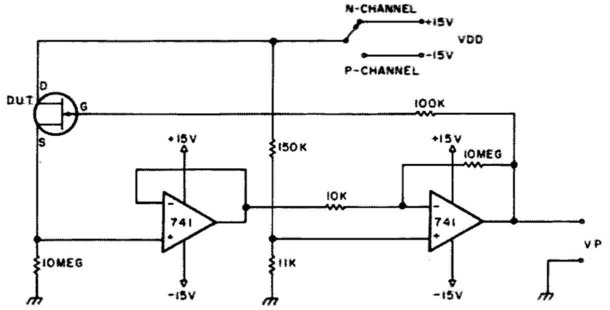
D1, D2 - GE-300 (UP TO 10W)
GE-511 (OVER 10W)

R1 - 50 OHMS OF NON-INDUCTIVE RESISTANCE (5) 250 OHM 2W 5% TOLERANCE CARBON RESISTORS (10W TOTAL)

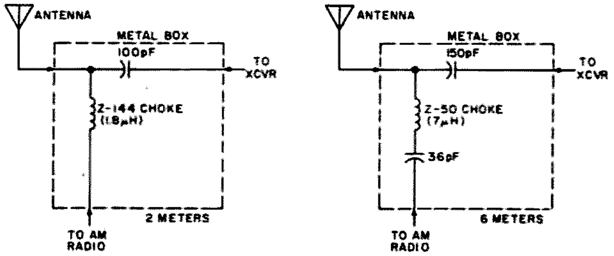
An attenuator useful on all of the amateur bands, but designed with 2m in mind. Capacitor C1 couples the appropriate amount of rf to switching diodes D1 and D2. D1 and D2 conduct only on transmit and pass the rf on to resistor R1. The attenuator is constructed in a minibox sized 3-1/4 by 2-1/8 by 1-1/8. Note that C1 can be mounted using a stiff piece of wire or a terminal strip. All leads should be kept at minimum length. Rf is present on both sides of C1 and must be insulated from the chassis. A small hole can be drilled in the box so C1 can be adjusted using an insulated shaft alignment tool. Thanks to Donald Bohm WB0FLG.



An audio oscillator from a 7400 TTL chip. The output waveform is a sawtooth and will drive other TTL devices. With the values shown, the frequency will be about 800 to 1000 Hz. Thanks to K7HKL.



A very simple circuit for measuring JFET pinch-off voltage. It's particularly handy when trying to match field effect transistors of the same generic type. The circuit also makes it easy to measure the bias range of an FET. The op amps sense the source current of the FET via the first 10 meg resistor. The first 741 is a buffer; the second 741 is preset to 1 volt and its output drives the device under test (DUT) until the source current equals 100 uA. This voltage then can be easily measured with a VOM or VTVM. All resistors are 5%, ¼ W. The polarity for Vp will be opposite with respect to VDD, which is correct since Vp is the reverse bias cutoff voltage. The cutoff current is set for approximately 100 uA. Thanks to Gerry Gannon, Phoenix AZ.

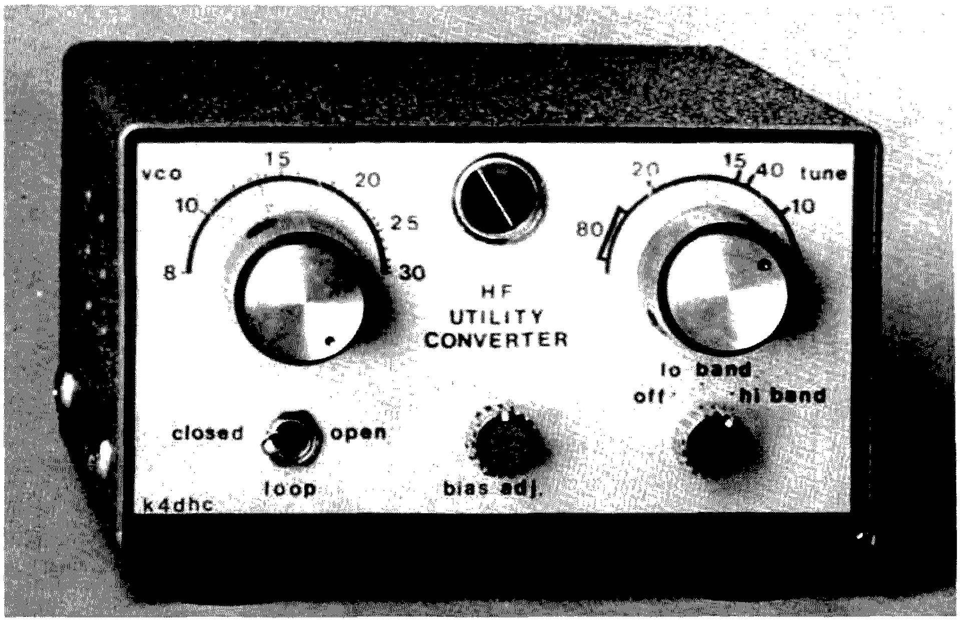


If you're thinking about a disguised antenna system to ward off the Hamburglar, this pair of circuits may be for you. Thanks to K0HZI.

Ray Megirian K4DHC
606 SE 6th Avenue
Deerfield Beach FL 33441

High Frequency Utility Converter

- - handy test rig for any shack



The completed converter mounted in its cabinet.

The simple little HF converter to be described here was constructed out of desperation as well as components normally associated with such things. The utter frustration of not having a converter available to check a new i-f system or the wrong crystal for the right band finally drove me to the brink of a bottomless pit over which, but for the solution shown here, I should have perished.

I did a lot of searching through my collection of magazines to as far back as 1964 to come up with a combination of circuits I thought would solve my problem. The result is a circuit requiring but one crystal and no complicated band switching. It will tune to any frequency from 3.0 to 30.0 MHz and convert it to almost any i-f frequency while employing just three transistors and one IC. You can't beat that with a stick.

Basically, the converter is nothing more than a dual gate MOSFET mixer with a tuned input circuit on gate 1 and a stable conversion oscillator signal on gate 2. The tuned circuit is a multiband tuner which covers the 3.0 to 30.0 MHz range without switching.[1,2] The oscillator portion employs a VCO which is tuned over the range of 8.0 to 30.0 MHz and can be phase locked to a 1 MHz crystal for stability and accuracy. Several articles on phase locked local oscillators have been published and all I had to do was take my pick.[3,4] Of the two I studied, the latter by Kenneth Robbins W1KNI was

more up-to-date and required fewer parts. I simplified it even more by eliminating some sections not absolutely necessary for a piece of gear that was to be used primarily for testing purposes.

Converter Circuitry

Fig. 1 is the schematic for the converter. Two of the gates contained in an SN7400N TTL IC are used as a crystal oscillator. The remaining 2 gates are used as buffers and are fed in cascade by the crystal oscillator output. Pulses from these last 2 stages are coupled into a pair of detector diodes, D1 and D2, which at the same time are modulated by output from the VCO. The signal from the detector is amplified and filtered by Q1 and associated circuitry to produce a control voltage for tuning diode D3.

In the original article, an agc circuit was included in the VCO section to maintain constant output. I found the oscillator was quite flat over the range I was operating, so the extra leveling circuits were eliminated. An IC buffer between the VCO and the detector and another between the VCO and external circuits were likewise omitted.

As in the original circuit, an adjustable bias is applied to Q1 to keep the collector at the desired operating point of 6 volts. This occurs when .5 mA flows in the collector load resistor. A 1 mA meter was used in the original article as an indicator for setting the bias. I substituted a battery status indicator with a 200 uA movement and shunted it to read 1 mA full scale. A place is provided on the PC board for mounting a shunt if you follow a similar plan. An audio output monitoring point is also available on the PC board if audio monitoring of phase lock is to be used, as was done in the original article. I found it adequate to use the meter for indicating lock.

The mixer is mounted on the same board with the PLL circuits and makes use of a type 40673 transistor. The multiband tuner assembly is mounted separately, as is the tuning capacitor for the VCO. Output from the mixer is untuned with an rfc forming the drain load element.

Construction

The majority of components are mounted on a PC board 2 inches wide and 3.8 inches long. The 2 variable capacitors, the bias pot, the meter, the antenna transfer switch, and the loop interrupt switch are all panel-mounted. The PC layout and artwork for the board I used are shown in Fig. 2.

The variable capacitors for the VCO and the tuner were identical. They had been liberated from transistor radios and were of the solid dielectric type. Each had 4 gangs with 2 sections of 130 pF and 2 sections of 20 pF each. I used the 2 large gangs for the multiband tuner and tied all four sections in parallel for the VCO. Most of the variables of this type do not have gangs of equal capacitance, so you may have to do a little experimenting with whatever you come up with in order to cover the range you want. The VCO is dependent solely on total capacity to determine its operating range, so look for units with plenty of capacity if you wish to cover a wide range. If you are forced to use a capacitor with unequal sections or values different than those used here for the tuner, some pruning of inductors will be necessary to cover the desired range. The low band inductor can be installed first across the larger of the 2 gangs and the response checked to see if it will resonate at the lowest frequency you require. If not, either add or subtract turns until it hits on frequency and then do the same for the high band coil. If either of the tuning capacitors you are using has integral trimmers, set them all to minimum and leave them there.

L1	15 turns #26 on T37-6 toroid. Tap 3 turns from cold end.
L2	36 turns #28 on T37-6 toroid. 2 turn link over center of main winding.
L3	35 turns #30 on T44-2 toroid. 2 turn link over center of main winding.

Table 1.

Total operating range of the VCO will naturally depend on the value of variable capacitor used for tuning. Mine had a total capacity of about 300 pF at full mesh and less than 10 pF at minimum. The operating range was approximately 8.0 to 30.0 MHz. This can be altered as desired by varying the value of LI, the size of the tuning capacitor, or both. Since I used this converter for bands above 80 meters and fed it into a tunable i-f of 3.5 to 4.0 MHz, the above-mentioned range was quite suitable.

It should be pointed out that standard air variables could be used for tuning if space is not a problem. In any case, some sort of vernier drive will be needed, especially for the VCO. In order to connect a drive to the capacitors, some sort of shaft extension is needed. I accomplished this with a 4-40 headless set screw 3/8" long and a 1/4" round fiber spacer with a center hole threaded for a 4-40 screw. A 4-40 tap was run into the existing hole in the capacitor rotor shaft far enough to take about a third of the set screw. The spacer was then threaded onto the

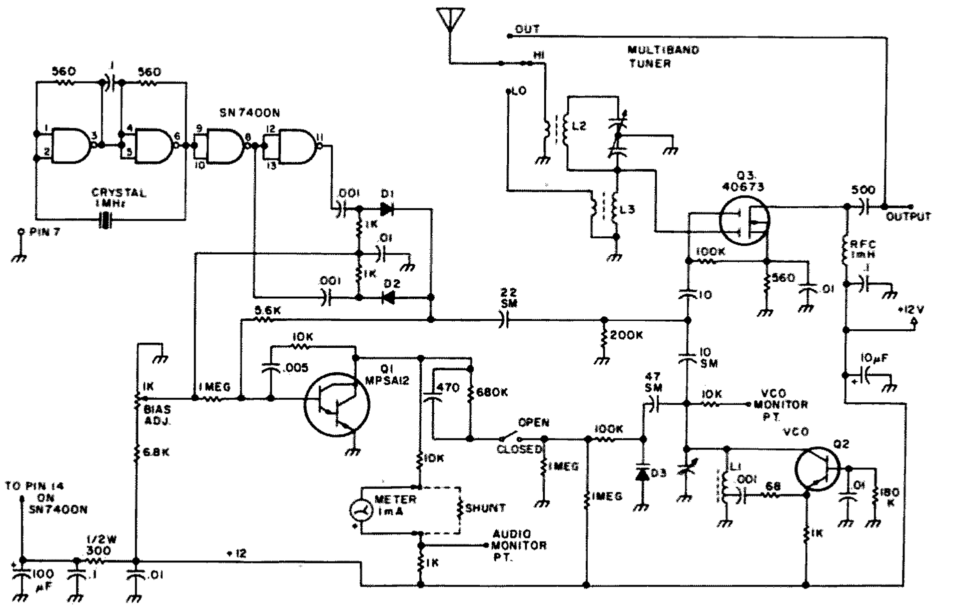
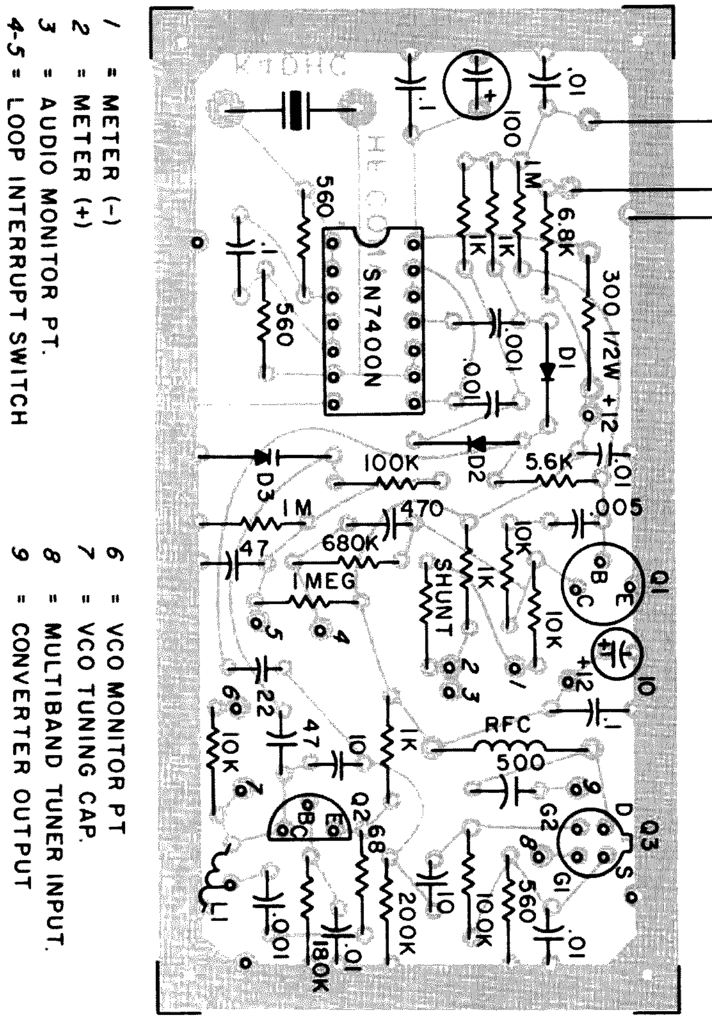


Fig. 1. Schematic for the converter.



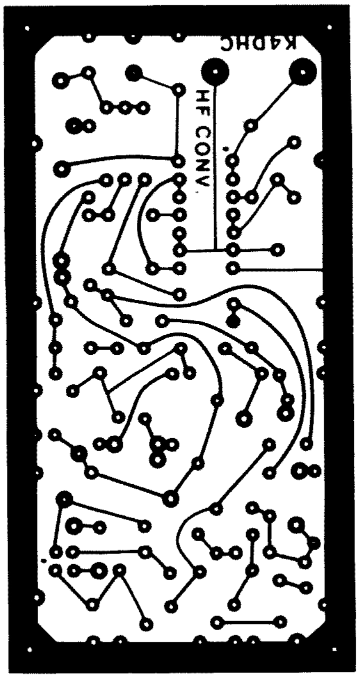


Fig. 2. Artwork for the PC board and component placement drawing.

remaining portion of the set screw to form a perfect 1/4" shaft. These extensions can be seen in the photo.

L1, the VCO inductor, is mounted on the PC board. L2 and L3 are wired directly to the terminals on the associated tuning capacitor with L3 cemented on top and L2 cemented to the back. Connections between the variable capacitors and pads on the circuit board can be made with bus wire for rigidity. Other connections can be made with ordinary hookup wire.

A copy of the front panel layout I used is shown in Fig. 3. The 2 vernier drives were miniature 10:1 planetary types by Jackson Bros. and were built into a standard 3/8" bushing. The pot, toggle switch, and rotary switch were all of the miniature variety so as to fit into the limited panel space. The battery status indicator used as phase lock meter was 1/2" in diameter. The cabinet was a Radio Shack 270-252.

As for choice of components where not specified, I used a pair of germanium diodes of unknown caliber for D1 and D2. The popular silicon 1N914 should work well here too. For the tuning diode, D3, an epoxy "bullet" rectifier diode worked best. Here again, there is room for experimenting and you might even want to try a real varactor diode if one is available.

The PNP VCO transistor I used was house numbered so I don't know the type, but just about any high frequency unit should be satisfactory.

All resistors are 1/4 Watt except the 300 Ohm dropping resistor which supplies power to the SN7400N IC. This is a 1/2 Watt unit.

The coil data provided in Table 1 is that used here. As mentioned earlier, these specifications will vary with the type of tuning capacitor used. The inductors are all wound on toroids and I used what I had available. Some substitutions as to mix and size can be made to harmonize with the inventory in your junk box.

Operation and Adjustment

Calibration of the VCO dial and the tuner dial are the first things to be done. I used a signal generator to feed into the tuner and observed resonance on a high frequency scope connected to the output. Not everyone has such a scope, so a high impedance detector and a meter could be substituted. Another method suggested in the original article was to place the tuner in series with the antenna input of a calibrated receiver, and the null in receiver response would indicate resonance of the tuner at the frequency indicated on the receiver. By whatever means you choose, mark off the frequencies of interest to you for both the high and low bands on the tuner.

Pad 6 on the PC board is a VCO monitor point. Here again, I used my scope to check frequency, but when this is not possible, a counter might be used or a well-calibrated receiver. The turns on the inductor may be spread or bunched together in order to shift the operating range of the VCO a fair amount if needed. When you finish calibrating, it would be best to cement the coil to insure stability.

A regulated power supply should be used to provide the operating potential of 12 volts. It might also be a good idea to check the voltage level

at pin 14 of the SN7400N to make sure it is between 5.0 and 5.5 volts. Some ICs may draw more or less current than others and require a different dropping resistor.

One consequence of operating a VCO over a broad frequency range is the drastic change in the ratio of varactor capacitance to tuning capacitance which occurs as the circuit is tuned over its operating range. At low frequencies, the diode capacitance is swamped by the variable capacitor, and hence the diode has very limited control over the frequency. At the high end, the diode dominates the tank circuit capacitance and exerts far more influence over resonance than the tuning capacitor. All this means is that at the lower frequencies, lockup is far more subtle and requires careful adjustment, while at the high end, just the reverse is true. The VCO snaps in with a vengeance on the higher frequencies. Lockup can also occur at fractional intervals and such points become more pronounced as frequency is increased.

During actual operation of the converter, the technique employed for setting the VCO is quite simple. First set the VCO to the desired frequency with the loop open. Adjust the bias for mid-scale reading on the meter and close the loop. Carefully search for lockup around the desired frequency. As you get close, the loop will capture the VCO and the meter will make a rapid excursion either up or down. Once lockup occurs, the meter will follow any slight tuning shift of the variable capacitor. You can also tell by listening to the receiver whether or not the VCO is locked. If you are operating on a whole number frequency, a birdie will be heard at any whole number dial setting of the receiver. If phase lock has not occurred, you'll hear all kinds of birdies up and down the band. Don't forget to check the bias whenever changing VCO frequency.

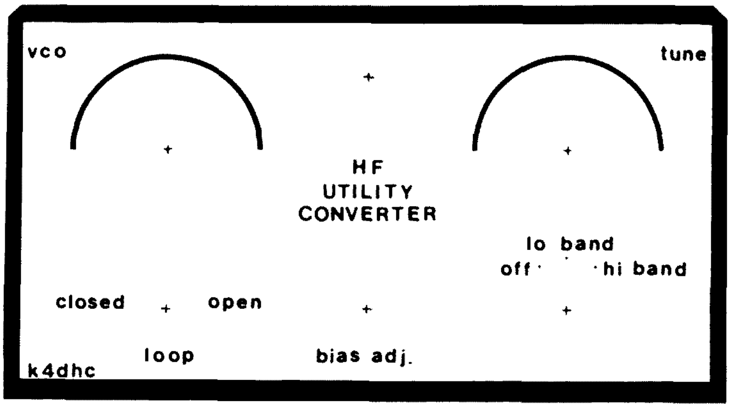


Fig. 3. Full size front panel artwork for the author's model.

With my 3.5 to 4.0 MHz tunable i-f, I set the VCO to 11.0 MHz for reception of the 40 meter band. For 20 meters, I have a choice of either 10.5 or 18.0 MHz. For 15 meters, either 17.5 or 25.0 MHz can be used. For 10 meters, I set the VCO to the low side since my unit stops at about 30.0 MHz. Since operation of both the VCO and the tuner is continuous between the abovementioned ham bands, you can set things up to listen to any portion of the spectrum in between.

Just for kicks, I found I could lock the VCO at 23,250 MHz and tune the CB band from 26.75 to 27.25 MHz using my 3.5 to 4.0 MHz i-f.

Conclusion

As I've tried to point out, I consider this converter more of a tool or test instrument than any kind of permanent receiver accessory. As such, it has no rf stage, the selectivity is limited, and no measures were taken to reduce spurious signals. You will find fairly strong birdies every MHz on the receiver and, if the VCO is set at a fractional frequency, it will cause a corresponding birdie in the receiver. For real serious listening, a more practical approach would be called for, including shielding, filtering, and an rf stage with bandswitching. Just the way it stands, however, I've gotten more use out of this gadget than any other tool on my bench. Have fun! ■

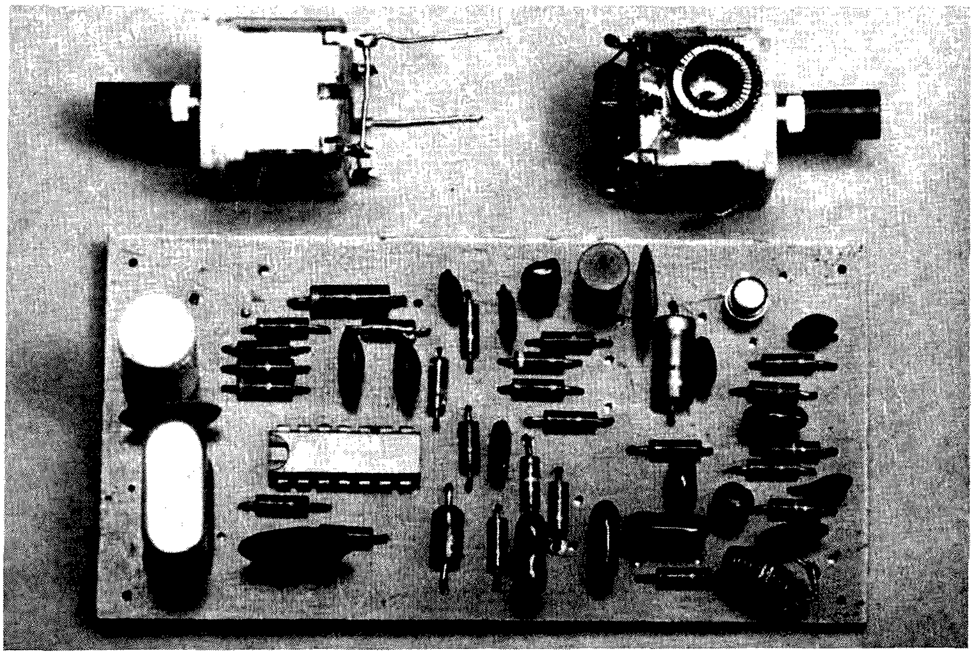
References

1 Joe Williams W6SFM, "The Miniature Multiband Tuner," *73 Magazine*, December, 1964, page 18.

2 Joe Williams W6SFM, "A Toroidal Multiband Tuner," *73 Magazine*, August, 1966, page 30.

3 E. J. Kirchner VE3CTP, "A Phase-Locked Oscillator for Advanced Receiver Design," *CQ Magazine*, September, 1966, page 38.

4 Kenneth W. Robbins W1KNI, "Transistors and ICs in a Phase-Locked Local Oscillator," *QST*, January, 1972, page 43.



A top view of the assembled PC board. The 2 variable capacitors have extension shafts in place.

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RTTY Scratchpad Memory

-- after this, try a UART

This article describes an erasable RAM memory for RTTY application. The memory is meant to be capable of storing 2 teletype lines (128 characters) of Baudot characters and reading them out at machine speed.

Thus amateurs who do not have a tape reader may type and store a message and play it an infinite number of times. The memory content may be erased and changed as desired as it is "volatile" – it disappears as the power is switched off and may be overwritten. If a fixed message is also desired, a ROM may be programmed and added or substituted for the RAM.

The RAM memory is substantially cheaper, but less flexible then the FIFO type memories such as used in the UT-4.

The circuitry is designed for use in combination with a UART (e.g., UT-2), but may be easily converted to run without it.

Principle of Operation

The heart of the memory system is a 1024 bit static RAM and its appropriate addressing logic.

To write into the RAM, a proper baud rate clock (e.g., 45.45 Hz) is enabled to advance a chain of SN7493 binary addressing counters by 8 per Baudot character. Synchronously, the start bit (1), character bits (5), and stop bits (1-1/2=2) are read serially into the RAM data input. Thus, a 1024 bit RAM can store (1024/8) 128 Baudot characters. To read the memory content, the binary addressing counters are clocked at baud rate, and the RAM content is displayed serially at the data-out pin of the IC. Means are provided for multiple or single read cycles, resetting, and displaying the half and full cycle memory address with an LED indicator.

Circuit Description

IC1, a 555 timer, is used as a master clock. If used for both, the RAM plus a UART, it should run at 16x the baud rate. If used for the RAM memory alone, it should run at the baud rate (e.g., 60

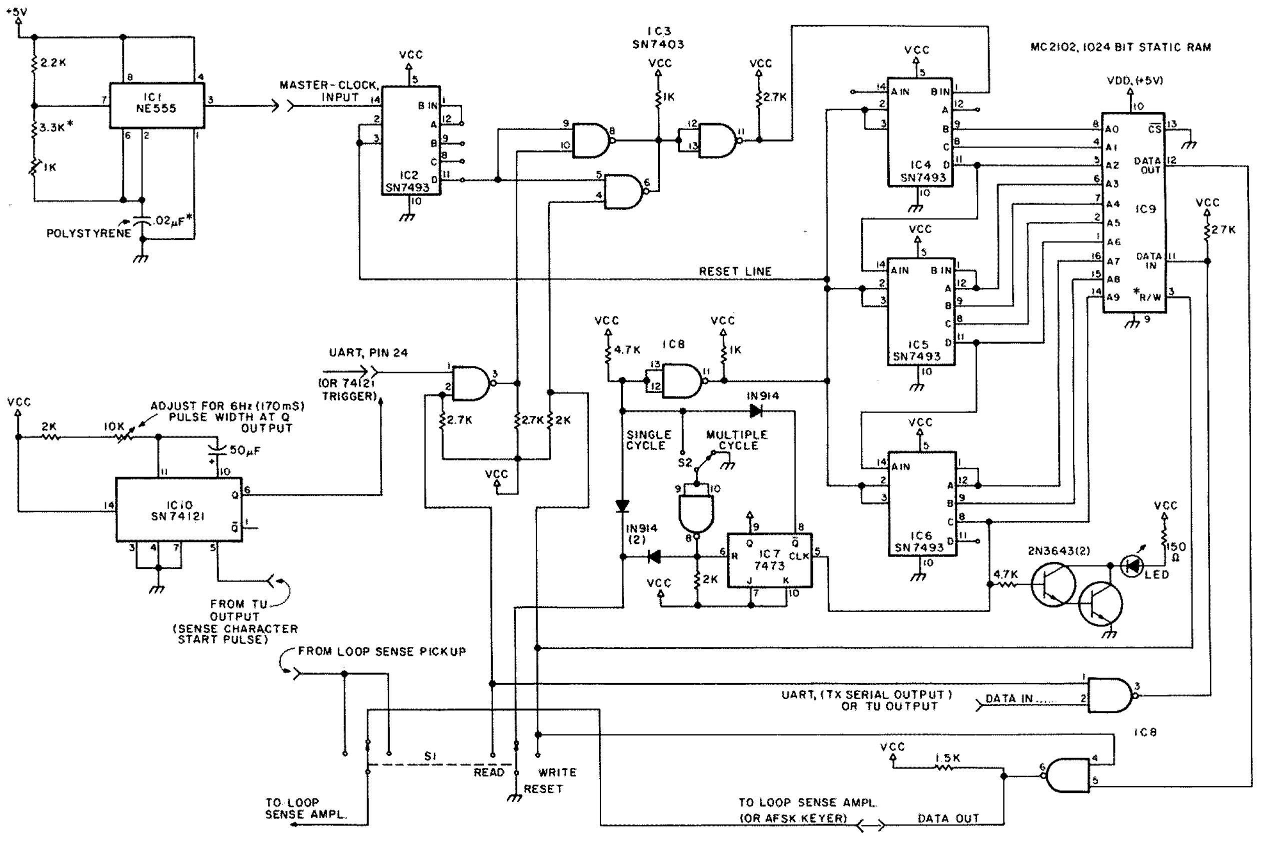

*Fig. 1. Master clock. RAM memory board, for Baudot type RTTY character storage. *Values shown are for 728 Hz (16 x 45.45 baud). **Note: low = write; high = read.*

wpm = 45.45 baud). IC2, an SN7493 4 bit binary counter, may be deleted since it only attenuates the clock speed from 16x to 1x. It is only needed if the clock is used for a UART circuit at the same time. IC3, an SN7403 NAND gate, enables and disables the clocking of the binary SN7493 addressing counters (IC4,5,6) for the RAM. These gates enable the clocking of IC4,5,6 for the duration of 1 Baudot character, that is, they advance the addressing counters by 8, and therefore enable the sequential writing or reading of 7-1/2 (8) bit Baudot characters. There are 2 unused counter outputs, which may be used for the addressing of 2 further RAMs. IC7, an SN7473 flip-flop, decodes a stop pulse when the RAM has cycled through all addresses. One half of IC8, a 7403 NAND gate, provides the switching for "reset" and "multiple" or "single" RAM cycles. The other half of IC8 serves as data input and output buffer. Transistor T1 switches an LED indicator "on" at the half cycle mark and "off" again at cycle completion, thus providing some indication of the cycle status.

If the circuit is not used in combination with a UART (e.g., UT-2), the IC3 gates must be switched from an alternate trigger circuit. An SN74121 monostable flip-flop, with an accurately calibrated time constant of (1/7.5 x baud rate), may be used to decode the start bit of a character and activate the clocking gates (IC3) for 7-1/2 (8) counts.

The RAM scratchpad has been used at my station for several weeks. I use it to loop CQ messages or for copying and replaying a couple of lines of my partner's RTTY transmission.

The circuitry fits easily on a 3-1/2" x 5" board, and the components were purchased for about $8 from James Electronics, California. ■

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Build This CW Filter

- - darned good

To eliminate the frustrations of QRM and avoid the high cost of crystal filters, many hams employ audio filters. Usually, these take the form of passive networks which are often lossy and may require hard-to-get inductors. They are also virtually impossible to tune at these frequencies.

Such problems can be solved through the use of active filters. The filter shown in this article is a single-section, parallel-tuned configuration which uses a negative impedance converter, or "gyrator," to replace the inductor. Basically, the gyrator's input impedance is the inverse of a reactance placed in its circuit. In this case, a capacitor C_L is gyrated from 0.0332 uF to an effective inductance of 1.87 henries. Values up to 100 henries and Qs over 200 are possible with this circuit. Unlike passive filters, this has a 6 dB gain at resonance and virtually a zero Ohm output impedance. The circuit shown has a bandpass of 85 Hz centered at about 865 Hz. With the transformer shown, the op amp can provide plenty of volume to drive headphones. It operates from a single supply of 12 volts but can be used with a dual supply (e.g., two 9 volt batteries). Circuit Q is controlled entirely by R_S, which may be made switchable to provide various bandwidths. Provision can also be made to tune the filter with a single potentiometer. C_L and C_T should be fairly high quality mylar or polystyrene, and the four resistors, R, should be matched to about 2%. Nominal values for R_S lie between 50k and 300k. Approximated design equations are shown in Table 1. ■

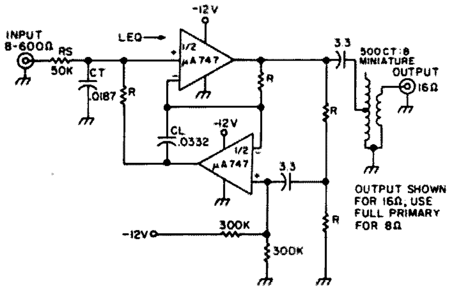


Fig. 1. Schematic. 850 Hz filter. R—7.5k.

$$Q = F_R/BW = 2R_S/(2\pi F_R \cdot L_{EQ})$$

$$L_{EQ} = R^2 C_L$$

$$F_R = 1/(2\pi\sqrt{L_{EQ} \cdot C_T})$$

Table 1. Design equations.

Originally published in Ottawa Amateur Radio Club Bulletin, *The Groundwave*, April, 1975.

73 Magazine *Staff*

The London Bus Tuner

- - effective for short antennas

A better, but less interesting, title for this article might be "a programmable, compact, medium power antenna matching device." The London bus comes into the affair because in searching for a way to inexpensively house an antenna matching network, we recalled the ticket dispensing machines used by attendants on the London buses – a machine which they carry with a large knob on one end.

One of the problems in housing any medium to high power antenna matching circuit, especially one using a rotary inductor, is that the construction cost starts to soar quite rapidly if one is forced to use a conventional large enclosure and a front panel turns indicator for the inductor. On the other hand, the use of a continuously variable inductor is superior to a fixed, tapped inductor if one wants to have a matching circuit which will accommodate a wide range of impedances on any HF band. This article mainly presents a few construction ideas and suggestions for housing a wide range antenna matching circuit at reasonable cost. Dimensions are given for one specific circuit, but they can be scaled up or down depending on the specific components used.

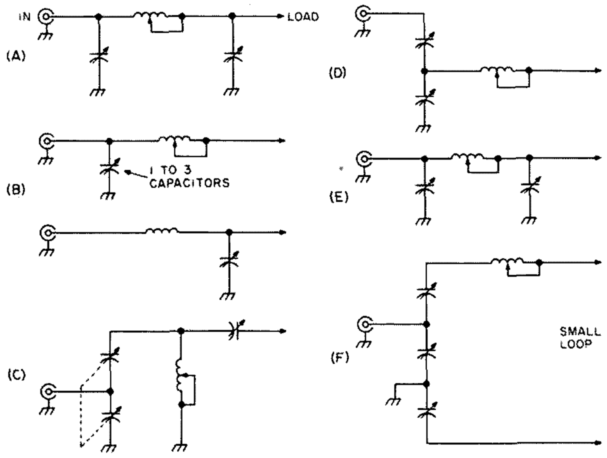


Fig. 1. These are some of the matching networks that can be formed by the interconnection of four "floating" components – a variable inductor and three single section variable capacitors. Component values are discussed in the text.

The circuit described in this article consists of just four floating components – three variable capacitors and a variable inductor. By keeping these components above ground and providing for their internal interconnection (programming), a variety of matching circuits can be formed as shown in Fig. 1. Each form can have its particular advantage, depending upon which band from 160-10 meters is being used and what form of antenna one is trying to match. The circuit possibilities range from simple L networks to a "transmatch"-type circuit. Besides matching networks, the components can be interconnected to form simple one section low pass, high pass, or trap-type filters for experimental purposes. This flexibility is often useful when one wants to quickly set up a trap or other type LC circuit for experimental work in a transmitter or receiver.

The inductor used is a standard Johnston 28 uH unit. Various surplus types of the 18-33 uH size, such as from the Command Set series, are also usable. In fact, it often pays to buy one of the old transmitters just for the rotary inductors! With 300 pF capacitors rated at 1500 volts, just about any antenna form can be handled up to the 500 Watt level from 160-10 meters. With 100 pF, 2000 volt units, a kW can usually be handled from 80-10 meters. Towards the other end of the scale, if one is using a barefoot rig of the 150 Watt category, the use of the reasonably priced and more readily available Hammarlund MC325M variables (325 pF, 1000 volt) is a good choice for 160-10 meter capability.

The whole subject of finding variable inductors and capacitors at "amateur" prices for anything above the QRP level could develop into an article by itself. About the best that can be said is that bargain hunting still pays off. For instance, all the electrical items for a 500 Watt level matching circuit could be found for $18 at Fair Radio, PO Box 1105, Lima OH 45802. The items a surplus house has in stock are in a constant state of flux, but usually something suitable can be found. Don't overlook the old BC-191/BC-375 tuning units and the previously mentioned ARC-5 (Command Set series) transmitters. They often are available at reasonable prices, although the variable capacitors/inductors have odd shaft sizes and call for a slight bit of mechanical ingenuity to use.

A matching circuit using a 28 uH rotary inductor and three 100 pF, 2000 volt capacitors was housed in an inexpensive 9 x 6 x 5 inch enclosure (Bud CU1099). The inductor was placed parallel to the long side of the enclosure. The turns counter assembly is simple but effec-

tive (see Fig. 2). A 5 digit left-hand drive veeder root count (Burstein-Applebee #18A1507-3 at $1.49) has its ½" belt drive wheel driven by a 2" belt drive wheel placed on the rear shaft extension of the inductor. The 2" drive wheel and rubber belt used were junk box tape recorder parts. The counter reads from 0 to about 600, and this is enough accuracy to ensure resettability to a fraction of a turn. Many other similar mechanical turn counters can be used.

The three capacitors were directly mounted on an approximately 8 x 2 inch piece of piexiglas. This plexiglas plate was mounted to the panel of the enclosure with regular metal hardware with about a 1½" standoff from the panel. Insulated shaft couplings were used on each variable to complete its insulation from the enclosure. Leads from each component (# 16 or # 14 hookup wire) were routed to a long barrier terminal strip (similar to Radio-Shack 274-670) mounted on the rear inside panel via an insulating piece of plexiglas. Short pieces of wire with spade lugs at each end are then used to interconnect components as desired. Only two SO-239 coax receptacles show on the rear outside of the enclosure. One could, as an alternative to the above, bring out each component to binding posts on the rear panel. But, since high rf voltages may be encountered, this would require that the posts be mounted on a piece of plexiglas which in turn is mounted over a cutout in the rear panel.

If one has some pre-knowledge of the impedances to be matched, a specific matching circuit configuration can be used immediately. Otherwise, the pi-network of Fig. 1(a) or the circuit of Fig. 1(c) are always good ones to start with. Note that the "transmatch" circuit of Fig. 1(c) normally uses a dual variable, so the two single variable capacitors used instead have

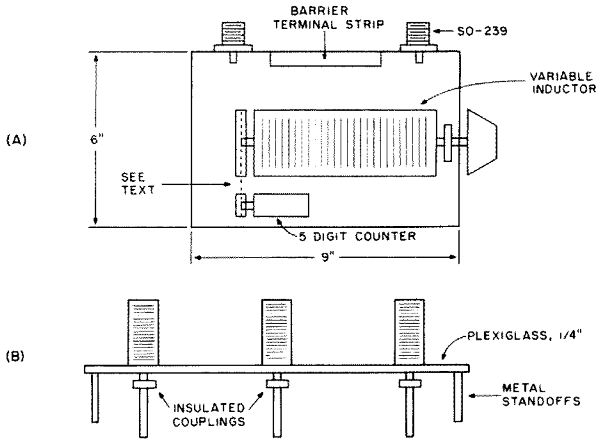


Fig. 2. Compact construction of a medium power tuner in a 9 x 6 x 5 inch enclosure. (a) Top view without capacitors. (b) Capacitors mounted on a piexiglas strip, which in turn is mounted above the variable inductor by standoffs to the front panel. Details are in the text.

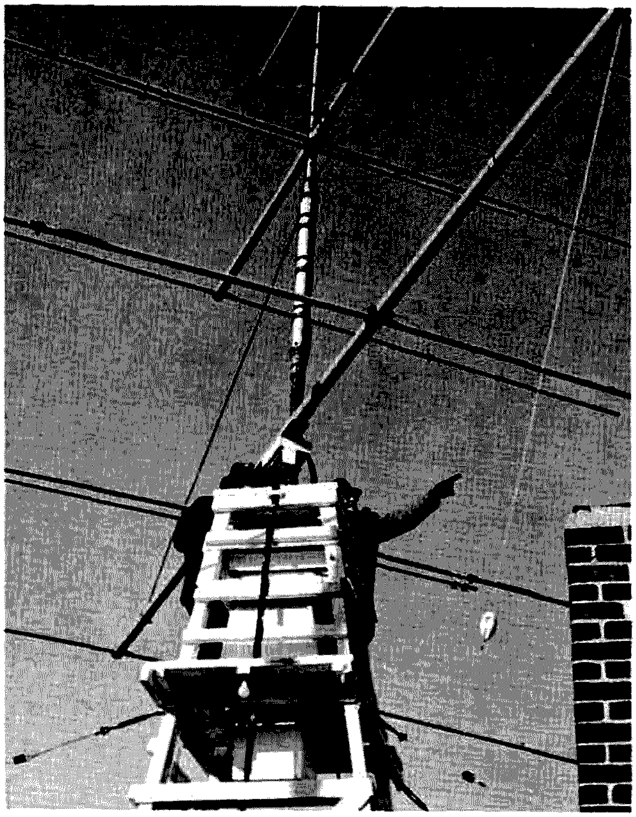
to be simultaneously rotated to simulate a dual variable. One can then try other matching configurations to achieve the best transfer of power. Generally a good rule of thumb is that the matching circuit which uses the *minimum* amount of inductance to match into the load *and* which provides a clear swr minimum on the coax line between the transmitter and the matching circuit will be the most efficient circuit to use. To see which circuit does this is easily facilitated by logging the turns counter readings for the variable inductor. ■

Rich Force WB1ASL
Publications Editor

The WIBB Story

-- a visit with the king of 160

What started out as a simple journey to Winthrop, Massachusetts, for Stan WA1UMV and me, to take a picture for the cover of 73's new publication about the 160 meter band, *The Challenge of 160 Meters!*, quickly turned into one of the most interesting days I have spent since becoming involved with amateur radio.



W1BB and the author atop one of Stew's towers. The tower was built in the 1930s and is located atop the house on Pleasant Street, Winthrop MA. Stew is indicating the way to Europe.

What, you may ask, were we doing in Winthrop MA to take a picture for a book about 160 meters? Winthrop is the home of 160 meters' most distinguished and recognized enthusiast, Stewart Perry W1BB.

I spoke to Stew by phone a few days before, and he invited us down to take a picture of some of his prize QSL cards. The cards were those he had used to obtain the first DXCC certificate issued exclusively for 160 meter operation.

As we drove up in front of Stew's house, it was not hard to recognize it as the home of an avid ham. Besides the numerous antennas on the roof of the large Victorian two story home, there was a convertible parked in the driveway which carried a whip antenna with the largest loading coil I've ever seen. In fact, the cover for the coil was made from an inverted plastic trash pail. On the paii was written W1BB/160.

We were greeted at the door by Stew W1BB, a very distinguished looking gentleman, who escorted us to his ham shack on the second floor.

As we walked into the room, it was like taking a step back in time. There in front of us was the shack of yesteryear — the type of place you would visualize when reading about the early days of radio. Yet intermingled among the vintage equipment was a modern up-to-date amateur station.

Stew explained that this station was just one of three he operates. It, however, was the oldest, and most of the visible equipment was built around 1935. He had at that time built transmitters for every band from 160 through 2 meters and could, through a series of patch cords, QSY from one band to another in a matter of seconds.

He demonstrated his first transmitter for us. It was a spark unit, and the noise was deafening. In the corner was a giant knife switch. Stew explained that such a switch used to be required for lightning protection, and this particular switch was used to ground his 160 meter doublet (which was fed with 600 Ohm open wire line). Next to it was an allband tuner which employed three variable capacitors, plug-in coils and an rf ammeter in each feedline leg.

Stew's two other stations consisted of a smaller station

in his bedroom for those late night openings and a larger station at the site of the Winthrop water tower, where, in addition to operation for the Winthrop Emergency Radio Net, for which he is radio officer, Stew has permission to conduct some of his 160 meter tests. The tower braces Stew's 160 meter inverted vee beam 265 feet above the ocean's surface.

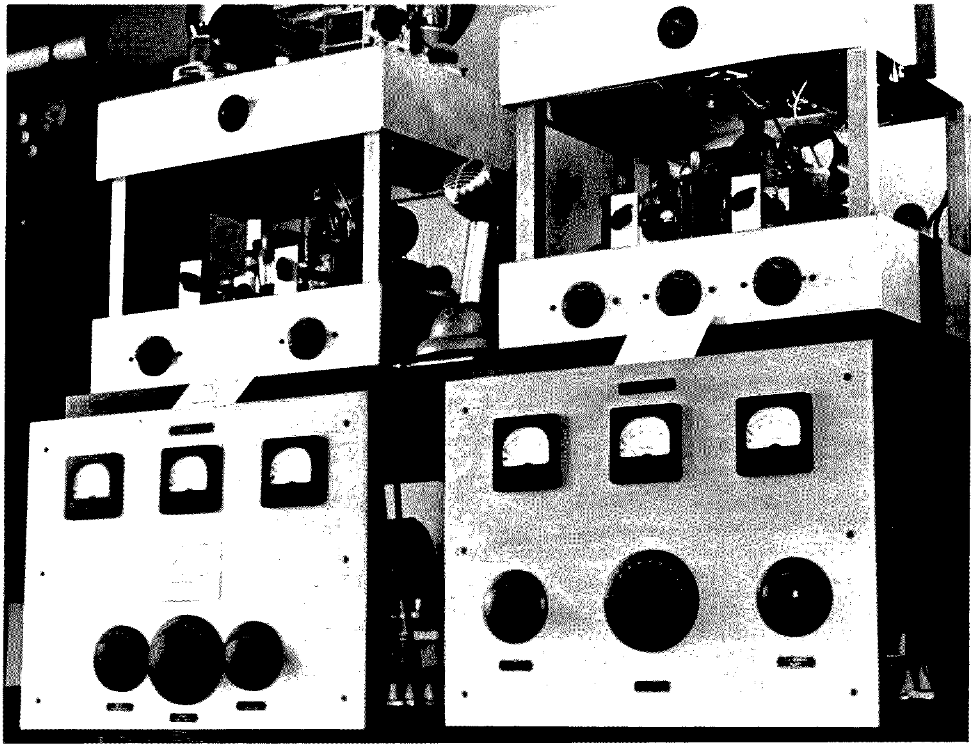
While Stan took pictures of the shack and QSLs, Stew and I went into the kitchen, where, over a cup of coffee, I found out how Stew Perry W1BB had, over a period of 65 years, come to be one of the best known and respected gentlemen of the "gentlemen's band."

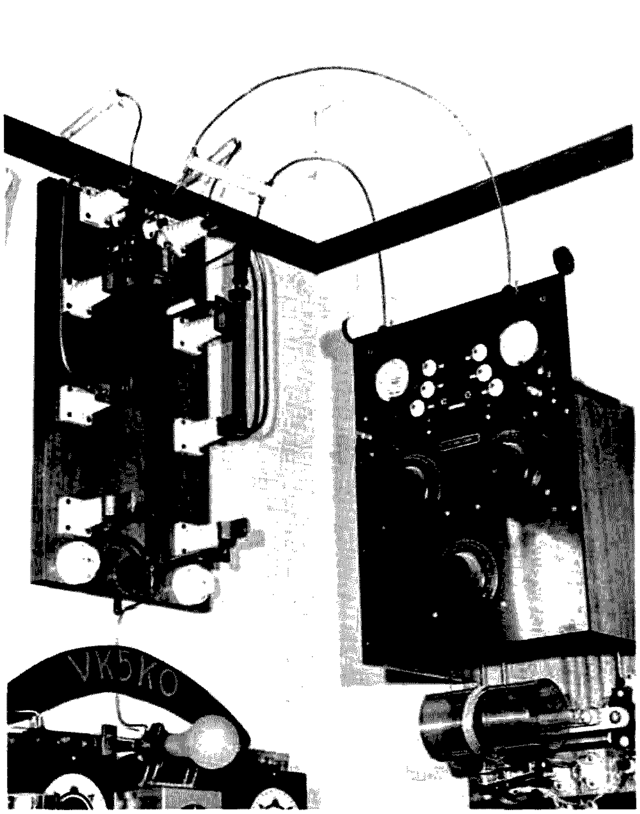
The Perry family has lived in the same house on Pleasant Street since Stew's birth in 1904. When Stew was 8 years old, his interest in radio was kindled by a neighbor. As he tells it, one day he was playing in his backyard when his next-door neighbor Eddy O'Toole, who was always interested in scientific things, called him over to show off his new crystal radio. Stew listened and heard dots and dashes. Eddy explained they were coming from the Boston Navy Yard (NAD) and were talking about a large ship which had recently sunk. Well, the ship turned out to be the Titanic, and the incident was the start of Stew's interest in radio. Of course he wanted to make a radio, and Eddy told him how to do it. All he needed was a Quaker Oats box, some wire, a slider, and a galena crystal. So he went to Bin's Radio in Boston and purchased the materials, and it wasn't long before he was listening to NAD.

It was right after this that Stew managed to obtain an old Ford spark coil and get on the air himself. In those days, no one had a license, he explained, and he signed the call SS, which are his first two initials. Stew thinks they were operating somewhere around 500 meters, but no one really knew the exact frequency. The estimate was based on NAD, which used to call Stew once in awhile to ask that he QRT because he was interfering with them. They were operating near 500 meters. The first contact Stew had was with Eddy O'Toole, his next-door neighbor, which was followed by others with people in the neighborhood.

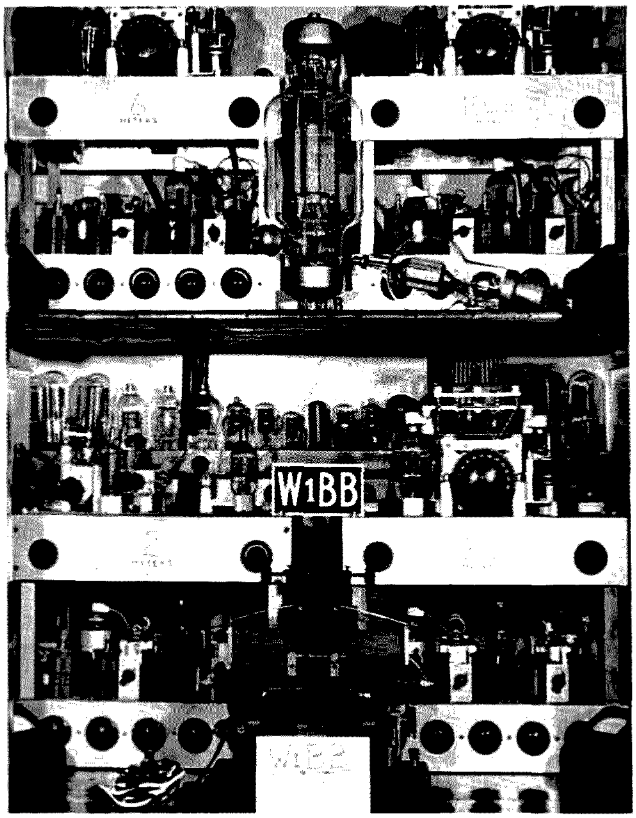
After a while, licenses started to be issued for radio operation. And as Stew puts it, "Those with licenses would squeal on those without them." So he decided to get one. He went to the Customs House in downtown Boston and took the test. It consisted of a 5 word per minute code test, which you had to pass before taking the written exam. The written part was all essay-type questions and covered theory, rules, and regulations. One part of the exam was to draw a complete diagram of a station, including a receiver, transmitter, and antenna system. Another question was to explain how radio frequency waves were generated, starting at the power lines and ending with the antenna. Other questions dealt with

Whip antenna mounted on W1BB's auto. The loading coil is covered with a plastic trash can. Stew worked mobile on 160 meters for over 25 years, using both AM phone and CW.


Several of W1BB's transmitters built circa 1935. These transmitters could be switched from one to another in a matter of seconds.



The large knife switch in the corner of W1BB's station on Pleasant Street. The switch was used to ground his 160 meter antenna for lightning protection. Next to the switch is an allband antenna tuner.



Some of W1BB'S switchable transmitters built around 1935, as well as his spare tube collection. In the forefront on the bottom shelf is one of his original spark transmitters from 1912. A demonstration proved the noise from this unit to be deafening.

such things as Leyden jars and mud capacitors. Stew said it was an easy exam if you knew about radio. As luck would have it, he passed the exam on the same day war was declared – the beginning of World War I. He was issued his operator's license, but not a station license.

After the war, word came down that station licenses were to be issued. Stew thought that it would be nice to get 1AA (at that time W prefixes were not used), so he got up at 4 o'clock in the morning and went to the Customs House only to find that others had the same idea and were already in line. As it turned out, he was issued 1BB, which he has held ever since.

At that time hams were given the frequencies of 1750-2000 kHz, the forerunner of today's 160 meter band. According to Stew, they used to try to operate as close to the bottom of the band as they could but the spark transmitters were so wide that a signal on 160 meters could be heard from 100 meters to 250 meters. Hams tried to sharpen their signals by using a helix auto transformer, which consisted of a tank coil of about 15 turns and a variable link of about 7 or 8 turns, but it did not help very much. Signals were never sharp until the advent of the vacuum tube.

While it was illegal to operate during World War I, Stew studied and managed to obtain his commercial radio license. As a result of this license, in 1920 he went to sea as a commercial operator, operating in the 500 meter band. His life at sea was to last, on and off, for the next six years.

In 1932, the 160 meter trans-Atlantic tests began. These tests were sponsored by a group of British hams, including G2II and G2PL, and were conducted every Saturday morning at European sunrise. American hams would call for the first five minutes past the hour, and then listen while the European hams would call for the next five minutes. When a contact was made, the calling schedule would stop. At this time no one thought of counting countries – just getting a trans-Atlantic contact was excitement enough.

After the tests had been conducted for a few years, hams did start counting countries. In 1935, W1BB listed Belgium as country number 1, after receiving a QSL from ON4NU. Others also started counting, including W1LYV, W2IV and W2EQS.

By 1968, 33 years later, Stew had confirmed his 100th country with a card from CE3CZ in Chile. He now has 139 confirmed on 160 meters alone.

Stew says it's now easier to work DX on 160, due to the fact that more is known about the band. We have better antennas and better receivers, and propagation is better understood. For example, in the beginning no one considered opening during American sunsets. All DX was worked during European sunrise. But now it is known that the band also opens for a couple of hours after the western sunset. Antennas have also changed. Early hams used Zepps and horizontal doublets. Now we find that verticals, inverted vees and inverted L's work better as transmitting antennas. Also, it is now known what countries can be worked on 160 and schedules can be made.

As to the type of antenna Stew would suggest for 160 meter work, he says an inverted L type with a good ground system is the simplest. And he stresses a *good ground system*. The inverted

L, he explains, is nothing more than a top-loaded vertical. In stressing the point about the ground system, he uses the example of ZE7JX, who needed to work Australia. He started with a few ground radials and kept adding more and more. Before he achieved his goal, he had buried more than 16,000 feet of wire but had kept the antenna the same. Stew has a ground system which he installed in 1940. It consists of 7' X 4' zinc plates, connected together like the spokes of a wheel, with the antenna in the center.

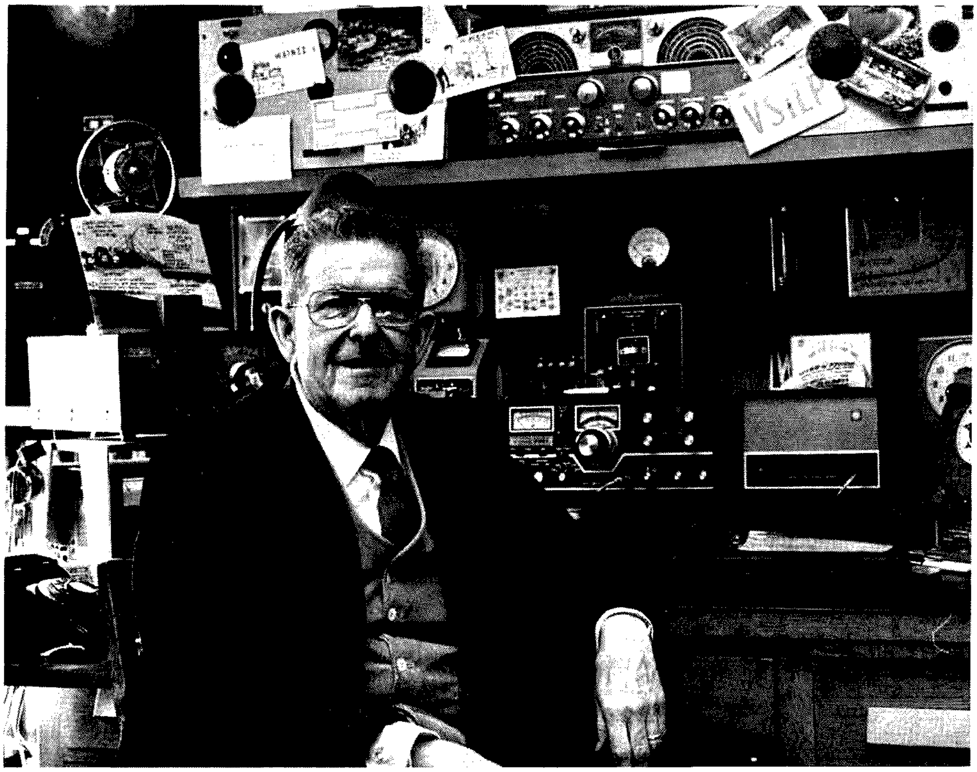
As for receiving in a quiet area, a resonant antenna such as a sloping dipole or a vertical is suggested by Stew. However, in a noisy area the beverage antenna is best. A beverage antenna is a long long wire terminated with a resistance for directivity. It is run close to the ground and does remarkably well. Experiments have also been conducted while running the beverage antenna underground and underwater. Stew has used an underwater beverage with a length of 150', 6-7' below the surface. He says the results were spotty. KV4FZ has achieved great success with an underwater beverage 300' in length, 4-6" below the surface.

Stew sees a bright future for 160 meters, marked by increased activity. As long as the newcomers abide by the unwritten rules and observe the "DX window" (an area historically reserved for foreign stations from 1825-1830 kHz), the band should offer many hours of enjoyment to hams.

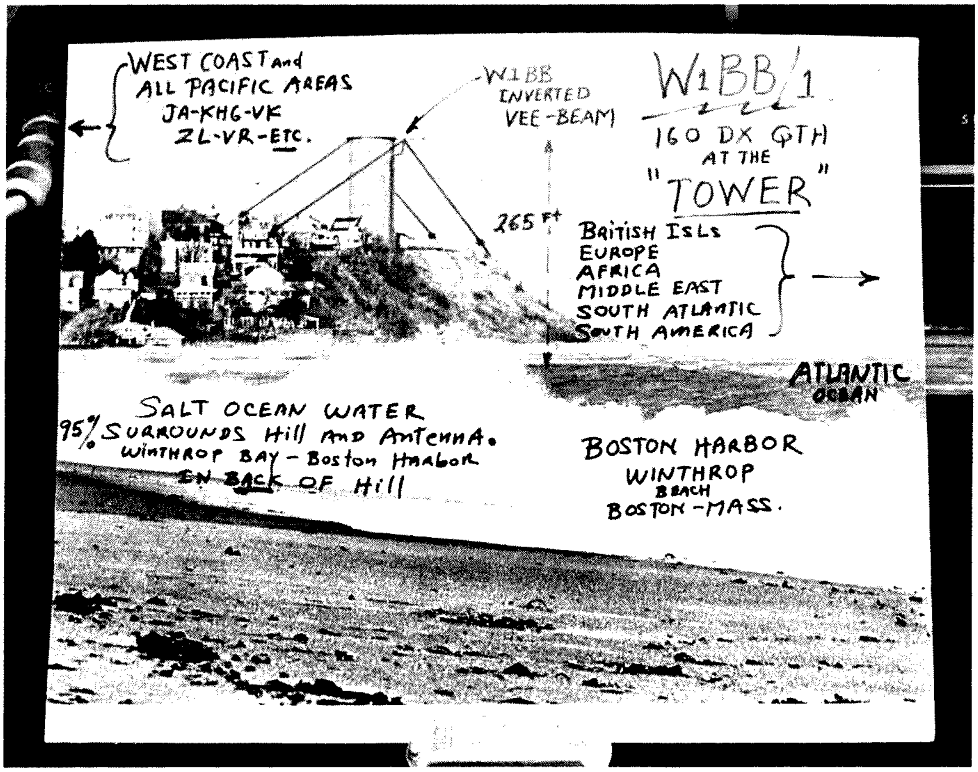
Aside from his accomplishments on 160 meters, Stew also works other bands and has the capability of going on any band from 160 to 2 meters. He seems to work 20 meters the most, often checks into 80 meter nets, and gets on 40 occasionally.

Stew's reaction to the recent FCC proposals to be offered to WARC is that they look very well thought out. He was surprised to see that they proposed the 160 meter band go back to its original starting point of 1750 kHz. He had hoped that the band would be left as it stands (but with the elimination of Loran).

To express how a shift in



Stewart Perry W1BB, whose station has been in use since 1912. Stew holds the first DXCC issued for exclusive 160 meter operation.



W1BB's secondary station location, showing the position of his inverted vee beam strung from a water tower 265 feet above the Atlantic Ocean.

frequency makes a dramatic change in the propagation of signals on the 160 meter band, Stew relates the story of HB9CM. It seems that HB9CM was working a stateside station on 1827 kHz and received a signal report of RST 449. He decided, for experiment's sake, to go up to 1995 kHz to see if his signal strength would change. He came up to an RST 579. And that, Stew says, is sometimes the difference between the top and bottom of the band when the MUF is just right. "And," he adds, "we used to all try to stay as close to the bottom of the band as possible. In those days, it was thought the lower frequencies were the best for DX."

As to the proposed 1875 meter band which the FCC will include in its recommendations to WARC, Stew does not see it being anything like 160 meters. He thinks the band, if it is ever approved, will be more akin to two meters in its range and application.

After concluding my discussion with Stew, we all departed to the site of his station at the Winthrop water tower. Standing on top of the cliff next to his two element inverted vee beam antenna 265 feet above the Atlantic Ocean, Stew stretched out his arm and said, "That way's Europe." He moved his arm and said, "That's North Africa." He moved it a little more: "And that's South Africa." It was a site to make any DXer's heart green with envy. Here was a man who did what many had thought was impossible. He managed to be the first to work 100 countries on 160 meters, after 33 years of operation. For Stew, though, I'm sure it was not hard, because he enjoyed every minute of it. It is only right that a person who feels so much good for something should excel at it. He is a real gentleman from among those on the "gentlemen's band," 160 meters.■

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Ten Watts On 2

-- it's possible with this rock crusher!

An easy to carry portable pack for your two meter FM rig is a great asset for any ham: to keep in touch at work, on hikes, during walk-a-thons or other public service events, and just to have more fun with amateur radio. Fortunately, making a decent and reliable portable carrying case, with self-contained batteries (rechargeable, of course) and antenna, only takes a bit of scrounging and care.

You'll notice that my efforts culminate in a rig that runs *ten* Watts output, not the usual 2 or 3 Watts of other portables. However, it isn't exactly hand-held, nor does it weigh a couple of pounds (the porta-pak tips the scales at 7½ lbs.). But the advantages far outstrip the drawbacks: much greater power output to hit the more distant repeaters reliably, no great outlay of cash for another transceiver (you use your present mobile rig), and the fact that most other hams I've seen carry their HTs on their belts anyway – so a shoulder strap rig is just as "hand-held" as theirs is!

The Rig

The first thing you need is an FM transceiver, of course. My Icom IC-22A is shown in the photos; any of the standard power 10 Watt rigs (Midland, Heath, Standard, Genave, etc.) could work as well. Even if your powerhouse runs 25 Watts out, it may have a low power mode which can be modified to run 5 or 10 Watts. Alternately, a home brew or module-type kit built rig, like the VHF Engineering units, could be made portable this way.

The Case

The case for the rig is a slightly altered cassette tape recorder affair (you used your recorder for slow scan anyway, now here's where the case can come in). It originally measured 28 by 19 by 7.5 cm, obtained at a local flea market for less than $2.00. These things are usually vinyl covered cardboard, stitched up as in the photos, and are surprisingly rugged. If you really want to be creative, have your local sweet young thing, wife, or even yourself throw together a custom job out of leather. Be sure to put a strap on it so you can sling it over your shoulder – and don't forget to leave room for the batteries!

The FM transceiver, in my instance, was a bit too large for the cassette carrying case, so I extended the cover flaps and used velcro as a securing device. Velcro is that material with zillions of little hooks on one surface and an equal number of loops on the other so that when you press the two together, they stick. A couple of small pieces (20¢ at the local fabric shop) hold very tenaciously and can be sewn, glued, or stapled to the case. Velcro is much easier to use and is just as strong and reusable as snap fasteners or buckles and straps. Besides, it makes that satisfying "rip" when you go to open the case.

Batteries

The rig sits on top of the battery pack, as you can see in the photos. This nicad pack has ten "D" size cells all strapped together and puts out 3.5 Amperes for a solid hour. With 150 mA receive current (all dial lamps on) and 2.2 A transmit draw for 10 Watts output, the pack runs all day and night in regular service without a recharge. If you don't want the rig to sit on top of the batteries, you can lay them end-to-end alongside the transceiver inside the case. Hopefully, you'll find a case thick enough for this – but mine worked great with the batteries at the bottom.

"C" size nicads will last nearly as long on a charge, but you'll be working them harder and they may poop out just when you need them most. Alternate energy sources are the newer gel-cell batteries, which have no nicad "memory" effect, and are somewhat less expensive. Lead acid wet cells are usable, and are sometimes available at Olson Electronics, flea markets, and surplus houses. Some battery manufacturers are listed at the end of this article. I imagine that if you could find a small motorcycle battery, it would work fine. A two Ampere-hour rate at one hour is about minimum for useful, long single-charge life from the battery power source.

Connecting the battery to the transceiver is not that much trouble, obviously, but taking a little more time to add a switch and connector makes the porta-pak more versatile. I used a small 3

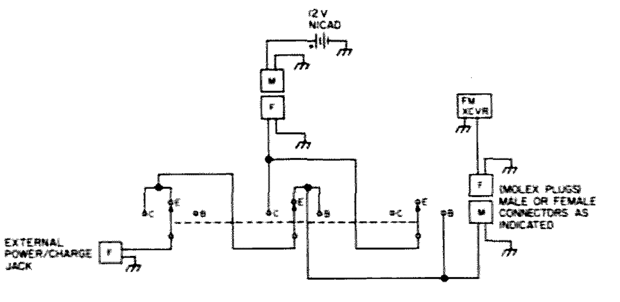


Fig. 1. Schematic of power switching for the portable rig. C – charger goes to jack for charging nicads; E – 12 V power to jack for external supply; B – battery connected to FM transceiver.

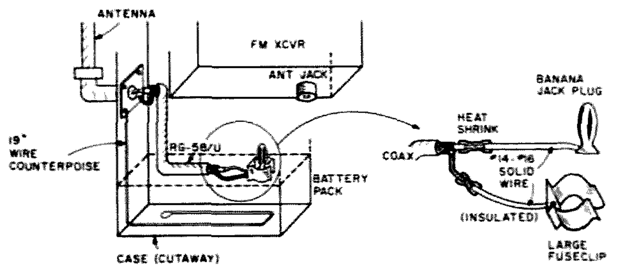
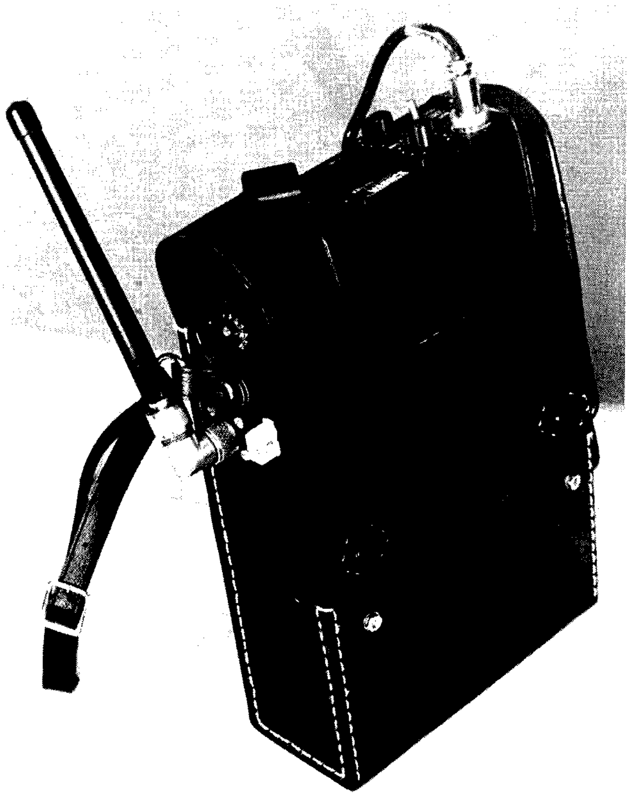
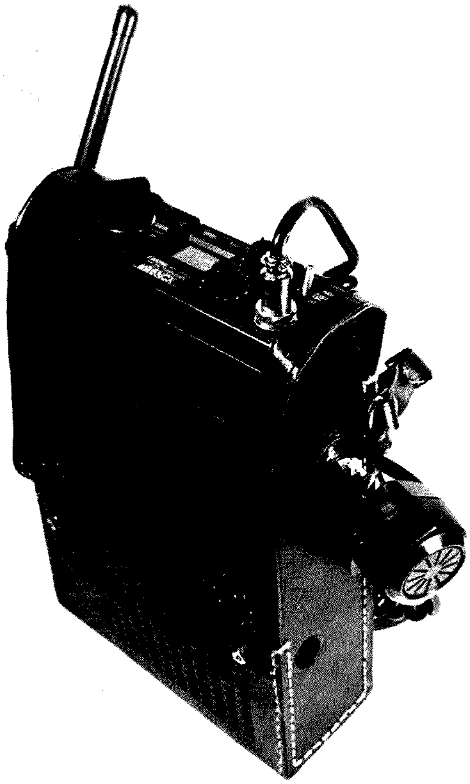


Fig. 2. Diagram of the right angle coax connector and the case with its 19 inch antenna counterpoise.

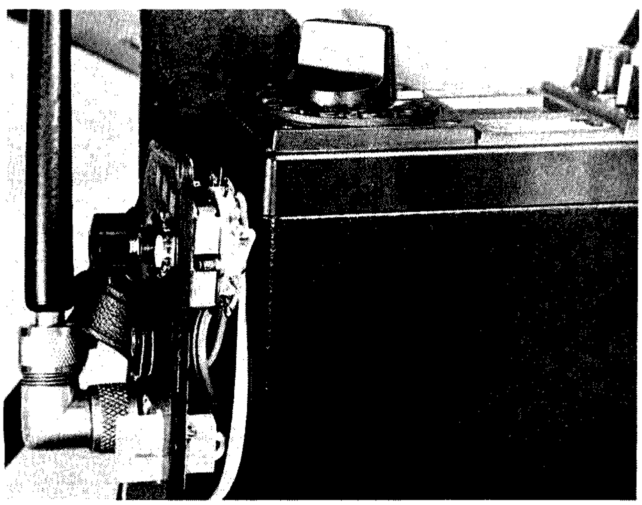


Left-front view showing antenna, power jack, and switch.

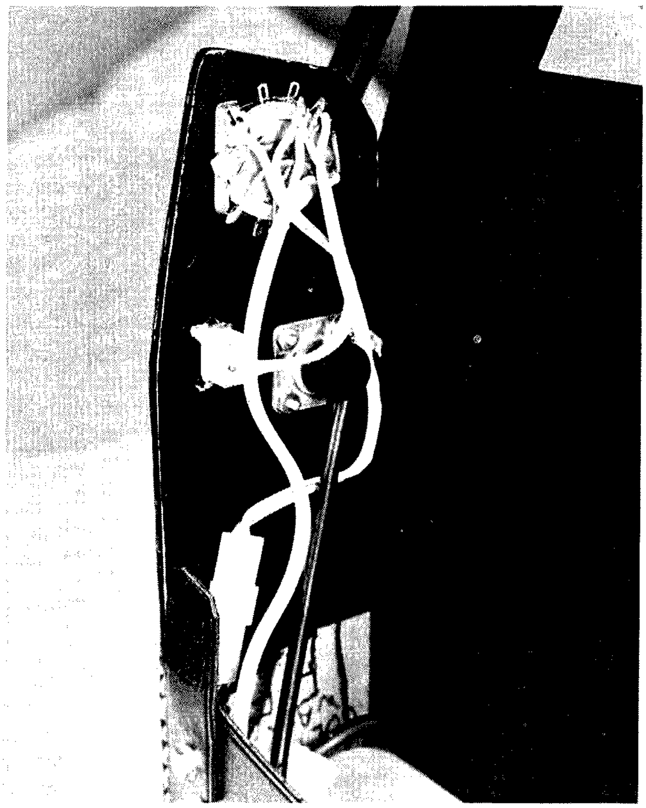


Right-front view showing microphone clip.

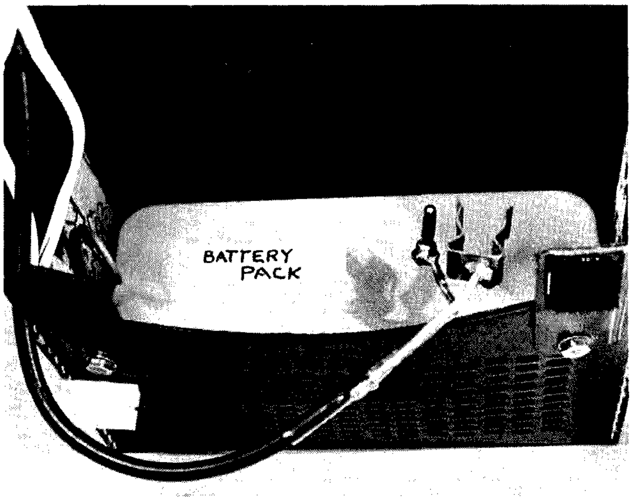
pole, 3 position rotary switch to either connect the rig to the battery, hook the rig to the external power jack, or connect the battery to a charger via the external jack. Fig. 1 shows the switching setup, and the mounting arrangement is visible in the photos. The external power/ charge jack can be epoxied to a carefully cut hole in the side of the case, while the rotary switch is mounted conventionally. I suppose that if there were more room in the carrying case, a charger could be built in. However, I found that the 12 volts available at the case's power jack when switched to the "charge" position is useful for running lamps, HF QRP gear, or other equipment from the nicads, without having to remove them from the case.



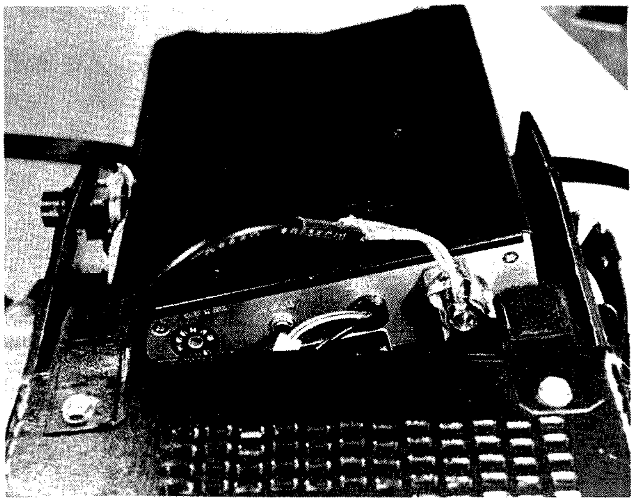
Close-up with top cover flap lifted.



Power switch and antenna wiring. Notice counterpoise wire running from SO-239 down far inside corner of case.



Coax connector with battery sitting in the bottom of the case.



Close-up of transceiver rear panel with coax connector.

Antenna

The antenna connection is about the most difficult thing to accomplish, since the rig sits upended on the batteries and the antenna jack sticks out of the transceiver's rear panel. Adding a coax elbow and associated connectors made the IC-22A jut too far out of the carrying case, so I made connections to a sawed-off banana jack and an old fuse-clip holder, resulting in a very shallow right angle coax connector. See Fig. 2 and the photos for more information. I found that solid #14 or #16 insulated wire worked best for 1½ inches between the home brew connector and the RG-58/U coax, preventing the flimsy coax braid and center conductor from breaking off at the connector while the rig shifts around slightly in its case. Use heat shrink tubing around the solder joints. At two meters, the connector is a bit lossy (10-15%), but it's the best solution to the problem of keeping the porta-pak as compact as possible.

I mounted an SO-239 antenna jack at the side of the case, and used a coax elbow here so that a rubber ducky, 19 inch whip, or external antenna can be screwed on. When I first used the portable rig, I was disappointed in the results because of the poor radiation efficiency. However, when I ran a 19 inch counterpoise wire from the SO-239 grounded mounting ears down around the bottom of the case, results improved as much as 20 dB! So the whip or helical antenna now acts as the radiating end of a vertical dipole, much more effective than the antenna alone stuck on the end of a short length of coax. Handie-talkie owners might try this trick too, since it really improves signal strengths. The wire doesn't seem to bother anything when the porta-pak is hooked up to an external antenna, since it is connected to the shield of the SO-239.

Results

I've been using my portable ten on two for nearly six months now, and have consistently out-talked and out-performed belt-mounted HTs. I didn't have to lay out $30 for an external mike, either! Once I worked several San Francisco Bay Area repeaters from Yosemite National Park – and was full quieting with the 10 Watt power level (I also had about 5,000 feet of height). I never have to remove the rig out of its case when used in the car or home, thanks to its provisions for external power and antenna. And, there is no problem with car theft – I take the porta-pak with me!

I've been to plenty of club meetings, amateur flea markets, and ham get-togethers with this little system, and if the interest generated in it is indicative of a universal appeal, many more will be built. I hope this article helps with some general guidelines and ideas, so you can more easily build your own 2 meter FM super porta-pak. ■

Two Rechargeable Battery Manufacturers:

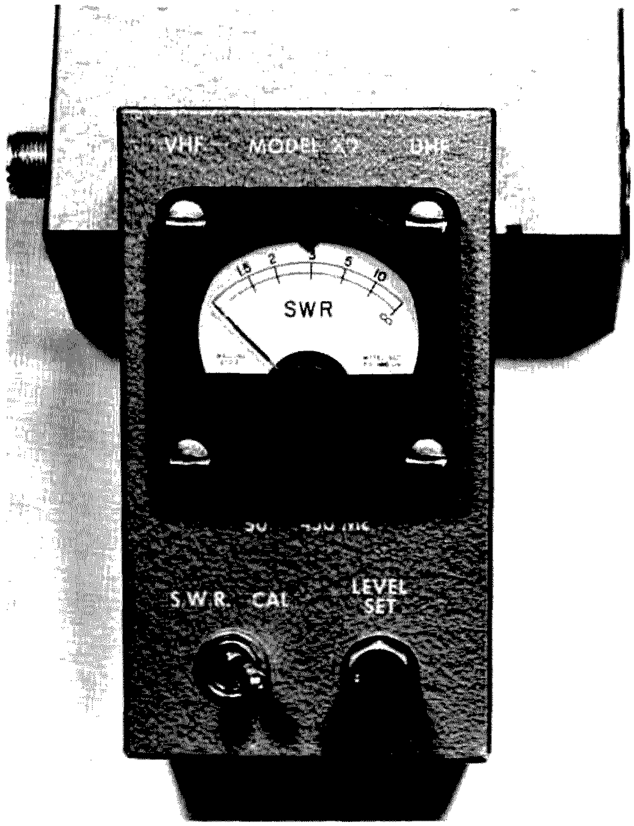
Elpower Corporation, Subsidiary of Eldon Industries, Inc., 2117 South Anne Street, Santa Ana, California 92704, (714) 540-6155.

Gates Energy Products, Inc., 1050 S. Broadway, Denver, Colorado 80217, Attn: George Sahl.

UHF SWR Indicator

- - 1296, anyone?

W. E. Parker W8DMR
2738 Floribunda Dr.
Columbus OH 43209



The line may be left connected in the transmission line, and the meter box conveniently placed on top of the transmitter.

There are many inexpensive standing wave ratio indicators that are listed as good up to two meters and do function well. At frequencies above approximately 150 megahertz the results leave something to be desired.

There are several valid reasons why the swr indicators are inadequate. In order to have good sensitivity at the lower frequencies (80 meters), the coupling loops used for forward and reflected wave sampling are usually six inches long, and are close-coupled to the center conductor of the transmission line. If the sampling loops are shortened and loosely coupled, then the sensitivity for the lower frequencies is greatly reduced.

Another reason for poor operation is that the coupling loops required for low frequency operation represent almost a quarter wave at the ¾ meter band (≈500 MHz). Distributed capacity between the long coupling loops and the inner coaxial conductor is excessive.

The diode rectifier characteristics become more important at the higher frequencies. The position of the pickup loops with regard to spacing, direction and concentricity must be very carefully aligned if their electrical characteristics are to be as similar as possible. Once aligned or positioned, the loops must remain rigidly affixed if a level of confidence in the indicator is to remain.

If the coupling loop is to be a small percentage of a wavelength (1/20 or about 5 percent), a length of one inch is about the maximum to be considered. If the indicator is to be used with low power transmitters (½ to 2 Watts), the loop should approach the one inch length. For high power transmitters, the loop may be as short as 1/8 of an inch. This is that portion of the loop that is parallel to the coaxial center conductor.

The coupling loops form a circuit with a resistor such that the mutual coupling is positive (+) in one case, and negative (-) in the other. The same effect could be obtained if a single loop was used for sampling, then rotated 180 degrees, and then sampled. Inspection of the equations that follow will show this is taken into account.

That portion of the loop parallel to the center conductor and the resistor form a third component, the distributive capacity element C. See Fig. 1.

The output rf voltage e_o is made up of e_r and e_m. A voltage divider is formed by distributive element C and R.

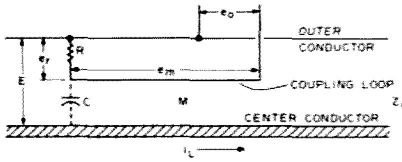
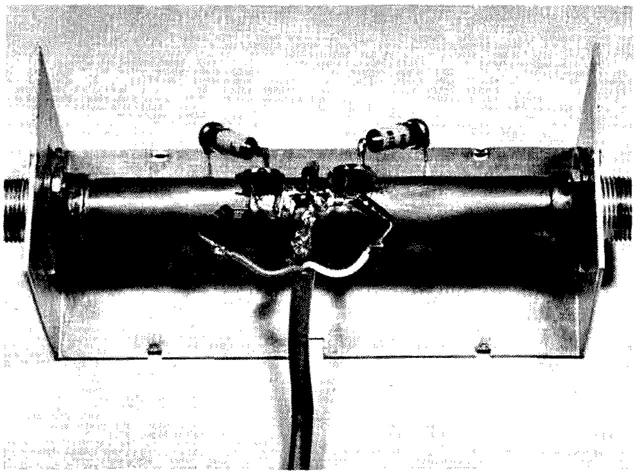
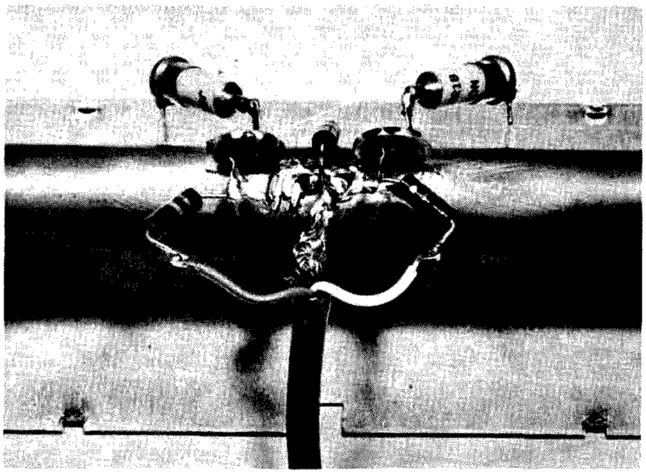


Fig. 1.



The ½ inch copper water pipe transmission line mounted in a minibox with components attached.



The edges of the button bypass capacitors have been soldered directly to the line. The 39 Ohm resistor is in the middle. A heat sink should be used when soldering directly on the diodes.

Then,

$$e_r = \left[\frac{R}{R + X_c}\right] E$$

and if R is much less than X_c,

$$e_r = \frac{RE}{X_c}$$

and since jwC equals $1/W_c$,

$$e_r = REjwC$$

$$e_m = I\ [jw\ (\pm M)]$$

by induction.

The sum of e_r and e_m is (factoring out jw)

$$e_o = jw\ (CRE \pm MI)$$

The directivity of the indicator, its ability to discriminate between the forward and reflected wave components, depends upon the relationship $CR = M/Z_o$, where Z_o is line impedance.

Substituting for CR,

$$e_o = jw\ (E\frac{M}{Z_o} \pm MI) = jwM\ (\frac{E}{Z_o} \pm I)$$

Another relationship must be stablished before again substituting in the rf output voltge equation for e_o. It is important to note capital letter E is used to designate the line voltage.

The voltage E at *any* point n a transmission line is the sum of the forward and relected voltages, or

$$E = e_f + e_r$$

It should be remembered that e_r during the next few equations represents the reflected voltage; it should not be confused with e_r, the voltage across resistor R.

Then,

$$I = \frac{e_f}{Z_o} - \frac{e_r}{Z_o}$$

The minus sign is because the reflected wave travels in the opposite direction.

$$I = I_f + I_r$$

where

$$I_r = -\ \frac{e_r}{Z_o}$$

There are two cases to consider: (a) when the resistor is toward the load; and (b) when the resistor is toward the source. So, substituting for E and I in the e_o equation for each case,

$$e_o = jwM\ \left(\frac{e_f + e_r}{Z_o} + \frac{e_f - e_r}{Z_o}\right) = \frac{jwM}{Z_o}\ (2e_f)$$

$$e_o = jwM\ \left(\frac{e_f + e_r}{Z_o} - \frac{e_f - e_r}{Z_o}\right) = \frac{jwM}{Z_o}\ (2\,e_r)$$

The equations show that the rf voltage from the loop before rectification is directional and proportional to the voltage in the transmission line (due to the forward and reflected wave respectively). Fig. 2 shows that even though E_s is zero, E_r and E_f are still present.

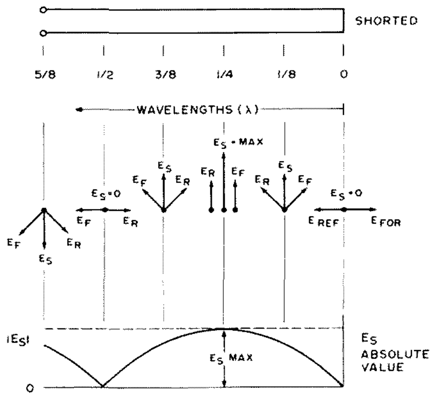


Fig. 2. Diagram of voltage standing waves on transmission line.

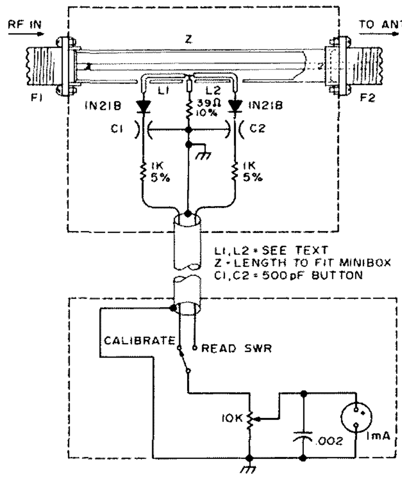


Fig. 3. UHF swr indicator.

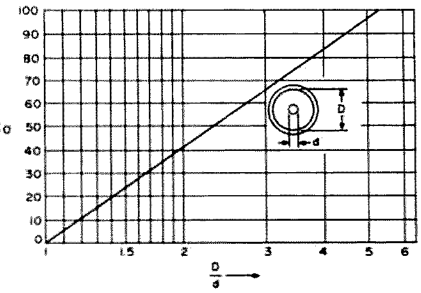


Fig. 4. Ratio of diameters to line impedance.

The frequency limits of the indicator are exceeded when resistor R is not very much lower than distributive element C, and when mutual inductance M is not nearly purely reactive.

Construction Details

A length of copper water pipe is used for the wave sampling section of the transmission line. The use of tubing helps to maintain a constant line impedance, keep the inner field distortion to a minimum, and radiation leakage down. For the center conductor, a #7 or a #3 AWG copper wire will provide a line impedance of 75 or 50 Ohms, respectively. Thin wall model builder's brass tubing of equivalent o.d. was used in constructing the indicator in the article. See Figs. 3 and 4.

To accommodate the sampling loop, drill three 1/8 inch diameter holes ¾ of an inch apart in the copper tubing. Form the insulated sampling loop, and insert the leads through the three holes. Single conductor, tinned, #22 AWG, with thin wall insulated sleeving added, maintains its shape better than stranded wire for the sampling loop. With 3/8 of an inch lead protruding out of each hole, temporarily bend each load so as to make the loop captive. This will help prevent the loop from slipping out of position during the fastening of the end fittings.

Solder the end of the conductor selected for the center lead to a mica-filled SO-239 coaxial fitting. Other types of fittings such as the N or the BNC may be used, but different mechanical arrangements will be required.

The other SO-239 fitting requires modification if no other holes are to be drilled in the outer copper tubing. The modification consists of removing the center pin of the connector. Depending upon the brand and vintage of the connector, some pins are removable by a simple "C" ring clip. Others have a rolled-in ridge for fastening, etc. After the pin has been removed intact, use a drill to establish clearance so that the pin can be freely inserted from the rear side of the connector.

Temporarily slide the copper tubing and loop subassembly over the center conductor with the fitting previously connected to one end. Determine through inspection the proper length the center conductor should be to permit the recently removed center pin to slide into the fitting with the slightly enlarged hole without protruding. The fitting must also butt against the end of the outer copper line. After the proper length has been determined, solder the pin to the center conductor.

Make two rings about 3/8 of an inch long by cutting the ends off a standard copper elbow or coupler section. With all burrs removed, the rings, line, and end fittings are ready for soldering. A 250 Watt gun or iron will speed the assembly.

If the assembly is to fit inside a ready-made minibox, the box selected and the length of the line should be compatible. The box will help keep the sampling loop from being disturbed once positioned. A ¾ inch hole in each end of the box is required, with one hole slightly elongated, so that when the box ends are sprung back slightly, the line assembly may be inserted. The assembly of the rest of the components is straightforward.

To adjust the loops, the line should be inserted into a transmission line, first in one direction and then the other, until the two sets of readings are almost identical (except reversed). Once obtained, place a drop of quick-drying model cement at each of the sampling loop exit leads, without disturbing their placement. Fig. 5 is a typical meter scale.

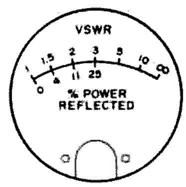


Fig. 5. Typical vswr meter scale.

If the 1N21Bs and resistors have been matched even with the humble ohmmeter, and the parts layout is reasonably symmetrical, little effort should be required to position the pickup loops.

The line and meter may be mounted together in a larger single box if desired. It may also be desirable to use a set of connectors in the interconnecting cable to insert an extension cable when needed to provide remote readings during backyard antenna matching sessions.

The directivity of this indicator, and its ability to discriminate between forward and reflected wave components from 50 MHz to 500 MHz (and maybe even higher), is excellent. The use of type N fittings is recommended for frequencies above 500 megahertz. ■

Raymond Barnum WA4MFT
Homer GA 30547

At Last! A 10m Band Plan

-- requires a CB radio

Here is a plan to use CB rigs on 10 for a worthwhile purpose. If a large number of amateurs go for the idea and equip themselves with a converted CB rig, the result could be a real feather in the ham's cap.

My plan calls for the conversion of the so-called "synthesized" 23 channel rigs to operate with 23 channels on 10. These channels would have uses designated for them as depicted in the accompanying chart. Rag chewing, DX, and routine net operation would be possible with this system, but the real value of it would be seen in a communications emergency.

Where the Citizens Band could be expected to be almost useless in a real emergency due to the immense numbers of undisciplined operators that inhabit its channels, the training and discipline of hams could be expected to yield a very effective local communications system. Because of the fairly low expense involved (compared, say, to 23 channels of coverage on the six or two meter bands), there should be quite a few hams who would provide themselves with the capability to participate in the system.

The rigs themselves are almost ideal for this use; they are small, light, all solid state, and made to operate on 12 to 14 V dc. Most have noise limiter circuits and are very adequate receivers. Conversion for the plan presented here can be accomplished in one evening for around thirty dollars (the cost of six new crystals). To make the conversion, one needs a schematic (usually supplied with the rig), a soldering iron for small work, and the ability to identify and work with basic electronic components. Most hams are so equipped.

The conversion involves changing 6 crystals in the rig. These crystals are in the 37 MHz range; each is to be replaced by a crystal whose frequency is exactly 2 MHz higher. The exact frequencies can be found by consulting the schematic or by looking at the original crystals in the rig. The replacements can be ordered from a manufacturer like International Crystal. Once the changes are made, the receiver and transmitting circuits must be peaked for best sensitivity and power out; my Radio Shack Mini 23 required no other changes. My other CB rig (Royal Sound Model 336) has a similar schematic and should give the same result, though I have not tried it. If you have difficulty, contact another ham who has had some successful experience modifying commercial gear. The detailed conversion of a variety of these rigs is beyond the scope of this article.

Channel	Frequency	Proposed Use
1	28.965	Calling & Distress
2	28.975	Emergency Traffic
3	28.985	Emergency Traffic
4	29.005	Net
5	29.015	Net
6	29.025	Net
7	29.035	Local Rag Chew
8	29.055	Local Rag Chew
9	29.065	Local Rag Chew
10	29.075	Local Rag Chew
11	29.085	Local or DX Rag Chew
12	29.105	Local or DX Rag Chew
13	29.115	Local or DX Rag Chew
14	29.125	Local or DX Rag Chew
15	29.135	Local or DX Rag Chew
16	29.155	Local or DX Rag Chew
17	29.165	Local or DX Rag Chew
18	29.175	Local or DX Rag Chew
19	29.185	Local or DX Rag Chew
20	29.205	DX Only, Short Contact
21	29.215	DX Only, Short Contact
22	29.225	DX Only, Short Contact
23	29.255	DX Only, Short Contact

Table 1. Channels 7 through 19 could be pre-empted for emergency net traffic, should the need arise.

The purpose of this article is to propose a way in which converted CB rigs can be used on one of the ham bands that is apparently under-used and in danger of being lost to amateurs. The idea has potential, but is obviously not completely worked out. If you have objections to this proposal or suggestions on how a better system can be set up, by all means put them on paper and send them to either the editor or myself. Certainly the establishment of such a public service oriented communications system would attract favorable press coverage and the amateur's use of the rf spectrum would be given added justification. ■

Event Timer With Memory

- - double check gravitational laws

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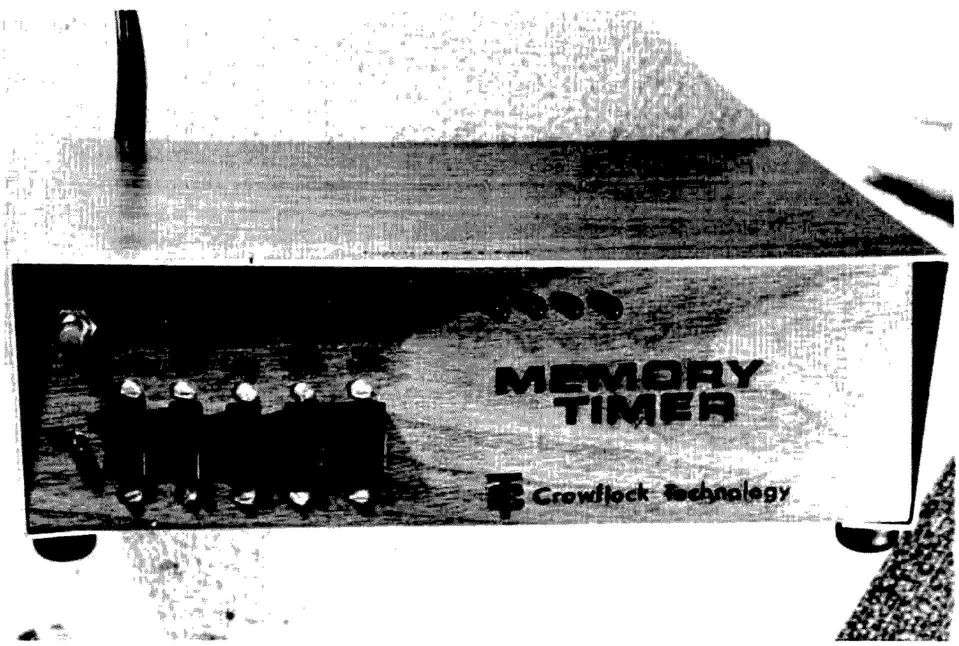
Columbia MD 21045

After observing the dubious method used with a crummy timer by my high school's physics teacher to demonstrate the theoretical relationships between distance, speed, acceleration, mass, and time, I decided there must be a better way.

In the true spirit of engineering, I went home and (with time off from homework) worked feverishly on a solution to the above-mentioned farce. "This can be done with digital logic," I grunted, since I am a hopelessly confirmed logic freak. So . . . I whipped out my battered TTL data book and started scrawling those funny looking symbols. The next day I discussed it with the physics teacher – and was commissioned with $45 to build it for the school.

Enough about why – what's it supposed to do? Briefly speaking, the device will time several events with 2 digit resolution using either 1 or 1/10 second accuracy. The time elapsed for an event since initial triggering (t = 0) is both instantly displayed and written into the memory.

At present, an operator must trigger the circuit manually when an event occurs; an automatic triggering option is planned to be added soon. After all the events have occurred (up to 16 times may be stored), the times of the events may be read out at the operator's convenience. (Sound like a stopwatch? It is – in a remote sense.) Also, for those who like blinking lights, a free run mode is available which simply counts off seconds or tenths of seconds on the display.



The metalworking for the front panel was done with a drill and with flat and triangle files.

How Does It Work?

By referring to Fig. 1 and Fig. 2, one sees that simply by pressing RESET, the address counter is preset, the counter chain is cleared, and the clock is disabled. Now, if a storage of "event times" is desired, RUN/READ must be at RUN, FREE RUN/MEM must be at MEM – and don't forget to select the range with the S-S/10 switch. After the device is reset, watch what

happens when the MAN TRIG switch is hit: The S-R FF is set, enabling the clock, and the address counter is incremented to 0000 binary. Meanwhile, that delayed one shot, triggered, just sits back for around a microsecond, waiting for the address counter to ripple through. When the address is stable . . . *bam*! goes a 1 microsecond negative going pulse on the write line, the data shoots in the memory and appears on the readouts a little while later!

Subsequent triggering initiates the above nonsense again, with the exception that the clock is not enabled, simply because it already *was* in the initial triggering, and since then has been toggling away at the decade counter chain.

To read, the reset switch is pressed, and the READ/RUN switch is set to RUN, opening the write line. The times are then read out sequentially from the memory on the display.

In the FREE RUN mode, the write line is disabled again, but this time the memory $\overline{WR}$ pins see the gated clock. In this fashion, the memory is used as an exotic "latch," updating the output of the last two decade counters to the displays one thousand times a second. The address on the memory in this mode is irrelevant.

Construction

The acquisition of components for this project was quite an exercise in penny pinching. Exactly $45 was spent after the parts shopping spree. Note that the parts include the case, transformer, breadboard, ICs, etc. — in other words, everything needed. The spacers used to mount the boards were made from copper tubing — cut, constricted, and tapped for 4-40 screws. The interconnection wire was pulled from an unused multi-conductor cable. Talk about being cheap!

The electronics were constructed on *two* breadboards, a nice master-slave arrangement that minimizes space requirements and (usually) interconnections. The prototype boards were wired literally point to point; that is, wiring was done by soldering the wire directly to the two points concerned — using insulated wire, of course. Upon completion, the undersides of the boards would confuse a rat looking for its nest, but the technique worked anyhow.

Two points that must be stressed are that power and ground buses *must* be heavy gauge wire, and that a .01-.1 microfarad capacitor must be connected with short leads between +5 V and ground every few centimeters along the power bus. The reason is that TTL ICs generally create garbage on their supply lines, and this garbage can confuse ICs further on down the power bus unless effectively bypassed. (A good rule to follow is to assemble the boards and *then* solder the capacitors on, every two ICs or so.) Just another ounce of prevention, folks.

Because the readouts have no limiting resistors and because of other shortcuts, the current demand hovers around 900 mA. The LM309K 5 V regulator runs

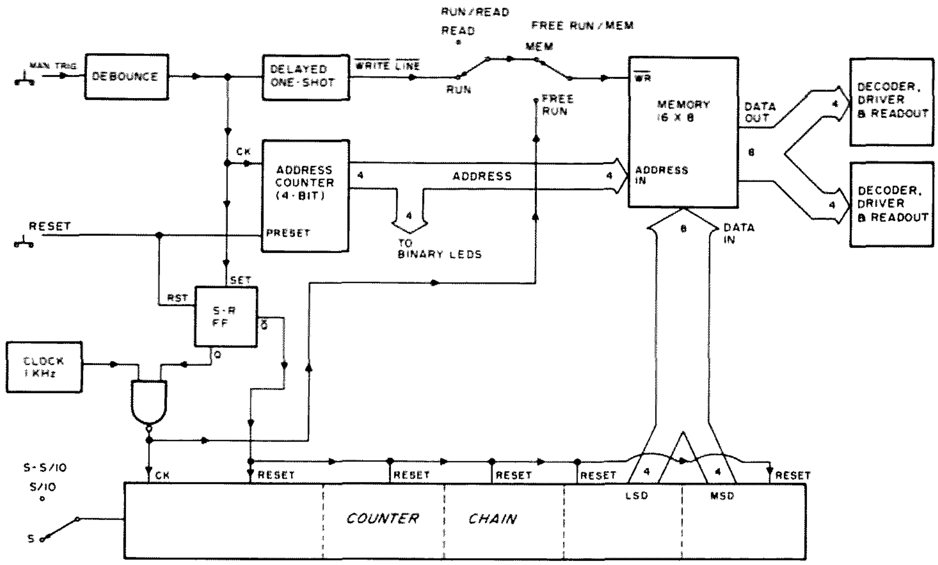
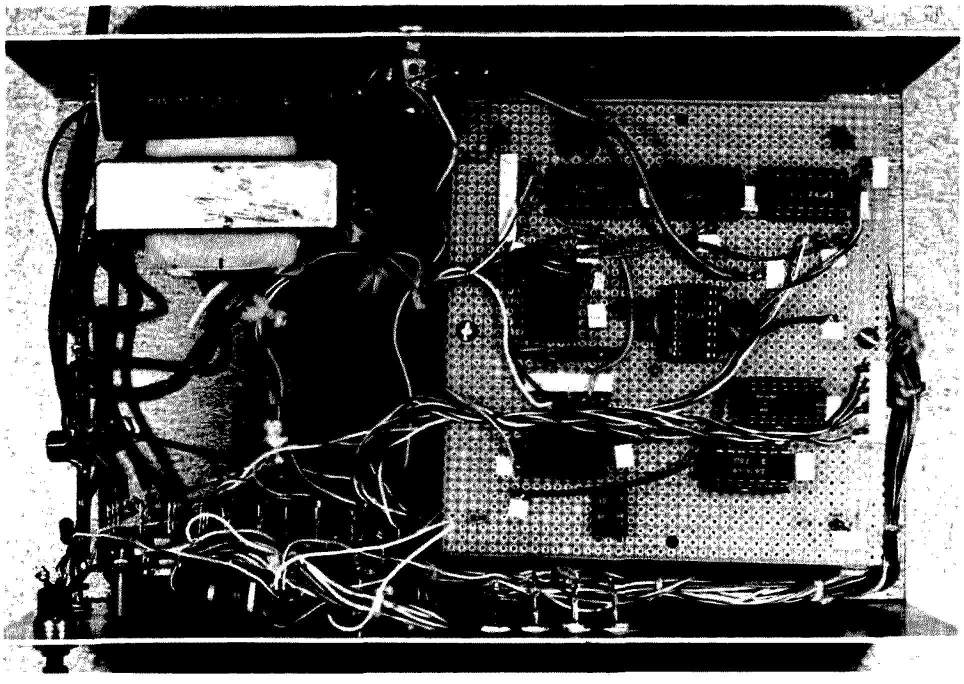


Fig. 1.



Top view. Quite a mess, but judicious use of color-coded wires simplified debugging enormously.

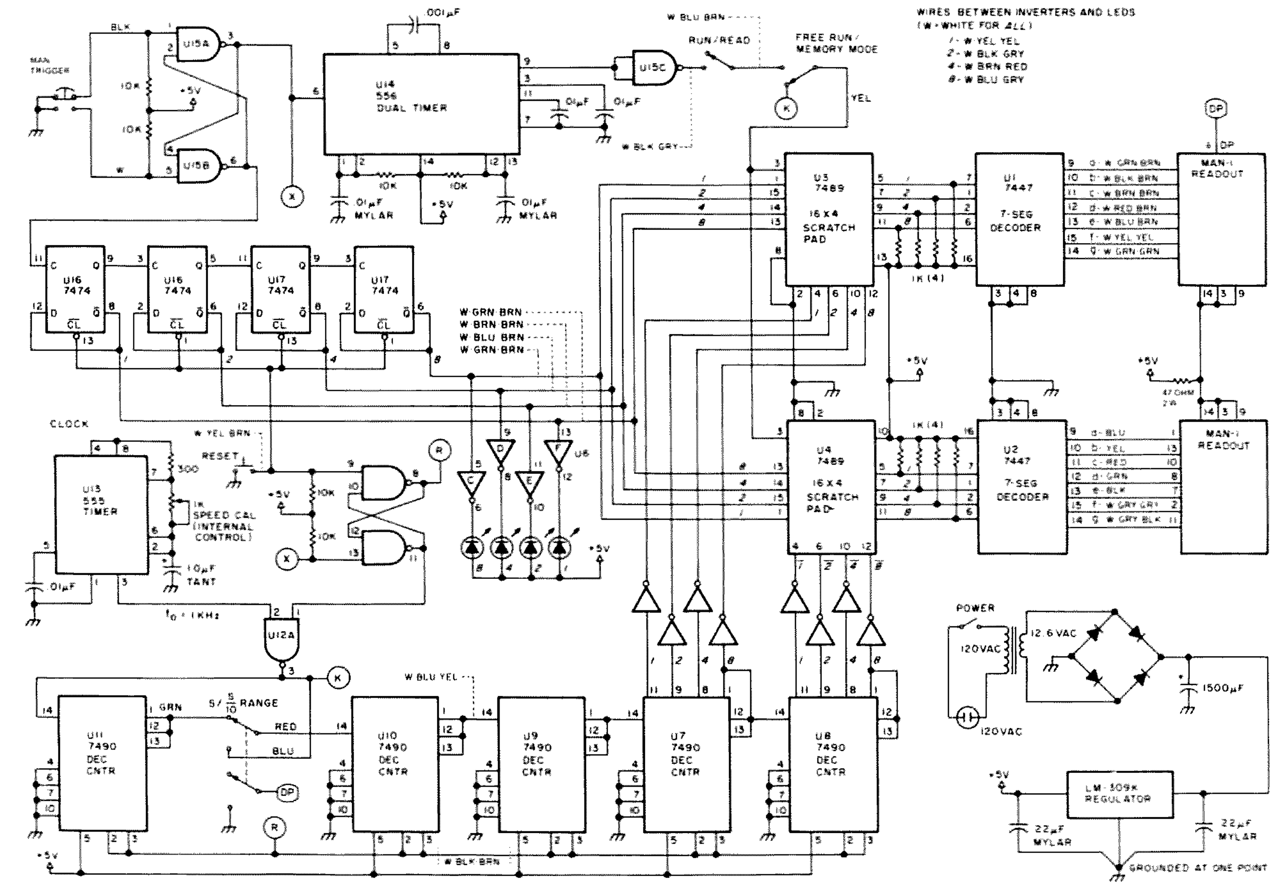
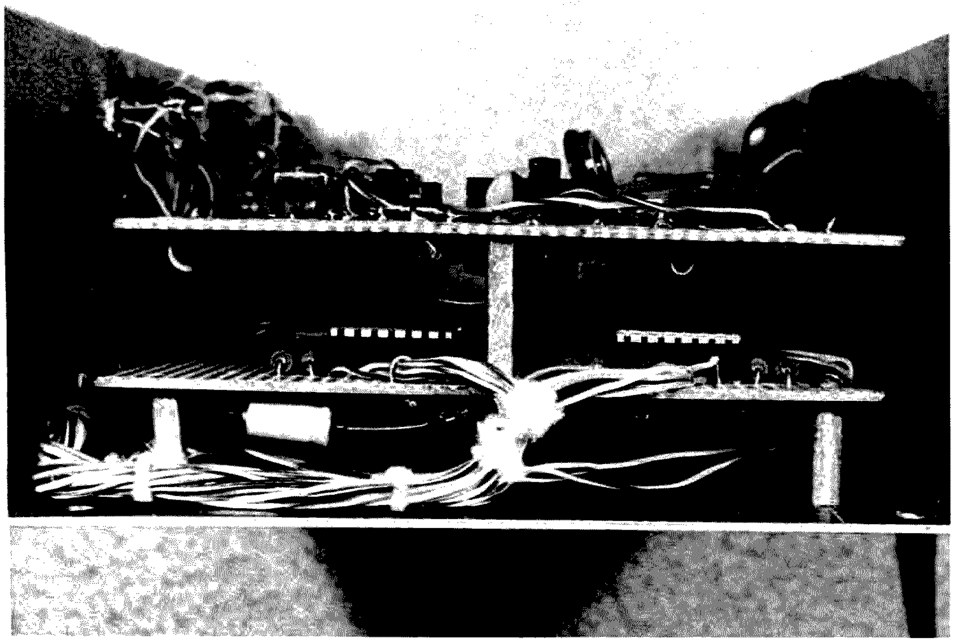


Fig. 2.

moderately hot, not scorching, but still stays in spec. In fact, the regulator is rather hard to destroy, in that it will shut itself down if too hot.

The debugging equipment consisted of a Dumont 304-H oscilloscope, a cheapie VOM, and a homemade logic probe – truly not an expensive troubleshooting lab.

A final remark about construction: The finished appearance will only be as good as how carefully one builds it; the number of tools in the tool box does not necessarily determine the final appearance.



Side view showing stacking of boards and cable ties made of cotton string.

What's It to Me?

It could not be said what one could possibly use the timer for. However, it obviously has applications other than as a peculiar conversation piece. Not only did it win honorable mention and an SR-11 calculator in the Baltimore Science Fair, but also building it and learning from my mistakes while debugging it was half the fun.

If you build it, I encourage you to add embellishments and change it if you like. Since the circuit itself reflects many features of TTL technology, you'll learn from it. Make it a creative project. ■

Sheet Metal Brake

-- build microwave components

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The ham who builds his own equipment often winds up with one final problem: What kind of a box do I put it in? Small cabinets are not always easy to find, especially when one considers problems of size and appropriate configuration, and the difficulties of "shoe-horning."

The answer is to make one's own cabinets, each custom designed to fit the project it will house. The device to be described in this article won't do everything that the brake in a sheet metal shop will do, but it will suffice for most tasks.

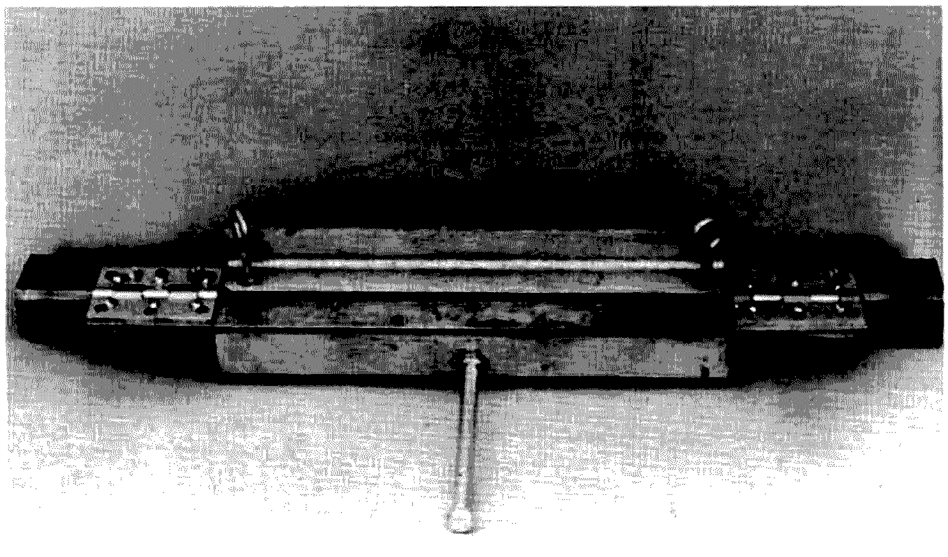
Ours cost less than $10.00 to build, will handle a 10½" bend, and works quite well on the stock normally used for electronics enclosures. It bends aluminum, whether "soft" or "hard," galvanized iron stock, copper, and so forth. It was built with ordinary tools — nothing more exotic than an electric hand drill and 8-32 and ¼-20 taps. We advise the use of a drill press, if you have one, but it is not imperative; further, you can do without the taps if you don't have them.

We built our brake out of 5 feet of 1¼" angle iron, obtained from a local hardware store, a pair of 3" butt hinges, two dozen 8-32 x 3/8" machine screws (half flat head and half round head), a 3/8" x 6" machine bolt, with two nuts and a lock washer to fit, and two ¼-20 x 2½" eye bolts, with nuts. If you do not choose to tap the 8-32 holes, you'll also need lock washers and nuts for the 8-32 machine screws.

Now, before you run down to the hardware store and buy all this stuff, read through the rest of the article. Further along, we'll suggest a couple of possible modifications which, if you can arrange them, may simplify things considerably. Also, they'll mean your purchases will be a bit different.

Let's take a moment now to identify the major parts of our sheet metal brake. We're frank to say that we could find no reference which would tell us the real technical names of these parts, so we made some up and believe they will suffice.

First, there is the *bed*, on which one places the piece of sheet metal to be bent. The work piece is firmly clamped to the bed by means of the *shoe*, which holds the work accurately in place, and provides a radius against which the bend is made. The actual bending is accomplished by means of the *bar*, which is hinged to the bed. To the bar must be attached a device of some kind to provide the leverage necessary to make the bend. That's where our 6" bolt comes in. And, by the way, when you do get to the hardware store, pick up a couple of extra hacksaw blades. You'll need them!



Let's go on the assumption that you are building the brake out of 1¼" angle iron, as we did, and to the same dimensions. And, by the way, it doesn't have to be 1¼" angle; it could be some other size, but probably shouldn't be less than 1". Use what you can conveniently get. In any case, you'll need a piece five feet long. Select it carefully, looking especially at the ends, which often get deformed when a longer piece is cut up. You'll want a piece that is entirely straight and true. When you get it home, cut it into four pieces. Two pieces should be exactly 18" long, one exactly 12" long, and the fourth what's left over — a bit less than 12", because of the saw cuts.

Put the two 18" pieces on a flat surface, back to back, so that they form an inverted "T". Temporarily clamp them together with a couple of small "C" clamps, then turn over the whole assembly and put it in a vise, clamping it securely at the center. Viewed from one end, the two pieces will now form a "T", and the upper surface of the "T" should be absolutely

flat across both pieces of angle.

Now, take a good look at one of the hinges you have bought. Probably each leaf of the hinge will have three countersunk holes in it. However, you're not going to use the hinges as the manufacturer intended. If you did, the hinge pin would not be axial with the juncture between the bed and the bar. To attain this axial condition, simply flop the hinge over, and thereafter ignore the holes made in it by the manufacturer.

One hinge is going to be mounted at each end of the two 18" pieces of angle you are working with. Further, the axis of each hinge pin must be in exact line with the juncture between the two pieces of angle. Line up each hinge carefully, and mark the pieces of angle for cuts which will clear the hinge pin and surrounding metal on each hinge. These cuts, made with a hacksaw, don't have to be super accurate, but they must remove enough metal from the vertex of each piece of angle to allow the center portion of the hinge to drop in, leaving each leaf of the hinge flat against its respective piece of angle (see Fig. 1). In our case, we had to remove about ¼" from the vertex of each piece of angle to a depth of about 3-1/8" from each end.

Once this hacksawing is finished, so is most of the hard labor. Realign the two pieces of angle as before, and put them back in the vise. Put each hinge in its position and, as before, carefully align its pin with the juncture line between bed and bar. Remember also that each hinge goes on upside down,

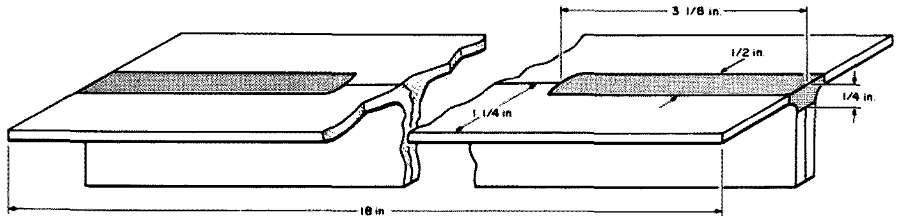


Fig. 1. Enough metal is cut out (shaded areas) to allow room for the hinge pins and surrounding metal.

with its countersunk holes toward the pieces of angle. Moreover, each hinge should now lie flat, with the hinge pin and surrounding metal in the slot you have just hacksawed out.

Securely clamp each hinge in place and center punch on each leaf of each hinge three locations for your 8-32 round head mounting screws. These locations should be relatively close to the hinge pins, yet far enough away to clear the screw heads, and the nuts, if you intend to use them. While the hinges are still clamped, drill out the three holes with a No. 29 drill, which will accept an 8-32 tap. When all holes are drilled, remove the hinges and redrill the holes in the hinges only with a No. 18 drill, which will clear the 8-32 machine screws. If you're going to use lock washers and nuts, you can drill with the No. 18 to begin with. If you are using the drill-and-tap method, with the hinges off, you can now tap the holes in the bed and in the bar, and then remount the hinges. Fig. 3 shows how the hinges mount.

Next job is to mount the shoe. It is positioned atop the bed, as shown in Figs. 2 and 3, and is a 12" piece of angle. Carefully align one edge of the shoe with the juncture of the bed and bar, and clamp it in place. Then, about ½" in from each end, drill through both the shoe and the bed with a No. 7 drill, which will accept a ¼-20 tap. Remove the shoe and redrill the two holes in it to clear the ¼" x 2¼" eyebolts which will be used here as clamps. Use your ¼-20 tap on the two holes in the bed. Run a nut about ½" on each eyebolt before installing it, and you will find that the combination will clamp the shoe firmly to the bed.

Again, if you are not going to tap the holes in the bed, you will find it necessary to devise an alternate method of clamping. Later on you will see that we attached the brake to a piece of 2" x 2" lumber to afford a means of holding the brake in a vise or clamping it to the workbench. From this, one method of providing a clamp for the shoe that suggests itself would be to run long quarter-inch bolts through the wood mount, with nuts between the mount and the brake bed, but with the bolts extending through both bed and shoe. Then wing nuts might be used for clamping.

The final task is to provide some leverage for making the actual bend in a piece of sheet metal. We accomplished this by mounting the last piece of angle – the one slightly less than 12" long – to the bar. It was clamped to the bar and seven No. 29 holes were drilled in a staggered fashion across the length of the angle. The clamps were removed and the holes in this last piece were tapped with an 8-32 tap. Holes in the bar were then redrilled to pass the 8032 machine screws, and countersunk so that the flat head screws would be flush with the surface of the bar.

If any screw heads are slightly cocked, they should be filed flush. If problems still remain, all is not lost. When a piece of metal is to be bent, a thin sheet of paper or plastic slipped between the work piece and the surface of the bar will protect it.

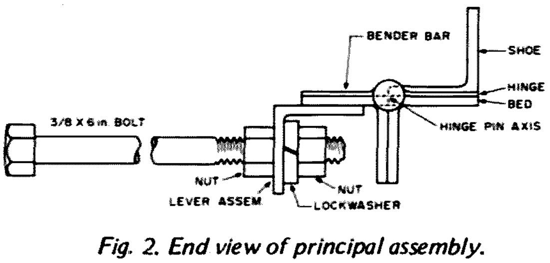


Fig. 2. End view of principal assembly.

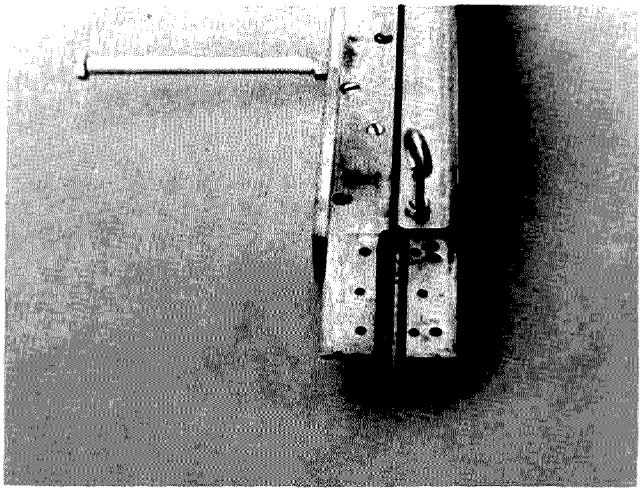


Photo shows how ends of pieces of angle iron are hacksawed out to provide mounting for hinges.

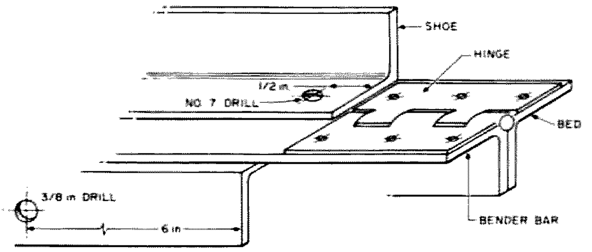


Fig. 3. Hinge positioning and location of bending lever.

Here again, if the builder does not wish to tap the holes for the 8-32 mounting screws, he may drill the holes to clear them and use lock washers and nuts on the under side. If this is done, precaution should be taken to drill the holes in positions so that there is room for the nuts on the underside of the angle.

The final step is to add the 3/8" x 6" machine bolt to the outer face of the piece of angle we have just attached to the bar. Simply find the center of the outer face of that piece of angle, and drill a 3/8" hole through it. Run a nut on the machine bolt about ½", put the end of the bolt through the 3/8" hole, and secure it on the inside with a lock washer and nut.

It is at this point that a couple of attractive alternatives suggest themselves. Note that when this last piece of angle has been attached to the bar, these two pieces form an inverted "U", as shown in Fig. 2. Since the means of attachment is unimportant, so long as it is sturdy, the two might be welded together, if you have access to welding equipment. Note, however, that if any portion of the welding bead extends above the face of the bar, it will have to be ground or filed off, to prevent marring the work.

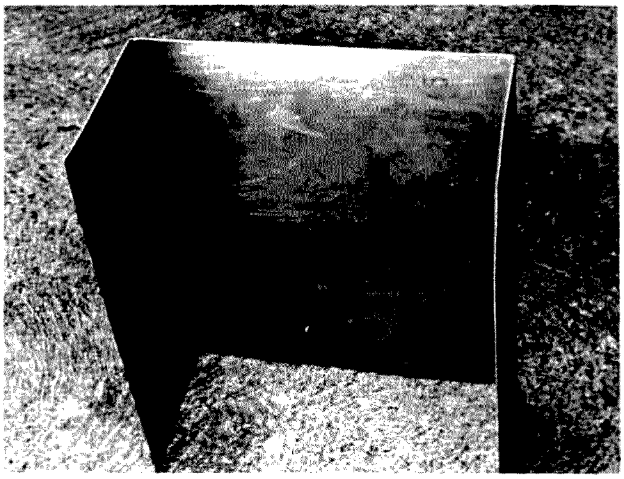


Photo shows half of a cabinet produced with the brake described.

Even more attractive is the idea of substituting a piece of channel for the bar, and perhaps even for the bed. This would obviate the use of screws, welding, or any other means of attachment.

As indicated earlier, some means must be devised to hold the brake securely while it is in use. We simply used wood screws to attach the bed to a piece of 2" x 2" lumber about two feet long. When not in use, the brake may be stored in an obscure corner. To use it, we simply clamp the 2" x 2" to the bench with a pair of large "C" clamps, or hold it in a vise. ■

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The Easy Ammeter

- - current news

Have you ever wanted to measure the current flow of a particular transistorized device that is sitting on your workbench?

If you are like most of us, you are basically lazy and sometimes bypass this important step, due to the inconvenience of breaking the power lead and then having to resolder it again.

Here's a really easy way to measure current flow. Since most transistorized gear is powered from a battery pack of some sort, all you have to do is stick a piece of double-sided printed circuit board between any two batteries, as shown in the diagram.

Touch the two meter leads to each side of the PC board and there you have it — instant current reading without cutting and soldering any wires. ■

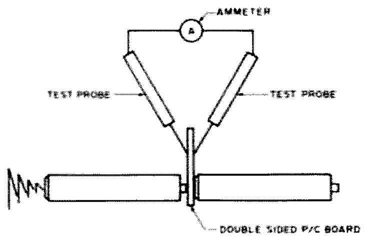

Fig. 1.

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Try a Conduit Vertical

- - low angles are great for DX

Ever since my Novice days, not all that many years ago, I've been spending most of my time on the air in search of that increasingly elusive critter known as "DX". However, with the serious decline in the sunspot cycle and sometimes total lack of DX on the air during this past year, I found I was spending more time in good old-fashioned rag chews. As a result of working some states on bands I'd never worked them on before, I became interested in trying to achieve 5 Band Worked All States.

The first problem I had was in getting back on the 80 meter band. After upgrading from Novice, I had sold off my 18 AVQ allband vertical in favor of a beam with which I set out to chase DX. Having nothing really suitable enough from which to string a good dipole antenna, I decided on a ground mounted vertical. Now, the handbooks are replete with vertical antenna designs, but few ever suggest means for building an unguyed, free-standing configuration by using easily obtainable materials. I recalled that when I had first gotten on the air as a Novice, I built myself a home brew rotatable dipole for 15 meters. You may recall this old *ARRL Handbook* design, which utilizes two ten foot lengths of 1/2 inch thin wall electrical conduit mounted on a short length of 2" x 2" redwood with standoff insulators. I felt this same type of construction should work in home brewing a vertical.

I found that thin wall electrical conduit of 1", 3/4", and 1/2" would telescope into one another, but not with a sliding fit. By cutting a couple of two inch lengths off the ends of the 3/4" section and slitting them lengthwise, I was able to expand these small sections to fit around the end of the remaining length of 3/4" conduit as shims, spaced about 8" from one another (see Fig. 1). This shimmed end, with the help of a little electrically conductive lubricant, was easily forced into one end of the 1" conduit.

To insure electrical continuity and to prevent slipping of the two sections, I drilled radial holes through the two joined sections at the shim locations and inserted heavy pan head sheet metal screws.

The same procedure was followed in telescoping the 1/2" conduit into the other end of the 3/4" conduit. To prevent corrosion at the joints, it is suggested that they be sealed at their ends with a bead of automotive grommet sealant or vinyl electrical tape.

When the three lengths of conduit were fastened together, I prepared a vertical support using a 4 foot length of 2" x 4" redwood. Four 2" standoff insulators were mounted on the redwood support, and equally spaced from one another, beginning at approximately one foot from one end. A fifth standoff insulator, which may be of smaller size, is attached at the free end. The one inch conduit section is then fastened to the ends of the four insulators using loops of 3/4" perforated metal stripping which is available in most hardware stores (see Fig. 2). To prevent the conduit from sliding down through the loops when the finished antenna is elevated, pan head screws are inserted through holes in the loops and fastened to the bottom conduit section.

Since the finished length of the three telescoped sections of conduit is approximately 27 feet 4 inches, it will be necessary to add an adjustable base loading coil to enable the finished antenna to resonate properly at various frequencies. One end of this coil should be fastened to the bottom end of the one inch conduit section, and the other end is fastened to the unused standoff insulator (see Fig. 3). An SO-239 coax fitting should be mounted on the lower end of the redwood support, near the end of the loading coil fastened to the standoff insulator, by means

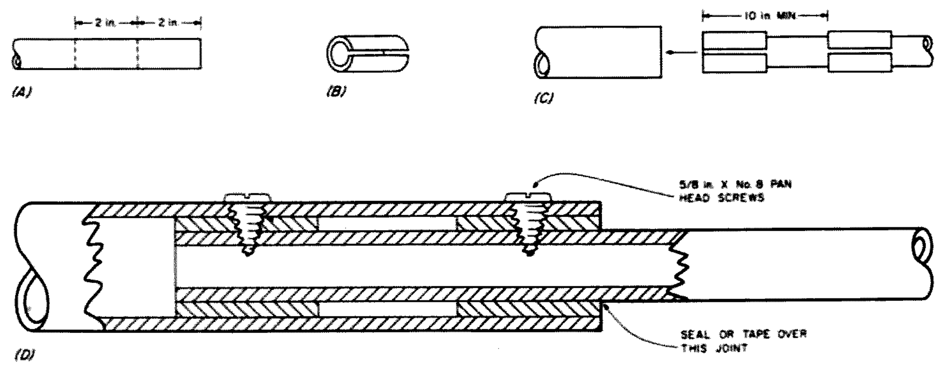

Fig. 1.

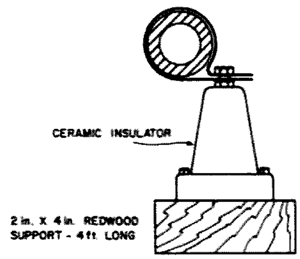

Fig. 2.

of a right angle metal bracket. A short length of wire, to serve as a coil tap, is run from the center conductor of the SO-239 coax fitting to the desired resonance spot on the loading coil, and soldered at each end. The tap location on the loading coil is a fit-and-try operation after the antenna is erected and placed on the air, the object being to find the tap location which gives the lowest swr at the desired operating frequency.

If you intend to use the antenna for more than one operating frequency, you will need to have a small clamp connection on the tap wire which will allow you to move its location on the loading coil. If your station includes a transmatch or similar matching device, you may eliminate the loading coil and simply run your tap wire directly from the coax fitting to the lower end of the one inch conduit. Loading of the antenna is accomplished by simply tuning the transmatch for lowest swr.

Having completed assembly of the antenna and its support, it is a simple matter to fasten the redwood support with U-bolts to a pipe of at least 1-1/2" diameter driven into the ground a minimum of 4 feet. Get some help in elevating the antenna and mounting it on the pipe, however, because it is not a lightweight antenna, and you will very likely break the ceramic standoff insulators if it falls to the ground.

As with any vertical antenna, a network of radials should be securely connected to the ground side of the SO-239 coax fitting at the base of the antenna. A few eight foot ground rods, also connected to this ground side of the coax fitting, should be driven into the ground equally spaced from one another on a 12" radius from the support pipe.

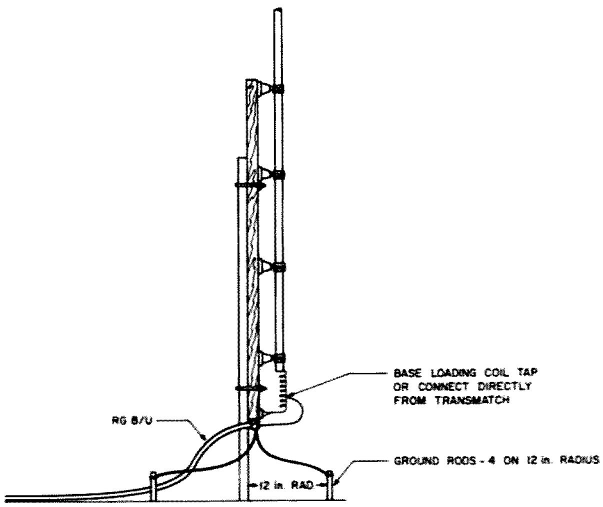

Fig. 3.

This antenna has been in operation at our home QTH for nearly a year and has stood up well to windstorms with no damage. We have managed to obtain many of the QSLs needed for 5 BWAS on 40 and 80 meters using this antenna, and it has also operated well on 40 and 80 meter DX in the most recent CQ WWDX contest. It has also performed admirably in acquiring those states needed for the Bicentennial Worked All States Award.

If you want a good antenna for 80 and 40 (and other bands for that matter), the electrical conduit vertical is a cheap and effective way to go, especially if you don't have the room, or inclination, to string up one or more dipoles. ■

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The IC-PC Connection

-- convenient and cheap

Having become enveloped in the digital mania, and breadboarding many circuits, I came across a problem that I'm sure many have stumbled across. As the projects became more complex, I found the wires coming off the perfboard it was constructed on more numerous. This becomes a big headache when modifying the circuit and having to unsolder, then resolder, all those darn wires. A cheap, but easy, connector was the only way. Not wanting to spend all my time hunting around for the right type of connectors, I decided to gamble and sent off for some ordinary "Soldertail Standard" IC sockets hoping they would be easy to modify. Luckily they worked out quite well, and I'm surprised no one has thought of it before. Since from 8 to 24 pin (and greater) IC sockets are easy to latch on to, the quantity of wires coming off the board presents no problem. Here's how it's done.

First, that socket pops apart by snapping off the cap or top section, leaving you the base or bottom section. Those things you're picking off the floor are the pins. The pin holes in the cap need to be drilled out wide enough to accommodate the width of the wire, and the pins have to have the formed spring contacts bent apart so the wire can slip down between them. The pins are a little difficult to work with, so be patient, and whatever you do don't do this over a shag rug because the only way to find a lost pin is the hard way, barefoot and unexpected.

To put it together, just thread the wire(s) through the cap, strip off 1/16" of insulation and solder to the pin. Once all the other pins are completed, slide the pins back into the base and slide the cap down until it snaps in place. Fini! When using ribbon cable, the end product looks good enough to use these connectors on the finished project when laid out on etched circuit board. Since "Soldertail Standard" sockets when used as the male connector won't plug into a "Low Profile" socket, you will have to use the "Soldertail Standard" for both male and female. ■

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An 82S23 PROM Programmer!

-- now build those projects using one!

The 82S23 is merely the Schottky version of the 8223 programmable read only memory which has become popular in home-built amateur radio equipment. A year ago the 8223 was plentiful on the surplus market. Now, however, the supply is drying up because it is no longer manufactured (at least not by Signetics Corporation). Being an experimenter, I bought the Schottky type PROMs when they were offered at the same price as the 8223. I was in trouble immediately. My programmer was the usual simple type the circuit of which has been published in several hobby magazines. Even by using a fusing potential of 15 volts and no current limiting, I could not blow the links.

A Solution

A chance acquisition of the publication, *Signetics Bipolar Memories* (current issue, no date), led to a solution to my problem. Among other things, the manual shows a circuit for programming the 82S23 and the 82S123 (3-state output). Evidently a short rise time and a controlled amount of fusing current are required to completely and permanently fuse the links in a Schottky PROM. Five 1-shots are used to automatically pulse three parameters of the PROM. A hurry-up version of the circuit was put together and it works just fine. No construction details are included in the manual, so a potential builder might benefit from my labors.

The Schottky programmer is complicated and costly when compared with the simpler programmer usually used for home programming of the 8223 (e.g., *RTTY Journal*, February, 1976, page 9). Also, the programmer will not be used often, so the average ham will look to avoid buying parts. Be sure to check all switches to be used in the address and bit positions. Old toggle switches sometimes hang up and toggle later. This could ruin a PROM. I lost one that way even though I had checked and doubled-checked the switch.

Remember that there are two configurations for double-throw toggle switches (something that even the catalogs don't always mention). Some switches have the "ON" position coincident with the toggle handle, and in others the handle is opposite the "ON" position. Wiring will be made more difficult, but be sure to install the switches so the positions of the toggle handles mean the same thing. A quad NAND gate and two 2N697 transistors may be used instead of the dual peripheral driver. A resistor of about 470 Ohms should be placed between the outputs of the gates and the transistor bases. Be careful in using a lower value of dropping resistor to get more brilliance if you substitute LEDs; the DUT (device under test) may have to sink too much current. An SE 9300 family transistor may be substituted for the MJE 1103 (it must be a Darlington type). Be sure to provide heat sinking for all three voltage regulators. The zener diode clamp at VR3 will overheat and fail if pin 3 of the regulator is left ungrounded for an extended period. An additional 1-shot and LED may be used to see if the 1-shots in the circuit are functioning. See page 84 of *Radio Electronics Magazine* for June, 1976.

Referring to page 26 of the Signetics manual, the timing diagram below the circuit diagram indicates the action initiated by the five 1-shots. However, more information is needed to fully explain the operation. See Table 1. CR1-CR3 are the diodes in the base circuit of Q2 (2N2222). Q1 controls the 15 volt input power to VR2. Q3 and Q4 are the substituted 2N697 transistors. Q3 controls output of

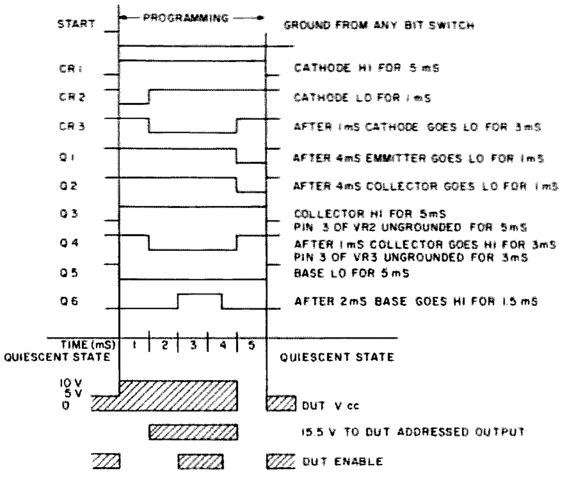
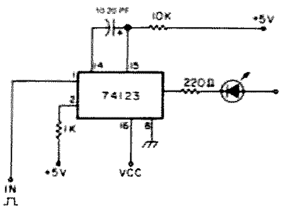


Table 1. Programmer timing diagram.

Fig. 1. Pulse catcher, Radio Electronics Magazine, *June, 1976.*



VR2, 5 volts for DUT verification and 10 volts during most of the programming cycle. VR2 output is forced to zero, however, near the end of the cycle, by action of Q1. Q4 switches output of VR3 from zero to 15.5 volts for fusing the links. Q5 and Q6 are in the NOR gate which enables the DUT. U4 is the substituted quad NAND gate.

With the simpler programmer, an address is selected and about 12.5 volts is applied for (hopefully) ½ second. In the Schottky version of the programmer, fusing operation is as follows:

1. DUT disabled;
2. Vcc raised to 10 volts for 4 ms;
3. After 1 ms (after start of programming), addressed output is raised to 15.5 volts for 3 ms;
4. After 2 ms DUT is enabled for 1.5 ms;
5. Both Vcc and fusing voltages go to zero for 1 ms.

At the end of the 5 ms programming period, conditions revert to their quiescent state (5 volts at Vcc and DUT enabled).

Inasmuch as these memories are irreversibly programmed, the unit should be checked each time it is used (DUT not installed).

U4 (7400) Not In Socket

1. All LEDs lighted.
2. Check 10 volts at DUT socket pin 16.
3. Check logic LO at DUT socket pin 15.
4. Check 15.5 volts at DUT socket pins 1-9 when BIT switches are in the N.O. position and 2 volts when in the N.C. position.

U4 In Socket

1. All LEDs lighted.
2. Check 5 volts at DUT socket pin 16.
3. Check 0 volts at DUT socket pins 1-9 when BIT switches are in the N.O. position and 5 volts in the N.C. position.
4. Logic LO at DUT socket pin 15.
5. Check 5 volts at DUT pins 10-13 when ADDRESS switches are in the "1" position and 0 volts when they are in the "0" position.

It is well to check that the DUT has not already been programmed or has missing bits for some other reason. After checkout of the unit as above, use the following procedure to verify the status of the DUT.

1. Set ADDRESS switches to the "0" position.

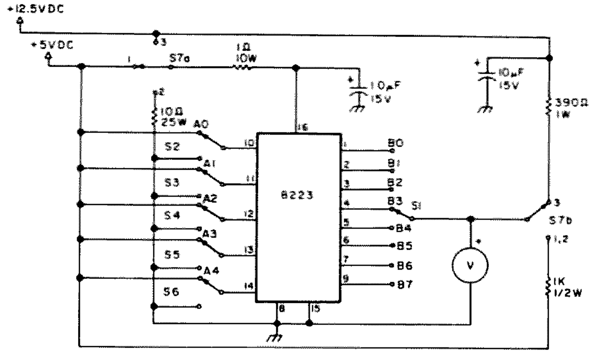


Fig. 2. "Simpler" programmer circuit.

2. Set BIT switches to the N.C. position.
3. Insert DUT.
4. Any LEDs that are lighted indicate blown links at address 00000.
5. Check other addresses as appropriate by setting the ADDRESS switches. (Do Not Touch The Bit Switches.)

Operation

Programming the DUT is pure simplicity, but attention to detail is enforced just as in any programming.

1. Set ADDRESS switches.
2. Actuate required BIT switch to blow the link.
3. The LED will light.
4. Actuate any remaining switch for logic "1" at that address.
5. Set next address and continue.

Conclusion

This programmer for Schottky PROMs works fine for the non-Schottky 8223. Industrial users of PROMs are not always so lucky with their exotic, automatic programmers. One $8,000 machine will program the 82S23 but not the 8223. There are substitutes for the 8223 and 82S23 but caution is advised; there are subtle differences. For instance, in some units, the outputs are programmed from "1" to "0" instead of from "0" to "1" as in the 8223 and 82S23.

A review of other programmer circuits in the Signetics manual makes it apparent that a "universal" programmer could be built to program at least all of the Signetics PROMs of this type. A universal programmer would make an excellent club project. In addition to automatic identifiers for repeaters and RTTY, the impact of microprocessors is beginning to be felt by almost everyone. As more "software" becomes available, operators will want some of their short routines stored in "firmware." ■

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Practical P.S. Design

- - do it right this time

One of the most common types of articles published is that on the building of a power supply. Usually the power supply will be a 12-14 volt unit which is capable of providing 3 Amps or so, which will power most solid state VHF transceivers. What is apparent from reading these articles is that most hams do not really understand power supply design, and, because of this misunderstanding, will waste parts and end up with a design which is not doing what the builder wants. This article will try to reveal some of the more common pitfalls, and present a simple design which will provide good, safe, general service.

The first part of any power supply to look at is the power transformer, diode rectifier, and filter combination. We want to get a transformer with a rating of greater then 12 volts, since we want a regulated output of 12-14 volts. It would be best to get a transformer of about 15 volts rms rating, but this is not a very common transformer. A transformer of a higher voltage rating (20 volts or so) is OK, but this would mean the regulator would have to dissipate a lot of heat, which wastes power.

About the best we can do is get a transformer which will deliver a solid 12.6 volts at 3 Amps. Some of the less expensive transformers will drop several volts at full current — try to avoid these. You may wonder how to get a regulated 12.6 volts from a 12.6 volt transformer. The trick is in the rating of the transformer in rms voltage. Since ac voltage is constantly changing in value, at any given instant its absolute voltage may be anything from zero to the peak value. Because of this, ac voltage is given based on how much work it will do. 12.6 volts ac rms will do the same work (heating a resistor) as 12.6 volts dc; however, the peak ac voltage is 1.414 times the rms voltage. A simple rule of thumb is, "split rms in two, and add this figure to the rms." This would say, 12 volts divided by 2 equals 6 — add this to 12 for 18 volts peak.

This method gives a ballpark figure which is close enough to work with. Using this figure of 18 volts, I know I want rectifier diodes which have a reverse breakdown rating of greater then 18 volts, and can handle current in excess of 3 Amps. This part is easy, since most power rectifier diodes handle at least 25 volts. In selecting the diodes, it is best to allow a margin of safety to allow for current surges and voltage spikes. The turn-on current surge could damage the diodes when the power supply is first turned on, but the resistance of the transformer's winding is usually enough to protect the diodes (which are able to handle currents on the order of 50 times the diode rating) for a very short period of time. In this case, a 5 Amp, 60 volt bridge would be good.

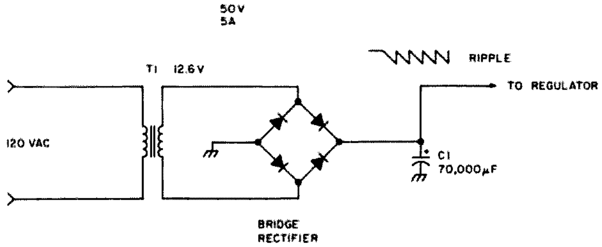

Fig. 1.

Now comes the filter. There are several types of filters, but we will only go into the most common, which is the capacitive input type. This filter is simply a capacitor across the output of the rectifier. This capacitor will, under no load conditions, charge to the peak value of the voltage from the transformer, or, in this example, to about 18 volts. The capacitor must have a voltage rating of at least 18 volts (preferably 20 volts). One of the major pitfalls is encountered in the selection of this capacitor. It does not need to be so large as to give pure dc at full load. Its value should only be large enough to prevent the voltage drop between charging pulses from the rectifier from dropping below the point where the regulator falls out of regulation. Most regulators will require no more then 3 volts across the series pass transistor to maintain regulation. That being the case, we may have 18 V-12 V plus 3 V for 15 volts minimum before dropping out of regulation. Fifteen volts minimum from 18 volts maximum gives a maximum of 3 volts allowable ripple. To have a larger capacitor and less ripple serves no useful purpose and wastes space with the larger capacitor. To figure this capacitor value, figure the regulator impedance as seen from the filter capacitor under full load: 3 Amps (full load), 18 volts (peak charge), divide (E/I equals R) 18 V by 3 A, giving us 6 Ohms.

A simple review reminds us that T equals RC, or resistance (in Ohms) times capacitance (in farads) equals time (in seconds) for a 63% charge or discharge of a capacitor. If we draw the discharge curve of a capacitor and label the top as the peak 18 volts, and the 63% discharge point (6.6 V), we can now see what percentage of the discharge time it takes for the capacitor voltage to drop below 15 volts (regulated output voltage plus 3 volts). In this case I will refer to the *Amateur Handbook*, where there is a printed graph which shows time constant vs. percent of discharge. The 3 V allowable discharge is about 16% of the charge which becomes, on the graph, 84% charge at about .2 time constant. As you can see, a greater peak voltage would allow more ripple to play with, and hence a smaller filter capacitor. In this case it will require 5 (1/.2) time constants to not drop below 84% of charge between charging pulses from the rectifier. The power supply will be running from 60 Hz ac and the full wave rectifier will put out charge pulses at a 120 Hz rate, or one pulse

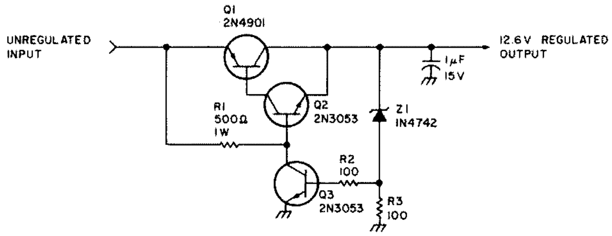

Fig. 2.

every 8-1/3 ms. Five times this figure gives a required time constant of .416 seconds. Now we know that R equals 6 Ohms and T equals .0416 seconds, and that T/R or .0416/6 equals .0069333 farads or 6,933 uF. This says that with the transformer and current requirements given, this power supply needs 7,000 uF for filtering.

After what has just been discussed, to remain pure I must mention that the regulator does not remain a constant 6 Ohms. This is because the regulator adjusts to maintain regulation and as such is more of a constant current sink. This being the case, the discharge curve will be a straight line (linear) until the regulator drops out of regulation. When dealing with the upper part of the discharge curve, as we are, the difference is unimportant, and falls into the area of slop to be covered by the "margin" factor.

Now for the regulator, another pitfall. Nowadays the easiest thing to do is use an IC regulator with a external pass transistor. For the sake of this article, the IC route won't be followed, since we would not learn much about how it works. Refer to Fig. 2 for the regulator we will be using. The series pass transistor will be selected mostly by the current capability. We want a PNP that can pass 3 Amps and dissipate 15 Watts or so. The dissipation required is determined by the voltage drop across the series pass transistor at full load. Since at that point the filter cap will also have maximum ripple giving lower average power, we can add a safety margin by maintaining the full voltage differential for our calculations. 18 V-12.6 V equals 5.4 V. 5.4 V x 3 A equals 16.2 Watts worst case dissipation. A small heat sink and almost any power transistor can handle that. Let me inject that to parallel series pass transistors is a total waste, in this case, as almost any power transistor can handle this power level.

To point out a common mistake, you cannot just parallel two transistors. Refer to Fig. 3(a). It won't work, although it will appear to. The base emitter junction is electrically a diode with a conduction voltage of about .6 volts for a silicon transistor, and about .2 volts for a germanium transistor. It may be assumed that no two junctions are exactly alike, and because of this, one will conduct before the other, not allowing the base voltage to rise further, to the conduction point of the second transistor. Thus it will not turn on unless the first transistor is damaged.

Two transistors can be paralleled if a small resistor is placed in the emitter circuit of each transistor. This allows a small voltage change in the base emitter circuit, with the current through the transistor. If one transistor conducts more than the other, the voltage builds across the junction of the conducting transistor, causing the other transistor to turn on harder, striking a balance. Without this emitter balancing resistor, the second transistor is wasted. Refer to Fig. 3(b).

Now to pick a series pass transistor ... PNP ... 20 Watt ... inexpensive, and some gain. As you can see, almost any PNP power transistor will do, but let's pick a 2N4901. This transistor is rated for 40 V, 85 W, and costs about $1.75 from Motorola. The gain for this device is a minimum of 25, which means that at 3 Amps we must be able to supply a worst case base current of 120 mA. The best way to do this is to use another transistor which will amplify a much smaller current. For the driver transistor, we will pick a 2N3053, which has a breakdown voltage of 40 volts and a minimum gain of 25. Refering to Fig. 2, we will wire Q1 and Q2 together as shown, in a compound Darlington configuration.

Now to figure the value of resistor R1, which must supply enough base drive to provide the worst case drive to Q2. Since Q2 must drive Q1 with a maximum of 120 mA (output current divided by gain of Q1), we will drive that 120 mA by the gain of Q2 to get a rounded off 5 mA drive requirement for Q2. At 3 Amps output, the filter capacitor voltage will be dipping to as low as 15 volts, so with a worst case low input voltage of 15 volts and division by .005 Amps, we find that the resistor value should be about 500 Ohms. To figure the power dissipation of the resistor, we must take the maximum voltage across it, which occurs at no load, with maximum charge on the filter capacitor. We know from earlier that the no load voltage will be about 18 volts. The base of Q2 will always stay within about 1/2 volt of the output voltage, so we now know that the worst case voltage across R1 will be about 6 volts. Again, using Ohm's Law, we take the 500 Ohms and divide into the 6 volts to our current at 120 mA. I times E equals P, or .12 Amp times 6 volts equals .72 Watts. A one Watt resistor would be in order here.

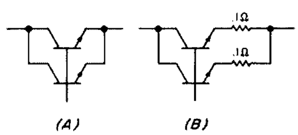

Fig. 3.

Now for the feedback loop which makes this into a regulator. Z1 is a 1N4742, 1 Watt, 12 volt zener diode. It is connected as shown with R3, whose only purpose is to sink any leakage the diode might have and to assure that the diode operates in its proper current range. The value is not critical and the 100 Ohms shown will allow about 6 mA to flow through the diode before regulation takes place. The purpose of R2 is only to protect Q3 against a sudden current surge that might damage the base junction before the regulator can respond. With Q3 installed as shown (almost any NPN transistor will work), any current in excess of the 6 mA designed to flow through Z1 will turn on Q3, causing it to steal base current from Q2 until the output voltage reaches the cutoff point of Z1. The circuit won't allow the output to go above 12.6 volts (the extra .6 volts comes from the base junction of Q3), and if it tries to go below 12.6 volts, Q1 and Q2 drive harder and won't allow that. So what we have is a rock solid 12.6 volts.

Now for the final pitfall. C2 is not a filter capacitor. To try and filter at this point will waste a big capacitor. C2 should only be a small capacitor to *bypass* any high frequency noise which might appear at this point. A 1 uF will do just fine.

In conclusion, while this article was intended to show how to design a simple power supply and avoid some of the common pitfalls, if built it will provide a solid, pure 12.6 volts at a continuous 3 Amps. In fact, since all was figured on worst cases, it will supply in excess of 3 Amps and not feel much strain. Current limiting and overvoltage protection could be added with little effort. ■

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Yaesu FRG-7 Impressions

-- take note, SWL fans!

Manufacturers' specifications look very tempting. They can seem to provide the optimum solution to your radio receiving problems. And, remarkably enough, usually the specifications are accurate.

Dry figures, however, don't tell the story as well as hands-on intimacy. Unfortunately, it's seldom that one gets to take a prospective purchase home for a familiarization period before plunking down a wad of that green stuff. And once that green stuff has changed hands, often it's difficult to whistle it back!

That brings us to the subject of this article, one man's experience with a receiver that's new to the American market. Perhaps these experiences will assist you in making a decision as to whether the FRG-7 is your cup of tea.

First impressions are strong, often lasting. The first impression presented by the FRG-7, as it is being unwrapped from its heavy plastic cocoon, is that of exquisite neatness. It's packaged complete with every type of connector you could possibly need and even a hank of antenna for a random wire (called "long-wire" by those who don't know their nomenclature) antenna for reception of signals your dipole might not pick up too well. Look at the front, and you'll be impressed by the orderly array of controls. Nothing is "Mickey Mouse." Yaesu has been making high quality transceivers too long to half-mast its standards!

The instruction book, unlike that of many imports, is written by a person familiar with the English language. It's not quite as complete in detail as one might like, and is really a far cry from those put out by the E. F. Johnson Company before it deserted amateur radio for the dazzling dollars of CB. It's not too skimpy, though, and contains a pull-out diagram that can be read easily without the aid of a magnifying glass! From the list of recommended test equipment for servicing, one gets the impression that Yaesu would like for owners to keep their hands out of the receiver's innards. That's probably founded on past experiences with other solid state products!

It takes only a few minutes to absorb the simple operating procedures. You set the controls for the frequency band desired . . . and snap on a thumb-sized toggle switch. And, as an aside, unlike most Japanese-manufactured radio receivers, that toggle switch is in the primary of the power transformer, not in the "B+" lead!

I hope you do your initial listening either on AM phone or on CW. It works quite acceptably on both of those. But if your first try is on SSB, you may conclude that you made a regrettable mistake in judgment when you bought a Yaesu FRG-7! Let's face it. The combination of 1000 kHz per band with a dial that has a backlash of 100 Hz makes getting a voice to sound intelligible, let alone natural, an exacting task! It can be done, as improbable as that may appear initially. On top of those two characteristics, the receiver has an uncanny affinity for AM carriers. Comparing it with a Drake TR-4C on the 7150-7300 kHz segment discloses far greater interference from carriers (even during daytime reception) on the FRG-7. This test was made by switching the dipole from one receiver to the other with a coax switch.

The ceramic filter used in the final i-f of the FRG-7 really is not suited for SSB reception in crowded amateur bands.

Switching to a shortwave broadcast band quickly alters the unfortunate opinions that one may have formed while attempting to hear SSB signals. It performs quite creditably. The audio quality, of course, will not satisfy a "hi-fi" fan, but the limited frequency response stems from the comparatively-sharp i-f selectivity.

It's hard to fault the receiver's performance on CW. It tunes easily. It's rock-stable. It has a choice of three audio response curves. In short, it's a honey!

You'll notice I've omitted any listing of specifications, presuming you've looked over that information, scanning catalogues or dealers' handouts. I've just given you my impressions. For many years I've used only Drake or Collins receivers. The FRG-7 plainly is not in the same league as these. And, of course, at $299.00, you really can't expect it to be. If one comes down out of the clouds and sheds any delusions of getting three thousand dollars worth of receiver for three hundred dollars, he just may find the FRG-7 a very satisfying bit of equipment. Don't look for perfection; you won't find it! But if you look for a full-coverage receiver that'll do an excellent job of receiving CW, a very good job of receiving AM voice, and an acceptable (after you've gotten used to it) job of receiving amateur SSB signals — one that doesn't cost an arm and a leg — you'll have to search far and wide before you find one that'll top the Yaesu FRG-7. ■

June 1977

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SSTV Meets the SWTP 6800

-- modulate video with a micro

Soon after completion of my SWTPC 6800 system, I thought, "Now what can I do with it?" Since my hobby is ham radio coupled with an interest in SSTV, the answer was obvious. I decided to start in a small way with a program to load my WØLMD SSTV keyboard (Ref. 1). This project was quite successful, and I next attempted a more ambitious one — to generate SSTV in the CPU main memory. It became obvious that to generate SSTV I must first slow the microprocessor way down to accomplish the proper timings. I started by writing a short feasibility program which generated timing pulses and video in the proper relationships. I fed these pulses into an SSTV modulator which uses only three ICs and is external to the SWTPC 6800 system. This program's performance exceeded my expectations; however, it had one large drawback. The picture dot patterns had to be entered a byte at a time into the main memory which was a big job. This article tells about my third program, which automatically loads memory and generates SSTV pictures.

The system.

00	00	F0	80	00	00	FF

Fig. 1. Hexadecimal representation of seven picture dots in memory.

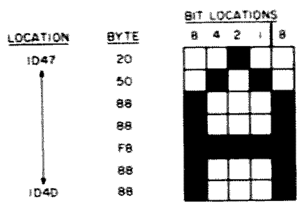


Fig. 2. Coding of the dots to form the letter A.

Memory Location	Present Value	Name
031A	75 (Hex)	Number of lines/ picture Half frame = 45
02E3	80 (Hex)	Horizontal line freq. 80 = 15 Hz (USA) 70 = 16-2/3 (Europe)
02E4	5D (Hex)	Sync pulse width Horizontal = 5 ms Vertical = 30 ms

Table 1.

Sample SSTV generation with some unwanted ac ripple sneaking into the monitor to mess things up!

The Specifications

I think a short technical discussion is in order as to how I accomplish this. I first decided on a few basic specifications which were taken from my WØLMD keyboard design. These were:

1. An SSTV picture will contain 30 ASCII characters in a 5 x 7 dot matrix pattern.
2. An SSTV picture dot will consist of three scan lines (vertical) and 1 dot (horizontal).
3. An SSTV picture will consist of 117 scan lines.
4. An SSTV scan line will consist of 7 eight bit bytes (6 data, 1 sync).
5. An SSTV picture in the SWTPC 6800 memory will consist of 819 bytes (117 lines x 7 bytes/line).

As you can see from these specifications, the memory requirements are quite negligible and my first feasibility program fits easily into the 4K of memory provided with the basic SWTPC 6800 system.

Well, now that we have a set of specifications, how is the programming accomplished? The only programming language which makes sense in this application is assembly language. The 6800 assembly language instructions coupled with the use of MIKBUG makes programming the SWTPC 6800 system an easy task. My first job was to flowchart the entire program, which is a highly recommended practice for anyone attempting such a project.

The Seven "Picture Bytes" — and the Software

Now let's examine in general how the seven picture bytes are used to generate the various sync pulses or picture dots. An example is shown in Fig. 1.

The example represents a typical SSTV scan line in memory. The first operation the program does in the transmit mode is load from memory the first byte into an accumulator. The accumulator in the 6800 is a powerful register which can be used to add, compare, or shift data. This byte is compared to see if it is FF. If it is, then it is a sync pulse. If not, it must be a data byte. The accumulator is then shifted to the left a bit at a time. If the shifted bit is a one, then bit 0 of the parallel interface adaptor (PIA) is turned on.

If the bit is zero, then the interface bit is turned off. If the byte is a sync byte (FF), then interface bit 2 is turned on for 5 or 30 milliseconds. Sound easy? Well, it is. All that is required is to connect these pulses to an SSTV modulator and out come SSTV pictures. Obviously, programming delays must be executed between all steps. Three program constants control all of these delays: one for the horizontal line frequency, one for the sync pulse durations, and one for the number of scan lines. Just think of the possibilities! By manipulating these constants, any number of scan lines can be transmitted (up to 117) at any frequency, which is only limited by the CPU cycle time and memory speed.

The generation of the SSTV is quite easy; the biggest trick is to place the correct dots in the picture at the correct location. This is accomplished by use of a translate table and a dot table. The translate table is used to tell the program

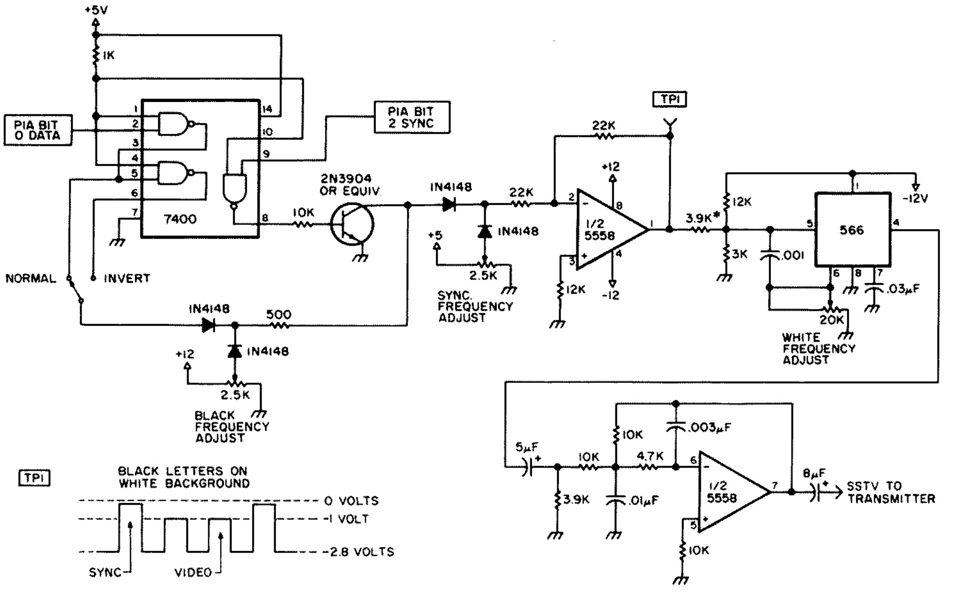


*Fig. 3. SSTV modulator schematic. *Adjust value of resistor if required for correct SSTV frequency swing.*

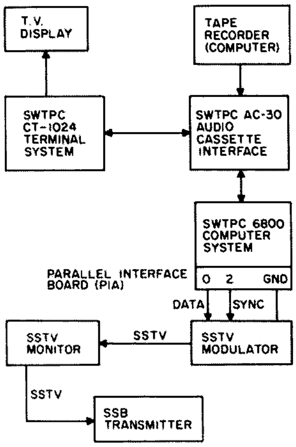


Fig. 4. Block diagram of computer hardware interconnections.

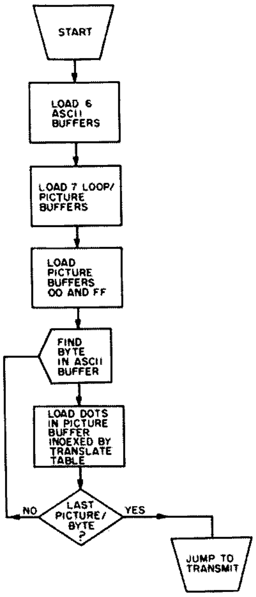
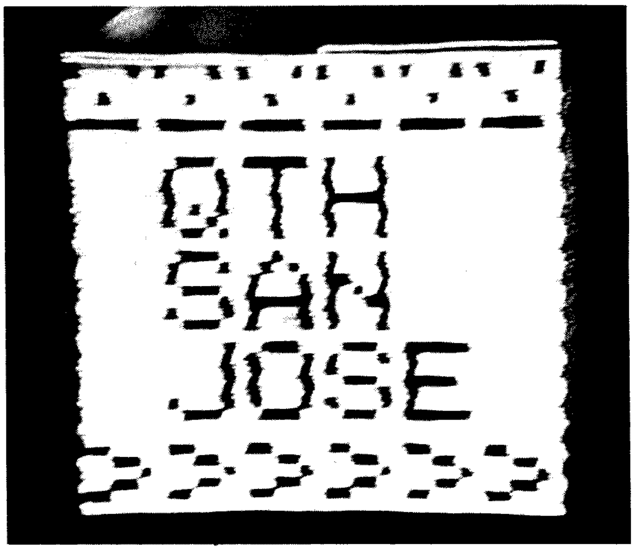


Fig. 5. Load SSTV picture program flowchart.



Another sample (along with the ripple).

where in the dot table the correct dots are located. The dot table is a 5 x 7 ASCII dot matrix array of bytes. The character dots were taken from the specification sheet of the 2513 Character Generator ROM chip (Ref. 2). Not all characters (ASCII) were coded in this program, due to their uncommon usage. The translate table in this program allows for expansion of 13 dot patterns without rewrite of my generator routines. The reader can code any of the patterns to suit his needs. In order to accomplish this task, I should explain in detail how the various tables are coded. Fig. 2 is an example of how to code the dots for the letter A.

As you can see, you are only limited by your imagination. With a little ingenuity, a set of graphic-like dot patterns can be created. The translate table in memory is contiguous with the dot table. The low order address of the translate table is equivalent to 6 of the 8 ASCII code bits. For example, let's take the letter A. The ASCII code for A is 41 hex. If you strip off the 8 and 4 bits, the code remaining is 01 hex. If you look in the translate table location 1D01 (hex), you will find a 47. This value means that the address of the dot bytes for A are located at 1D47 in memory. You will find in the translate table (1D00 to 1D3F) a number of 04 characters. This value is a blank character and is placed on numbers with ASCII codes between 21 and 2D. The characters are rarely used and 13 of these codes can be used for special graphics. The character codes (ASCII) 5B-5F will load characters with an inverted VEE. Now that you have a rough idea of how the program operates, let's use it.

The program makes a few assumptions about how your 6800 system is configured:

- The PIA card is in location 7 (address 801C).
- MIKBUG or equivalent is used, with the following routines: E07E – output a string of characters; E1D1 – output a single character; E1AC – input a single character.
- At least 8K of memory.
- PIA bits 0 are data pulses and bits 2 are sync pulses.

The PIA can be changed easily on any bit convenient on your system. Some of the program constants which can be modified to fit your specific requirements are shown in Table 1.

The program can be executed by loading MIKBUG location A048 and A049 with 0000 and typing G. The first routine executed is LOAD. This routine loads the picture buffers as you type in. The first message printed on the TV terminal is:

PICTURE FORMATS 0-5
1 2 3 4 5

The program is now asking for you to load 5 lines of 6 characters each. You first type in the picture number you want to load followed by 30 characters. The first character of each line will be placed under its corresponding line number.

You can now load all 6 pictures or type an ASCII letter to end the process. The next message printed on the TV terminal screen is:

SELECT LOOPS-PICTURES
LOOP MAX=9
?

The program is now asking

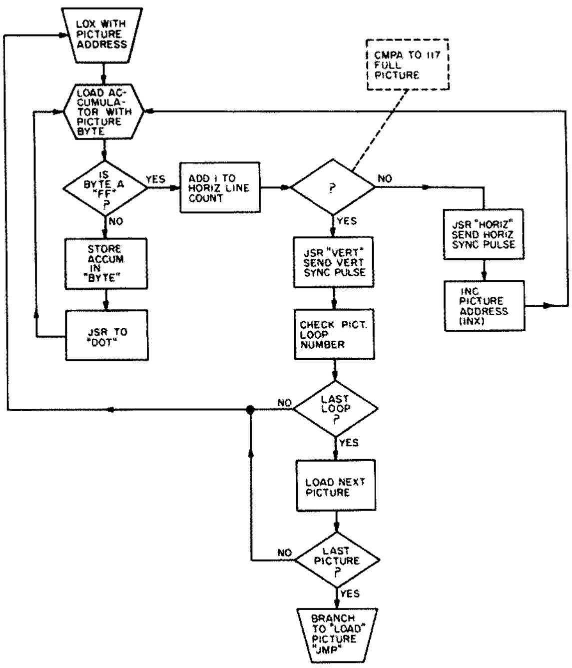


Fig. 6. Transmit SSTV picture program flowchart.

```
LOC    OBJECT  M  SOURCE STATEMENT

                           TITLE  SSTV3
       801C A   PIA        EQU    H'801C         PIA ADDRESS
       E07E A   OUT        EQU    H'E07E         MIKBUG  OUTPUT
       E1D1 A   OUTEEE     EQU    H'E1D1         MIKBUG OUTPUT
       E1AC A   INEEE      EQU    H'E1AC         INPUT A CHARACTER
0000                       ORG    H'0000
                ***************************************************************
                ***               THIS PROGRAM LOADS AND GENERATES SLOW
                ***               SCAN AMATEUR RADIO (SSTV) PICTURES.
                ***                6  PICTURES ARE GENERATED PROGRAM RUNS ON A
                ***               SWTPC 6800 SYSTEM, PROGRAM WRITTEN BY:
                ***               C W ABRAMS (K6AEP) SAN JOSE , CALIF. 2/14/77
                ***************************************************************
0000  CE 0020 A LOAD       LDX    #MENU1
0003  BD E07E A            JSR    OUT            PRINT PICTURE MENU1
0006  BD 0275 A            JSR    BUFF           LOAD ASCII BUFFER
0009  B6 0274 A            LDAA   BYTE1          CHECK FOR LOOP
000C  84 F0                ANDA   #H'F0          MASK OUT 4 LOWER BITS
000E  81 30                CMPA   #H'30          ASCII NUMBER T
0010  27 EE                BEQ    LOAD
0012  CE 0055 A            LDX    #MENU2
0015  BD E07E A            JSR    OUT            PRINT PICTURE MENU2
0018  8D 68                BSR    LOOP           PICTURE/LOOP ROUTINES
001A  BD 00EA A            JSR    NUM            LOAD PICTURE DOTS
001D  7E 02F0 A            JMP    SEND           BRANCH TO SEND
0020     10     MENU1      FCB    H'10           HOME UP
0021     16                FCB    H'16           CLEAR SCREEN
0022     0D                FCB    H'0D           CARRIAGE RETURN
0023     5049              CHAR   /PICTURE FORMATS 0-5/
0025     4354
0027     5552
0029     4520
002B     464F
002D     5240
002F     4154
0031     5320
0033     3020
0035     35
0036     0A                FCB    H'0A           LINE FEED
0037     0D                FCB    H'0D           C.R.
0038     2031              CHAR   / 1     2     3     4     5/
003A     2020
003C     2020
003E     2032
0040     2020
0042     2020
0044     2033
0046     2020
0048     2020
004A     2034
004C     2020
004E     2020
0050     2035
0052     0A                FCB    H'0A
0053     0D                FCB    H'0D
0054     04                FCB    H'04           END PRINT
0055     10     MENU2      FCB    H'10
0056     16                FCB    H'16
0057     0D                FCB    H'0D
0058     5345              CHAR   /SELECT LOOPS-PICTURES/
005A     4C45
005C     4354
005E     204C
0060     4F4F
0062     5053
0064     2D50
0066     4943
0068     5455
006A     5245
006C     53
006D     0A                FCB    H'0A
006E     0D                FCB    H'0D
006F     4C4F              CHAR   /LOOP MAX=9/
0071     4F50
0073     2040
0075     413B
0077     3039
0079     0A                FCB    H'0A
007A     0D                FCB    H'0D
007B     3F                CHAR   /?/
007C     04                FCB    H'04           END PRINT
                ***************************************************************
                ***               LOOP- THIS ROUTINE LOADS THE LOOP
                ***               COUNT AND PICTURE BUFFERS TO BE
                ***               TRANSMITTED
                ***************************************************************
007D     00     CNT4       FCB    0              TEMP LOOP PROG COUNT
007E     00     CNT5       FCB    0              TEMP PICTURE NUMBER
007F     00     CNT6       FCB    0              TIMES LOOP BUFFER IS LOADED
0080     0000 A DATA1      FDB    0              ADDRESS OF LOOP BUFFER
0082  7F 007F A LOOP       CLR    CNT6
0085  BD E1AC A LOOP1      JSR    INEEE
0088  97 7D                STAA   CNT4           STORE LOOP ASCII CHAR
008A  86 2F                LDAA   #H'2F          ASCII SLASH
008C  BD E1D1 A            JSR    OUTEEE         PRINT SLASH
008F  96 7D                LDAA   CNT4
0091  84 F0                ANDA   #H'F0
0093  81 30                CMPA   #H'30          IS CHARACTER A NUMBER ?
0095  27 01                BEQ    LOOP2
0097  39                   RTS
0098  BD E1AC A LOOP2      JSR    INEEE
009B  97 7E                STAA   CNT5           STORE PICTURE ASCII
009D  84 0F                ANDA   #H'0F          STRIP OFF ASCII 30
009F  97 7E                STAA   CNT5
00A1  96 7D                LDAA   CNT4
00A3  84 0F                ANDA   #H'0F          STRIP OFF ASCII 30
00A5  97 7D                STAA   CNT4
00A7  D6 7F                LDAB   CNT6
00A9  C1 00                CMPB   #0
00AB  27 1E                BEQ    LOOP3          IF 1ST TIME LOAD BUFF ADDRESS
00AD  DE 80     LOOP5      LDX    DATA1          LOAD X WITH NEXT ADDRESS
00AF  96 7D                LDAA   CNT4
00B1  A7 00                STAA   X              STORE IN BUFFER LOOP
00B3  08                   INX
00B4  96 7E                LDAA   CNT5
00B6  A7 00                STAA   X              STORE PICTURE IN BUFFER
00B8  08                   INX
00B9  DF 80                STX    DATA1          STORE NEW ADDRESS
00BB  7C 007F A            INC    CNT6           ADD 1 TO CNT6
00BE  96 7F                LDAA   CNT6
00C0  81 07                CMPA   #7
00C2  27 0E                BEQ    LOOP4          IF 7 RETURN
00C4  86 20                LDAA   #H'20          ASCII SPACE
00C6  BD E1D1 A            JSR    OUTEEE         PRINT A SPACE
00C9  20 BA                BRA    LOOP1          GET NEXT LOOP NUMBER
00CB  CE 00D3 A LOOP3      LDX    #LPBUF         LOAD BUFFER ADDRESS
00CE  DF 80                STX    DATA1          STORE IN TEMP ADDRESS
00D0  20 DB                BRA    LOOP5
00D2  39        LOOP4      RTS
00D3     000E   LPBUF      RMB    14             LOOP AND PRINT BUFFER AREA (1 EXTRA)
                ***************************************************************
                ***               NUM- THIS ROUTINE TAKES ASCII CHAR FROM
                ***               THE 7 CHARACTER BUFFERS AND PLACES THE CORRECT
                ***               DOTS IN THE PICTURE BUFFERS
                ***************************************************************
00E1     00     CNT3       FCB    0              DOTS TO BE LOADED
00E2     0000 A CNT7       FDB    0              ADDRESS OF PICTURE
00E4     0000 A CNT8       FDB    0              ADDRESS OF ASCII BUFFER
00E6     00     CNT9       FCB    0              CURRENT ASCII CHARACTER
00E7     00     CNT10      FCB    0              NUMBER OF ASCII BYTES
00E8     0000 A CNT12      FDB    0              ADDRESS OF DOTS IN TABLE
00EA  BD 01F0 A NUM        JSR    LP0            ZERO DOTS WITH SYNC PULSE
00ED  8D 79     NUM4       BSR    FAP
00EF  B6 0167 A            LDAA   CNT13
00F2  81 06                CMPA   #6
00F4  27 6D                BEQ    NUM5
00F6  7F 00E7 A            CLR    CNT10
00F9  7C 00E7 A            INC    CNT10          SET UP CHARACTER COUNT
00FC  DE E4     LBA        LDX    CNT8           LOAD ADDRESS OF 1ST PICTURE
00FE  A6 00                LDAA   X
0100  97 E6                STAA   CNT9           STORE BYTE IN CNT9
0102  BD 01CA A            JSR    FSLA           FIND ADDRESS OF SL PUT IN CNT12
0105  BD 0250 A            JSR    LND1
0108  BD 0200 A            JSR    SLL1           SCAN LINE 1
010B  BD 025A A            JSR    LND            LOAD NEXT DOTS
010E  BD 0218 A            JSR    SLL2
0111  BD 025A A            JSR    LND
0114  BD 0223 A            JSR    SLL3
0117  BD 025A A            JSR    LND
011A  BD 022E A            JSR    SLL4
011D  BD 025A A            JSR    LND
0120  BD 0239 A            JSR    SLL5
0123  BD 025A A            JSR    LND
0126  BD 0244 A            JSR    SLL6
0129  BD 025A A            JSR    LND
012C  BD 024F A            JSR    SLL7
012F  96 E7                LDAA   CNT10
0131  7C 00E7 A            INC    CNT10
0134  81 06                CMPA   #6
0136  27 1C                BEQ    NUM1
0138  81 0C                CMPA   #12
013A  27 18                BEQ    NUM1
013C  81 12                CMPA   #18
013E  27 14                BEQ    NUM1
0140  81 18                CMPA   #24
0142  27 10                BEQ    NUM1
0144  81 1E                CMPA   #30
0146  27 16                BEQ    NUM2
0148  DE E2                LDX    CNT7
014A  08                   INX                   INCRIMENT ADDRESS IN X
014B  DF E2                STX    CNT7
014D  DE E4                LDX    CNT8
014F  08                   INX                   INCRIMENT ADDRESS IN A
0150  DF E4                STX    CNT8
0152  20 A8                BRA    LBA
0154  BD 0264 A NUM1       JSR    ADD1
0157  DE E4                LDX    CNT8
0159  08                   INX                   INCRIMENT ADDRESS IN X
015A  DF E4                STX    CNT8
015C  20 9E                BRA    LBA
015E  7C 0167 A NUM2       INC    CNT13          SET UP TO LOAD NEXT BUFFER
0161  20 8A                BRA    NUM4           LOAD NEXT BUFFER RTS IF LAST
0163  7F 0167 A NUM5       CLR    CNT13          CLEAR BUFFER LOAD COUNT
0166  39                   RTS
                ***************************************************************
                ***               FAP- THIS ROUTINE SETS UP THE ADDRESSES FOR
                ***               THE LOADING OF ALL PICTURE BUFFERS, PROGRAM
                ***               BRANCHES TO MAIN LINE WHEN COMPLETED
                ***************************************************************
0167     00     CNT13      FCB    0              CURRENT BUFFER TO LOAD
0168  B6 0167 A FAP        LDAA   CNT13
016B  81 06                CMPA   #6             IS IT 6 TH BUFFER?
016D  27 5A                BEQ    FAP6           IF SO RETURN TO MAIN LINE
016F  81 00                CMPA   #0
0171  27 14                BEQ    FAP0
0173  81 01                CMPA   #1
0175  27 1B                BEQ    FAP1
0177  81 02                CMPA   #2
0179  27 22                BEQ    FAP2
017B  81 03                CMPA   #3
017D  27 29                BEQ    FAP3
017F  81 04                CMPA   #4
0181  27 30                BEQ    FAP4
0183  81 05                CMPA   #5
0185  27 37                BEQ    FAP5
0187  CE 1C00 A FAP0       LDX    #B0
018A  DF E4                STX    CNT8           ASCII BUFFER
018C  CE 0464 A            LDX    #1124
018F  DF E2                STX    CNT7           PICTURE BUFFER
0191  39                   RTS
0192  CE 1C1E A FAP1       LDX    #B1
0195  DF E4                STX    CNT8
0197  CE 0797 A            LDX    #1943
019A  DF E2                STX    CNT7
019C  39                   RTS
019D  CE 1C3C A FAP2       LDX    #B2
01A0  DF E4                STX    CNT8
01A2  CE 0ACA A            LDX    #2762
01A5  DF E2                STX    CNT7
01A7  39                   RTS
01A8  CE 1C5A A FAP3       LDX    #B3
01AB  DF E4                STX    CNT8
01AD  CE 0DFD A            LDX    #3581
01B0  DF E2                STX    CNT7
01B2  39                   RTS
01B3  CE 1C78 A FAP4       LDX    #B4
01B6  DF E4                STX    CNT8
01B8  CE 1130 A            LDX    #4400
01BB  DF E2                STX    CNT7
01BD  39                   RTS
01BE  CE 1C96 A FAP5       LDX    #B5
01C1  DF E4                STX    CNT8
01C3  CE 1463 A            LDX    #5219
01C6  DF E2                STX    CNT7
01C8  39                   RTS
01C9  39        FAP6       RTS
                ***************************************************************
                ***               FSLA THIS ROUTINE TAKES AN ASCII BYTE IN
                ***               CNT9 AND PUTS THE ADDRESS OF ITS DOTS
                ***               IN CNT12
                ***************************************************************
01CA  96 E6     FSLA       LDAA   CNT9           CURRENT BYTE
01CC  84 3F                ANDA   #H'3F          STRIP OFF 8 AND 4 BITS
01CE  CE 1D00 A            LDX    #H'1D00        LDX WITH TRANSLATE TABLE
01D1  B7 01D5 A            STAA   FSLA1+1
01D4  E6 00     FSLA1      LDAB   X              TRANSLATE TABLE OFFSET IN B
01D6  96 E6                LDAA   CNT9
01D8  84 40                ANDA   #H'40
01DA  81 40                CMPA   #H'40          IS IT AN ASCII LETTER ?
01DC  27 09                BEQ    FSLA2          IF SO BRANCH
01DE  F7 01E3 A            STAB   FSLA3+2
01E1  CE 1E00 A FSLA3      LDX    #H'1E00
01E4  DF E8                STX    CNT12
01E6  39                   RTS
01E7  F7 01EC A FSLA2      STAB   FSLA4+2
01EA  CE 1D00 A FSLA4      LDX    #H'1D00
01ED  DF E8                STX    CNT12
01EF  39                   RTS
                ***************************************************************
                ***               THIS ROUTINE SETS UP BLANK DOT
                ***               WITH TIMING PULSES (LP0) ROUTINE
                ***************************************************************
01F0  CE 0464 A LP0        LDX    #1124          PICTURE 0 ADDRESS
01F3  4F        LP1        CLRA
01F4  C6 06                LDAB   #6             6 BYTES BLANK
01F6  A7 00     LP2        STAA   X              STORE 0
01F8  08                   INX
01F9  5A                   DECB
01FA  C1 00                CMPB   #0             ARE 6 BYTES STORED ?
01FC  27 02                BEQ    LP3
01FE  20 F6                BRA    LP2
0200  86 FF     LP3        LDAA   #H'FF          SYNC PULSES
0202  A7 00                STAA   X
0204  08                   INX
0205  8C 1796 A            CPX    #6038          PICTURE 5 END ADDRESS
0208  27 02                BEQ    LP5
020A  20 E7                BRA    LP1            STORE NEXT BYTE
020C  39        LP5        RTS                   RETURN
                ***************************************************************
                ***               SCAN LINE ROUTINES, PLACES DOTS IN
                ***               THREE LINES
                ***************************************************************
020D  96 E1     SLL1       LDAA   CNT3           SCAN LINE 1 LOAD
020F  DE E2                LDX    CNT7
0211  A7 00                STAA   X
0213  A7 07                STAA   7,X
0215  A7 0E                STAA   14,X
0217  39                   RTS
0218  96 E1     SLL2       LDAA   CNT3           SCAN LINE 2 LOAD
021A  DE E2                LDX    CNT7
021C  A7 15                STAA   21,X
021E  A7 1C                STAA   28,X
0220  A7 23                STAA   35,X
0222  39                   RTS
0223  96 E1     SLL3       LDAA   CNT3           SCAN LINE 3 LOAD
0225  DE E2                LDX    CNT7
0227  A7 2A                STAA   42,X
0229  A7 31                STAA   49,X
022B  A7 38                STAA   56,X
022D  39                   RTS
022E  96 E1     SLL4       LDAA   CNT3           SCAN LINE 4 LOAD
0230  DE E2                LDX    CNT7
0232  A7 3F                STAA   63,X
0234  A7 46                STAA   70,X
0236  A7 4D                STAA   77,X
0238  39                   RTS
0239  96 E1     SLL5       LDAA   CNT3           SCAN LINE 5 LOAD
023B  DE E2                LDX    CNT7
023D  A7 54                STAA   84,X
023F  A7 5B                STAA   91,X
0241  A7 62                STAA   98,X
0243  39                   RTS
0244  96 E1     SLL6       LDAA   CNT3           SCAN LINE 6 LOAD
0246  DE E2                LDX    CNT7
```

```
0000 CE 00 20 BD E0 7E BD 02 75 B6 02 74 84 F0 81 30
0010 27 EE CE 00 55 BD E0 7E 8D 68 BD 00 EA 7E 02 F0
0020 10 16 0D 50 49 43 54 55 52 45 20 46 4F 52 4D 41
0030 54 53 20 30 2D 35 0A 0D 20 31 20 20 20 20 20 32
0040 20 20 20 20 20 33 20 20 20 20 20 34 20 20 20 20
0050 20 35 0A 0D 04 10 16 0D 53 45 4C 45 43 54 20 4C
0060 4F 4F 50 53 2D 50 49 43 54 55 52 45 53 0A 0D 4C
0070 4F 4F 50 20 4D 41 58 3D 39 0A 0D 3F 04 00 00 00
0080 00 00 7F 00 7F BD E1 AC 97 7D 86 2F BD E1 D1 96
0090 7D 84 F0 81 30 27 01 39 BD E1 AC 97 7E 84 0F 97
00A0 7E 96 7D 84 0F 97 7D D6 7F C1 00 27 1E DE 80 96
00B0 7D A7 00 08 96 7E A7 00 08 DF 80 7C 00 7F 96 7F
00C0 81 07 27 0E 86 20 BD E1 D1 20 BA CE 00 D3 DF 80
00D0 20 DB 39 84 20 DB 39 02 02 09 00 09 00 09 00 09
00E0 00 00 00 00 00 00 00 00 00 00 BD 01 F0 8D 79 B6
00F0 01 67 81 06 27 6D 7F 00 E7 7C 00 E7 DE E4 A6 00

0100 97 E6 BD 01 CA BD 02 5D BD 02 0D BD 02 5A BD 02
0110 18 BD 02 5A BD 02 23 BD 02 5A BD 02 2E BD 02 5A
0120 BD 02 39 BD 02 5A BD 02 44 BD 02 5A BD 02 4F 96
0130 E7 7C 00 E7 81 06 27 1C 81 0C 27 18 81 12 27 14
0140 81 18 27 10 81 1E 27 16 DE E2 08 DF E2 DE E4 08
0150 DF E4 20 A8 BD 02 64 DE E4 08 DF E4 20 9E 7C 01
0160 67 20 8A 7F 01 67 39 00 B6 01 67 81 06 27 5A 81
0170 00 27 14 81 01 27 1B 81 02 27 22 81 03 27 29 81
0180 04 27 30 81 05 27 37 CE 1C 00 DF E4 CE 04 64 DF
0190 E2 39 CE 1C 1E DF E4 CE 07 97 DF E2 39 CE 1C 3C
01A0 DF E4 CE 0A CA DF E2 39 CE 1C 5A DF E4 CE 0D FD
01B0 DF E2 39 CE 1C 78 DF E4 CE 11 30 DF E2 39 CE 1C
01C0 96 DF E4 CE 14 63 DF E2 39 39 96 E6 84 3F CE 1D
01D0 00 B7 01 D5 E6 00 96 E6 84 40 81 40 27 09 F7 01
01E0 E3 CE 1E 00 DF E8 39 F7 01 EC CE 1D 00 DF E8 39
01F0 CE 04 64 4F C6 06 A7 00 08 5A C1 00 27 02 20 F6

0200 86 FF A7 00 08 8C 17 96 27 02 20 E7 39 96 E1 DE
0210 E2 A7 00 A7 07 A7 0E 39 96 E1 DE E2 A7 15 A7 1C
0220 A7 23 39 96 E1 DE E2 A7 2A A7 31 A7 38 39 96 E1
0230 DE E2 A7 3F A7 46 A7 4D 39 96 E1 DE E2 A7 54 A7
0240 5B A7 62 39 96 E1 DE E2 A7 69 A7 70 A7 77 39 96
0250 E1 DE E2 A7 7E A7 85 A7 8C 39 7C 00 E9 DE E8 A6
0260 00 97 E1 39 DE E2 5F 08 5C C1 A3 27 02 20 F8 DF
0270 E2 39 00 00 00 BD E1 AC B7 02 74 81 30 27 2C 81
0280 31 27 30 81 32 27 34 81 33 27 38 81 34 27 3C 81
0290 35 27 40 81 36 27 44 39 5F BD E1 AC FE 02 72 A7
02A0 00 5C 7C 02 73 C1 1E 27 EE 20 EE CE 1C 00 FF 02
02B0 72 20 E5 CE 1C 1E FF 02 72 20 DD CE 1C 3C FF 02
02C0 72 20 D5 CE 1C 5A FF 02 72 20 CD CE 1C 78 FF 02
02D0 72 20 C5 CE 1C 96 FF 02 72 20 BD CE 1C B4 FF 02
02E0 72 20 B5 80 5D 00 00 00 00 00 00 00 00 00 00 00
02F0 7F 02 E7 7F 02 EC 7F 02 ED BD 03 D4 FE 02 E8 A6

0300 00 FF 02 EA 81 FF 27 0B B7 02 E5 8D 4A FE 02 EA
0310 08 20 EC 7C 02 E7 B6 02 E7 81 75 27 0B 8D 7B FE
0320 02 EA 08 FF 02 EA 20 D7 BD 03 B7 7C 02 ED B6 02
0330 ED D6 7D 11 27 08 7F 02 E7 FE 02 E8 20 C1 FE 02
0340 EE 96 7F F6 02 EC 11 27 0B BD 03 DA 7F 02 E7 FE
0350 02 E8 20 AB 7E 00 00 7F 02 E6 7C 02 E6 4F B6 02
0360 E5 49 B7 02 E5 25 0C 20 1A F6 02 E3 5A C1 00 27
0370 09 20 F9 86 01 B7 80 1C 20 EF F6 02 E6 C1 05 27
0380 09 20 D7 86 00 B7 80 1C 20 DF 86 00 B7 80 1C F6
0390 02 E3 5A C1 00 27 02 20 F9 39 86 04 B7 80 1C 86
03A0 04 F6 02 E4 5A C1 00 27 02 20 F9 4A 81 00 27 02
03B0 20 EF 4F B7 80 1C 39 86 04 B7 80 1C 86 1E F6 02
03C0 E4 5A C1 00 27 02 20 F9 4A 81 00 27 02 20 EF 4F
03D0 B7 80 1C 39 7F 02 EC CE 00 D3 A6 00 97 7D 08 A6
03E0 00 97 7E 08 FF 02 EE 7C 02 EC 7F 02 ED 96 7E 81
03F0 00 27 14 81 01 27 18 81 02 27 1C 81 03 27 20 81

0400 04 27 24 81 05 27 28 CE 04 64 FF 02 E8 20 28 CE
0410 07 97 FF 02 E8 20 20 CE 0A CA FF 02 E8 20 18 CE
0420 0D FD FF 02 E8 20 10 CE 11 30 FF 02 E8 20 08 CE
0430 14 63 FF 02 E8 20 00 39 00 00 00 00 00 00 00 00
```

TRANSLATE AND DOT TABLES

```
1D00 40 47 4E 55 5C 63 6A 71 78 7F 86 8D 94 9B A2 A9
1D10 B0 B7 BE C5 CC D3 DA E1 E8 EF F6 40 40 40 40 40
1D20 04 04 04 04 04 04 04 04 04 04 04 04 04 04 58 0B
1D30 12 19 20 27 2E 35 3C 43 4A 51 04 04 04 04 04 04
1D40 00 00 20 50 88 00 00 20 50 88 88 F8 88 88 F0 88
1D50 88 F0 88 88 F0 F0 88 80 80 80 88 F0 F0 88 88 88
1D60 88 88 F0 F8 80 80 F0 80 80 F8 F8 80 80 F0 80 80
1D70 80 78 80 80 80 98 88 78 88 88 88 F8 88 88 88 70
1D80 20 20 20 20 20 70 08 08 08 08 08 88 70 88 90 A0
1D90 C0 A0 90 88 80 80 80 80 80 80 F8 88 D8 A8 A8 88
1DA0 88 88 88 88 C8 A8 98 88 88 70 88 88 88 88 88 70
1DB0 F0 88 88 F0 80 80 80 70 88 88 88 A8 90 68 F0 88
1DC0 88 70 A0 90 88 70 88 80 70 08 88 70 F8 20 20 20
1DD0 20 20 20 88 88 88 88 88 88 70 88 88 88 88 88 50
1DE0 20 88 88 88 A8 A8 D8 88 88 88 50 20 50 88 88 88
1DF0 88 50 20 20 20 20 F8 08 08 20 40 80 F8 F8 F8 F8

1E00 F8 F8 F8 F8 00 02 00 00 00 00 00 00 08 10 20 40
1E10 80 00 70 88 98 A8 C8 88 70 20 60 20 20 20 20 70
1E20 70 88 08 30 40 80 F8 F8 08 10 30 08 88 70 10 30
1E30 50 90 F8 10 10 F8 80 F0 08 08 88 70 38 40 80 70
1E40 88 88 70 F8 08 10 20 40 40 40 70 88 38 70 88 88
1E50 70 70 88 88 78 08 10 E0 00 00 00 00 00 00 20 00
```

Program B. Hexadecimal object listings for SSTV generation program.

can enter up to 7 loops/pictures and the process can be terminated by entering an ASCII letter for the loop number. An SSTV picture can be looped up to 9 times. This type of programming will provide over 8 minutes of SSTV. Seven loop/pictures are entered with loop counts of 9. Upon entry of the 7 loop/pictures, the SSTV transmission is executed. After transmission, the program branches back to the load routine.

Summary

This completes the description and operation of the program. If you require more information, please write. All letters with enclosed return postage will be answered. Fig. 3 is an SSTV modulator which I use. The circuit was constructed on a vectorboard and installed in a minibox. The design is quite straightforward and can be duplicated with little cost and difficulty. The timing pulses are interfaced to the computer by a 7400 NAND gate. White letters on a black background or black letters on a white background are selected by an SPST switch. The video and sync pulses are mixed by 4 diodes, 1 IC, and 1 transistor. This video then drives a 566 function generator. The output triangular waveform is shaped into a sine wave by the output active filter.

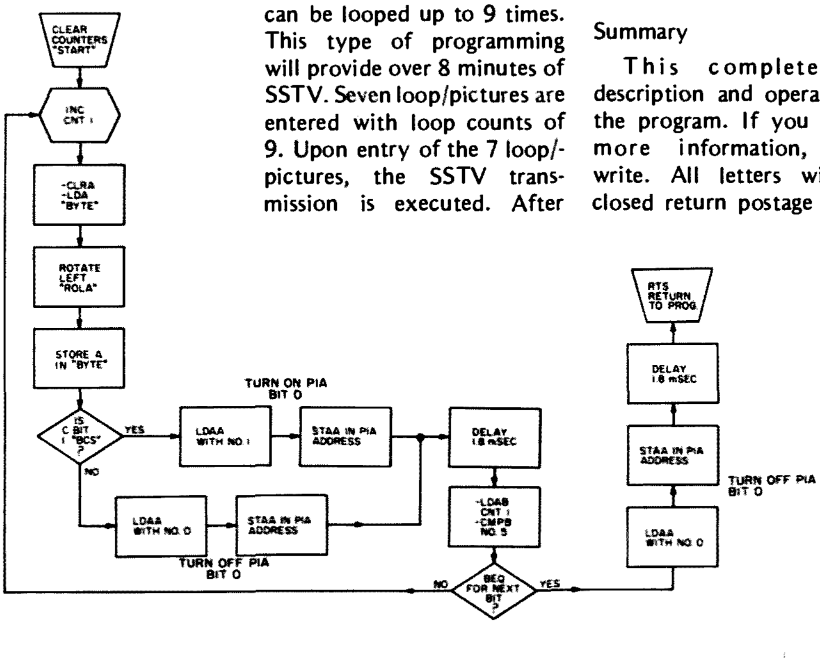


Fig. 7. Transmit SSTV picture dot program flowchart.

Conclusion

Fig. 4 is a block diagram of the hardware configuration of my system. Figs. 5, 6, and 7 are flowcharts of the three

```
0248 A7 69              STAA   105,X
024A A7 70              STAA   112,X
024C A7 77              STAA   119,X
024E 39                 RTS
024F 96 E1     SLL7     LDAA   CNT3        SCAN LINE 7 LOAD
0251 DE E2              LDX    CNT7
0253 A7 7E              STAA   126,X
0255 A7 85              STAA   133,X
0257 A7 8C              STAA   140,X
0259 39                 RTS
                        ************************************************************
                        ***        LND LOAD NEXT DOTS IN CNT12
                        ************************************************************
025A 7C 00E9 A LND      INC    CNT12+1     INCREMENT ADDRESS OF SL DOTS
025D DE E8     LND1     LDX    CNT12       LOAD X WITH ADDRESS OF DOTS
025F A6 00              LDAA   X           LOAD SL DOTS IN A
0261 97 E1              STAA   CNT3        STORE SL DOTS IN CNT3
0263 39                 RTS
                        ************************************************************
                        ***        ADD1 LOAD +163 TO CNT7
                        ************************************************************
0264 DE E2     ADD1     LDX    CNT7        LOAD ADDRESS OF PICTURE
0266 5F                 CLRB               CLEAR B
0267 08        AD1      INX
0268 5C                 INCB
0269 C1 A3              CMPB   #163        CHECK FOR 163 TIME
026B 27 02              BEQ    AD2         IF SO BRANCH
026D 20 F8              BRA    AD1         ADD NEXT COUNT
026F DF E2     AD2      STX    CNT7        STORE NEW ADDRESS
0271 39                 RTS
                        ************************************************************
                        ***        BUFF THIS ROUTINE SETS UP AND LOADS THE ASCII
                        ***        CHARACTER BUFFERS
                        ************************************************************
0272    0000 A DATA     FDB    0           BUFFER CHARACTER ADDRESS
0274      00   BYTE1    FCB    0           BUFFER INPUT BYTE
0275 BD E1AC A BUFF     JSR    INEEE       GET A CHARACTER
0278 B7 0274 A          STAA   BYTE1       STORE A BYTE
027B 81 30              CMPA   #H'30
027D 27 2C              BEQ    BUFF0
027F 81 31              CMPA   #H'31
0281 27 30              BEQ    BUFF1
0283 81 32              CMPA   #H'32
0285 27 34              BEQ    BUFF2
0287 81 33              CMPA   #H'33
0289 27 38              BEQ    BUFF3
028B 81 34              CMPA   #H'34
028D 27 3C              BEQ    BUFF4
028F 81 35              CMPA   #H'35
0291 27 40              BEQ    BUFF5
0293 81 36              CMPA   #H'36
0295 27 44              BEQ    BUFF6
0297 39        BUF2     RTS
0298 5F        BUFN     CLRB
0299 BD E1AC A BUF1     JSR    INEEE
029C FE 0272 A          LDX    DATA        LOAD INDEX WITH BUFFER ADDRESS
029F A7 00              STAA   X           STORE CHARACTER IN BUFFER
02A1 5C                 INCB               INC CHARACTER COUNT
02A2 7C 0273 A          INC    DATA+1      INC BUFFER ADDRESS
02A5 C1 1E              CMPB   #30         IS IT THE 30TH CHARACTER ?
02A7 27 EE              BEQ    BUF2
02A9 20 EE              BRA    BUF1
02AB CE 1C00 A BUFF0    LDX    #B0
02AE FF 0272 A          STX    DATA
02B1 20 E5              BRA    BUFN
02B3 CE 1C1E A BUFF1    LDX    #B1
02B6 FF 0272 A          STX    DATA
02B9 20 DD              BRA    BUFN
02BB CE 1C3C A BUFF2    LDX    #B2
02BE FF 0272 A          STX    DATA
02C1 20 D5              BRA    BUFN
02C3 CE 1C5A A BUFF3    LDX    #B3
02C6 FF 0272 A          STX    DATA
02C9 20 CD              BRA    BUFN
02CB CE 1C78 A BUFF4    LDX    #B4
02CE FF 0272 A          STX    DATA
02D1 20 C5              BRA    BUFN
02D3 CE 1C96 A BUFF5    LDX    #B5
02D6 FF 0272 A          STX    DATA
02D9 20 BD              BRA    BUFN
02DB CE 1CB4 A BUFF6    LDX    #B6
02DE FF 0272 A          STX    DATA
02E1 20 B5              BRA    BUFN
                        ************************************************************
                        ***        SEND- THIS PROGRAM GENERATES SSTV PICTURES
                        ***              PREVIOUSLY LOADED INTO SIX BUFFERS
                        ************************************************************
02E3      80   MSEC     FCB    128         DOT DELAY(60 HZ VIDEO)
02E4      5D   PUL1     FCB    93          PULSE WIDTH DELAY
02E5      00   BYTE     FCB    0           TEMP BYTE STORAGE
02E6      00   CNT1     FCB    0           CHAR DOT COUNT
02E7      00   CNT2     FCB    0           HORIZ LINE COUNT
02E8    0000 A PIC1     FDB    0           PICTURE START ADDRESS
02EA    0000 A PIC2     FDB    0           TEMP NEXT BYTE ADDRESS
02EC      00   CNT16    FCB    0           TEMP LOOP THRU PROGRAM
02ED      00   CNT14    FCB    0           TEMP LOOP
02EE    0000 A CNT15    FDB    0           NEXT LOOP/PICT ADDRESS
02F0 7F 02E7 A SEND     CLR    CNT2        INITALIZE HORIZ LINE COUNT
02F3 7F 02EC A          CLR    CNT16
02F6 7F 02ED A          CLR    CNT14
02F9 BD 03D4 A          JSR    LOOPN       SET UP PICTURE/LOOP
02FC FE 02E8 A          LDX    PIC1
02FF A6 00     SEND1    LDAA   X
0301 FF 02EA A          STX    PIC2        STORE ADDRESS OF NEXT DOTS
0304 81 FF              CMPA   #H'FF       SYNC PULSE ?
0306 27 0D              BEQ    SEND2       HORIZ OR VERT PULSE
0308 B7 02E5 A          STAA   BYTE        STORE DOTS IN BYTE
030B 8D 4A              BSR    DOT         TRANSMIT DOTS
030D FE 02EA A          LDX    PIC2
0310 08                 INX
0311 20 EC              BRA    SEND1
0313 7C 02E7 A SEND2    INC    CNT2        INC LINE COUNT
0316 B6 02E7 A          LDAA   CNT2
0319 81 75              CMPA   #117        IS IT A FULL PICTURE ?
031B 27 0B              BEQ    SEND3       VERT SYNC
031D 8D 7B              BSR    HORIZ       SEND A HORIZ SYNC PULSE
031F FE 02EA A          LDX    PIC2
0322 08                 INX                INCREMENT DOT ADDRESS
0323 FF 02EA A          STX    PIC2
0326 20 D7              BRA    SEND1
0328 BD 03B7 A SEND3    JSR    VERT        SEND VERT SYNC PULSE
032B 7C 02ED A          INC    CNT14       LOOP THRU PICTURE
032E B6 02ED A          LDAA   CNT14
0331 D6 7D              LDAB   CNT4        PROGRAMMED LOOP
0333 11                 CBA
0334 27 08              BEQ    SEND4
0336 7F 02E7 A          CLR    CNT2        RESET HORIZ LINE COUNT
0339 FE 02E8 A          LDX    PIC1
033C 20 C1              BRA    SEND1
033E FE 02EE A SEND4    LDX    CNT15       NEXT BUFFER ADDRESS
0341 96 7F              LDAA   CNT6        NUMBER OF LOOP/PICT LOADED
0343 F6 02EC A          LDAB   CNT16       ACTUAL COUNT TRANSMITTED
0346 11                 CBA
0347 27 0B              BEQ    SEND5       LAST PICTURE
0349 BD 03DA A          JSR    LOOPN1      LOAD NEXT LOOPS
034C 7F 02E7 A          CLR    CNT2
034F FE 02E8 A          LDX    PIC1        LOAD X WITH PICTURE ADDRESS
0352 20 AB              BRA    SEND1
0354 7E 0000 A SEND5    JMP    LOAD        NEXT LOAD
                        ************************************************************
                        ***        DOT THIS ROUTINE GENERATES PICTURE DOTS
                        ************************************************************
0357 7F 02E6 A DOT      CLR    CNT1
035A 7C 02E6 A DOT1     INC    CNT1
035D 4F                 CLRA
035E B6 02E5 A          LDAA   BYTE        GET CURRENT BYTE
0361 49                 ROLA               SHIFT A LEFT
0362 B7 02E5 A          STAA   BYTE        STORE RESULTS
0365 25 0C              BCS    DOT2        CHARACTER DOT
0367 20 1A              BRA    DOT3        NO DOT
0369 F6 02E3 A DELAY    LDAB   MSEC        DOT ON/OFF DELAY
036C 5A        DEL1     DECB
036D C1 00              CMPB   #0
036F 27 09              BEQ    RET1
0371 20 F9              BRA    DEL1
0373 86 01     DOT2     LDAA   #1          LOAD 1 PIA BIT 0
0375 B7 801C A          STAA   PIA         TURN ON PIA BIT
0378 20 EF              BRA    DELAY
037A F6 02E6 A RET1     LDAB   CNT1        LOAD CHAR BIT COUNT
037D C1 05              CMPB   #5          IS IT BIT 5 ?
037F 27 09              BEQ    RET2        IF SO GET NEXT CHARACTER
0381 20 D7              BRA    DOT1        GET NEXT BIT
0383 86 00     DOT3     LDAA   #0          LOAD 0 NEXT BITS
0385 B7 801C A          STAA   PIA
0388 20 DF              BRA    DELAY
038A 86 00     RET2     LDAA   #0
038C B7 801C A          STAA   PIA         TURN OFF PIA BIT
038F F6 02E3 A          LDAB   MSEC        CHAR SPACE DELAY
0392 5A        DEL3     DECB
0393 C1 00              CMPB   #0
0395 27 02              BEQ    RET4        RETURN TO PROGRAM
0397 20 F9              BRA    DEL3
0399 39        RET4     RTS
                        ************************************************************
                        ***        HORIZ - THIS ROUTINE TRANSMITTS HORIZ SYNC PULSES
                        ************************************************************
039A 86 04     HORIZ    LDAA   #4          LOAD A BIT 2
039C B7 801C A          STAA   PIA         SET PIA
039F 86 04              LDAA   #4          DO LOOP 4 TIMES
03A1 F6 02E4 A HOR4     LDAB   PUL1        APPROX 1 MS DELAY LOOP
03A4 5A        HOR1     DECB
03A5 C1 00              CMPB   #0
03A7 27 02              BEQ    HOR2
03A9 20 F9              BRA    HOR1
03AB 4A        HOR2     DECA
03AC 81 00              CMPA   #0
03AE 27 02              BEQ    HOR3
03B0 20 EF              BRA    HOR4
03B2 4F        HOR3     CLRA
03B3 B7 801C A          STAA   PIA         RESET PIA
03B6 39                 RTS
                        ************************************************************
                        ***        VERT- THIS ROUTINE TRANSMITTS VERT SYNC PULSES
                        ************************************************************
03B7 86 04     VERT     LDAA   #4          LOAD A BIT 2
03B9 B7 801C A          STAA   PIA         SET PIA
03BC 86 1E              LDAA   #30         DO LOOP 30 TIMES
03BE F6 02E4 A VER4     LDAB   PUL1        1 MSEC DELAY LOOP
03C1 5A        VER1     DECB
03C2 C1 00              CMPB   #0
03C4 27 02              BEQ    VER2
03C6 20 F9              BRA    VER1
03C8 4A        VER2     DECA
03C9 81 00              CMPA   #0
03CB 27 02              BEQ    VER3
03CD 20 EF              BRA    VER4
03CF 4F        VER3     CLRA
03D0 B7 801C A          STAA   PIA         RESET PIA
03D3 39                 RTS
                        ************************************************************
                        ***        LOOPN- THIS SUBROUTINE SETS UP PROGRAM LOOPS AND
                        ***               PICTURE BUFFERS PREVIOUSLY LOADED
                        ************************************************************
03D4 7F 02EC A LOOPN    CLR    CNT16
03D7 CE 00D3 A          LDX    #LPBUF
03DA A6 00     LOOPN1   LDAA   X
03DC 97 7D              STAA   CNT4        LOOP NUMBER
03DE 08                 INX
03DF A6 00              LDAA   X
03E1 97 7E              STAA   CNT5        PICTURE NUMBER
03E3 08                 INX
03E4 FF 02EE A          STX    CNT15
03E7 7C 02EC A          INC    CNT16       INC TRANSMIT PICTURE COUNT
03EA 7F 02ED A          CLR    CNT14       CLEAR LOOP COUNT
03ED 96 7E              LDAA   CNT5
03EF 81 00              CMPA   #H'00
03F1 27 14              BEQ    N0
03F3 81 01              CMPA   #H'01
03F5 27 18              BEQ    N1
03F7 81 02              CMPA   #H'02
03F9 27 1C              BEQ    N2
03FB 81 03              CMPA   #H'03
03FD 27 20              BEQ    N3
03FF 81 04              CMPA   #H'04
0401 27 24              BEQ    N4
0403 81 05              CMPA   #H'05
0405 27 28              BEQ    N5
0407 CE 0464 A N0       LDX    #1124
040A FF 02E8 A          STX    PIC1
040D 20 28              BRA    LOOPN2
040F CE 0797 A N1       LDX    #1943
0412 FF 02E8 A          STX    PIC1
0415 20 20              BRA    LOOPN2
0417 CE 0ACA A N2       LDX    #2762
041A FF 02E8 A          STX    PIC1
041D 20 18              BRA    LOOPN2
041F CE 0DFD A N3       LDX    #3581
0422 FF 02E8 A          STX    PIC1
0425 20 10              BRA    LOOPN2
0427 CE 1130 A N4       LDX    #4400
042A FF 02E8 A          STX    PIC1
042D 20 08              BRA    LOOPN2
042F CE 1463 A N5       LDX    #5219
0432 FF 02E8 A          STX    PIC1
0435 20 00              BRA    LOOPN2
0437 39        LOOPN2   RTS
1C00                    ORG    H'1C00
1C00    001E   B0       RMB    30
1C1E    001E   B1       RMB    30
1C3C    001E   B2       RMB    30
1C5A    001E   B3       RMB    30
1C78    001E   B4       RMB    30
1C96    001E   B5       RMB    30
1CB4    001E   B6       RMB    30
                        END

 SYMBOL TABLE:

AD1      0267 A   AD2      026F A   ADD1     0264 A   B0       1C00 A
B1       1C1E A   B2       1C3C A   B3       1C5A A   B4       1C78 A
B5       1C96 A   B6       1CB4 A   BUF1     0299 A   BUF2     0297 A
BUFF     0275 A   BUFF0    02AB A   BUFF1    02B3 A   BUFF2    02BB A
BUFF3    02C3 A   BUFF4    02CB A   BUFF5    02D3 A   BUFF6    02DB A
BUFN     0298 A   BYTE     02E5 A   BYTE1    0274 A   CNT1     02E6 A
CNT10    00E7 A   CNT12    00E8 A   CNT13    0167 A   CNT14    02ED A
CNT15    02EE A   CNT16    02EC A   CNT2     02E7 A   CNT3     00E1 A
CNT4     007D A   CNT5     007E A   CNT6     007F A   CNT7     00E2 A
CNT8     00E4 A   CNT9     00E0 A   DATA     0272 A   DATA1    0088 A
DEL1     036C A   DEL3     0392 A   DELAY    0369 A   DOT      0357 A
DOT1     035A A   DOT2     0373 A   DOT3     0383 A   FAP      0168 A
FAP0     0187 A   FAP1     0192 A   FAP2     019D A   FAP3     01A8 A
FAP4     0193 A   FAP5     01BE A   FAP6     01C9 A   FSLA     01CA A
FSLA1    01D4 A   FSLA2    01E7 A   FSLA3    01E1 A   FSLA4    01EA A
HOR1     03A4 A   HOR2     03AB A   HOR3     03B2 A   HOR4     03A1 A
HORIZ    039A A   INEEE    E1AC A   LBA      00FC A   LND      025A A
LND1     025D A   LOAD     0000 A   LOOP     0082 A   LOOP1    0085 A
LOOP2    0098 A   LOOP3    00CB A   LOOP4    00D2 A   LOOP5    00AD A
LOOPN    03D4 A   LOOPN1   03DA A   LOOPN2   0437 A   LP0      01F0 A
LP1      01F3 A   LP2      01F6 A   LP3      0200 A   LP5      020C A
LPBUF    00D3 A   MENU1    0020 A   MENU2    0055 A   MSEC     02E3 A
N0       0407 A   N1       040F A   N2       0417 A   N3       041F A
N4       0427 A   N5       042F A   NUM      00EA A   NUM1     0154 A
NUM2     015E A   NUM4     00ED A   NUM5     0143 A   OUT      E07E A
OUTEEE   E1D1 A   PIA      801C A   PIC1     02E8 A   PIC2     02EA A
PUL1     02E4 A   RET1     037A A   RET2     038A A   RET4     0399 A
SEND     02F0 A   SEND1    02FF A   SEND2    0313 A   SEND3    0328 A
SEND4    033E A   SEND5    0354 A   SLL1     020D A   SLL2     0218 A
SLL3     0223 A   SLL4     022E A   SLL5     0239 A   SLL6     0244 A
SLL7     024F A   VER1     03C1 A   VER2     03C8 A   VER3     03CF A
VER4     03BE A   VERT     03B7 A

 CHECKSUM = B383

 LENGTH OF DSECT =      0 (0000)
 LENGTH OF ISECT =      0 (0000)

                  NO ERRORS.  NO WARNINGS.  THIS ASSEMBLY
```

Program A. Source listings for SSTV generation program.

you to type in the number of times each SSTV picture is transmitted. For example, a 3 loop would transmit approximately 24 seconds (3 x 8) of SSTV. The program will then respond with a slash after you enter the loop number. It will then wait for the picture you have just loaded (0-5). You

routines which make up the software. The flowcharts should be useful to anyone who wants to build this system around another microprocessor.

I hope you will enjoy using this SSTV generator. Over-the-air reports have indicated that the video is considerably more readable under QRM conditions than my WØLMD keyboard. The use of microprocessors are an obvious choice for the generation of SSTV. Considering that my special purpose SSTV keyboard is complex (44 ICs) and my SSTV 6800 generator runs on an unmodified SWTPC 6800 this proves that the microprocessor is the way to go for SSTV. ■

References

[1]"An SSTV keyboard," by Dr. Robert Sudding WØLMD, *CQ Magazine*, Sept., 1974, page 20.

[2]Signetics Corp., *Digital/Linear MOS IC Manual*, "2513 High Speed Character Generator Chip," pages 7-80 (1972 version).


```
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S121003C2020203220202020202033202020202020342020202020350A0D0410160D5345AE
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S121022BA7383996E1DEE2A73FA746A74D3996E1DEE2A754A75BA7623996E1DEE2A70E
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S121040B02E82028CE0797FF02E82020CE0ACAFF02E82018CE0DFDFF02E82010CE1175
S112042930FF02E82008CE1463FF02E8200039F8
S9030000FC
```

Program C. Paper tape format for SSTV generation program.

Aim Your Antenna With a Micro

-- beam heading BASIC program

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233 North Columbus Street
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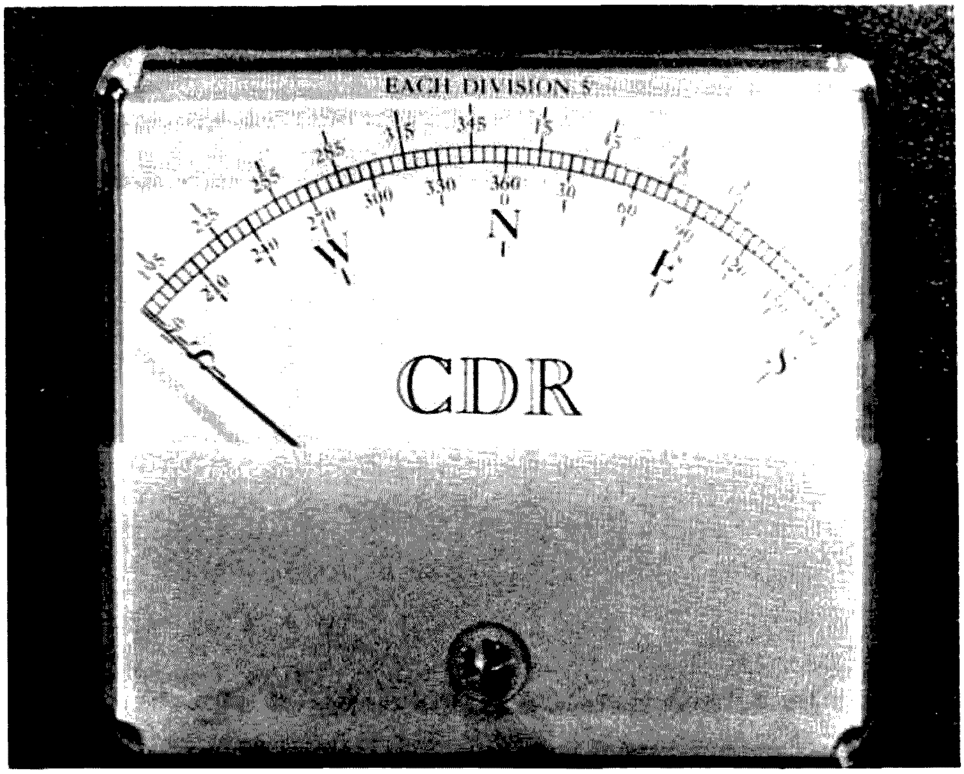


What direction?

This article describes a computer program that can provide accurate azimuth and distance information for properly aiming your beam antenna. Although the program was originally written in FORTRAN language for use with an IBM 370/155 computer, accessed through an IBM time-sharing terminal, the program is also presented in BASIC language. Also, the program can be modified to run on a microcomputer instead of through a time-sharing terminal.

Background

In the past year, several articles have appeared in *73 Magazine* describing methods of calculating beam bearing and distance. Two of these articles were "Aim your Beam Right" by WB4GVE (June, 1976) and "Global Calculations for the DXer" by W2IAT (August, 1976).

WB4GVE's article provided a method whereby azimuth information can be obtained using an HP-55 calculator. The basic azimuth equation is:

Degrees Azimuth =

$$270^\circ - \mathrm{Tan}^{-1}\left[\mathrm{Cos}\,\theta_1\left(\frac{\mathrm{Tan}\,\theta_1\,\mathrm{Cos}(\phi_2-\phi_1) - \mathrm{Tan}\,\theta_2}{\mathrm{Sin}(\phi_2-\phi_1)}\right)\right]$$

where

θ_1 = latitude of your QTH
ϕ_1 = longitude of your QTH
θ_2 = latitude of the distant QTH
ϕ_2 = longitude of the distant QTH

W2IAT's article described a procedure for determining the distance in statute miles between two stations using a non-programmable calculator. The basic equation for calculating the distance between any two points along the earth's surface in statute miles is:

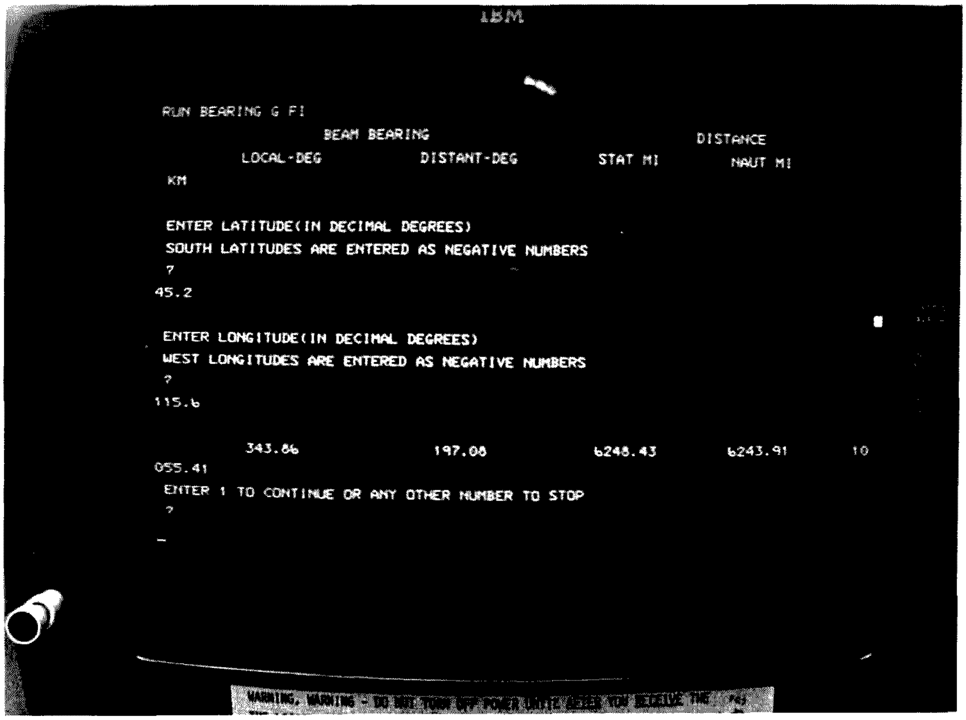
$$d = 69.05Z$$

$$Z = \left[\mathrm{Cos}^{-1}\left[(K_1)(\mathrm{Sin}\,LAT_D) + (K_2)(\mathrm{Cos}\,LAT_D)\,\mathrm{Cos}\,(LON_D - LON_H)\right]\right]$$

where

d = distance in statute miles
K_1, K_2 = constants determined by latitude of your QTH
LON_D = longitude of the distant QTH
LON_H = longitude of your QTH
LAT_D = latitude of the distant QTH

It should be noted that the constant used (69.05) is not the same as used by W2IAT (69.15). The appropriate constant for statute miles may be found in "Radio Data Reference Book," Second Edition, Radio Society of Great Britain (RSGB), p. 103, and "Reference Data For Radio Engineers," Fifth Edition, Howard W. Sams & Co., pp. 26-10.

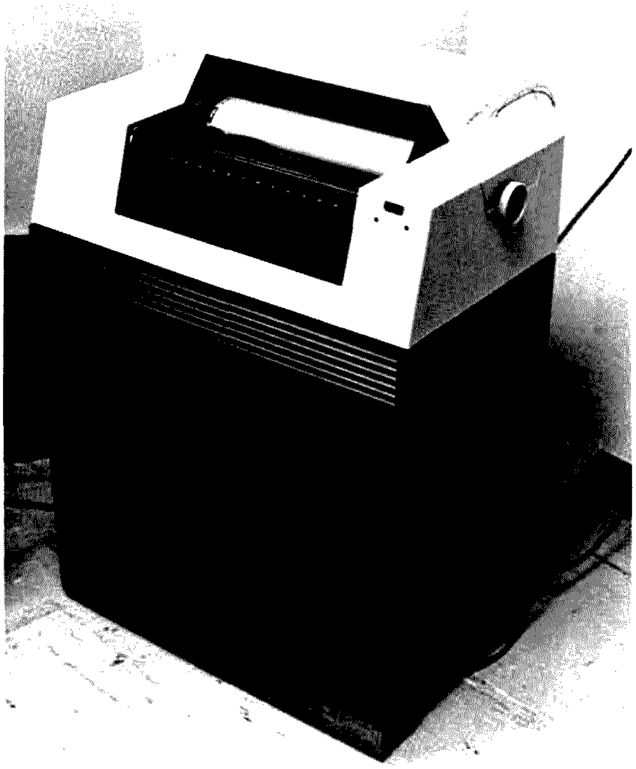


IBM 3277 time-sharing terminal.

Development

Calculating beam bearing using a computer instead of a calculator provides several distinct advantages. For one thing, a computer system can provide a detailed printout of the results for later use. Another advantage is that,

An actual terminal screen display.



IBM 3284 printer.

```
10          WRITE (2,100)
20          WRITE (6,100)
30    100   FORMAT(' ',T19,'BEAM BEARING',T61,'DISTANCE')
40          WRITE(2,110)
50          WRITE(6,110)
60    110   FORMAT(' ',T10,'LOCAL-DEG',T30,'DISTANT-DEG',T50,'STAT MI',T65,'NA
70          1 UT MI',T82,'KM')
80          WRITE(2,120)
90          WRITE(6,120)
100   120   FORMAT(' ')
110   129   WRITE(6,130)
120   130   FORMAT(' ENTER LATITUDE(IN DECIMAL DEGREES)')
130         WRITE(6,140)
140   140   FORMAT(' SOUTH LATITUDES ARE ENTERED AS NEGATIVE NUMBERS')
150         READ(5,*)PLAM2
160         WRITE(6,160)
170   160   FORMAT(' ')
180         WRITE(6,170)
190   170   FORMAT(' ENTER LONGITUDE(IN DECIMAL DEGREES)')
200         WRITE(6,180)
210   180   FORMAT(' WEST LONGITUDES ARE ENTERED AS NEGATIVE NUMBERS')
220         READ(5,*)PL2
230         WRITE(6,190)
240   190   FORMAT(' ')
250         PIE=3.141592654
260         PLAM1=41.87*PIE/180.
270         PLAM2=PLAM2*PIE/180.
280         N=1
290         PL1=-87.63*PIE/180.
300         PL2=PL2*PIE/180.
310   105   CONTINUE
320         QP=COS(PLAM1)*((TAN(PLAM1)*COS(PL2-PL1))-TAN(PLAM2))/SIN(PL2-PL1)
330         X=270.+((180./PIE)*ATAN(QP))
340         IF((PL2-PL1).LE.0.)GO TO 202
350         IF((PL2-PL1).LE.PIE)X=X-180.
360   202   IF(N.EQ.2)GO TO 300
370         PL3=PL2
380         PL4=PL1
390         PL2=PL4
400         PL1=PL3
410         PLAM3=PLAM2
420         PLAM4=PLAM1
430         PLAM2=PLAM4
440         PLAM1=PLAM3
450         Y=X
460         N=2
470         GO TO 105
480   300   CONTINUE
490         C=ABS(PL2-PL1)
500         IF(C.GT.PIE)C=2.0*PIE-C
510         Z=ARCOS(SIN(PLAM1)*SIN(PLAM2)+COS(PLAM1)*COS(PLAM2)*COS(C))
520         Z=Z*180./PIE
530         A=69.05*Z
540         B=60.00*Z
550         E=111.12*Z
560   125   WRITE(2,150)Y,X,A,B,E
570         WRITE(6,150)Y,X,A,B,E
580   150   FORMAT(' ',T09,F6.0,T30,F6.0,T49,F6.0,T64,F6.0,T79,F6.0)
590         WRITE(6,220)
600   220   FORMAT(' ENTER 1 TO CONTINUE OR ANY OTHER NUMBER TO STOP')
610         READ(5,*)NS
620         IF(NS.EQ.1)GO TO 129
630         STOP
640         END
```

Fig. 1. Computer program statement listing (FORTRAN).

not having a programmable calculator with "power-off" program storage, using a computer enables a program to be saved from one run to the next.

In developing the program, use was made of the basic equations for calculating azimuth and distance cited earlier. These have been built upon to provide beam bearings for use at both the local and distant stations and to furnish the surface distance between the two locations in statute miles, kilometers, and nautical miles. The program provides prompting for keying in coordinates and can display beam bearing (azimuth) and distance information on both the terminal screen and on an external page printer.

FORTRAN Program Details

Fig. 1 shows a listing of the 64 FORTRAN statements making up the computer program. Statements 10-30 write the headings 'beam bearing' and 'distance' on both the terminal screen (6) and an output data set (2) for possible later printout. Statements 40-60 write the subheadings 'local-deg,' 'distant-deg,' 'stat mi,' 'naut mi,' and 'km' the same way as the previous write statements, but on the next line. The "T" format is used to tab the subheadings across the lines in the same manner as a typewriter tab mechanism. Statements 80-100 write a blank line (space 1 line). Statements 110-150 prompt the user to enter the latitude and label it PLAM2. Statement 150 reads from the keyboard (5) in a flexible format (*). Statements 160-170 write a blank line on the screen (space 1 line). Statements 180-220 prompt the user to enter the longitude from the keyboard and label it PL2. Statements 230-240 write a blank line on the screen. Statement 250 assigns the variable PIE the value of pi (3.14.....). Statements 260-270 convert both local and distant latitudes from decimal degrees to radians. Statement 280 assigns variable N the value 1 (to be used later in the program). Statements 290-300 convert both local and distant longitudes from decimal degrees to radians. Statement 310 will be used to branch back to that point in the program from a later statement in the program. Statements 320-330 compute the beam bearing from one location to another. Statements 340-350 ensure that the beam bearing chosen is the shorter of the two possible (.LE. stands for "Less than or Equal to"). Statement 360 branches around statements 370-470 if N=2. Statements 370-470 reverse local and distant longitudes and latitudes, assign the variable Y to the previously computed beam bearing, set N=2, and branch back to statement 310 to compute beam bearing from the distant to the local QTH. Statement 480 is branched to from statement 360 if N=2 (both bearings

have been computed). Statements 490-520 compute the distance between the two locations. ABS (absolute value) strips off any negative sign and '.GT.' stands for "Greater Than." Statements 530-550 convert the distance to statute miles, nautical miles, and kilometers. Statements 560-580 write the answers under the appropriate subheadings on both the terminal and the output data set (for later printout). Format F6.0 means the number is printed in 6 spaces with no decimal places. Statements 590-610 prompt the user in determining whether to compute again using a new set of inputs or end the run. Statements 630 and 640 terminate the computer run.

BASIC Program Details

Fig. 2 shows a listing of the 63 BASIC statements used in rewriting the program in that language. Statements 10-60 prompt the user to enter distant latitude. Statements 70-110 do the same for distant longitude. Statements 120-210 perform the same function as FORTRAN statements 250-330. Statements 220-260 perform the same function as FORTRAN statements 340-350. Statements 270-390 are equivalent to FORTRAN statements 360-490. Statements 400-420 replace the IF statement on line 500 of the FORTRAN program. BASIC language does not contain an arc cosine (COS^{-1}) function. Therefore, the mathematical series giving a close approximation to this function has been substituted in statements 430-470. The series used is:

$$\cos^{-1} x = \frac{\pi}{2} - \left(x + \frac{x^3}{2\cdot3} + \frac{1\cdot3x^5}{2\cdot4\cdot5} + \frac{3\cdot5\cdot x^7}{2\cdot4\cdot6\cdot7} \cdots\cdots \right)$$

Statements 480-510 are equivalent to FORTRAN statements 520-550. Statements 520-580 print out the bearing and distance information. Statements 590-620 prompt the user in choosing between recomputation for another set of longitude and latitude and program termination.

```
10    PRINT
20    PRINT
30    PRINT "ENTER LATITUDE (IN DECIMAL DEGREES)"
40    PRINT "SOUTH LATITUDES ARE ENTERED AS NEGATIVE NUMBERS"
50    PRINT "LATITUDE";
60    INPUT A2
70    PRINT
80    PRINT "ENTER LONGITUDE (IN DECIMAL DEGREES)"
90    PRINT "WEST LONGITUDES ARE ENTERED AS NEGATIVE NUMBERS"
100   PRINT "LONGITUDE";
110   INPUT L2
120   PRINT
130   P1 = 3.14159
140   A1 = 41.87*P1/180.
150   A2 = A2*P1/180.
160   N = 1
170   L1 = 87.63 * P1/180.
180   L2 = L2 * P1/180.
190   Q2 = TAN (A1) * COS (L2-L1) - TAN (A2)
200   Q1 = Cos A1*Q2/SIN (L2-L1)
210   X1 = 270 + ((180./P1) * ATN (Q1))
220   L9 = L2-L1
230   IF L9 <= 0. THEN 270
240   IF L9 <= P1 THEN 260
250   GO TO 270
260   X1 = X1 - 180.
270   IF N = 2 THEN 390
280   L3 = L2
290   L4 = L1
300   L2 = L4
310   L1 = L3
320   A3 = A2
330   A4 = A1
340   A2 = A4
350   A1 = A3
360   Y1 = X1
370   N = 2
380   GO TO 190
390   C1 = ABS (L9)
400   IF C1 > P1 THEN 420
410   GO TO 440
420   C1 = 2.0 * P1 - C1
430   REM ARC COSINE MUST BE CONVERTED TO EQUIVALENT FORM IN BASIC
440   Z2 = SIN (A1) * SIN (A2)
450   Z3 = COS (A1) * COS (A2) * COS (C1)
460   Z4 = Z2 + Z3
470   Z1 = P1/2. - Z4 - Z4 ↑ 3/6 - Z4 ↑ 5*3./40. - Z4 ↑ 7 * 15./336.
480   Z1 = Z1 * 180./P1
490   A = 69.05 * Z1
500   B = 60.00 * Z1
510   E = 111.12 * Z1
520   PRINT
530   PRINT
540   PRINT "LOCAL-DEG", "DISTANT-DEG", "STAT MI", "NAUT MI", "KM"
550   PRINT
560   PRINT Y1, X1, A, B, E
570   PRINT
580   PRINT
590   PRINT "ENTER 1 TO CONTINUE OR ANY OTHER NUMBER TO STOP"
600   PRINT "CONTINUE";
610   INPUT N1
620   IF N1 = 1 THEN 10
630   END
```

Fig. 2. Computer program (BASIC).

Operation

After "signing-on" the time-sharing terminal, the program is called up for use and run. Immediately the headings and subheadings are displayed on the terminal screen. Then, the phrases "Enter latitude (in decimal degrees)" and "South latitudes are entered as negative numbers" appear on the screen. The desired distant latitude is then typed on the keyboard by the user. The same procedure is followed next to enter longitude. Computed values for beam bearing and distance then appear on the screen under the appropriate subheadings. At this point, the program will prompt the user with "Enter 1 to continue or any other number to stop." If a "1" is entered, the program will again prompt the user for new latitude and longitude values and will compute a new line of computed

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Regulated Nicad Charger

- - don't cook 'em!

More and more nicad cells are becoming available and many hams are utilizing them in portable rigs and test equipment. To avoid damaging these batteries though, a few precautions are necessary:

1. Always utilize the full capacity of the cell. Nicads have a sort of "memory" action and a unit that is habitually required to provide only ½ of its rated capacity will go dead at that half way level when the whole bit is needed.

2. Don't reverse charge a nicad. Keep the charge condition on all cells in a series string at the same percentage rate. Substitution of a partially charged cell into a series string of fully charged units may ruin the weaker cell through reverse charging.

3. When charging standard nicads (other than "Quick-Charge" units), limit the charge current to about 1/10 the rated Ampere-hour capacity. Excessive charge current causes overheating, which may result in seal rupture and venting of excess pressure. Once the seal is broken, the cell will rapidly dry out and become useless.

Item 3 above leads right into the reason for this article. Fig. 1 is representative of a "universal" type nicad charger circuit.

The transformer, rectifier, and filter capacitor are conventional design. The transformer itself is an 18 volt doorbell unit which gives a rectified dc output of 25 volts.

The current regulator is somewhat less conventional, as most hams are familiar with the emitter follower circuit in Fig. 2. Placing the load in the collector circuit as in Fig. 1 allows a measure of gain and results in better current limiting action.

In Fig. 1, resistor R1 is used to provide forward bias to the base of Q1, bringing that transistor into conduction. With no collector load (batteries) in the circuit, the emitter current is very low. Thus the resulting voltage drop across the base-emitter junction and R2 is not adequate to forward bias the two diodes, D1 and D2. This leaves the transistor in a full-on state with the whole supply voltage present at the output terminals.

Now, if we put a heavy load (0 Ohms) across the output terminals, the current will increase(!), but how much? Watch what happens. As the current increases, the voltage drop across R2 also increases. When the base-emitter drop plus the R2 drop reaches approximately 1.2 volts, the two diodes go into conduction and limit any further increase in base potential. Thus the current is limited to that point where the emitter circuit voltage drops equal the series turn-on potential of D1 and D2.

For silicon diodes, the turn-on potential is about 0.6 volts. This also holds true for the base-emitter junction of silicon transistors. This means that the required value for R2 is about 0.6 volts divided by the current limit desired.

Varying the load (using 1 to 18 nicad cells) reveals that the current limiting action will hold within 1 to 2 mA from 0 to 24 volts. In other words, you can charge any random number of cells from 1 to 18 without adjusting the charger.

Transistor Q1 should be chosen for a reasonably good hfe and a power capability of twice the total supply voltage times the current limit value. Since my primary interest is in 450 mAh penlight cells, my charge current is set at 45 mA. This means that my transistor must dissipate 25 volts times 0.045 Amperes, or 1.125 Watts. Double that for safety and a 2 Watt transistor is about right. ■

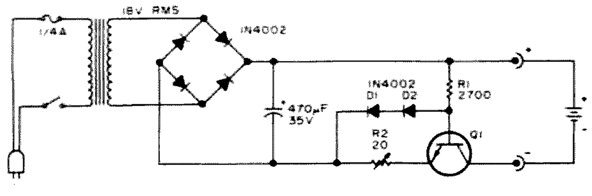

Fig. 1.

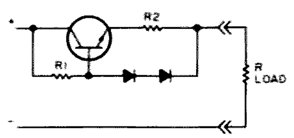

Fig. 2.

Complete Repeater Control System

-- all that's missing is the computer

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2736 Woodbury Drive
Burlington NC 27215

You can build a repeater that will perform better than many commercial units. You can do it with six small plug-in circuit boards, a transmitter, and a receiver. Three of these boards were described in *73* recently in connection with autopatch. The circuits described in this article are made to interface with the autopatch boards.

CW Identifier

The K2OAW identifier is repackaged into a 22 pin plug-in 4 x 6 inch board. This circuit was presented in the February, 1973 issue of *73 Magazine* in an article by Pete Stark. I did add an audio oscillator for feeding the audio board described in *73*, April, 1977. The circuit master, schematic, parts layout, and parts list are provided for you to duplicate Pete Stark's excellent design in a more convenient layout.

Timer Board

The timer board has the four second tail timer, the three minute timeout or "windbag" timer, and the five minute ID timer.

Request for transmitter on can originate from a signal being received (COS), local microphone (PTT), autopatch (AP), and the CW identifier board (ID HOLD). The shutdown control (TRANSMITTER ENABLED) is also an input. The four second and three minute timers are resettable by the action of the 2N3906 transistor which, upon being triggered, partially discharges the timing capacitor. This reset does not result in four more seconds or three more minutes, as only about half the delay can be reset out.

The ID timer and logic will start the identifier initially with COS, PTT, or AP going low, and will identify five minutes later. It is possible for two IDs to take place one after another if the five minute timer runs down and just afterwards COS goes low. I am working on a new logic scheme that will result in less extraneous IDs. I will try to lay it out so that it will plug in the same socket so that no wiring changes to the socket are necessary.

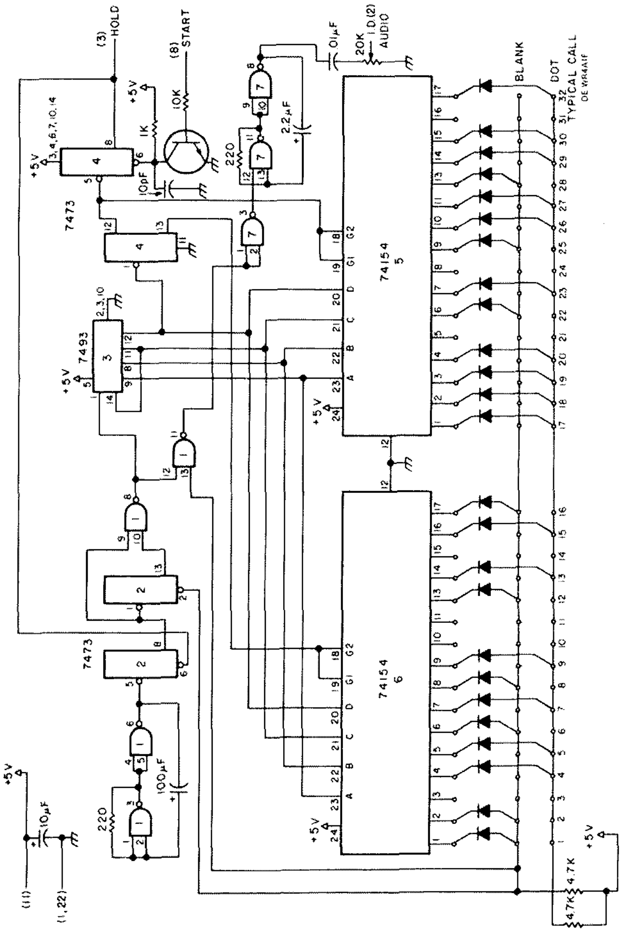


Fig. 1. K2OAW CW identifier.

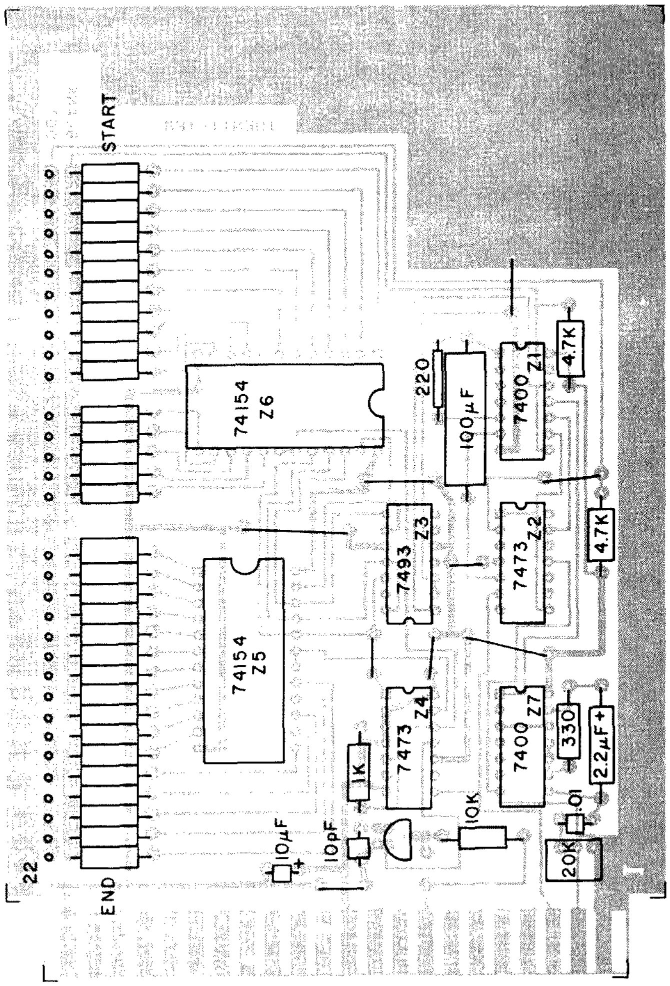
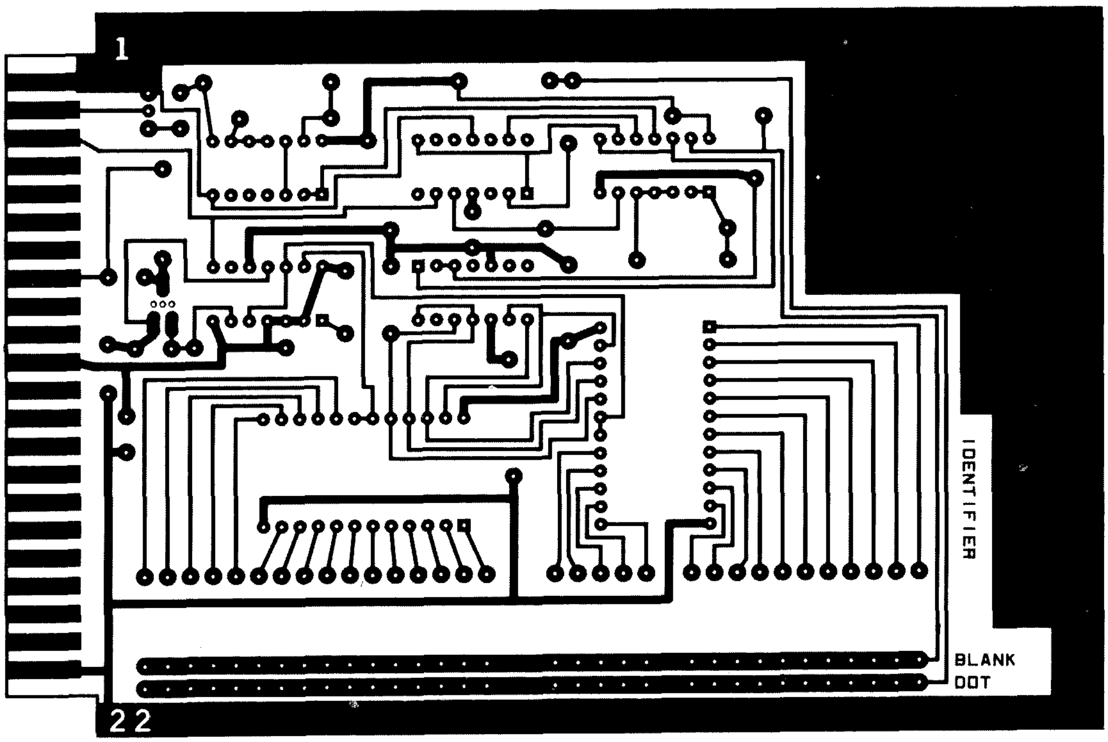


Fig. 2(b). Identifier component layout.

Fig. 2(a). Identifier board.



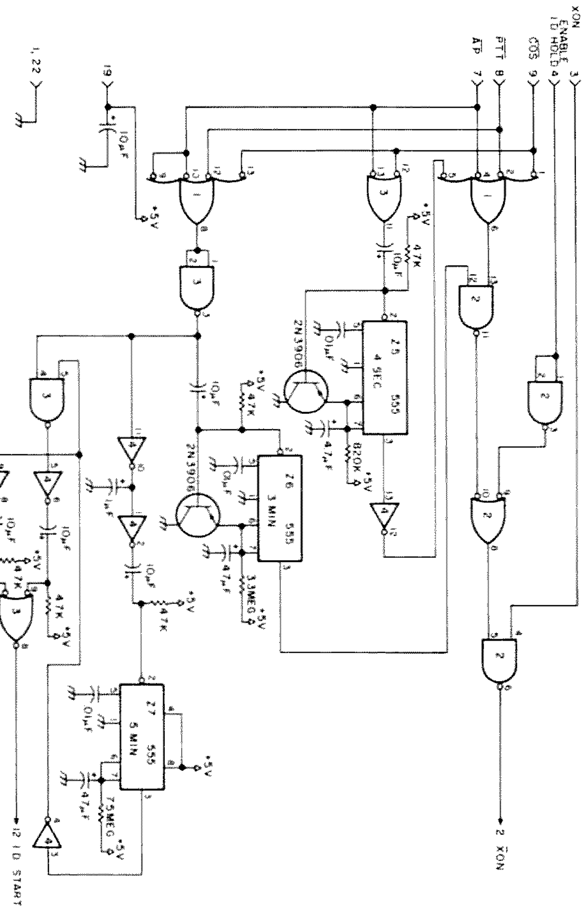


Fig. 3. Timer and control circuit schematic. Z1 – 7420; Z2, Z3 – 7400; Z4 – 7404; Z5, Z6, Z7 – 555.

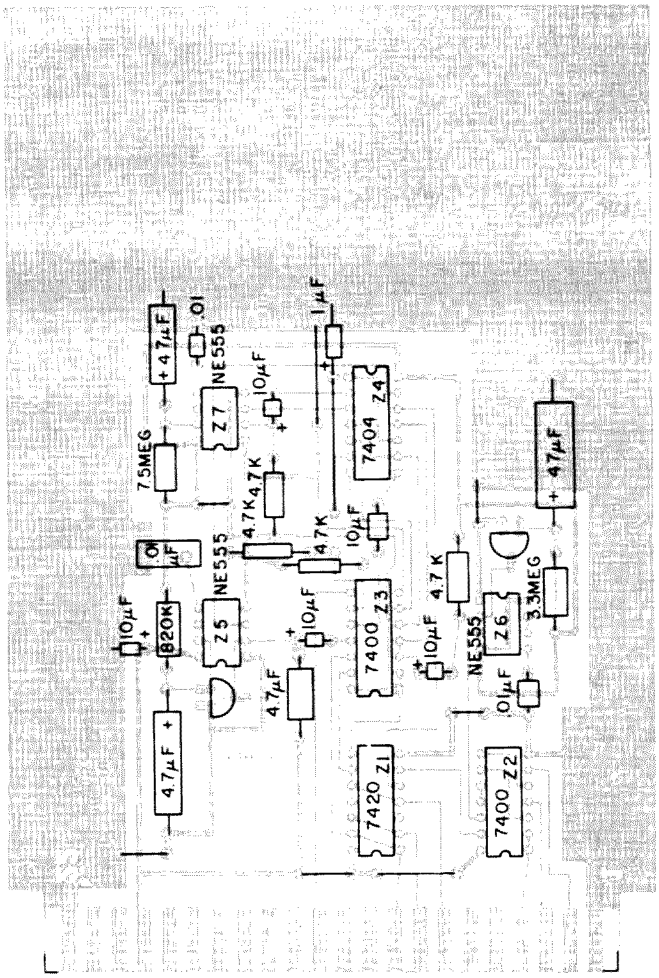
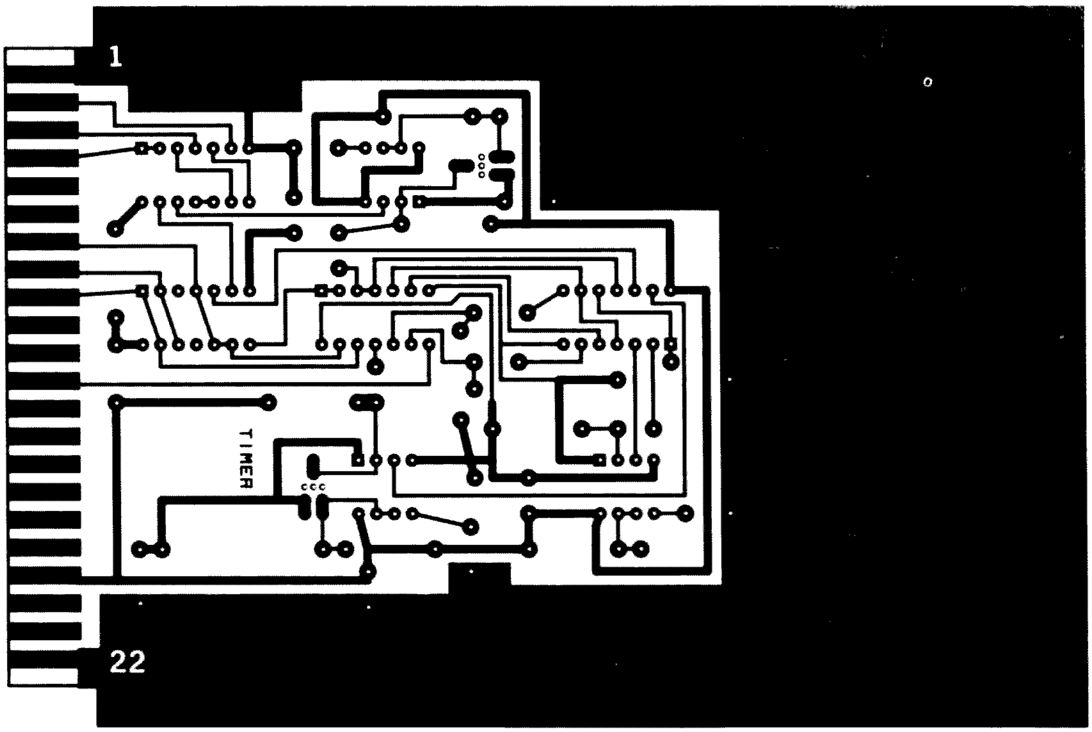


Fig. 4(b). Timer and control component layout.

Fig. 4(a). Timer and control board.



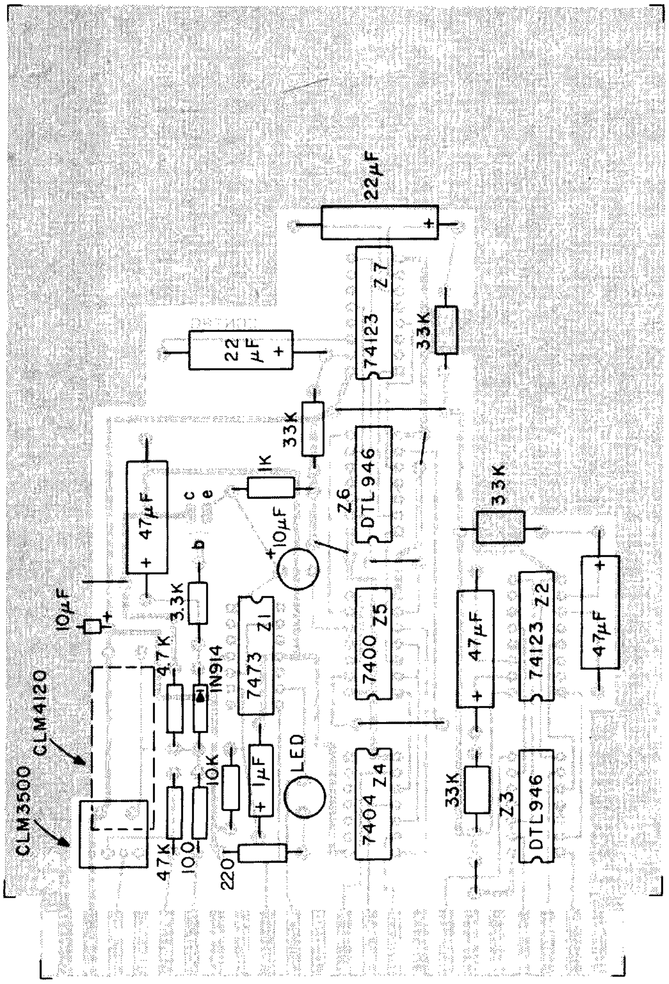


Fig. 6(b). Transmitter control component layout.

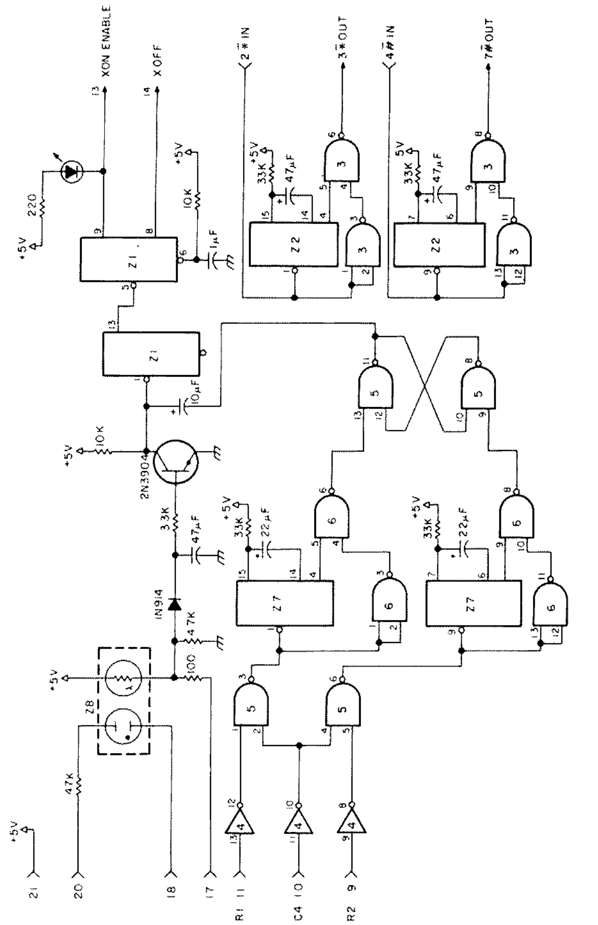
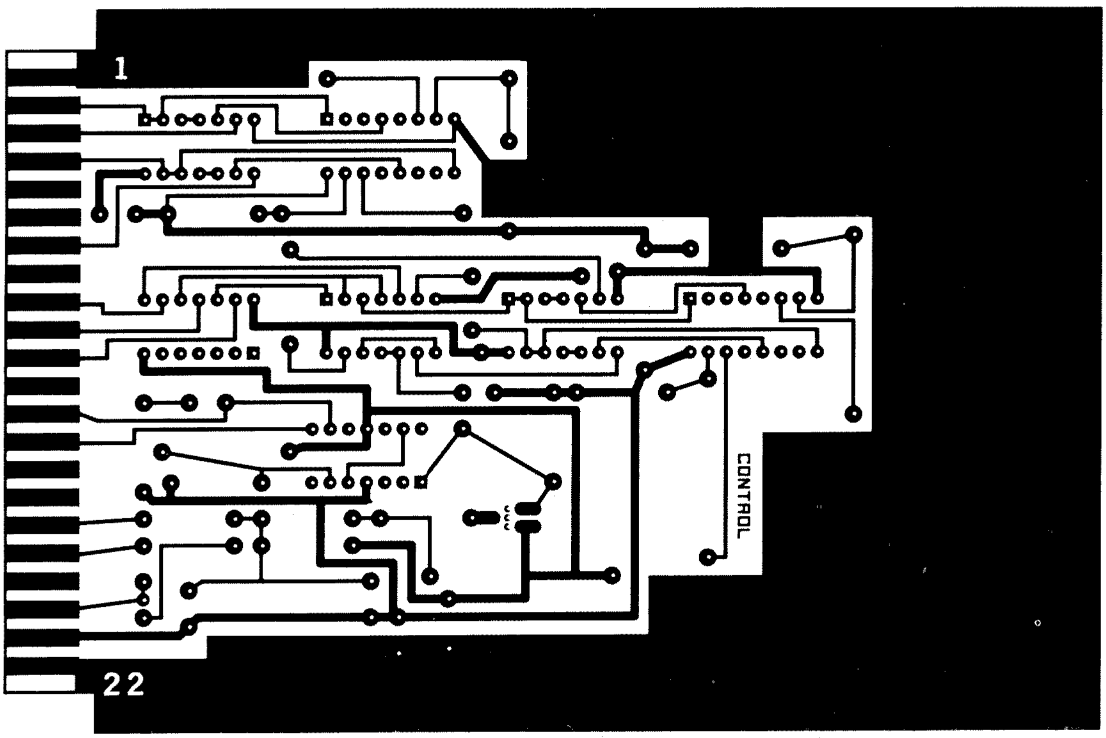


Fig. 5. Transmitter control. Z1 – 7473; Z2 – 74123; Z3 – DTL-946; Z4 – 7404; Z5 – 7400; Z6 – DTL-946; Z7 – 74123; Z8 – CLM 3500 or CLM 4120.

Fig. 6(a). Transmitter control board.



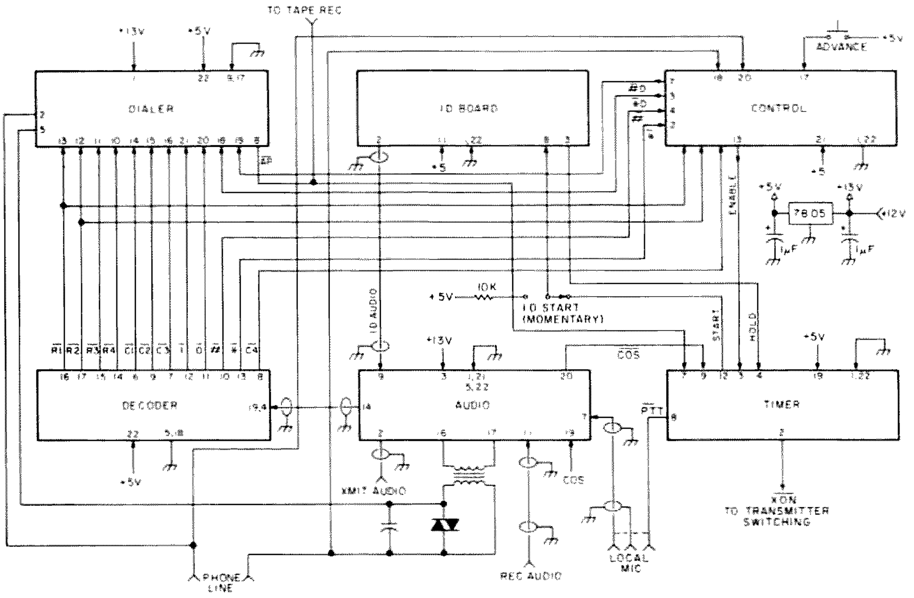


Fig. 7. Overall schematic.

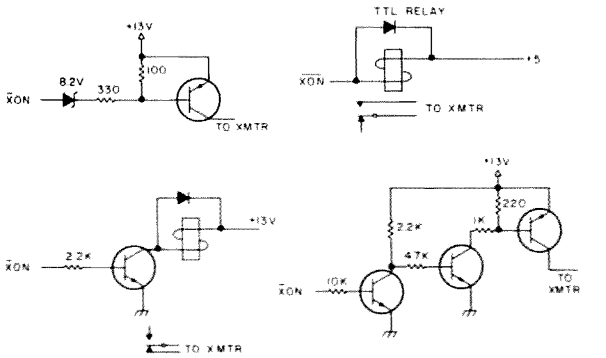


Fig. 8. Suggested transmit switching circuits.

or on the machine. The (A) and (B) buttons of the 16 button pad are pressed alternately to do this. The 74123 (a retriggerable multivibrator, Z7) is used as a half-second debouncer. In the article (April, 1977) on autopatch, I included the schematic for a (*) and (#) one-second debounce circuit. This circuitry is included on this board. The neon optoisolator only draws 2 mA from the phone line during ringing. A means for manually advancing the counter using a push-button is shown on the overall schematic. The 10k Ohm resistor and the 1 uF capacitor connected to pin 6 of Z1 insure that after a power failure the circuit will come on with the transmitter enabled.

Repeater Shutdown Board

This circuit is a must for remote controlled repeaters. This one will count the rings on the phone line and shut the repeater off by the "transmitter on enable" line going low. As a convenience and backup feature, touchtone in the fourth column can also be used to turn off

The Extender

A circuit master is included for an extender card. This card is soldered to a 22 pin connector. If you mount your circuit boards so that both sides are accessible for adjustment or test, then you will not need this aid (your boards will take up a lot of space though).

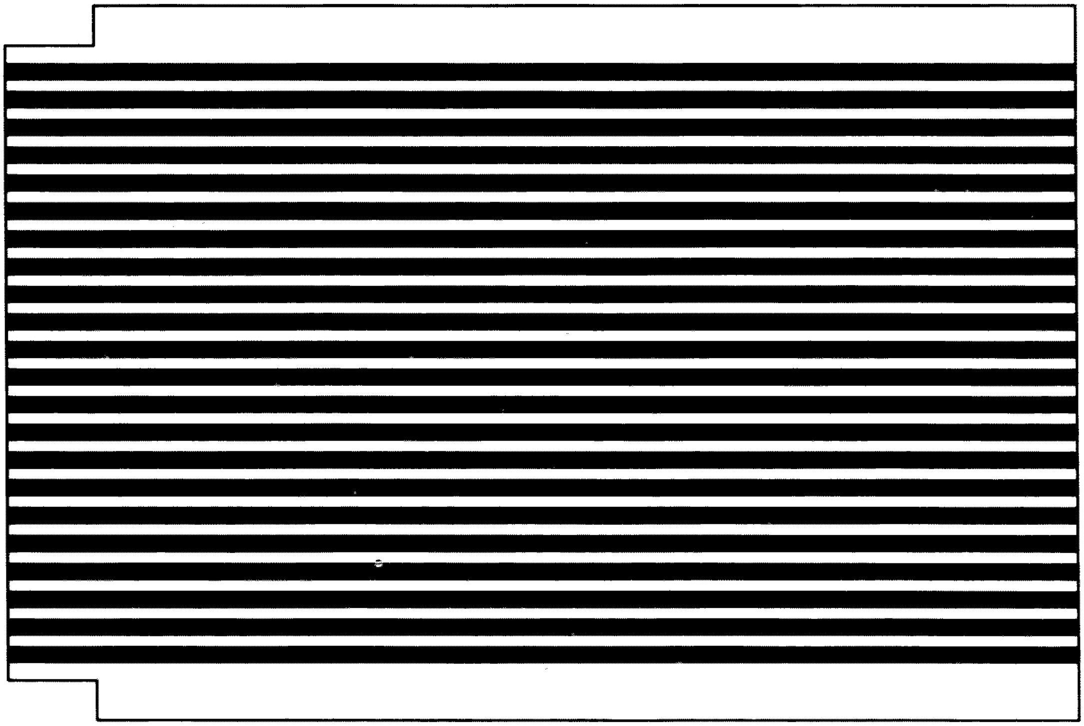


Fig. 9. Extender board.

Interfacing

The six boards will require very little to interface with a receiver and transmitter. An active high of three volts or so is needed from the receiver as a carrier operated switch (COS) signal. The receiver audio input to the audio board can come directly from the discriminator over a shielded wire. The 470k Ohm resistor on the audio board is large enough so that loading of the discriminator should not be a problem. A few circuits are given as suggestions for turning on the transmitter. You can, I am sure, think of a better one to fit your individual transmitter. A similar circuit can be used for the (AP) signal turning on the tape recorder.

If you use all six of these boards, you should remove the MC7805CP from the dialer board and mount the regulator on a good heat sink, as the five volt load will be near an Amp and the MC7805CP does not have enough heat sink mounted to the dialer circuit board.

K2OAW Identifier

Quantity	Description
2	220 Ohm ¼ W
1	1k Ohm ¼ W
2	4.7k Ohm ¼ W
1	10k Ohm ¼ W
1	100 uF 10 volts
1	2.2 uF 10 volts
1	.01 uF disc ceramic
1	10 uF dipped tantalum
(unk.)	Program diodes as required
2	7473
1	7493
2	7400
2	74154
1	20k pot, Bourns 3389W

Timer and Control

Quantity	Description
5	4.7k Ohm ¼ W
1	820k Ohm ¼ W
1	3.3 megohm ¼ W
1	7.5 megohm ¼ W
2	47 uF 10 V tantalum
6	10 uF 10 V dipped tantalum
1	4.7 uF 10 V tantalum
1	1 uF 10 V tantalum
3	.01 uF disc ceramic
1	7420
2	7400
1	7404
3	555

Transmitter Control

Quantity	Description
1	100 Ohm ¼ W
1	47k Ohm ¼ W
1	4.7k Ohm ¼ W
1	3.3k Ohm ¼ W
2	10k Ohm ¼ W
4	33k Ohm ¼ W
1	220 Ohm ¼ W
1	LED
1	1N914 diode
1	2N3904
3	47 uF 10 V tantalum
2	22 uF 10 V tantalum
1	1 uF 10 V tantalum
1	7473
2	74123
2	DTL 946
1	7404
2	7400
1	Optoisolator CLM 3500 or CLM 4120, Clairex Electronics, 560 South Third Ave., Mt. Vernon NY 10550, (914) 664-6602

Fig. 10. Parts list. Circuit boards and parts can be obtained from: Stafford Electronics, 427 South Benbow Rd., Greensboro NC 27401, (919) 274-9917.

Parting Shots

So good luck with your repeater project and please let me know about it. A QSL card with "it works" would be OK. If you have trouble getting any of the parts, send an SASE and I will try to help you find a source. Try the ads in *73* first because that is where I get most of the parts I use. In a project this large, errors are bound to creep in. Let me or the editor know about it and corrections can be made. ■

Transmission Line Primer

-- in case you don't know everything

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A number of articles have appeared in the amateur literature in the past few years attempting to "explain," or perhaps "explain away," the concept of reflected power on transmission lines. The conclusions reached by some of the authors range from "It doesn't seem to make any difference, so why worry about it?" to "I can't understand it, so it must not exist!" But of course reflected power does exist; part of the signal arriving at a point of mismatch on a transmission line is reflected back down the line just as surely as part of a radio signal striking the moon, or part of a radar signal striking an airplane, is reflected back the way it came. So the problem is in understanding how a transmission line operates. What seems to be needed is a new (to the amateur fraternity at least) way of looking at the problem.

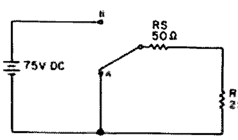

Fig. 1.

In the field of high speed digital logic, the characteristics of transmission lines and the effects of reflections on these lines is far more critical than in most radio communications systems. Luckily, the operation of a line driven with step functions or narrow pulses is also much easier to analyze than that of a line driven with constantly varying signals such as sine waves. Let's look into a very simple "digital" circuit consisting of a battery, a couple of resistors, and a chunk of cable. The analysis requires only the simplest of algebra and will provide tremendous insight into the whole subject.

First let's consider the trivial circuit in Fig. 1. When the switch is moved from contact A to contact B, a current of 1 Amp flows through the battery and both resistors, dropping 50 volts across RS and 25 volts across RL. Simple enough. Now let's move on to the circuit in Fig. 2, in which a long piece of cable, or transmission line, has been added. Now if we ignore the small resistance of the cable, we might expect this circuit to behave exactly like the first one. But it doesn't, not exactly! Remember that signals propagate along a transmission line at a finite speed; granted, it is a very high speed, usually greater than half the speed of light, but still a finite speed. This speed is specified by the line's velocity factor, which gives the speed of signal propagation on the line as a fraction of the speed of light. For most of the lines used by amateurs, this factor is about 0.66. That means signals propagate along the line at 0.66 times the speed of light, or about 0.66 feet per nanosecond. Then if our line in Fig. 2 is 660 feet long, it will take a signal 1000 ns, or 1 us, to get from one end to the other.

When the switch in Fig. 2 is thrown, current starts to flow through the battery, RS, and the end of the line. But it doesn't make it to the far end of the line, and RL, for 1000 ns. The obvious question at this point is "*How much* current flows during that 1000 ns?" Since there is no current at the far end of the line or in RL, then the value of RL can have no effect on the current. The only things controlling the current are the battery voltage, the value of RS, and the parameters of the line. The pertinent line parameter here is its characteristic impedance, or surge impedance. You've probably seen this defined as the impedance that would be seen looking into the end of an infinitely long line. It is equivalent, and perhaps easier to grasp, to say it is the impedance seen at the driven end of a cable before the signal has had time to reach the other end. And from that it follows that the line's characteristic, or surge, impedance (call it Z0), is the impedance seen by any signal moving along the line, that is, any wave propagating along a line always has its voltage equal to its current times Z0. Actually we've put the cart before the horse; the last statement is more nearly the textbook definition of Z0, and the previous two statements follow from it!

So if Z0 for the cable in Fig. 2 is 50 Ohms, the current through RS right after the switch is thrown is .75 Amps and the voltage across the near end of the line is 37.5 volts. If we look at the line 500 ns later, we find 37.5 volts across it at all points from the near end up to the middle and 0 volts at all points from the middle to the far end. Similarly we find .75 Amps flowing in the line at all points up to the middle and no current beyond. We are observing a signal, or wave front, or step, of 37.5 volts and .75 Amps propagating along the line at the rate of 0.66 feet per nanosecond.

Now let's consider what happens after 1000 ns, when the step reaches the far end of the line and RL. The ratio of voltage to current on the line is 37.5/.75=50, the line impedance. The ratio of voltage to current at RL must be the value of RL, or 25. So either the voltage, the current, or both must change. (Note that if RL were equal to Z0, no change would be necessary, steady state conditions would be reached in 1000 ns, and the only effect of the cable would be a time delay.) If either the voltage or the current at the far end of the line changes, this change won't be seen at the near end for another 1000 ns, during

which time the change propagates back along the line. This change traveling back along the line is called a reflection! But, as we have seen, any signal propagating along a line must have its voltage and current related by Z0. Thus the ratio of the change in voltage to the change in current caused by RL must be related by Z0. If we now designate the voltage and current moving from the near end toward the far end with a + superscript and those moving in the opposite direction with a - superscript, we can write three equations describing our findings:

$$E^+/I^+=Z0 \quad (1)$$

$$E^-/-I^-=Z0 \quad (2)$$

$$(E^++E^-)/(I^++I^-)=RL \quad (3)$$

Equation 1 says that the forward voltage and current are related by Z0. Equation 2 says that the reflected voltage and current are similarly related, but with an added - sign since the direction of propagation is reversed. Equation 3 simply says that the total voltage and current at the far end of the line, the sum of the forward and reflected waves, must be related by RL. The solution of these three equations for E^- and I^- yields:

$$E^-=(RL-Z0)/(RL+Z0)\cdot E^+ \quad (4)$$

$$I^-=(Z0-RL)/(Z0+RL)\cdot I^+ \quad (5)$$

Substituting the values from our example gives -12.5 volts for E^- and .25 Amps for I^-. Summing the forward and reflected components gives 25 volts and 1.0 Amp at RL.

Now let's follow the reflection back along the cable toward RS. If we look at the line 1750 ns after the switch was thrown, 750 ns after the reflection started, we will still find 37.5 volts and .75 Amps at all points in the first quarter of the line, but we'll see 25 volts and 1.0 Amp at all points in the last three quarters of the line. Remember that this 25 volts and 1.0 Amp are actually the sum of a forward wave (37.5 volts and .75 Amps) and a reflected wave (-12.5 volts and .25 Amps). We are watching a reflected wave propagate back to the near end of the line. After 2000 ns, the reflection reaches RS, where it sees a perfect match. Therefore, no changes in voltage or current are caused and no additional reflections are created. The reflected -12.5 volts combines with the 37.5 volts already present at the near end of the line to give 25 volts, the reflected .25 Amps combines with the .75 Amps already flowing giving 1.0 Amp, and steady state conditions are reached. Now the voltages and currents at the resistors are just like they were in Fig. 1. The steady state conditions of the two circuits are identical. The presence of the transmission line caused a transient condition, 2 us long in this case, to occur before steady state conditions were reached.

If we consider the battery and RS to be a transmitter and RL to be a load, in both Fig. 1 and Fig. 2 the transmitter delivers 25 Watts to the load once steady state conditions are reached. But in Fig. 2 the transmitter delivered 28.125 Watts to the line for 2 us. You might say the transmitter "thought" the load was 50 Ohms, the line impedance, and delivered power accordingly, until the reflected 3.125 Watt reflection got back and "told" it different.

So reflected power does exist. It's real, honest to goodness power, voltage in phase with current, capable of producing heat, doing work, or fitting whatever definition of power you care to use. And the job it does is "telling" the transmitter what's out there at the end of the line and forcing it to "adjust" its output accordingly. And if you're still worried about that "extra" power, consider what happens when you throw the switch back the other way. Again there is a 2 us transient condition. We continue to see 25 volts and 1.0 Amp (25 Watts) at RL for 1 us after the transmitter is turned off. And at the near end of the line we see -12.5 volts and .25 Amps (3.125 Watts) coming out of the line and being dissipated in the transmitter for 2 us! The "extra" power that we put into the line for 2 us when we turned the transmitter on came back out of the line for 2 us when we turned it off.

The circuit in Fig. 2 is just about the simplest possible case of line reflections. Now let's look at some of the reasons for its simplicity and see how things might get more complicated. Notice that we let the output impedance of our transmitter, RS, match the line impedance, Z0. This condition rarely exists in the real world! The widespread, and incorrect, use of the term "output impedance" to refer to recommended load impedance has led many people to believe that a transmitter designed to drive a 50 Ohm load has a 50 Ohm output impedance. While this is not impossible, it is highly unlikely. It takes a lot of extra work to make an amplifier of any kind, rf, audio, or anything else, have an output impedance anywhere near its recommended load impedance, and there is usually no reason whatsoever to try to do so. Except in very special applications, it would never even occur to the designer to think of such a thing! Therefore the reflected power will generally see a very large "mismatch" when it gets back to the transmitter and a considerable portion of it will be re-reflected. This means that, even in the simple dc circuits we've been looking at, the reflections, and the transient condition, will continue forever and the steady state conditions will never be reached but will be approached asymptotically by a series of discrete changes, or steps. This should not be too surprising, as it is very similar to charging a capacitor with a battery and resistor; the voltage on the capacitor never reaches the battery voltage, but approaches it asymptotically.

We also assumed we were dealing with a lossless line, a very difficult thing to come by! With any real line, part of the forward power is lost before it reaches the far end of the line, resulting in less power in the load and less reflected power. Similarly, part of the reflected power is lost before it gets back to the transmitter. This means that we've lost some of the information that "tells" the transmitter about the value of RL. Instead of "realizing" that the load is not Z0, but RL, the transmitter "thinks" that the load is something between Z0 and RL. This results in a little additional loss.

We also assumed the line was distortionless, or that it treated all frequencies in exactly the same way. This is another condition that is rarely even approximated in practice. The effect is to "round off" the nice square pulse we started with. Again this has no effect of the basics of reflections.

We have dealt only with impedances that were pure resistances, but while this greatly simplifies the math, it has no effect on the conclusions.

And finally we have only considered dc, or square pulse, conditions. But one of the basic principles of electronics tells us that if we know how a circuit responds to very narrow pulses, we can predict how it will respond to any other waveshape. We can create any arbitrary wave-

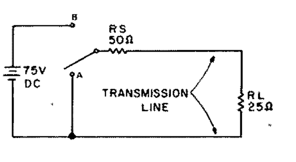

Fig. 2.

form by adding together a great number of narrow pulses and find the response by adding the responses to each of the pulses. When we consider sine waves, we must think of time delay in terms of phase shift and take into consideration the standing waves produced by the addition of the sine waves moving in opposite directions on the line. Things rapidly become much more complicated, but the basics remain unchanged: Any signal moving along a line does so with its voltage and current related by Z0; points of mismatch on the line cause reflections.

Please note that we've said nothing about the importance, or lack thereof, of reflections on overall system performance; that is not the purpose of this article. In a digital system, where the transmission line may be a couple of feet of hookup wire, or a few inches of copper on a PC card, reflections may be intolerable. In a relatively narrow band radio communications system, if the transmitter can operate into the load presented by the line, and the extra loss caused by reflections is tolerable, and the higher peak voltage caused by the standing waves doesn't break down the line, you can probably forget all about reflected power. The point is that reflections do exist, they are not a figment of some mathematician's imagination, and they don't violate any laws of nature!

So the next time you hear somebody claim that reflected power doesn't exist, or that the voltage and current in a reflected wave are always 90° out of phase, or that directional wattmeters can't be built, or any of the other absurd statements that are so often tossed about, sit down and draw a little circuit similar to Fig. 2 and think about it for a few minutes. All those stupid engineers are right after all! ■

Things Remembered

-- ever heard of an 807?

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I've never really been too certain about what it takes to be called an oldtimer — being licensed for 50 years, holding a two letter call, or perhaps having had your start with a spark gap transmitter. Whatever the specific element happens to be, memories have to play an important role, and this is an area where I'm making progress towards that "OT" designation.

After having been exposed to amateur radio for a quarter of a century and an actual participant in it for the past 20 years, I've begun to notice that a lot of things I once took for granted just aren't around any more.

Recently I put together a partial list of some of the things associated with amateur radio which were once important to me. Check it over and see if there's anything you recognize:

– Crystals for 80 and 40 meters that came in those rugged FT-243 holders.
– Those strange WV calls which were assigned to Novices briefly in the late 1950s.
– The thrill of using a VFO for the first time to explore the area below 3700 kHz.
– When you said "kilocycle" and everyone knew what you meant.
– A CW signal that was actually produced by a human being and not a device, mechanical or electronic.
– Blazing arguments about whether sideband would ever compete with AM.
– Transmitters that had a DSB mode.
– Building those Johnson or WRL screen modulators as a means of getting on phone inexpensively.
– Discovering that the screen modulator really worked.
– The night I actually heard someone over six meters on my Hallicrafters S-53A.
– Catalogs from mail-order electronics supply houses that were 200 pages thick.
– When six or seven manufacturers published catalogs.
– All those surplus equipment stores near Arch Street in Philadelphia where a 110 V ac DPDT relay cost a buck.
– Row after row of ARC-5 equipment in those surplus stores.
– An 807 which didn't become gassy after 50 hours of use.
– The Viking Adventurer, Globe Chief 90, Heath AT-1, and all the similar transmitters that made it possible for a Novice with a schoolboy's allowance to get on the air.
– Hearing the FCC examiner tell you that someone in Washington would send you your General ticket in about four weeks.
– Finding out that the examiner and the man in Washington were men of integrity.
– When you didn't have to own a linear and make an appointment to QSO on 20 phone.
– Something called 2½ meters.
– Or even 11 meters.
– Fidgeting with the BFO to unscramble those "Donald Duck" voices.
– A handful of guys fooling around with commercial FM gear on six meters.
– When it was rare to see a K-call in the "Silent Keys" column of *QST*.
– Almost coming to blows with someone over incentive licensing.
– When postage for a QSL card only cost two cents.
– An *enfant terrible* publishing a new ham magazine that was irreverent, humorous, and simply interesting to read.
– The *enfant terrible* has mellowed somewhat, but thankfully his magazine hasn't.

No, I'm neither ready nor qualified to be called an oldtimer. I really look forward to my next 25 years in ham radio, but in my "middle age" I can't help but look back and, like the well-known comedian, simply say, "Thanks for the memories." ■

Digital Bargain Hunting

- - tips on surplus computer goodies

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The computer hobbyist hardware market has been moving very rapidly, with new products being introduced nearly every day. If you are like me, you want to have most of them, too! No budget can stretch that far, if at all. Balancing the endless list of necessary peripherals against a dwindling level in your checkbook is a lot easier to do if you can take advantage of the used electronics market. I would love to have one of those new $900 dumb terminals, but in many ways it makes more sense to shop for a $300 used one, repair it if necessary, modify it to be just as dumb, and put the remaining $600 (?) into more memory, a disk, or good software.

Rest assured, a surplus computer equipment world does exist. My impression is that it is merging with the surplus market that hams have ravaged for years, just as ham radio and the computer hobby seem to be merging. To introduce you to what may be available surplus, I'll give you a few suggestions to get started, and then describe one of my more profitable adventures.

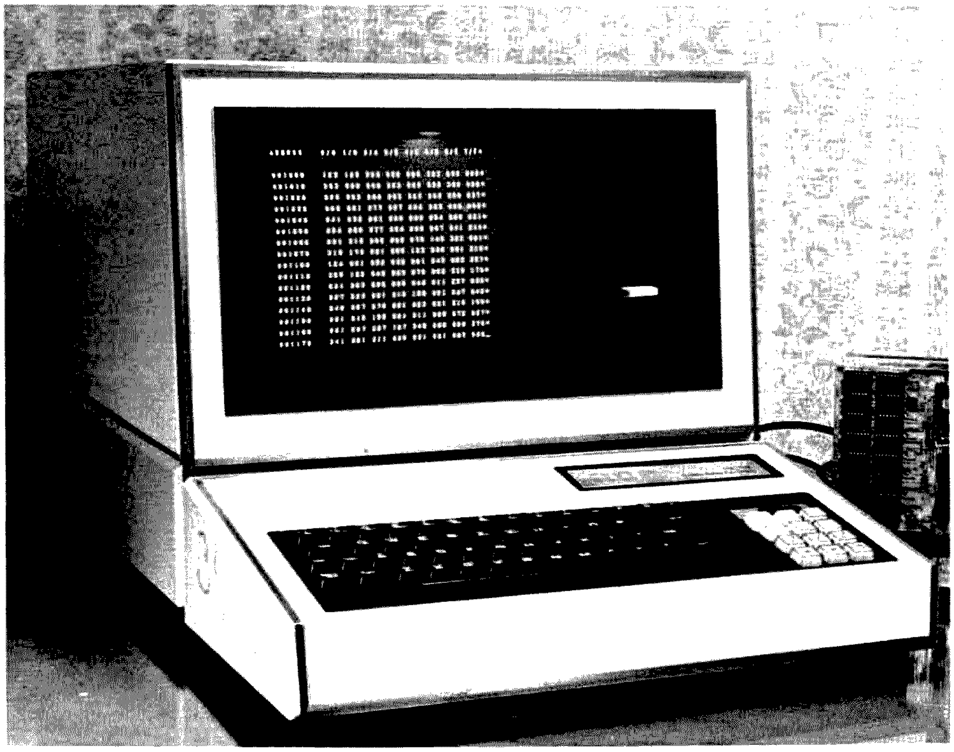


Photo 1. The RCA 70/752 Video Data Terminal has a hidden door to the right of the screen concealing controls for the display and alignment of the character generator. The keyboard can be moved up to one foot away from the display.

Preparation

First, you must convince yourself that digital equipment is not forbidden fruit into which you must not byte. I am reminded of the ham home brew enthusiast who for years builds test equipment, antennas, and transmitters of unending complexity, yet never touches his receiver or builds one because *a receiver is too tough to handle!* If you have an electronics hardware background, you have a head start and should not be intimidated. If you are a software expert trying to assemble your own system for the first time, there are a lot of people in computer clubs, ham clubs, and elsewhere who can help you. In any case, the best way to gain an appreciation for a new discipline, hardware or software, is to get your hands not only on it, but into it as well.

The second thing you must do is use common sense to gain an eye for the bargain. I've been burned a few times and went home with nothing more than a fancy boat anchor, but never for any great sum of money. After all, the higher the price, the more careful you automatically become. This field is moving so rapidly that a piece of gear which creates nausea in a state of the art hobbyist

could very well be only two or three years old and provide a lifetime of service at a fraction of the original cost. Look for equipment being offered with spare parts, or gear which uses the type of components you've seen advertised in the back pages of magazines. You should also look at each item with an alternative project in mind just in case you do goof (*caveat emptor*). For example, you buy a floating point box to do hardware arithmetic and then discover that it was the victim of a slight overvoltage. The box or card rack it came in is probably worth the cost and can be used later (I know, I can't get *my* car in the garage, either). An operations or maintenance manual sold with the equipment can be worth its weight in gold, but don't be fanatical about it. Many times you can reconstruct all you need to know by studying the equipment itself. After all, one goal of most hobbyists is to replace hard cash with personal time spent pursuing the hobby.

You should also know the market if you are to take advantage of it. Find out where the surplus houses are, what their specialty seems to be, and get on the mailing list for any flyers. Have a general knowledge of what a bargain price is so that you can make an intelligent decision when you come across that 400 pound transformer you desperately need to beef up your power supply. Read the ads in the back pages of magazines and have a feel for the current prices on used or surplus prime components.

Interested? Well, let me use one of my experiences to illustrate and at the same time describe one of the bargains available. For those of you who would like to have a used CRT terminal, but are not sure such things can be used by hobbyists, the following is a description of the RCA 70/752 Video Data Terminal, shown in Photo 1, and how I put it to use. For those of you who recognized it as a bargain and have one in your garage, drag it out, because the modifications I'll describe can be completed in minutes.

The Bargain

One day while watching my home brew 8008 system blink its LEDs magically, the mail brought me a flyer advertising the RCA 70/752 VDT (Video Data Terminal) with spare parts for $200. Smelling a bargain, I rushed to the store to examine it. It was a complete terminal with a 12-inch display of 20 lines of 54 characters (1080 total) and a detachable matching keyboard. It used a 1200 baud RS-232 interface and had internal memory. The keyboard was mechanical (IBM style) but was missing parts. The keyboard enclosure had extra function keys for cursor control and for *editing*, including single character erase, single line erase, full screen erase, and a mode for inserting data such as letters left out of words. There seemed to be many circuit boards inside with discrete components that had easily identifiable markings (2N3904, .01 uF, etc.). That

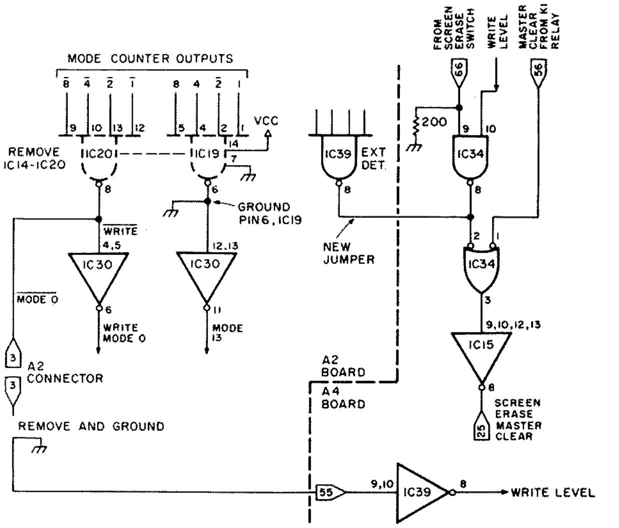


Fig. 1. Summary of modifications. Circuits for mode decoding and Screen Erase are shown before and after changes.

was important, because it told me that replacement parts for those boards would not be hard to find, and the type numbers indicated that the equipment was not very old. A card rack holding up to six cards was found inside the rear cover, but two cards were missing. That could present a problem, I thought, because the cards that were there had up to 48 ICs on them and none of the ICs had recognizable numbers. There were two muffin fans, a sturdy cabinet, and a healthy looking power supply. The spare parts turned out to be an extra matching cabinet (for a vector graphics display later??), a spare CRT and yoke (new), most of the power supply parts, and several spare boards (non-logic). A quality control tag inside the cabinet indicated assembly only three years previously! Encouraged, I dragged the thing to an ac

Photo 2. The mechanical keyboard was replaced by an electronic keyboard. The cursor and editing controls are on the right side of the control console.

outlet, plugged it in, and, with fear in the salesman's eyes, turned it on. After what seemed like hours, 1080 characters appeared on the screen ... all garbage ... but did light up and draw current, so I bought it.

During the following weeks, I must have disassembled and reassembled the thing four or five times, trying to uncover its secrets. I learned that it used a monoscope for character generation (*good grief!*). Imagine using a second special CRT to generate character video when a handful of ICs will do the same job! It also employed a magneto-strictive delay line memory (definitely not Altair bus compatible), which was no more than a long wire coiled up in a box. I had visions of trying to load it up on 80 meters as a compact antenna for my ham activities! The keyboard generated a 64 character ASCII subset with special characters for multiply (x), divide (÷), and ETX (end of text). It looked great but wouldn't work with two of the boards missing and the motor gone from the keyboard. I recognized my lack of mechanical aptitude and scrapped the old keyboard, building an electronic one to replace it. I used a keyboard that is widely advertised for around $20 and a KR-2376 keyboard ROM (see Photo 2). Since I didn't know which family of ICs I was dealing with in the terminal, I buffered the keyboard ROM with TTL, hooked it to the terminal, and applied the standard tests. No smoke, voltage levels okay, but no other response. After talking it up with many people, I located someone who had a 752 VDT working and borrowed his logic boards. It worked to some extent, but the characters were badly distorted. After replacing the video driver board with the new one from my spare parts, it worked perfectly!

I soon learned that the VDT operated only in the Screen Read mode. That is, the operator creates a message by pushing the Write key and typing the desired data. The ETX key must be the last character typed in. Editing can be done, as if off-line, using the editing keys I mentioned earlier. When finished, the XMT key must be pushed to transmit the data to the computer. Everything on the screen is transmitted, up to and including the ETX character. The VDT automatically inserts an STX (start of text) character at the beginning of the transmission. When transmission at 1200 baud is completed, the VDT switches to the receive mode, with the keyboard and function keys disabled. The computer may then reply, but must bracket its message between the STX and ETX characters also. When the VDT receives the ETX, it reverts to the Write mode, with the computer's reply on the screen and everything else erased.

At this point I was reasonably happy. After all, the only thing left to do was find my own logic boards to replace the ones I had borrowed and must return. I had considered the insane idea of duplicating the boards, but double-sided boards are tough enough without considering four layered boards (as these were). However, I reasoned, if I could decipher the logic family, I could simply wire-wrap the two boards I needed. After several iterations of sort and compare, I almost settled on DTL as the probable family. Vcc appeared always on pin 14 and ground on pin 7 (could be TTL). Vcc was set at +4.5 volts, a little low for TTL. Then, while trying to repair a bad connection I had created, I noticed that someone had mercifully installed an MC851P one-shot on the A21 filter board. DTL it is! To make a long story shorter, I succeeded in wire-wrapping the two boards using Motorola MC830/930 or equivalent ICs. The new boards just fit in the rack after trimming the wire-wrap pins on the sockets. My bargain terminal was working on its own for an investment of $250 and a lot of my time.

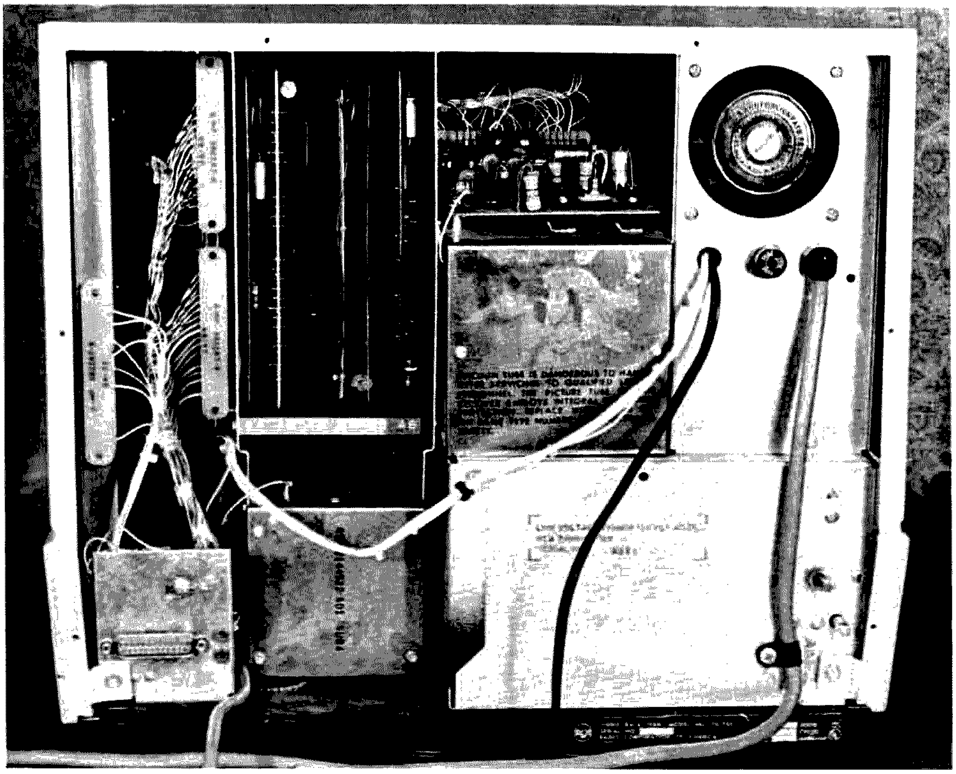


Photo 3. Rear view of the Video Data Terminal showing the logic card rack, RS-232 connector, and memory on the left. Power supply with integral fan is on the right.

Compatibility

Or was it? Yes, in part, but a working component does not make a working system. Having all data bracketed by STX and ETX became a sore point for me. Many of my programs required three characters from the VDT (STX, desired character, ETX). Also, the VDT always seemed to be in the wrong mode. There were two possible solutions to this problem: software adaptation or hardware modification. Software adaptation is cheaper for the hobbyist, so I tried that first. My input routine was written to grab at least two characters from the VDT before returning to the calling program, each time checking to see if an ETX had been received. If it was received, the program sent an STX to the terminal to put it into the receive mode. If ETX had not yet been received, more data was forthcoming from the ter-

minal. I found it best to never send ETX to the VDT, since that would switch it to the Write mode, and the possibility of losing the next computer output was very real. This scheme works very well and served me for some time. At least two weeks or more.

Not willing to leave well enough alone, I favored a hardware modification to the 752 to allow full duplex operation without having to deal with the STX and ETX characters. The criteria were that the VDT should always be ready to receive at 1200 baud, the cursor controls should always be enabled, the keyboard should provide parallel data directly to the computer, and there should be no requirement for the program to echo the keyboard to the display. In addition, I wanted the Screen Erase and Cursor Home functions to be under software control. It sounded like quite a task, but turned out to be a very simple modification.

Modifications

The logic cards are numbered A1 through A6 from left to right when facing the rear of the cabinet (see Photo 3). Remove A2, second from the left, and position it with the component side up and the edge connector to the right. Number the IC positions starting at the upper left. Positions with no ICs inserted are also numbered. You should end up with the ICs along the edge connector numbered as 4, 8, 12, etc., from top to bottom (see Photo 4). Now carefully remove IC14, IC15, IC16, IC17, IC18, IC19, and IC20. I found a solder sucker to be valuable here. If you too have wire-wrapped boards, simply unplug the ICs. These ICs decode which mode the terminal is in, and with them removed, it is in no mode at all. Next, solder a jumper wire between the holes where IC19 pin 6 and IC19 pin 7 were inserted. This grounds the $\overline{\text{Mode 13}}$ line and puts the terminal in the basic receive mode. You are done if you don't care about the other criteria I established. To enable the cursor controls and allow for direct keyboard entry to the display, remove the wire-wrap wire from pin 3 of the A2 connector (on the chassis) and connect it to ground. This modification enables the Write mode (with the Receive mode still active). Parallel data is taken directly from the keyboard, or from where the keyboard connects inside the VDT, on the A21 filter board. If you are using the mechanical keyboard, you will be able to bring out the Keyboard Strobe signal from the A3 board. Pin 44 is active low and pin 46 is active high.

If you want software control of the Screen Erase and Cursor Home functions, a less elegant modification can be made. Remove IC39 from the A2 board and bend pin 8 of the IC up so that it will no longer make contact with the board. Put the IC back into position 39 where it was. Run a jumper wire from pin 8 of IC39 (the one just bent) over to either pin 2 or pin 8 of IC34 on the A4 board. Use a connector of some sort so that the two boards may be easily separated later. This change creates a wire-ored connection between the Screen Erase function and the ETX detector. Now each time ETX is received by the terminal, the screen will be erased and the cursor will home to the upper left-hand corner. The VDT accomplishes this by zeroing the delay line memory. This takes one frame time, or 16.7 milliseconds. A software delay must be provided to prevent the computer from sending more data during the erase time. These modifications are summarized in Fig. 1.

Improvements

The modifications just described will prohibit Screen Read operation. To retain that feature, a more elaborate scheme could be used which gates the decoding ICs on the A2 board using a single switch to choose the type of operation you want. A UART could be added to the keyboard to provide serial transmission in both directions.

Conclusion

The RCA 752, although ancient by today's standards and techniques, comes available to the hobbyist for just that reason. Yet it can provide a low cost terminal with features that demand a very high premium if purchased new. If you come across one, you might also look for some of the other options available with it (and similar surplus terminals). Those options include the capability of plugging in a printer for hard copy direct from the screen, and a variable screen format which provides for almost any combination of lines and characters/line which total 1080 characters.

My thanks to Kurt Lessor and Andy Demland for their help in the rejuvenation of my terminal. Incidentally, I found a Z-80 Digital Group system under the Christmas tree this year. It uses a TV-based philosophy and I saw a very nice commercial monitor at the surplus store . . . ■

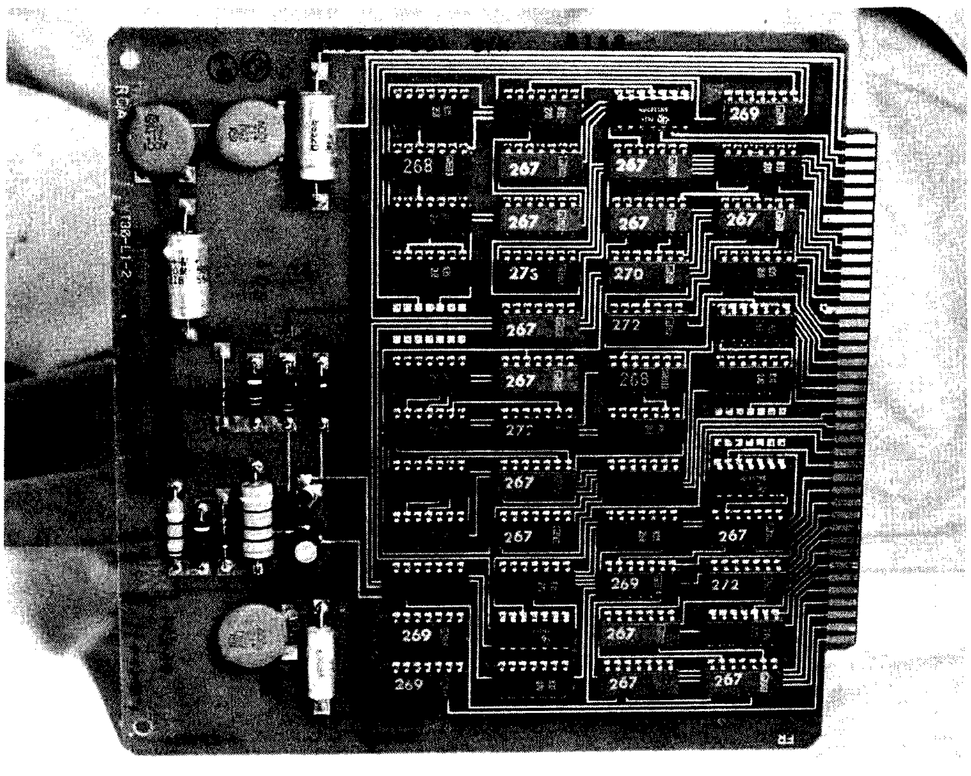
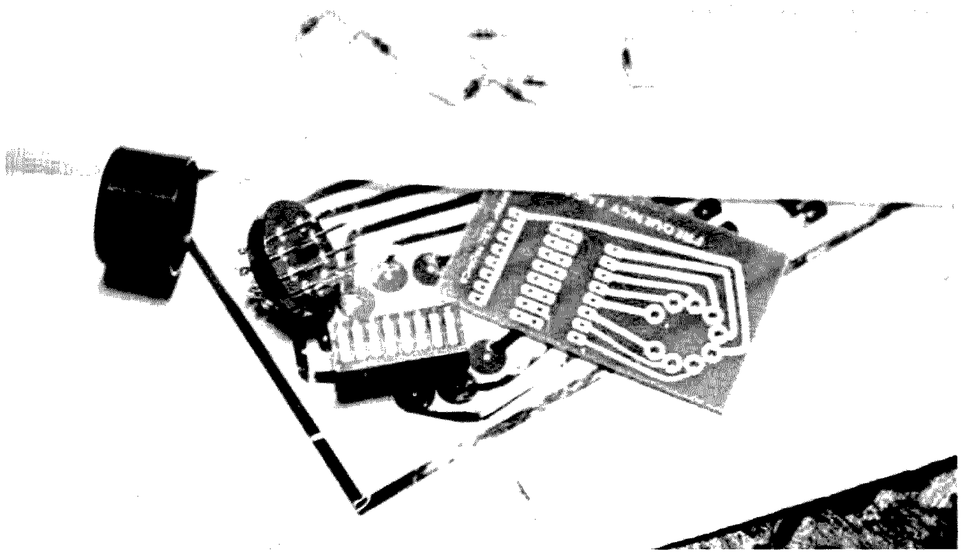


Photo 4. A typical logic board. ICs are numbered starting at the upper left.

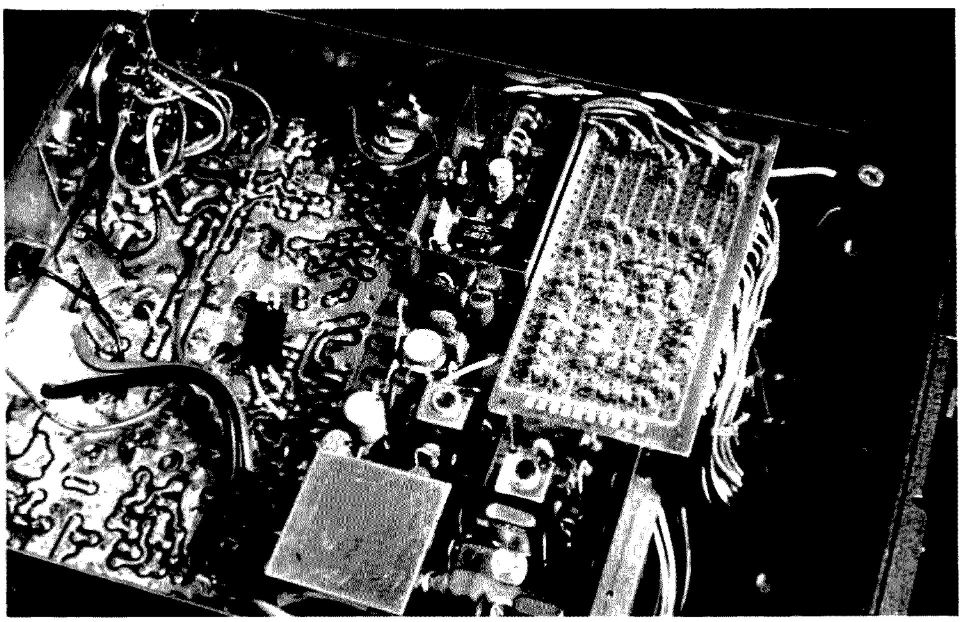
Circuit board with components. IC-22S plug, dip switch, and diodes are all the parts required. Circuit board design layout before reduction can be seen beneath parts.



Bill Richarz WA4VAF
4124 Colebrook Road
Charlotte NC 28215

More Channels for the IC-22S

-- using dip switches

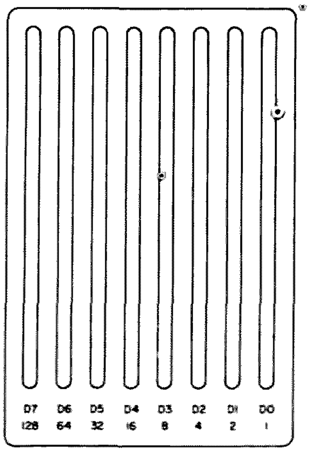


Interior view of IC-22S showing wires added to matrix board and soldered to accessory socket. Note wires are kept close to edge and taped together for a neat installation.

Icom's introduction of the 22S has ended the day of waiting for the mailman to bring those crystals for a particular frequency — that is, if you happen to own one of these little marvels.

The very same day I purchased my rig from the local dealer, I had completely programmed the matrix board for 22 channels by nightfall. For those of you that have not seen, heard, or owned the 22S, let me explain. Switching diodes are soldered to a very small matrix board which is plugged into the transceiver. A chart in the instruction manual indicates placement of the diodes for 128 frequency combinations, with 15 kHz spacing. A channel switch allows you to select one of 23 programmed

Fig. 1. Matrix board of IC-22S.



Matrix Board	128	64	32	16	8	4	2	1
Diode Position	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
or								
Dip Switch On	8	7	6	5	4	3	2	1
146.34 MHz	X						X	
147.18 MHz	X		X	X	X		X	

Fig. 2.

frequencies. I will not go into detail how this works; the important thing is, one need never purchase another crystal.

This brings us to the reason for this article. With 22 channels already programmed, I had only room left for one channel, which I had decided to add at some future date. I began looking at additional frequencies that I could program into the 22S, and discovered there were quite a few. Once I picked the final unprogrammed frequency and soldered in the diodes, I was finished. I would really be in worse shape than a crystal rig owner. He could change frequencies just by pulling a crystal out and plugging another in. To change a frequency in the 22S entailed the removal of a diode or two, and adding others into their proper positions. I found, while soldering the diodes to the board, that to make a mistake and have to remove one required three hands. The board itself would not take this type of abuse too many times.

At this point I decided there should be some way to switch those diodes in and out externally. After all, there are 128 selections available, and I might as well be able to take advantage of their use. One reason I had not programmed channel 23 was the deletion of a wire from the channel selector switch to the 23rd position on the matrix board. For some unknown reason, Icom overlooked this. There was a blank lug on the channel selector switch, so I ran a small stranded wire, similar to the others, from the blank lug to the 23rd position on the board. Channel 23 became the first white dot after channel 22. This was also to be the channel I would be able to program externally, by some type of switching arrangement.

By careful inspection of the matrix board and the schematic, I had a working idea of the design. The anode of each diode on a specific channel has 9 volts applied to it by selection of the channel switch. Their anodes are also common to each other. The cathodes of the diodes are soldered into selected holes marked D_0 to D_7. By simple mathematics, I concluded it would take 9 wires to run from the board to a switching arrangement. The accessory socket just happens to have 9 lugs to run the 9 wires. One of these lugs has a blue wire soldered to it, which is a metering point for the discriminator. Another lug is grounded with a .01 capacitor soldered between the blue

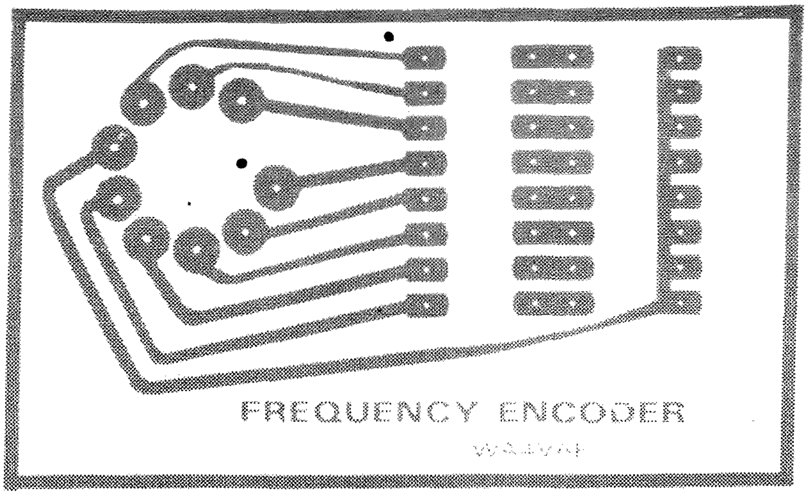


Fig. 3. Foil side of PC board shown actual size.

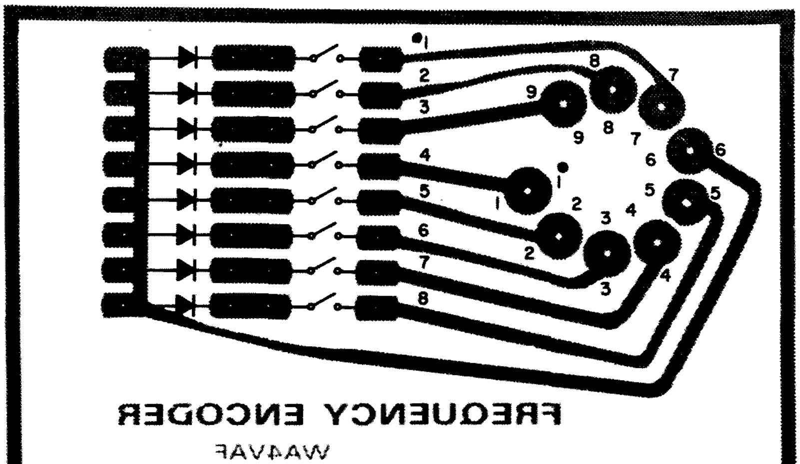
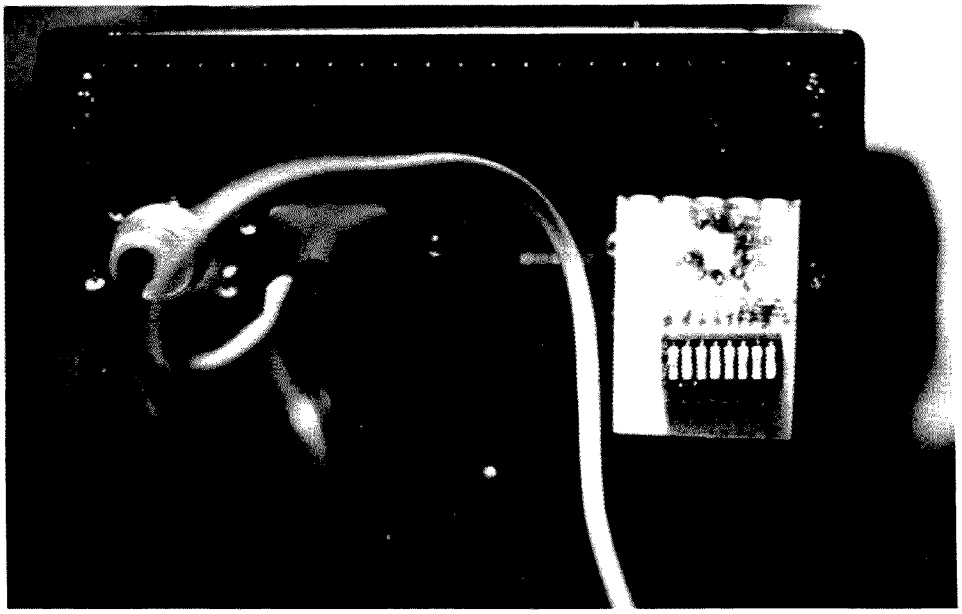


Fig. 4. Parts placement. Parts side of PC board with switches. Note pin 6 is the common anode lug, while the other lugs have the wires on accessory socket going to the matrix board soldered to them to allow the board to be positioned parallel to the 22S. The prototype protruded downward in a precarious position. Also note that the plug is soldered onto the foil side of the board.



Prototype board plugged into accessory socket of IC-22S. The author still uses this original on trips. The new board is a snugger fit, but the accessory socket had to be wired differently since the board was rotated to the left by 90 degrees.

wire and the ground lug. These were removed from the socket. The blue wire was rolled up and taped aside, while the capacitor was saved and the ground connection removed from the other lug. This allowed me to return the rig to the original condition at any time.

At this stage I ran a wire from the common anode connection of channel 23 of the matrix board to pin 6 on the accessory socket. At each diode position where the cathodes were normally connected (numbered D_0, D_1, D_2 on to D_7; see Fig. 1), I soldered a small wire and ran these to the socket and soldered them to lugs 1 to 8.

Now all I needed was external switching that would permit me to switch each diode in or out of the circuit. I ruled out some sort of minibox with toggle switches as being too bulky and also distracting from the clean-cut looking design of the 22S.

Sometime back, while thumbing through *73* looking over the ads in the I/O section, I came across a 16 pin mini-dip rocker switch. I decided this would be my switching device. Can't get much smaller than that. Since I had to plug the accessory plug into the rear socket, I proceeded to design a PC board which would be soldered directly to the pins

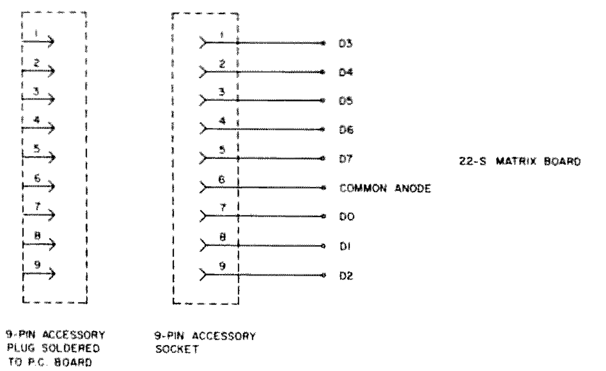


Fig. 5. Connections from 9 pin accessory socket to channel 23 on 22S matrix board.

on the rear of the plug. Just unscrew the cap on the plug and discard. I came up with a very small board which, when soldered to the plug along with the mini-dip rocker switch and 8 diodes, made a neat package that allowed me to plug the whole thing into the IC-22S.

The mini-dip rocker switch interconnects the plug and the 8 diodes. All the anodes run directly to pin 6. The cathodes can be switched in or out, or off and on, as the rocker switches read – thus, instant programming at the flip of a dip switch. Just look up the frequency on the chart in the instruction manual, and push the switches on or off with the tip of a ballpoint pen. The scheme works as if they were soldered to the matrix board itself, and I have found no undesired effects.

One word of caution: Don't try to do this while driving on the freeway. I usually throw the thing into the glove compartment for trips out of town or a vacation. The night before, I check my road map along with the *73 Repeater Atlas*. If a set of strange repeater frequencies come up I'd like to be able to work, out comes the little board. With the aid of the programming manual, in less than a minute I'm ready for that heretofore unaccessible repeater. The dip switch is numbered 1 to 8. I knew I'd have to remember the program is D_0 to D_7, or relabel the program D_1 to D_8. This is what I did; I had it reduced about ¼ the size of the original and then laminated.

What do you do if you lose your programming chart or forget it? Here is a simple formula that will give you the diode placement or switching input for the mini-dip switch:

$$N = \frac{(f - 146.010)}{.015} + 108$$

where N = Number, f = frequency desired in MHz.

Example: frequency desired (f) = 146.34.

$$N = \frac{(146.34 - 146.010)}{.015} + 108$$

$$N = \frac{.33}{.015} + 108$$

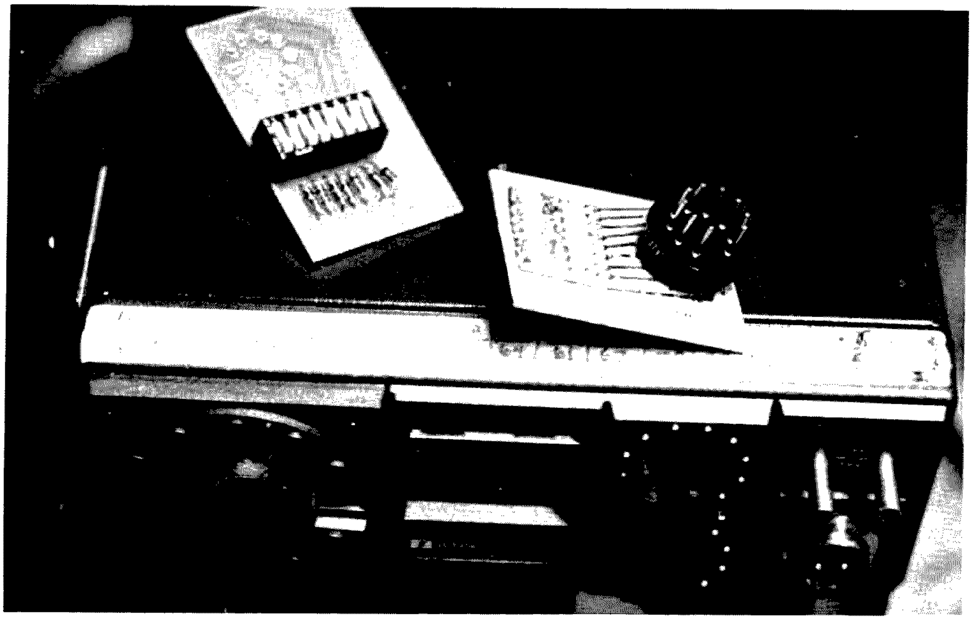
$$N = 22 + 108$$

$$N = 130$$

The programming table refers to this number under total "N". If you look at 130 in your manual, you will see it is indeed 146.34. But how does this number help in positioning of the diodes or, in our case, the switching of the external programmer? If you will notice the matrix board to which the diodes are soldered, you will see the numbers below each diode position. Starting with D_7, the number below it is 128, while D_6 is 64 and D_5 is 32. We can see at once each number is halved. You should be able to remember this; if not, make a chart as shown in Fig. 2, used for the example above.

Recall that earlier we received an answer of 130 for the frequency of 146.34. To obtain the position of each switch, simply find the largest number on the chart that will divide into our number of

130 (128 in this case). Put an X under D_7 or switch 8 depending on how you make up your chart. We now find that we have a remainder of 2. Find the next highest number on the chart that will divide into 2. Position D_1 or switch 2 will be found under the number of 2, with no remainder. Put an X at this position. When you have divided the remainder by the largest number each time, and finally have no remainder, you have completed the program. Be sure to mark an X in each position you used that number. Let's take a more complex example to see what happens when the number is too small to be divided by one of the 8 numbers on the chart.



External frequency programming boards on IC-22S. Board on right is prototype. Board at left is the new design which fits rear of the 22S a bit snugger. Note plug is soldered to foil side of boards.

Example: frequency desired (f) = 147.180 MHz.

$$N = \frac{(147.180 - 146.010)}{.015} + 108$$

$$N = \frac{1.170}{.015} + 108$$

$$N = 78 + 108$$

$$N = 186$$

Therefore: 186÷128=1 with a remainder of 58 (X at Position D_7). 58 cannot be divided by 64 so leave position D_6 blank. 58 can be divided by 32, so put an X at position D_5. We now have a remainder of 26. 26 can be divided by 16, so put an X at D_4. The remainder is now 10, which can be divided by 8. Put an X at position D_3. 4 will not divide into our remainder of 2, so leave D_2 blank. We do put an X at position D_1, since 2 will divide by 2. Since we have no remainder, D_0 is also left blank, and that completes the program for this particular frequency. All that's left to do now is switch the mini-dip rocker switches to the on position under the numbers where you have placed an X.

I carry a copy of this formula in my billfold and, after several moments of calculation, I have the correct switching inputs. This can be explained in computer terminology, but this method keeps it simple and allows the average ham with no background of this type to find the switch positions without cluttering his mind with computer logic. That's what the I/O section is for.

Back to the external switching board. Very few parts are required. The accessory plug comes with the 22S, as well as the diodes; just remember to save 8 of them. If you need more, a diode such as the 1N914 can be found from several mail-order houses in *73* at real bargains. The same goes for the mini-dip switch too, although I picked several of these up at a local hamfest at a buck apiece. Parts placement is shown in Fig. 4. This final layout of the board allowed a closer fit to the rig. You can outboard the thing into a box as I mentioned earlier, but for a compact neat switching circuit, you will probably want to make a board.

I've been using the prototype board I made for several months now. It certainly beats carrying a soldering iron around with you, and it's like having a crystal pack with 128 crystals at your disposal. When I want to change frequencies, all I do is "flip my dip." ■

Note: A drilled board complete with instructions can be obtained from the author or from Bryant Electronics, 1915 E. Independence Blvd., Charlotte NC 28205, for $4 ppd.

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Try a Scandie-Talkie

-- build a scanning HT

One of the most all-time popular and universally utilized amateur radio transceivers is the two meter FM handie-talkie. Proudly displayed by their owners, they appear at hamfests, flea markets, walkathons, parades, and other public service events as the easiest, most reliable form of quick communication. More and more mobile ops use them so they can take their rigs along from their cars, preventing theft of a car-mounted FM transceiver. Dangling one from your belt has the added advantage of imbuing you with instant high-class ham radio social status. Anyway, they're great fun. But the problem for the uninitiated has always been trying to get one of your own for something less than the minor fortune required for most of these gems.

Photo 1. Scandie-talkie and obviously gleeful author in dorm room ham shack.

This article explains how easy it is to home brew/kitbash your own HT, with features of no other talkie available anywhere, and at a low cost. Its features are:

Four channel scanning receiver, one channel (easily expanded) transmitter. The scanning feature lets you monitor several repeaters at once, or a mix of repeater and simplex channels. Don't miss a call from a friend because you couldn't listen to more than one frequency; now you can "time-share" your channel snooping! Of course, you can always switch to the manual mode or lock out channels you don't want to scan at any time.

First-class performance, with highly selective sensitive receiver and 1 Watt transmitter. The receiver section is the most important part of any rig, and this one has big advantages over using a cheapie tunable police band monitor as the receive section of the HT. Two rf stages, double conversion, two ceramic i-f filters, and crystal-controlled. No mickey-mouse compromises.

Easy-to-get main parts; the receiver is ready-made, the transmitter is an easily built kit.

Lower cost than the least expensive commercial HT! Even if you bought everything new, it would only come to about $135 (and don't forget this one *scans*). If you're not too impatient and like to attend flea markets or auctions, you can build it for about $50-75.

Hand-held designed so that the receiver alone can be removed in seconds, its own battery pack snapped in, and used as a pocket scanning monitor.

External mike built in; no need to go to extra expense since everyone uses one anyway. Push-to-talk, of course.

The Receiver Section

The receiver I used for my scandie-talkie is a Radio Shack Realistic (registered trademark) PRO-5 UHF pocket scanner, which I converted to two meters. Radio Shack also manufactures a PRO-4A VHF-high band only pocket scanner, as well as a PRO-6 VHF-high/low band model. Other pocket receivers are made by Pace, Johnson, and several scanner manufacturers. Alternately, Tempo makes a new tiny pocket scanning receiver, and a 12 channel fixed receiver which could be used. All are excellent receivers, and when tuned up as outlined below, compare with the best commercial HT receiver. Their selectivity alone makes it worth the nominal extra cost over a tunable public service

Photo 2. Note classy poster backdrop, also collapsible whip antenna stuck into antenna jack of HT.

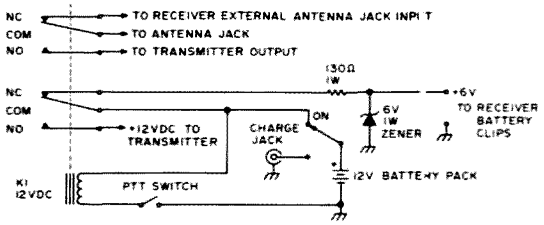


Fig. 1. Hand-held wiring schematic, showing relay hookups and receiver 6 V regulator wiring.

band receiver – a PSB rig just won't cut it unless there's only *one* very strong local repeater and you don't like simplex operation!

I bought my well-used scanner for $15. I've seen them go for $30-45 at flea markets and auctions, if you want to wait for one. You'll save a good deal of cash if you do wait – particularly if you can bargain person-to-person at a flea market table and not get stuck bidding away your savings in an auction. Of course, you can buy a brand new shiny one at Radio Shack almost anywhere. The modifications I describe here won't lower the resale value in any way, nor destroy the rig's appearance. All can be restored to the original.

If you get a PRO-4A, 5, or 6, the first step is to remove the batteries in their little snap-in case. Save this case because you can use it when you want separate monitor-only operation. Remove the two screws at the bottom of the case, squeeze the sides of the case half (with the speaker grill on it) near the crystal socket cover, and pull the bottom of the case back and away. There's a screw in the middle of the PC board, and when you remove it, you can separate the other half of the case from the board.

Look at Photo 5 and notice the small PC board mounted on top of the larger one. That smaller board has the front-end and mixer which determines the band for which the receiver was designed. The larger PC board has the i-fs, filters, oscillators, and scanning/audio/squelch circuits – they're essentially the same for all three models.

Of course, the VHF-high and VHF-high/low band models, the PRO-4A and the PRO-6, don't need conversion, only tuning to optimize their two meter performance. More on this later. To convert the UHF PRO-5 receiver to two meters, all you have to do is make some air-wound coils to replace the three UHF hairpin coils on the front-end/mixer board. You can see the ones I made in the photo, on the small board. They are 6 turns, #22 solid tinned wire, 5/16" long and ¼" in diameter each. To replace the originals with these, use a solder sucker and schlumpf up the solder on the pins which hold the small board to the larger one. Gently pry the two boards apart. Now use the solder sucker to remove the solder from the ends of the three UHF coils, and also from the tap wires where they connect to the coils. Leave the tap wires in the board. Now solder in the new coils, and put the taps at about the same relative position on these coils as on the UHF ones (e.g., if the UHF tap was about ¼ of the way up from one end of the total winding, the VHF tap position would also be ¼ way up the total winding). Save the UHF coils in case you ever want to put the receiver back on that band. Clean, remount, and solder the front-end/mixer board back on the main PC board, and you're finished with this simple conversion.

Once you've got the VHF coils in place, tuning up the receiver is just like tuning up the VHF-high and VHF-high/low models – tweaking three trimmers and two coil slugs. Tuning all three models is strongly recommended for maximum performance on two meters, since all these radios come from the factory stagger-tuned for a broad response from the 148-170 MHz. This leads to poor sensitivity on 146 MHz and sometimes severe image and cross-talk problems. If you maximize the front-end response for on a frequency near midband in the FM segment of two meters, all those bad responses disappear and the sensitivity is much enhanced.

I tuned my receiver by inserting a 2 meter crystal, listening to a weak signal, and peaking the three trimmers on the front-end board for maximum response. Use an insulated tool for this! Then I touched up the i-f input coil, shown on the photo next to the front-end board. With the weak signal input removed, adjust the oscillator coil (near the crystals) for maximum noise. Repeat the procedure a few times – be sure to keep the input signal well below full noise quieting – and optimize the front-end trimmers as a last step. Now you've got a first-quality selective scanner with a sensitivity of about 0.5 uV. By the way, Radio Shack has avail-

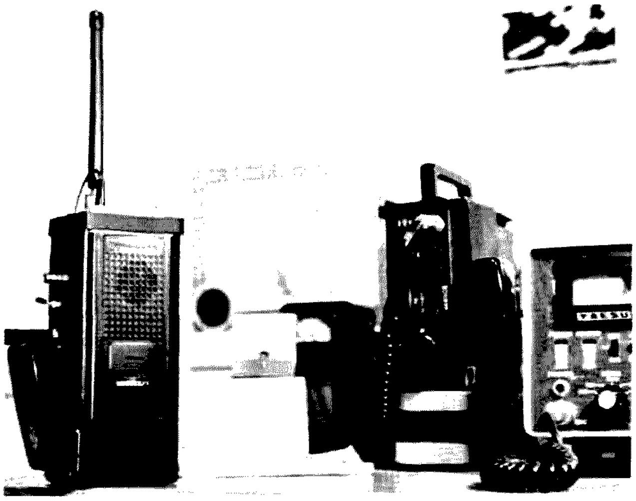


Photo 3. Close-up of talkie with author's other ham gonk. Rubber ducky installed; microphone on its bracket.

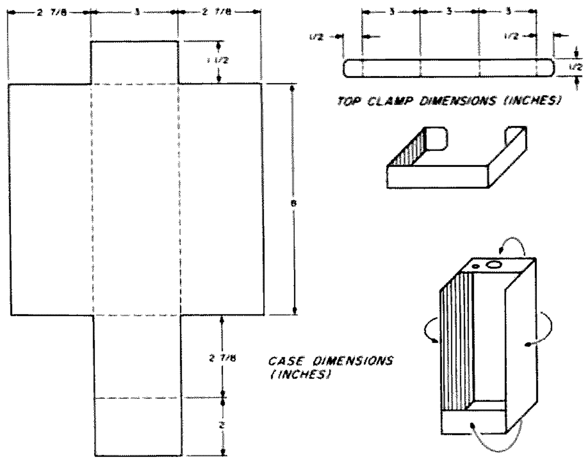


Fig. 2. Aluminum case, clamp dimensions, and fold lines.

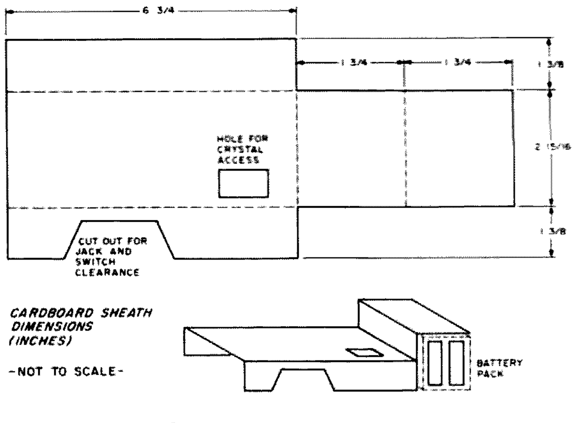


Fig. 3. Cardboard sheath dimensions and folding guide.

able on order service manuals for the PRO series; these are about $2 each. The one for the PRO-5 is #20-169.

Hint: A good weak-signal source is a cheapie tunable VHF-high band police receiver. Tune it to about 157 MHz and listen for its oscillator (at about 146 MHz) on the scanner. Orient the two for the signal level needed. Be sure to tune the police radio carefully – these pocket scanners are very selective and you might swish the oscillator right through their passband.

Since you'll need crystals for this gem, Radio Shack can supply them (fast!) for $6 a throw. If they're not in stock at the store for the frequencies you want, they will have them sent within a week. However, regular monitor crystals work fine (3rd overtone, approximately 45 MHz output) and are usually cheaper. Tufts Radio carries this type for $4.50. I have an Icom IC-22A and alas! its receiver crystals don't work. The 22A uses 15 MHz fundamental crystals and they will oscillate in the scanner, but in a third-overtone mode, about 30 to 60 kHz off their marked frequency! Oh, well, monitor crystals are cheap and easy to get . . .

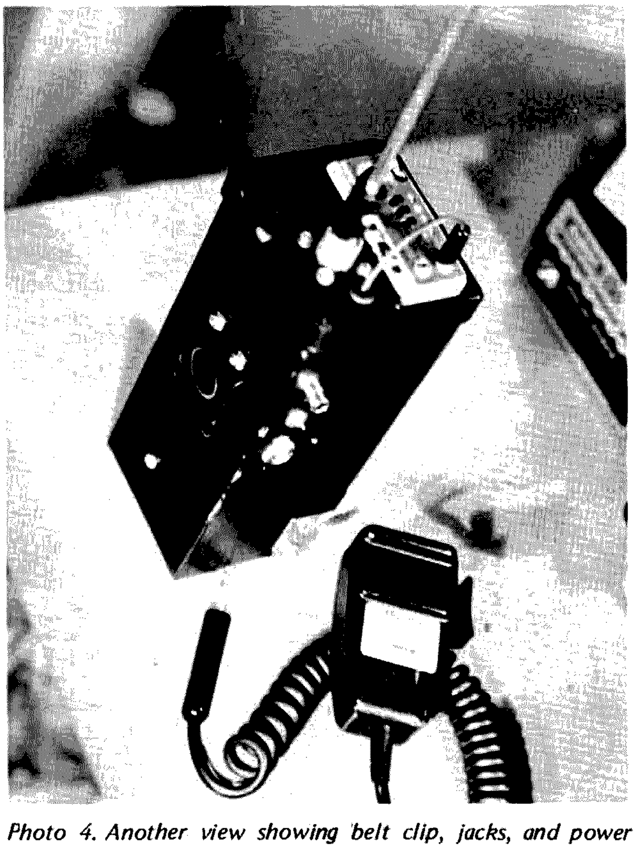


Photo 4. Another view showing belt clip, jacks, and power switch.

The Transmitter

The model TX-144 transmitter can be purchased in kit form from VHF Engineering, 320 Water Street, Binghamton, New York 13092. It is well designed, easy to build, costs only $29.95, and puts out a peppy, well-modulated 1 Watt signal. Mine is mounted with brass brackets that hold it about 1/16" off the HT case, soldered to each end of the PC board. The transmitter will take any low-impedance (500 Ohms) microphone, including a carbon mike, which is what I used. Follow the directions with the kit to see how to hook up any variety of microphone you may have handy.

By the way, the carbon mike you see in the photos is a Telex TEL-66C noise-cancelling affair, the classy kind you see private pilots using. Mine, in fact, did come from a well-worn aircraft. It's ideal for a handie-talkie because it tends to reject wind, street, or other noises normally present in portable operations. It's also quite lightweight.

Crystalling up the transmitter is a bit more simple than the receiver. Icom crystals work, as do any crystals in the 18 MHz range. These are available nearly anywhere. You may find, as I did, that the capacitor in parallel with the TX-144's crystal trimmer is a bit too large. I changed it to a 12 pF ceramic trimmer (it was 22 pF fixed silver mica), and now all the crystals tune in on frequency when the main trimmer is at half-mesh.

I have used this single-channel version for months now, but should you want more transmit channel capability (you already have 4 receive channels), it's a simple matter to add a few more crystal sockets. Mount a micro "PC board" size rotary switch on the case underneath the mike jack. There is plenty of room, as you can see in Photo 6.

Wiring and Switching

Fig. 1 gives the wiring schematic for the transmitter-receiver. The relay performs two functions – switches the antenna from the receiver to the transmitter, and similarly switches the +12 V dc line between the two. This relay is a tiny little 12 V affair I found at a flea market, Potter and Brumfield HP-4038. Most any kind of small 12 volt DPDT relay should work. It should

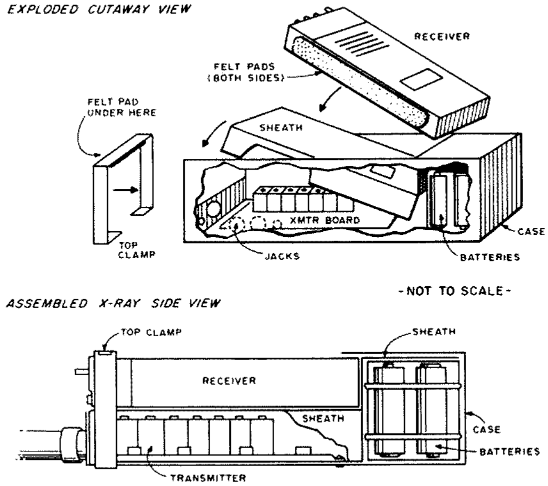


Fig. 4. Assembly sketches.

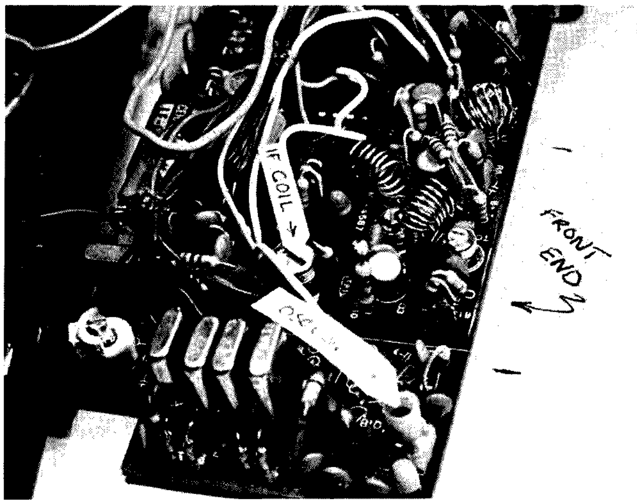


Photo 5. Inside PRO-5 receiver, showing new front-end coils and main PC board alignment points.

be mounted as close to the antenna jack and transmitter power output port as possible. Short leads minimize losses! The receiver signal is routed through a short length of RG-174/U subminiature coax to a mini phone plug which connects into the external antenna jack of the scanner. It goes through a grommet where it passes through the metal case. The photos reveal all.

The scanning receiver uses 6 V dc while the transmitter runs on 12 V. Rather than having awkward plugs sticking out all over the thing, or running the receiver off its own batteries and having to use a complicated relay, I made a 6 V regulator built around two insulated mini alligator clips. The clips go on the receiver's battery contacts and the zener diode and resistor fit neatly in the vacant battery compartment. Now everything in the HT runs off 12 V. Then, if you ever want to use the receiver separately, you just unclip the regulator and snap in the original battery pack. Versatility!

Don't forget to include the charging jack for the handheld's batteries. It's switched in when you turn the rig off, and also provides direct access to the 12 V supply at that jack so you can run other projects off the batteries without taking them out of the case.

The Case – Boxing It Up

The case is made from a sheet of aluminum 1/16" thick. Fig. 2 shows the dimensions and folding lines. It's not too difficult to bend with a bench vise and a good supply of hardwood blocks. Use a mallet and cloth to avoid hammermarks and vise teethmarks.

The top lip is drilled and filed out to accept the SO-239 antenna jack. Or, you can mount a BNC jack there instead. Don't forget a hole for the receiver's antenna coax, big enough so a grommet will fit there. The little clamp-bracket shown slips over the case and holds the receiver's top section in place, the bottom of the receiver being held by the case's battery holder lip.

Looking down the case, the charge/12 V jack is on the left side at the top rear, then the power/charge switch, and finally the microphone jack. The microphone holder bracket is mounted at the lower front of the left side. Be sure you saved the belt clip from the pocket scanner – mount this at the rear of the case so you can hang the rig from your belt or anywhere else you care to clip it.

Figs. 3 and 4 and Photo 9 show the way the whole thing is put together. The batteries are at the bottom; jacks, wiring and transmitter are mounted at the back of the case; and then the whole thing is covered with a cardboard sheath so the receiver can set on top. Works great. Make a hole in the cardboard to get access to the transmit trimmer and crystal, and slip another thin sheet of cardstock over it so the receiver's regulator wiring doesn't get into the transmitter through the hole. The receiver is pressed into the case with heavy felt placed at either side of its cabinet, then the top clamp is slipped over the whole works. The top clamp also has some felt at its inside front, so that the receiver is firmly cradled into place with the thick felt. The result is a rugged mar-free compact

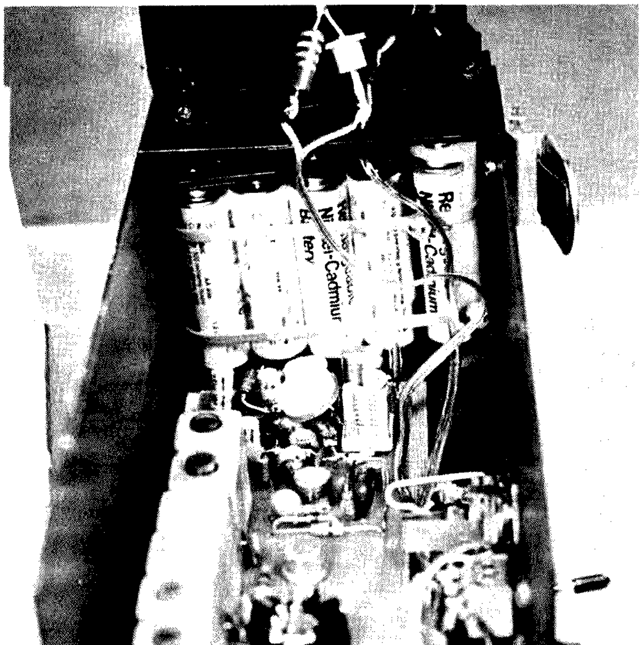


Photo 6. Cardboard sheath removed, looking down into battery compartment. Notice the 6 V regulator zener and resistor clipped inside receiver.

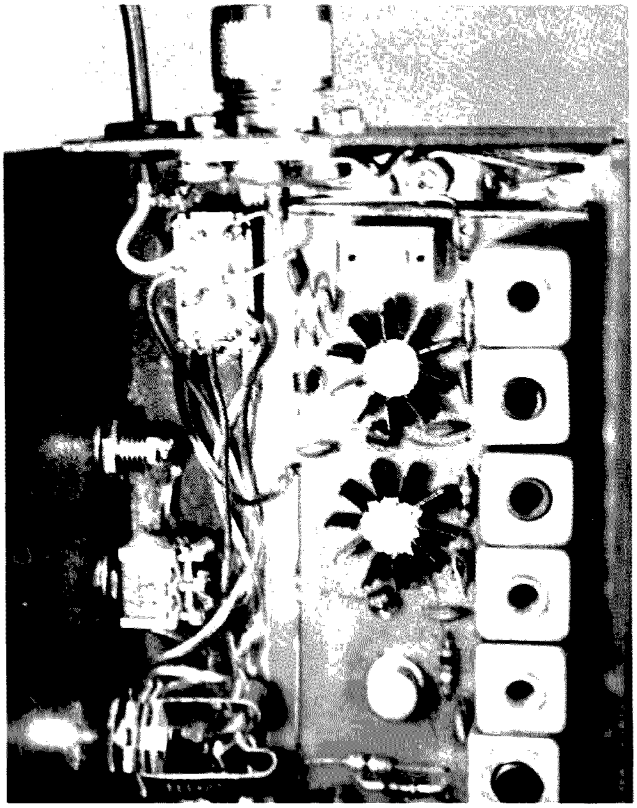


Photo 7. Close-up of the business end of the HT, showing the relay wiring.

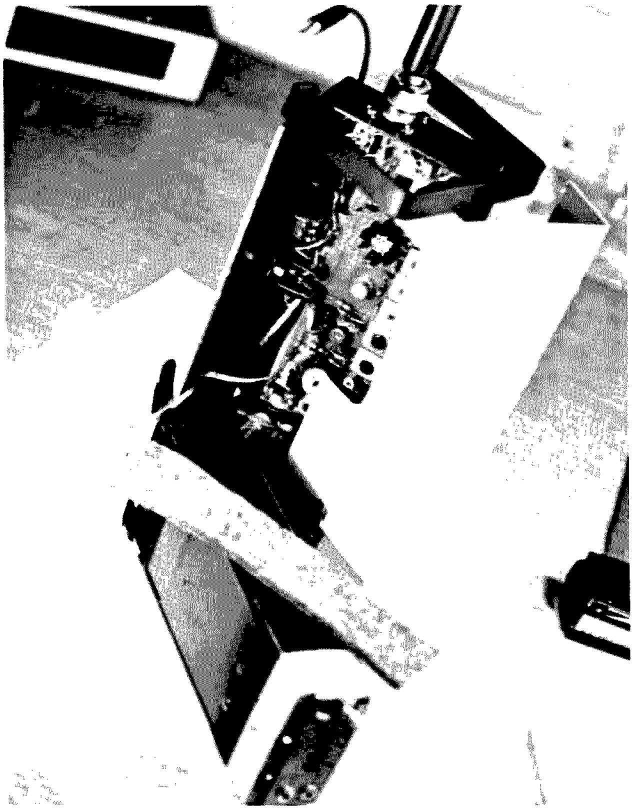


Photo 8. Case, sheath, clamp, receiver, and felt ready to go together.

unit.

Batteries

The battery choice is pretty much left to the builder, but I strongly recommend using nicads instead of carbon-zincs. The design leaves room for the 10 nicads I've lashed together with cable ties, as shown in the photos and figures. The cardboard sheath for the rest of the transmitter/power circuits also extends to cover the top of the batteries so their power connectors (made from the tops of old 9 V batteries) won't short out against the metal case.

Results and Conclusion

This HT is no toy, nor does it involve any compromises. Its performance emphasizes this over and over again. It hears 'em all and talks up there with the higher power rigs.

I've had many hams ask me if the scandie-talkie was commercially built. It always gets much interest wherever I go, particularly with the pretty red blinking LEDs scanning across the top attracting attention. I've had a great deal of fun using it for quick and reliable portable communications. I never miss a call with that scanner going!

Build this HT and join the fun of portable operation with a professional looking, sounding, and performing rig. And this two meter talkie does what no other hand-held does — it scans! ■

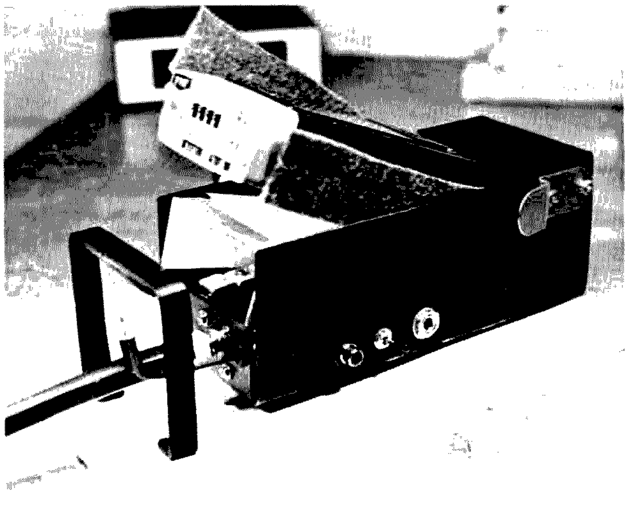


Photo 9. Nearly assembled . . .

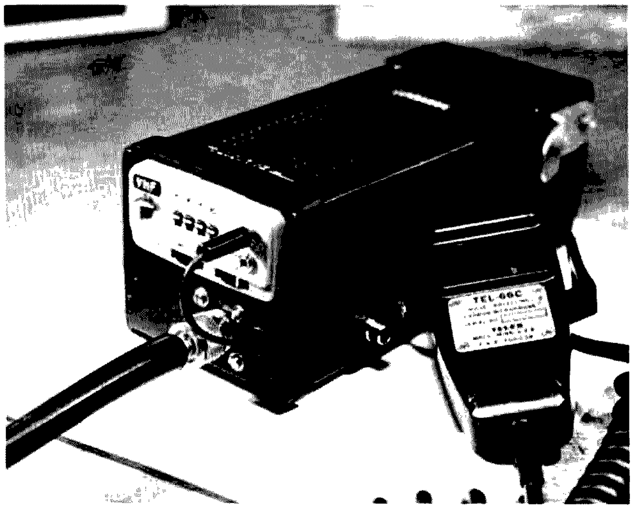


Photo 10. Presto! A super HT!

Current-Saver Counter Display

-- multiplex those LEDs!

Bob Hart K7YGP
622 West 4th St.
Medford OR 97501

Probably one of the greatest difficulties in building a counter or anything else that has a digital display is providing the large amount of current necessary to run the display and drivers. The easiest way to minimize this problem is to turn on only one digit at a time in a sequential fashion at a rate fast enough to eliminate flicker. If the duty cycle is low enough (ON time small in relation to OFF time), no current limiting resistors are needed in series with the digit segments. Without series resistors, there is less power wasted in heat, so power requirements are less.

Back in the December, 1976, *73* (p. 140), WA1UFE wrote an article describing (among other things) how he reduced the total current requirements of the LED display in his counter by sequentially strobing the individual display digits. His circuit is shown in Fig. 1. A 7492 binary counter (or a 7490 decade counter with no feedback) connected as a divide by 10 counter is continuously clocked by a 1 kHz signal from his counter time base. Each of the 10 counter states is decoded by a 7442 1 of 10 decoder and used to turn on a PNP switch transistor connected in series with the anode of each 7 segment LED digit. This results in each digit being turned on for 10 per cent of the time at a 100 Hz rate. Notice that there are no dropping resistors in the circuit. The only limits to current flow are the switching transistors, the driver IC, and the LEDs themselves. This allows most of the supply voltage to be dropped across the LED resulting in excellent efficiency.

Well, all this is good, but as far as I'm concerned it doesn't go quite far enough. If the LED display is the most power hungry component in a counter, its drivers (7447) come in a good second. Each one of those little beasts consumes at least 265 mW. (In comparison, a fully lighted 7 segment display dissipates around 420 mW, a 7490 about 160 mW, and a 7475 approximately 160 mW.) With eight 7447s driving eight digits (as in the WA1UFE counter) that's a total of at least 2.1 Watts

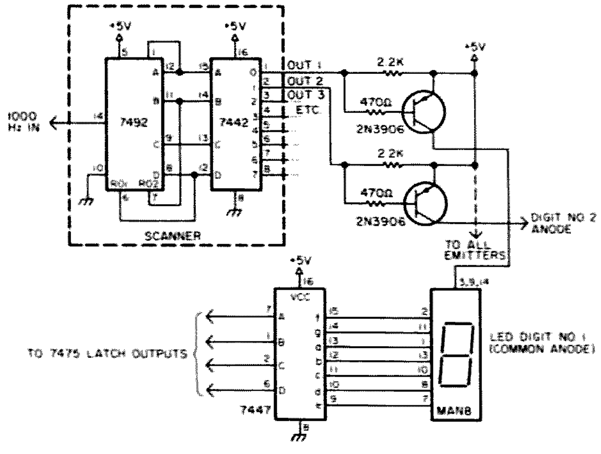


Fig. 1. WA1UFE display strobe.

(424 mA at 5 V). That turns out to be a fairly large contribution toward heating your shack (at least for a solid state device!).

So what can be done about it? There has to be some way to tell the LED which segments to display for which numeral. Ah-ha! he says. Since, when strobing, only one digit is on at a time, why not decode the 7 segment drive one digit at a time? This way you can be rid of the power load of all but one decoder/driver. Again, in the case of the WA1UFE counter, this would reduce the driver power requirements by a factor of 8. Following are two ways this could be done. The first is for the person who has already constructed a display system and doesn't feel like tearing it down and starting over. The second is for new designs and has the added advantage of being less expensive — only one 7447 is needed for the entire display.

The system for the existing display is merely a modification of display strobing. When a digit has been turned off by the strobe circuitry (which is 90 per cent of the time), its driver is just sitting there twiddling its open collector outputs. So why not turn it off too? This can be done by switching the 7447 Vcc in the same manner as was done for the LED anodes (see Fig. 2). If you are already strobing your digits, the driver as well as the digit can be strobed by reconnecting the PNP switching transistors to the individual 7447 Vcc pins. The LED anodes are then connected directly to the 5 volt bus. If you feel the display is too bright, an easy way to halve the brightness is to connect pin 4 of the 7447 (blanking input — called the BI/RBO node in the literature) to the 1 kHz signal that drives the strobe counter. Whenever this signal is low (and it's low half the time that any digit is on) the 7447 output is blanked, resulting in a 5 per cent (rather than 10 per cent) duty cycle. As shown in the schematic, the line driving the blanking inputs should be buffered by 7404 inverters since the BI/RBO node represents a load three times that of a normal TTL input (now why did they go and do that?). One inverter should be capable of driving three blanking inputs. Three buffers (inverters) are needed to drive the eight digits of the counter. Using this circuit with a MAN 1 display, the average segment current is about 8 mA (5 per cent duty cycle) giving brightness sufficient for a brightly lit room. With no signal driving the blanking input, segment current is 16 mA average and results in a very bright display.

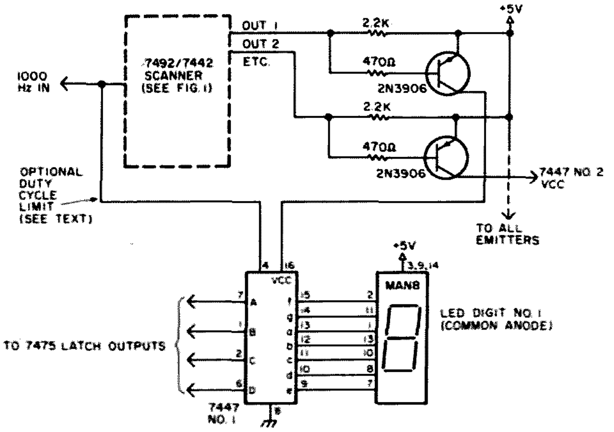


Fig. 2. Display and driver strobe.

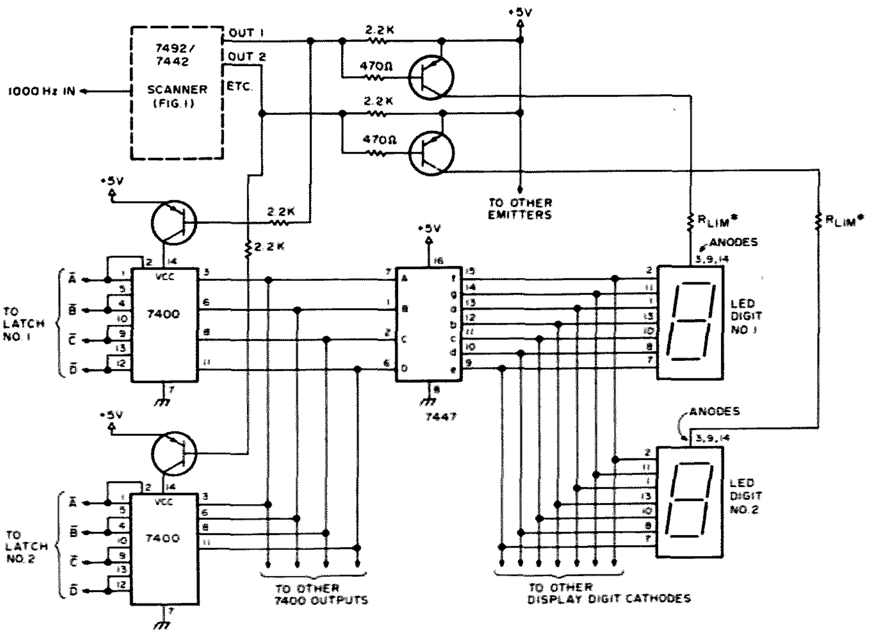
Starting from Scratch

This section is *not* required reading unless a) you enjoy modifying projects that are already working fine, b) you think it's time to start a new design, c) you wonder when the heck I'm going to say something about multiplexing, or d) you want to put off taking out the garbage for a few more minutes. A little thought about the last described circuit shows that since only one 7447 is used at a time, only one should be necessary for the entire system! All that is needed is a way to switch the 7447 to each BCD output and each 7 segment LED in sequence. This switching system (called a multiplexer!) is not as difficult to accomplish as it sounds. The PNP switches that were used in the original strobe system are now reconnected to the digit anodes and all of the like segment cathodes are connected in parallel (a to a, b to b, etc.) to the outputs of the 7447. This effectively connects one digit at a time to the 7447 driver.

In order to switch the BCD inputs from the 7475 latches, I will resort to a trick that will undoubtedly cause a few designers to cringe. It does not follow the teachings according to Texas Instruments, but it does work. Anyway, each BCD coded signal is applied to the inputs of a 7400 quad NAND and all the like outputs of the several 7400s are wired together. Data switching is accomplished by turning on the Vcc to the desired 7400. The complete multiplexed display system is shown in Fig. 3.

Unfortunately, this circuit will not work for all displays. The problem is that the out-

Fig. 3. Multiplexer for common anode LEDs. All transistors 2N3906 or equivalent. Note — inputs to F400 multiplex switches are inverted data.



put of the 7447 can only sink 20 mA per segment. This means that if you have 8 digits the average current per segment cannot exceed 2.5 mA. The resistors (sorry) in the segment lines serve this current limiting purpose. This would probably work fine for the smaller displays or possibly the newer high efficiency types (HP 5082-7650 – I don't know where to get them). For complete flexibility, the segment driver should be able to sink a maximum of 200 mA. That would allow ten digits at 20 mA per segment. The obvious way to do this is to add external transistors to the segment driver lines. An additional disadvantage to this is that this circuit will only drive common anode LED displays. Take a look at the ads in the back of this *73* and you will find that the inexpensive displays that were originally designed for calculators, clocks, and multiplexed operation are almost all common cathode types.

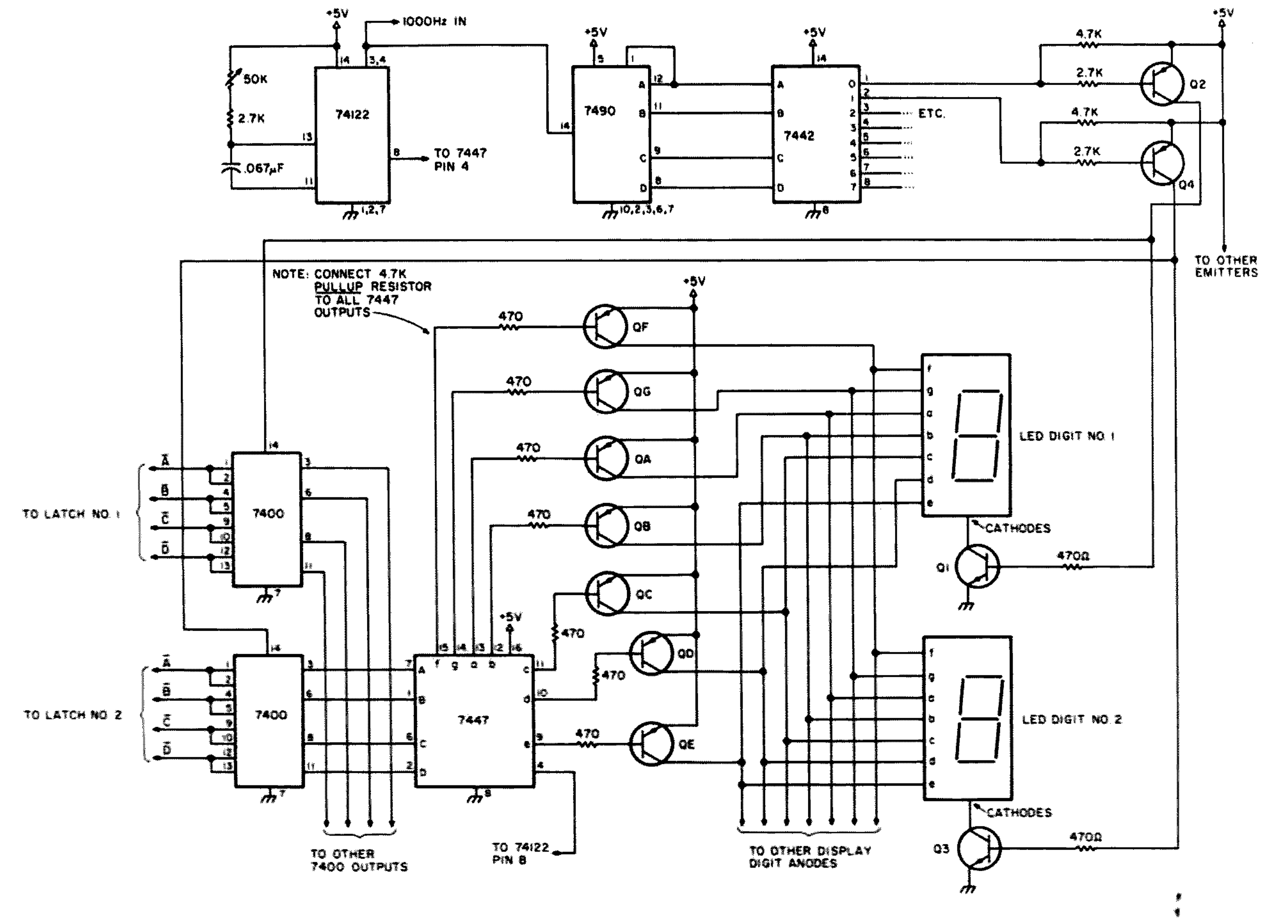
Since we are starting from scratch in this section, we might as well design the final display driver for common cathode displays. It should also be capable of driving up to 10 digits at 20 mA per segment (look at Fig. 4). One additional feature is a one shot (74122) tied to the blanking input of the 7447. This allows variable display intensity by changing the amount of time the digits are strobed on. Duty cycle of each digit can be varied from 10 per cent (full blast) to less than 1 per cent (almost off). If you don't want all this versatility, then leave out the 74122 and connect the blanking input to the 1 kHz clock as previously described. The rest of the circuit is just an expansion of the previous circuits. A 7490/7442 1 of 10 multiplex driver is used to strobe the display digit cathodes (through Q1, Q3, Q5, etc.) and at the same time turn on the required 7400 multiplex gate (through Q2, Q4, Q6, etc.). An important point is that the 7400 gate inputs are connected to the Q outputs of the 7475 where normally data is taken from the Q outputs. This is done because the 7400 inverts signals applied to its inputs. If no inversion can be tolerated, use a 7408 (same pinout but is an AND gate rather than a NAND gate) as the multiplex gate. It will work the same as the 7400 except that the data will not be inverted.

Because we are using common cathode digits, the outputs of the 7447 are polarity inverted by Qa, Qb, Qc, etc. Transistors Qa, Ab, etc., and Q1, Q3, etc., should all be capable of conducting 200 mA continuously (to be on the safe side). For the PNP types (Qa, Qb) a Sylvania ECG 159 or a Motorola HEP would work well. An ECG 123 or HEP S0002 are ideal transistors to use in the Q1, Q3, etc., slots. Q2, Q4, etc., can be any silicon PNP transistor. Actually, you could probably use any silicon transistors of the proper polarity you happen to have for any of the devices. Give them a try – if they get too hot to touch, try something else.

The End

There are a few more ways to light a display besides just connecting a 7 segment LED to the tail end of a 7447. While the other methods make things a bit more complex, some of those help control your electric bill and others can reduce your parts bill. So use one of these systems in your next (what the heck – rip that new counter apart) project. If anyone asks, you'll be in a position to bore them at length about the marvels of multiplexing. ■

Fig. 4. Multiplexer for common cathode LEDs. See text for transistor types. Inputs to F400 multiplex switches are inverted data.



Chaz Cone W4GKF
53 Old Stone Mill Road
Marietta GA 30067

Instant QSO Recall System

-- gaining peer respect

Notice the choice of the word "gain" rather than "earn" in the title of this piece. What I'm going to tell you about will dazzle and amaze your friends — and hams all over the world. The technique is easy to implement, costs very little, and satisfies a craving deep within some of us to continually be "one up" on everyone within earshot (or receiver-shot).

I've been a radio amateur for nearly 25 years, and I can tell you the name, QTH, and other interesting information about anyone I've ever QSOed — and I can find the information in about four seconds or less.

Now, I work with computers every day, and I've been interested in microprocessors ever since I saw the first MITS ad — but if you're thinking of a QSO file application, I can beat any affordable machine technique for under $15.00.

Before I tell you this deceptively simple procedure, let me examine with you *why* someone would want to do this. Why would you want to store away and retrieve quickly information about radio contacts?

The reason *I* do it is that I get a boot out of coming back to a call with the caller's name, like: "Hi, Brad. How are things in Omaha?" It blows his mind, usually, and we end up discussing the system (and my phenomenal "memory"). And, of course, after 20+ years of doing this I just can't stop!

Most of us who care about such things have tried QSO filing systems and abandoned them. If you filled out a 3 x 5 card on every contact, you would soon have too many cards to warehouse, much less use to enable finding any particular contact quickly. And using a whole card is a waste of space and material (in addition to being ecologically unwholeseome). So what's the system?

My system, and I don't claim originality, requires that you purchase 676 file cards. I use 4 x 6 cards; you might want 3 x 5 or even bigger ones. You'll also need a box in which to put them and some alphabetic dividers. I bought all three items in a stationery store (at today's prices the total bill is about $14.00). Try to get dividers with mylar-reinforced tabs, and index cards with lines on at least one side.

With a pen or pencil (here's your chance to be creative) write "AA" in the upper right (or left) corner of a card. Make the letters comfortably large, since they should last a lifetime and your eyesight will not always be as keen as it is today — 3/8 to ½ inch high should do nicely. In the same way, put "AB" on the second card, "AC" on the third, and so forth. By the time you're through, the last card will be lettered "ZZ" and your writing hand will be *very* tired. I actually had my wife do this lettering; it kept her busy for a couple of hours and she didn't spend a dime during that period — maybe I've got something here after all.

Take a break, solder all connections to this point, and relax. Admire your handiwork (or your wife's). Insert the dividers into the deck of cards in front of each group, so that there are 26 cards behind each divider. See how symmetrical it all is? Psychologists say that symmetry is gratifying.

There's your instant-access QSO file. It will hold more than 20,000 QSOs, and you'll be able to find any one of them in less than four seconds. *And*, it will never occupy more space than it does right now.

I put one QSO per line on each card as I work a new station. I record callsign, name, QTH, date, band and whether a QSL was sent/received (a checkmark for a QSL sent, a circle if one is received). There is additional room for other info if you wish, and, if there is a lot you want to write about a specific contact, you can put an asterisk on the line and write paragraphs on the back of the card.

Hold it! Which card does a QSO go on? I put the contact on the card that matches the *last two letters* of the callsign. I chose the *last* two instead of the first two, because this gives a more normal distribution; in many DX countries you will find callsigns grouped heavily toward the front of the alphabet. See how it works? As an example, my "KF" card has everyone on it that I've ever worked whose call *ends* in "KF": W7GKF, EA3RKF, WB6NKF, and so forth. I would be on *your* "KF" card.

That's all there is to it. When I hear a CQ (or call one), I can locate the right card as soon as I hear his callsign, determine if we've talked before, and come back with his name in practically no time. If it's a first contact, I fill out his line during the QSO. You've got room on a 4 x 6 card to put comments like: "photography," "cars," "DX," and so forth on the line, so that you can recall his special interests on your next QSO. If you are into Ten-X hunting, county hunting, DX chasing, or other subinterests, you can tell instantly whether this contact is a new one or not.

It's not much trouble to maintain (really!), and it's a great memory substitute.

Get yourself a box, 676 4 x 6 cards, and a set of alphabetic dividers, and snow your friends! ■

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New PC Techniques Unveiled!

-- dig out your old chemicals

Regardless of how you go about it, etching printed circuit boards can be a chore unless you happen to be making them commercially on a continual basis. After all, when the artwork is complete for the first board, making additional boards is not all that difficult. The same is true for any other type of printing process – the first page is always the most expensive.

However, if you are like most hobbyists, you are not interested in making 50 to 100 identical PC boards. Usually, you are interested in building one circuit at a time. This leads us to the basic problem faced by all hobbyists today – it takes as much effort to make that one PC board for your favorite project as it does for a manufacturer to make fifty.

For this reason, printed circuit boards for the casual builder of electronic projects have become both a solution and a problem. They are a solution to reducing the time it takes to wire a circuit *after* the board is etched. They are a problem due to the time that it takes to etch the board in the first place. They are a solution to minimizing wiring errors – after the boards are etched. They are a problem in that an error in the artwork will be duplicated in all boards etched from the original artwork. In this case a small error in the beginning is multiplied by the number of boards etched.

In this article, we will review some advantages and disadvantages of PC boards, various techniques available today, a few application guidelines, and the recently introduced "Stamp It & Etch It" product. Let's begin with some disadvantages of PC board construction.

Disadvantages

Printed circuit boards (or the etching of them) can be a big bugaboo in any circuit builder's life. If you have etched boards before, you already know why this is so. In many instances, you may have discovered that it takes much longer to etch the board than it does to mount and solder components on it. While you were making that discovery you may also have concluded another characteristic of making circuit boards: Depending on the technique you use, it may take just as long to make one as it does to make 5 or 10. Why? Well, whether you are making 1 or 50, you must first prepare the preliminary layout, plan the location of components, make the final artwork, and, depending on the process used, prepare a negative or positive film.

Up until this point, the required time is the same regardless of the number of boards being made. The next steps involve exposing and developing the PC blanks, and finally etching the boards themselves. If you have the facilities, it may be possible to etch several boards in one tank. This mass production is the main advantage to using PC boards in the first place. For the average hobbyist, however, the advantage of mass production has little value, since many of our projects usually involve only one type of board at a time.

Also, if you are not fortunate enough to have a special place set aside to make PC boards, another disadvantage becomes obvious. Each time you want to make a board, it is necessary to set up equipment, being careful of chemical spills and then putting everything away when the project is completed.

This can sometimes be very annoying, to say the least. Especially when you accidentally change the color of your kitchen countertop with a little ferric chloride.

Some Advantages

But before I paint too bleak a picture of PC board techniques, what are some of their advantages? I've already mentioned that once they are etched, PC boards can save you much time in wiring a circuit – in addition to minimizing wiring errors. Also, once you have perfected a layout and worked the bugs out of a critical rf circuit, the results can be duplicated by anyone following the same layout.

For prototypes and one of a kind projects, PC boards can also be very useful. In most of these applications, the film process is usually bypassed by making the layout directly on the copper blank (using dry transfer, resist pen or tape). This technique can save much time in getting your circuit from the "paper" stage to a finished product.

In addition, new tech-

niques are continually being developed to make it easier for the hobbyist to build electronic devices. One new development is the "Stamp It & Etch It" technique, which will be evaluated later in the article. This kit is actually a set of rubber stamps consisting of TO-3 pads, 1C pads, component and edge connector fingers. But, I'm getting ahead of myself. More on this later.

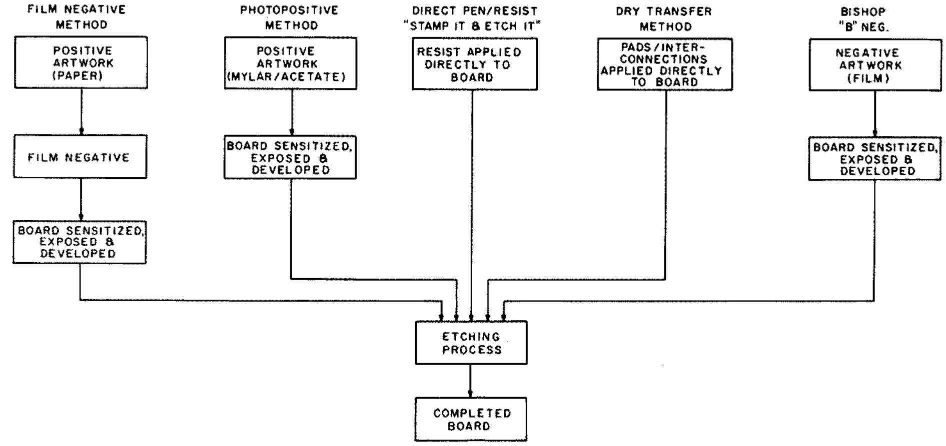

Fig. 1. Block diagram of the steps required for each method.

Present Practices

There are several ways to make PC boards today. To name a few of the present methods: direct pen resist/etch, dry transfer, film negative, photopositive, Stamp It & Etch It, and the patented Bishop Graphics method called the "B" Neg drafting system. See Fig. 1 for a diagram of these methods.

1. *Direct pen resist*. This is perhaps the most basic technique and, for simple circuits, is probably one of the easiest to apply. Once you have made a preliminary layout sketch of the PC pattern, you simply transfer it to a clean PC blank with a "resist pen." This is a felt-tipped type pen containing a heavy lacquer that is unaffected by the ferric chloride etching solution. When the copper board is placed in this solution, the copper is removed wherever it is not protected by the lacquer. In effect, the lines drawn by the pen are the actual circuit conductors on the completed board.

2. *Dry transfer method*. In this technique, pressure-sensitive pads and tapes representing terminals and connections are used. Once the layout has been drawn on paper, it can be transferred to the copper blank using carbon paper and retracing the lines. An alternate method is to draw the circuit in pencil directly on the copper board.

Next, the pattern is protected by applying dry transfer pads to the appropriate areas on the copper surface. These pads usually come in sheet form and are transferred to the copper surface by rubbing them off the sheet with an old ball-point pen that no longer writes. Then the conductor paths are made using tapes of various widths, depending on the circuit requirements. From this point on, the board is etched in the usual manner.

A variation to this method is to tape the board completely with wide masking tape. Then cut out the taped areas where you want to etch the copper away. The remaining masking tape will protect the copper from the etching solution. This method is particularly useful in rf circuits where large ground plane areas of copper are desired.

3. *Film negative method*. This is the standard in the electronic industry, since it provides extreme accuracy and high density of complex circuits. There are various types of drafting aids available for many applications. For example, there are tapes, tape shapes, donut pads, die cut multipad figures (for transistors, integrated circuits, etc.), connector strips, and many more. These pressure-sensitive drafting aids come in the standard sizes of 1:1, 2:1 and 4:1.

Here's how to use them. Start with a sheet of drafting paper with 0.1" grid lines. After you have drawn your layout to the scale desired, lay a sheet of Mylar™ or clear acetate over the pencil copy. With Mylar, I find it better to place the frosted side up – since you can easily write on this surface.

The next step is to transfer the pressure-sensitive pads to the correct places over your pencil layout. To remove small patterns from the backing, slip the blade of an X-acto™ knife under the pattern and lift it off. Then, using the knife blade as a holding tool, position the adhesive pattern over the artwork. If you happen to get the pattern positioned wrong, just slip the knife blade under it, lift it and re-position it. Once the patterns have been placed, a special black tape is used for interconnections.

We now come to the photographic step. If your layout is a 1:1 scale, you can make a contact negative using sheet film. This is recommended only for photography buffs who have their own darkroom. If you don't have a darkroom, the easiest thing to do is bring it to a photographer or a drafting/reproduction house and tell them what you want. The usual charge for making a negative is two to three dollars. If the scale of your artwork is other than 1:1, it will be necessary to have the negative reduced appropriately.

Once you have a negative of the circuit, it will be necessary to transfer the image to the copper blank. First, the copper is "sensitized" with a special chemical, usually in a spray can form. This is usually done in subdued light for photographic purposes. The coating must be uniform and dried for a period of time. Complete instructions for this process comes with the chemicals you buy, so we won't go into great detail here. The remainder of the process includes exposing the sensitized board with the mask over it, and developing the pattern. Then the board is etched in the usual manner.

Even in my abbreviated and once-over-lightly discussion of the steps involved, the whole process seems a bit complicated for most weekend projects. Then, when you consider the two to three hour process time, it seems there must be a better way. Many people I have talked to are turning more and more to local, commercial PC fabricators. But here again, cost may become prohibitive. Our local PC house charges around $5 or $6 for a 4" x 6" board. In many instances, the board costs as much as all the components that go on it. Is there an easier way?

4. *Bishop "B" Neg drafting system and the photopositive method*. Both of these methods have the advantages of eliminating the photo process of developing a film negative, but as a result they are suitable for 1:1 artwork only.

Basically, the Bishop "B" Neg method produces nega-

tive artwork which is used with a negative photoresist. By working with negative artwork directly, there is no need to have a film negative made – thus saving you time and money. Another advantage to this system is that it can be changed at any time without the expense of having a new film negative processed.

Additional information on this method can be obtained from: Bishop Graphics, Inc., 20450 Plummer Street, Chatsworth CA 91311.

An alternate method with similar results is the photopositive method. A positive resist has been developed that operates in reverse from the standard negative resist. Once your board has been sensitized with this positive photoresist, you can use positive artwork on Mylar or acetate film directly to expose the copper blank. In addition, no highly volatile hydrocarbon developers are needed as with the negative resist. Instead, only ordinary household diluted lye (sodium hydroxide) or caustic soda in water is used as a developer for the positive photoresist.

As with the Bishop "B" Neg system, changes may be made on the positive artwork without having to go to the expense of the photographic process.

Although there may be other suppliers of positive acting photoresist products, one company I am familiar with is Trumbull, 833 Balra Drive, El Cerrito CA 94530. They have a complete line of artwork aids, drill bits, and copperclad boards, and they spoil the hobbyist with prompt shipments.

5. *Stamp It & Etch It.* Always looking for new and easier techniques, I noted an ad one day for ACE Laboratories (now Rainbow Enterprises, PO Box 2366, Indianapolis IN 46206). What really caught my eye in the ad was the statement, "... reduces printed circuit board artwork from 2 hours to 10 minutes ..." This statement and the fact that the kit is offered on a satisfaction guaranteed basis was enough for me to send them $10.00 to find out what it was all about.

A few weeks later, I received my package and was anxious to open it up. This is what the kit contains:

(1) Individual rubber stamps consisting of PC board connector fingers, 16-pin dual in-line IC socket, 10-pin round, 8-pin round, TO-5, TO-18, large/small donut pad;
(2) Resist ink (small bottle);
(3) Ink pad;
(4) Resist pen (felt marker type);
(5) Etching containers (plastic bags).

Making a PC board with this method eliminates the preliminary artwork and photography. You merely stamp the component patterns directly on the PC board, use the lacquer pen to connect the components, and then etch the board. I used this basic method to etch a board containing 13 ICs, and the results were fairly good. However, as always, there are a few precautions that can be taken to insure that you obtain the results you are trying to achieve.

The usual preparations of the copperclad board should be made, such as a thorough cleaning to remove any dust, film or fingerprints. After the PC board is cleaned and dried, lay it aside and proceed to prepare the stamps. This is done by inking the pad sparingly with the lacquer supplied. Only about a 1" square area is required for most jobs. Trying to ink more than this will result in the pad drying out before you are finished with the board.

If you are using the stamps for the first time, ink them well and practice on a paper blotter. This is necessary in order for you to get the feel of the operation – and also to fill the pores in the rubber stamp material. When you feel confident in using the stamps, your next step is the PC board itself.

I found it difficult to place the stamp exactly where I wanted it on the board "free hand," without it sliding and smearing the ink. This problem was solved by using a small piece of wood (1" x 2", about 6" long) as a guide. Just hold the guide flat against the PC board with one hand, while you slide the rubber stamp against the guide until it rests flat against the copper surface.

Another variation to this technique can be used if you have several ICs in a straight row. Just temporarily clamp the guide and circuit board in a small vice along the line of the ICs. It's much easier to print each IC along the stationary guide, and you end up with all components in a relative straight line without too much effort.

The IC patterns seem to work out best. The first PC board I etched with this kit took more than the advertised ten minutes. However, the stamps do make it easier to etch a board.

They also have another feature which may have been overlooked. Before you begin to prepare a PC board for etching, it's usually necessary to prepare preliminary artwork. This is the process of determining component placement and interconnecting lines. I have found the rubber stamps invaluable for this phase of the process. In the preliminary circuit layout on paper, the stamps are used with an ordinary office-type ink pad. This is a great timesaver in producing professional-looking transistor and IC pin connections. This method is also much cheaper than using pressure-sensitive adhesive decals for the preliminary artwork. Bear in mind, however, that the stamps do have limitations and that the results depend to a great extent on how you use them. ■

Alexander MacLean WA2SUT/NNN0ZVB
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How Do You Use ICs? - - part VII

Most of this series has been concerned with digital ICs. Just for a change of pace, here's one of the workhorse linear ICs – the LM380 series of audio power amplifiers.

There are two in the series: the LM380 (or LM380N), which is a two Watt power amplifier IC, and the LM380N-8 (or LM380CN), which is a 600 mW power amplifier in a minitype DIP (dual in-line package).

Besides the power difference, the pin connections are not the same, so we will take one at a time.

The first hurdle to get over is the power. It may not seem like much to talk about something which only puts out 600 mW or two Watts. This must be put into correct perspective.

Most amateur and communications type equipment usually has an audio power output in the neighborhood of one or two Watts. Even the much prized R390 or R390A only has a 600 mW output.

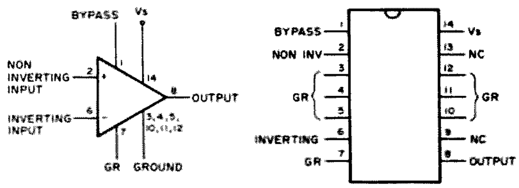


Fig. 1. LM380N 2 Watt audio amplifier IC.

If that doesn't convince you, just think how loud those teensy transistor radios sound. Most of them are only about 100 mW or so. Make no mistake. These audio ICs are well within the useful range of audio output power for most purposes.

Both ICs can actually put out more power than these basic ratings, but this gets into problems with heat sinking and other special precautions. This series is devoted to the easy and reliable.

Fig. 1[1] shows the pin configuration for the LM380(N) and the schematic symbol. This IC is in the 14 pin DIP configuration that has been commonly seen in this series.

Taken all by itself, the schematic representation of the device as a sideways triangle may seem a bit dumb. Once again we are faced with the problem that this is another computer symbol, the one for the amplifier function, which was retained for the device in other applications.

It is dumb, but it is what you are going to find on most of the schematics that use this and other IC amplifiers.

This means audio, i-f, rf, op and the works. They all use this same symbol, so watch the device number and the pin connections carefully.

This IC is another device with a minimum of external parts to go with it. There are a wide range of values that may be used depending upon the application though. Most are not critical, but you will have to understand how and why the choices were made.

Keep in mind that this device was intended for a number of purposes and has features that are not immediately applicable to the audio amplifiers you will be using.

It was designed to perform a number of audio jobs in intercoms, TVs, radios, tape recorders, etc., and for various control amplifier applications. Its use as a communications type audio amplifier is what we are interested in.

In order to simplify the circuit, it will be described in sections with the explanation of the associated parts.

Fig. 2 shows the IC and its usual output circuit. R1 and C1 are theoretically optional.

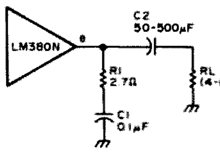


Fig. 2. LM380N output circuit.

They are there to prevent a 5 to 10 MHz oscillation which may occur with some types of operation.[2]

When bench testing the IC, they did help to prevent audio oscillation with some circuits. The values shown are the specific values to be used.

C2 is the output coupling capacitor. The low impedance output is capacitively coupled to the load. The voltage rating should be higher than the source voltage by a slight margin at the least.

The value is not critical for communications work. The typical range of values is from 50 uF to 500 uF. The basic effect is on the low frequency response. For hi-fi use you would want the larger value.

The LM380 will work with a load from four to 16 Ohms impedance. This gives you quite a bit to play with. There are plenty of speakers in this range and it will also work with your 8 Ohm ham headphones or a set of stereo phones.

The stereo phones can be hooked up as either a 16 Ohm load (series) or a four Ohm load (parallel). The advantage of using the phones as a four Ohm load would be that the shell of the plug could be grounded when the jack was chassis mounted. For 16 Ohm use, the jack would have to be insulated from the chassis.

There is slightly more output with the sixteen Ohm hookup, but not so much as to be critical. There will also be differences in the amount of actual audible output depending upon the efficiency of the speaker or headphones used. Still, the IC should be usable with almost anything standard you have on hand.

Fig. 3 shows the power, grounding, and bypass circuitry of the IC. Pin 14 is the Vcc source pin and pin seven is the nominal circuit ground. Notice that there are six other ground pins.

These are not because extra grounding was needed. Their specific purpose is to be part of the heat sinking mechanism. When used with a PC board, they draw heat off to the solid foil where it can be dissipated safely.

The IC is designed for use with a minimum voltage of 8 and a maximum of 22 volts; however, those tested would not work below ten volts source.

While not always shown, the Vs pin should be bypassed if the supply is more than a few inches away from the IC. It probably is a good idea to bypass it anyway. This is to prevent audio oscillation. The value is not critical, and for most audio uses, 0.1 to 10 uF is common.

The other bypass capacitor shown is also optional in some circuits. Its function is to bypass the supply to the internal small signal high gain sections of the IC where power supply hum or other noise can get in and be amplified.

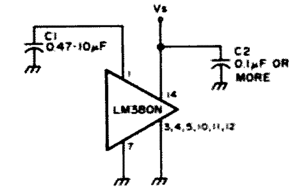
There is an internal split load resistor for these stages which is bypassed to ground when extra decoupling is desired.

For audio circuits, this is usually desirable. Here the common value is in the 5 to 10 uF class, but it is not too critical. This does have an effect on the frequency response, but for audio use, there did not seem to be any appreciable difference with or without in the test circuits.

It probably won't degrade performance for communications work either. Use the bypass to take advantage of the extra decoupling.

We now come to the matter of power output. At the beginning of this article, the LM380 was listed as a two Watt amplifier. This presupposes that it gets the required drive and the rated source voltage.

Fig. 3. LM380N power, bypassing, and ground circuit.



With its full 22 or so volts, it will have that much output, but not with less source voltage. Here what seems like a decided liability actually works for you.

Most transistorized or IC amateur and communications type equipment is also designed for mobile use, specifically with a design center of the 13.8 volts or so that the normal car or truck will have. Nominally this is specified as twelve volt operation. This can make design work easier for you.

Instead of a wide range of operating conditions, you can expect the 12 to 13.8 volt range to be your norm. These test circuits were tested from 12 to 14 volts for actual operating characteristics.

This automatically uses the first rule of IC and transistor work: Don't push the ratings. The 14 volts is well within the rated voltage for the device and is a very safe margin. The big question is: What does it do to the actual performance?

Mathematically, you get quite a bit less output with less source voltage. When tested, it worked out to about 500 mW at best. This may not sound like much on paper, but in terms of real sound it is more than you want.

This will take some explaining. The output voltage through the capacitor is the signal voltage that drives the speaker or headphones.

This voltage is derived from the source voltage. The IC automatically centers itself at one half the source voltage and the output voltage swing is the source voltage minus the voltage differential required for the device to operate, usually several volts.

This means that the output voltage will be less than the source voltage by several volts. That is all there will be. You can drive the input up to the point where this maximum signal output voltage is used up.

Overdriving will result in distortion caused by the signal being clipped when there is no further output voltage swing available.

Not to worry. Just keep it in perspective. You can't hear a number. How does the IC sound? The IC was tested using the output from an FM tuner as the signal source. This is a more demanding signal than speech, as music shows up distortion much quicker and the acceptable distortion level is less.

Using a good quality speaker, a number of types of signals were tried, everything from acid rock to classical music. Rough measurements of the output to the speaker showed approximately 500 mW available without distortion. Slightly more power was available before distortion became unacceptable.

However, listening in the room the speaker was in was somewhat uncomfortable. It was too loud. In fact, it could be heard through much of the rest of the house. The room door had to be shut to continue testing.

At these power levels, that safety factor becomes quite an advantage. After several hours of continuous use at the maximum usable level at fourteen volts, there was no evidence of any heat problem. There is a built-in thermal overload circuit, but

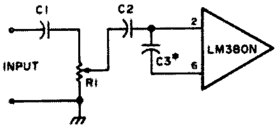


*Fig. 4. LM380N input circuit (*optional for tone).*

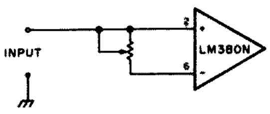


Fig. 5. Common mode volume control.

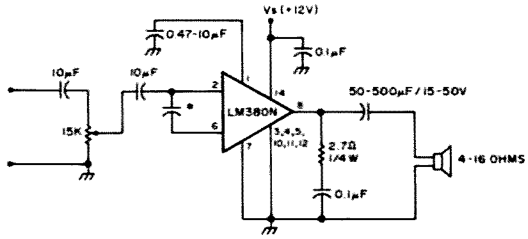


*Fig. 6. Full schematic, LM380N audio amplifier. *See text.*

the device did not even feel warm to the touch.

For enjoyable room listening, much less power was needed. 30-40 mW would fill the room. There was one slight problem at that power. The base response suffered. For communications work this would not even be noticed, but with music it was noticeable.

This may not be a fault with the IC or circuit though. None of the components were really chosen for hi-fi response. As the volume control was almost all the way down, the low resistance across the IC's input may have caused the loss. It is more likely that at the low power level there was simply too little drive to the speaker at low frequency.

This is a problem with any speaker. It takes more power to drive them well at low frequencies. This usually means poor response unless a base boost circuit is used. This would be uncommon and unnecessary for communications use.

The input circuitry of this IC is the hardest part to understand, but not to use if you know what you want.

There are two inputs, one inverting and one non-inverting. They do just what the name implies. For audio use the non-inverting input is commonly used. But what to do with the other? There are several options because the device was intended for many types of inputs.

The unused input can be left floating, grounded through a resistor or capacitor, or grounded directly. The application notes give the particulars for other uses; what we want are the standard receiver audio section type answers.

In this case, the usual procedure is to leave the inverting input floating or ground it directly. The audio input goes to the non-inverting input, pin two.

This is shown in Fig. 4. C1, C2, C3, and R1 are not critical, but do have an effect on the input, so a word of explanation is in order.

C1 and C2 are signal coupling capacitors. Their value is not critical. The voltage rating should be sufficient to block the dc voltage from the preceding stage from getting to the IC input.

The value affects the frequency response, the low frequencies in particular. For communications use, anything from 0.05 uF on up will do. For best low frequency response, a small electrolytic can be used. Values around 10 uF are common.

The high frequency response of the LM380 is quite good. In fact, the audio quality is rather brilliant. It is more high frequency response than is needed or usually wanted.

Most communications amplifiers are built to limit high frequencies, so there is usually the equivalent to C3 in most circuits. Even for music it sounds better to take out some of that brilliance and make a more natural sound.

The C3 value is not critical and is usually a matter of personal choice. A value of 0.005 to 0.05 uF would be the likely range.

In the schematic shown here, C3 is between pins 2 and 6. It can also go between pin 2 and ground. It made no appreciable difference if pin 6 was grounded or ungrounded. Grounding may be advisable in some circuits to avoid stray coupling to the input, particularly if the inverting input is used and the other is left unused.

Volume control R3 is not critical. The test circuit used a stray 15k Ohm volume control. It would seem likely that anything up to 1 meg would also work. A smaller value might also work, but at some point might make for less signal to the amplifier.

In this circuit, the volume control is capacitor coupled to the IC. It seemed to work as well when the tap went directly to pin 2 of the IC, but there may be some loading of the IC with a low resistance across it.

In a transistor circuit, trying to use a volume control the same way as in a tube grid circuit would upset the bias of the transistor and mess up the circuit, so the control is normally isolated from the input.

With ICs you often have the option of using a tube type volume control circuit, but the isolated volume control as shown is more common.

The IC is quite sensitive. It is rated at 0.5 V ac maximum input. It only took a tiny amount of the available input voltage for full undistorted output. Going beyond this will certainly cause extreme distortion and may damage the IC.

For your own test purposes, the output from an FM tuner makes a good wide range test signal. An audio oscillator is a good steady test signal. Remember to keep the level low. Start with the IC's volume control all the way down and raise it gently until you get a clear signal.

There is one trick type of control circuit peculiar to the IC which relies on its differential amplifier capability. This is the "common mode" control shown in Fig. 5.[3]

Here the two inputs are played off against each other and the circuit provides very little loading to the IC or the signal source.

This circuit is not common for communications use and is shown for example only. The normal audio hookup of the IC is what you want for most audio or communications purposes.

This basic complete circuit is shown in Fig. 6[2] with typical parts values. This will certainly handle any job you will be interested in doing at first.

Fig. 7[4] shows a similar circuit from an actual receiver schematic. This is only shown for example and not for duplication. One of the interesting things about it is that it would appear to be in error.

Before getting into the errors, look at the input circuit. It is quite similar to the test circuit shown. The inverting input is directly grounded. The 0.001 uF capacitor would appear to be for audio tone quality.

The volume control is similar to the test circuit. The exact significance of the 0.047 uF cap and 10k resistor combination was not explained in the text.

It may be partly for tone quality or perhaps some form of peak limiting to the IC. It may even perform some filtering action in the circuit.

The value of the output resistor is not given nor is the 0.01 uF capacitor explained. Perhaps again for audio response. In any case, that far the circuit is fairly straightforward.

The trouble comes with the rest of the schematic. Part of it suffers from assuming that the reader already knows the LM380 audio IC.

The pin with the asterisk (*) obviously refers to the ground pins 7, 3, 4, 5, 10, 11, and 12. The bypass capacitor obviously refers to the bypass pin. But this is only obvious if you are already familiar with the IC and know that pin 1 is bypassed.

The schematic is ambiguous. The nine could refer to either of the two pins near it. As it happens, pin

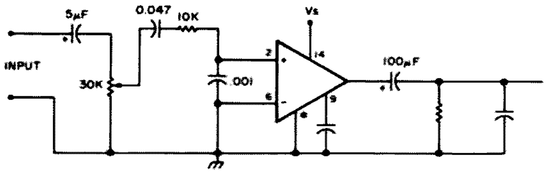


Fig. 7. Schematic from published article.

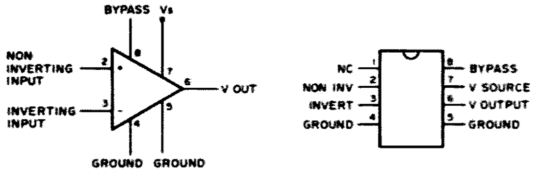


Fig. 8. Mini-DIP 600 mW LM380N-8 symbol and pinout.

nine of the LM380N is no contact, which is quite non-committal.

The bypass should have been labeled pin one and the output is pin eight. All told, this could have been a very frustrating project to duplicate.

This shows why it is so important to get the data sheet for an unfamiliar IC. The pinout diagram would have shown the error and the application notes would have given enough information to make corrections.

Most of the simple audio uses will follow a hookup very similar to our test circuit, which could probably be dropped right into any project using the LM380N as its audio amplifier stage.

The only time you might want to deviate from something similar is when the text clearly gives a reason for a different hookup. A given circuit might be more susceptible to rf pickup or the like and require extra circuitry.

We next come to the LM380CN, the mini-DIP LM380N. This is nothing more than an eight pin IC about half the length of the other. It will still fit into a standard IC socket.

The important thing to watch is that the pin connections are not the same as the other IC, and, of course, the power is not the same.

Other than that, the hookup is just about the same, at least as far as the external components. Fig. 8[1] shows the pinout and schematic symbol and Fig. 9 shows the whole amplifier schematic. It is virtually the same as the other.

Within the 12 volt design range it gives just about the same performance, perhaps slightly less output but not enough to matter.

There is one serious drawback though. To get the comparable output it means that the IC is working at almost full capacity. It runs slightly warm to the touch.

As a design decision, there would seem to be little in favor of using this IC. Unless you are really into teensy, it would be better to use the larger IC.

It will give better performance within that range and it will be running very conservatively. This translates into longer term reliability.

There is a wide price differential between sources for prime quality LM380s, but the usual difference between the 2 Watt and the 0.6 Watt is only about 35¢, hardly worth bothering about.

There are several ways to buy the LM380. You can buy prime quality or an experimenter's selection. This will give you a higher IC count but will contain defective units.

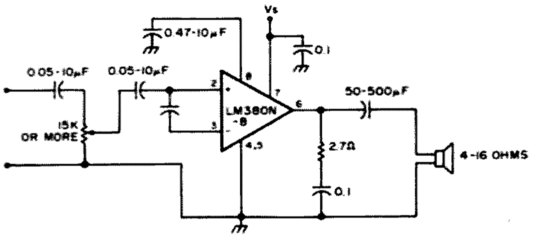


Fig. 9. LM380N-8 600 mW audio amplifier circuit.

For your first time out, get some prime quality. Two or three will do for a start. Then make up a test circuit using your supply and speaker. See how the prime quality units sound and perform. Then you can try the experimenter's bagful.

The selection I got contained several that were not even audio amplifiers, and there were only about 12 usable out of the original 50.

This was quite a bit less than advertised, but on a price per unit basis, quite a bit cheaper than buying prime quality. You will probably get about the same results, but without a working standard to compare with, you may have a hard time testing and knowing that you are right.

This brings up a word about how these things can act up. There are four basic categories of trouble and there may also be some slight shading in between.

1. The unit can be quietly uncommunicative. It just sits there in the circuit and no audio comes out. All other indications are normal.

2. There can be audio but it will be weak or distorted. This is where a knowledge of how the circuit is supposed to work pays off. It could be circuit trouble, too. At this point, you have to wiggle a few wires and make sure the IC is properly seated in the matrix or socket. All other indications are normal.

3. The IC draws too much current. This may or may not give good audio response — usually not or it hums. The IC should not draw more than about 25 mA when idling. Usually it does not go high with the 12 volt or so supply in use. Some ICs want to go a few hundred mA. This is decidedly unhealthy. Scrap them pronto.

4. The IC is suicidal. This IC usually doesn't work at all but draws over an Amp. While testing one, the power supply meter was doing a tarantella at 1.5 to 2 Amps. Not a sound out of the IC. As I reached for the supply lead, smoke began to curl up from the board. Exit one IC.

This brings up a practical testing matter. You don't want to watch your supply go up in smoke because of a defective IC. Make sure your supply is protected by fuses and common sense.

It would be a good idea if the whole physical layout is right within eyesight in front of you when the power is applied. Then if anything takes off you will be able to quickly cut off the power.

I use a clip lead on the ground lead of the power supply and touch it to the circuit ground to apply power at first. If nothing goes wild I clip it on and watch for any later effect. So far my supply has remained in one piece using this system.

This is probably more detail then actually needed for most applications. It really is a simple IC to use successfully. However, by now you should have all the information you need to apply it to any use you have and know how to make allowances in other circuits if you did not have the exact parts specified. ■

References

[1] *Linear Integrated Circuits*, National, Feb., 1973, pp. 5-41.

[2,3] *Linear Applications*, Volume 1, National (Radio Shack) Section AN69.

[4] "Yes, You Can Build This 2m Receiver," Jim Huffman WA7SCB, *73 Magazine*, April, 1976, p. 18.

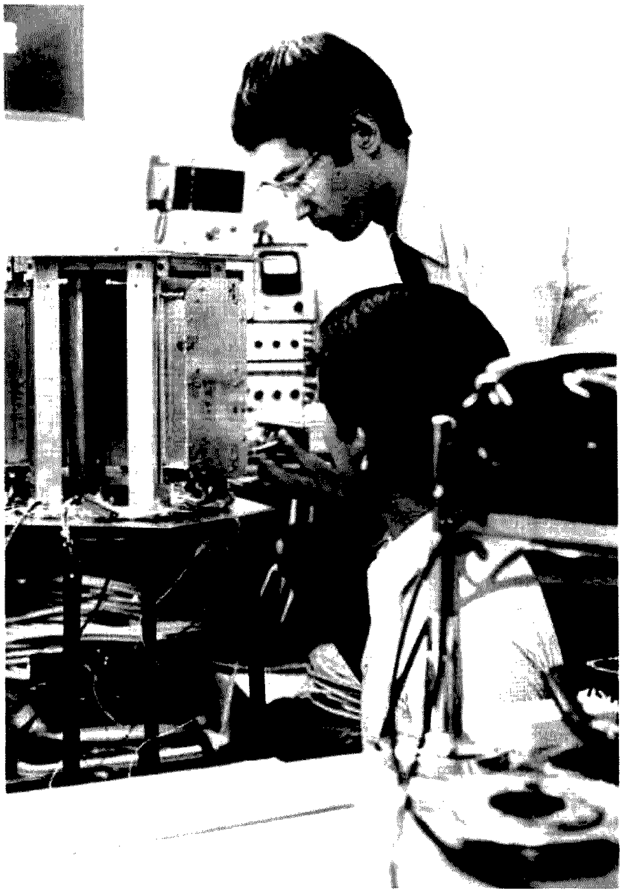
AMSAT

Amateur radio is about to undergo a fundamental change. About fifty years ago the discovery that the HF bands would support long distance communications revolutionized amateur radio. At that time amateurs were limited to working their friends across town or the occasional DX station using high power and long wire antennas on the long wave bands. With the introduction of the short wave bands, DX contacts became commonplace, with small antennas and relatively low power. Encouraged by this DX potential, amateurs explored the HF bands, using shorter and shorter waves to work the world. Time passed, technology improved, frequencies got higher, and wavelengths shorter, until a barrier was found at a wavelength of about ten meters. The ionosphere only allowed reasonably reliable DX contacts at frequencies below about 30 MHz. Thus, for years, DX contacts were in the main limited to HF. Now that barrier is being broken and a fundamental change in amateur radio is again about to take place.

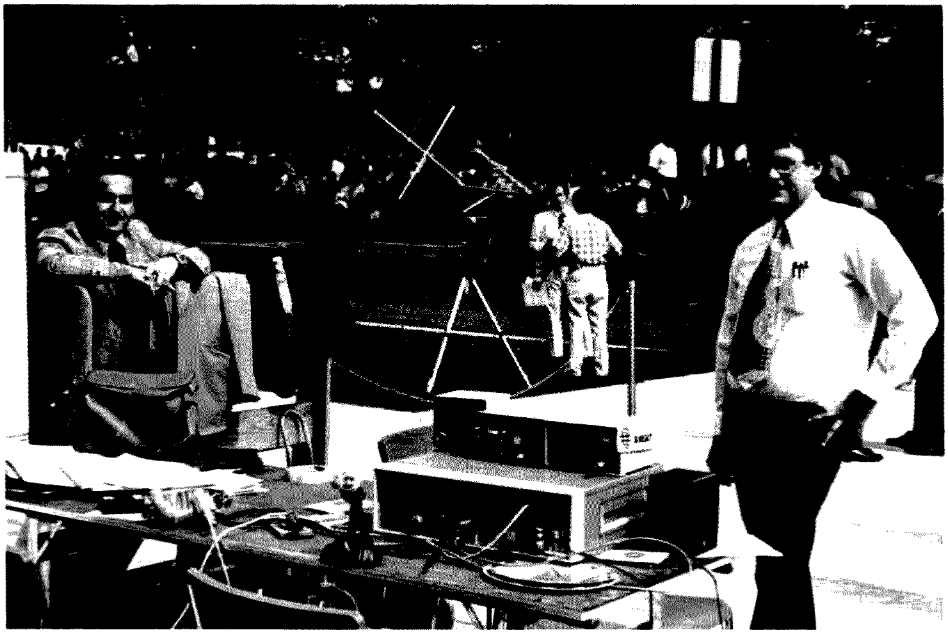
In the change that amateur radio is about to undergo, whole new bands will open up, with characteristics unlike any of those existing at present. When will that change take place? It will begin with the successful launch of the first AMSAT-Phase III spacecraft now scheduled for late in 1979.

AMSAT is a worldwide organization of radio amateurs with more than 3000 members in over 85 countries. However, everyone communicating via the AMSAT-OSCAR 6 and 7 spacecraft are not members of AMSAT, and there is no requirement that they become members. It is estimated that many thousands of radio amateurs have made use of the OSCAR spacecraft. If you count the amateurs who have been involved in commanding the spacecraft (so as to ensure that they are available for use when scheduled), and you count those amateurs involved in publicizing AMSAT (and making known the capabilities of the existing satellites and the potentials of the new ones), and you count the amateurs building those new ones, you will find that only a few hundred out of an estimated 50,000 radio amateurs worldwide are pioneering their way into the satellite era of amateur radio.

AMSAT is currently managing the day-to-day operations of the AMSAT-OSCAR 6 and 7 spacecraft. These satellites are in low altitude orbits and allow communications ranges of up to 5000 km or so without any skip zones. However, the band is open for only about 20 minutes at a time, five or six times a day, when the satellite passes within range. While satellite communications are indeed possible, they are somewhat more difficult than conventional communications using the HF bands. Also, relatively little commercial equipment is available to users at this time. The AMSAT-Phase III spacecraft will open the VHF bands for hours at a time. In use, these bands will appear to be similar to the HF bands, in that they will open up for communications with stations to the east of the user, slowly change to include areas to the north and south, and then open up to the west before closing down. There will, however, be a lot of overlap between these areas. Contacts will be possible with the whole of the northern hemisphere and much of the southern for hours at a time with no skip zones. No skip zones. Can you imagine what that will mean? Anyone in the northern hemisphere will be able to hear anyone else. Can you imagine a round table QSO between stations in New York, Washington, Los Angeles, Miami, Tokyo, Paris, Tel Aviv and Moscow — all able to hear each other at the same time? This is not possible using the HF bands. Nets, emergency traffic handling, educational demonstrations and plain CQ calls will all assume a new dimension.



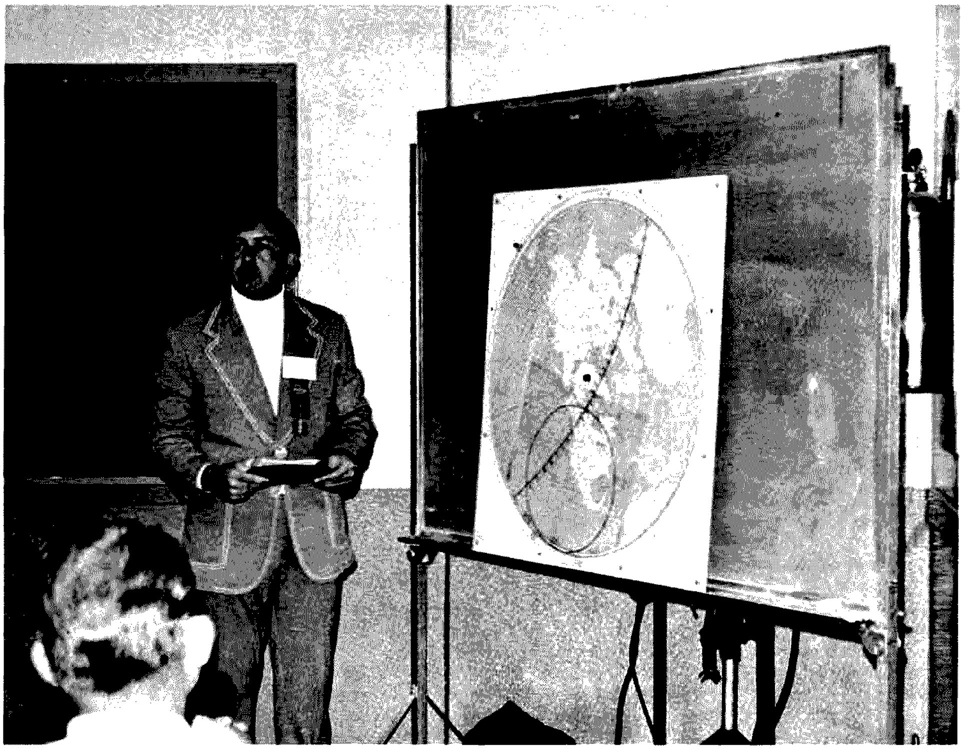
Japanese amateurs working on prototype of Mode J transponder for the AMSAT-OSCAR D spacecraft.



Tom Clark WA3LND standing next to a low cost portable OSCAR terminal on the mall in Washington DC at the opening of the National Aeronautics and Space Museum, July, 1976.

Historically, AMSAT has worked to build operational, simple to use satellites, and now our goal is within sight. Our space program has been international in the true cooperative spirit of amateur radio. Our first spacecraft was AUSTRALIS-OSCAR 5, built in Australia by radio hams at Melbourne University. It was not a communications satellite, but carried, among other things, a prototype command system which proved that radio amateurs could control the operation of satellites in outer space. AMSAT-OSCAR 6, built by Australian, German, and American hams, was the first long-life amateur radio communications satellite. Designed for a one year lifetime, it is only now showing signs of old age after four and a half years of faithful service. AMSAT-OSCAR 7, built by American, Australian, Canadian, and German hams, is now approaching its three year operational design lifetime.

In order to keep interest in space communications active through 1980 (when the first AMSAT-Phase III spacecraft is expected to become operational), AMSAT is stretching its



Dave Clingerman W6OAL, conducting a classroom demonstration.

to within a few miles of the exact location. NASA is now studying an operational satellite system to do just that, saving incalculable numbers of lives and thousands of dollars in search and rescue costs. Data collection techniques using remote sensors relaying data via satellite to a central location have been demonstrated. Mobile terminals have been set up in cars, boats and private aircraft. Medical emergency traffic has been simulated. Electrocardiograph data has been transmitted coast to coast, phone patches have linked Hawaii to the mainland US, and direct "broadcasting" experiments have taken place. Many of these activities are only being talked about by the professionals, or, if they are being done, are being done at many times the cost, in terms of both the spacecraft and ground equipment.

AMSAT-OSCARs 6 and 7 have paved the way. They have shown that we can use the satellite bands and have some grasp of the potential that they have to offer, but impressive as these are, much is yet to come. Contacts via AMSAT-OSCARs 6 and 7 require some technical expertise. The spacecraft must be tracked as they speed across the sky, since passes only last about 20 minutes and the range is limited. The AMSAT-Phase III spacecraft will change all that. Spacecraft OSOs will become very simple to implement. Communications will be possible for hours at a time, but these capabilities will not come for free.

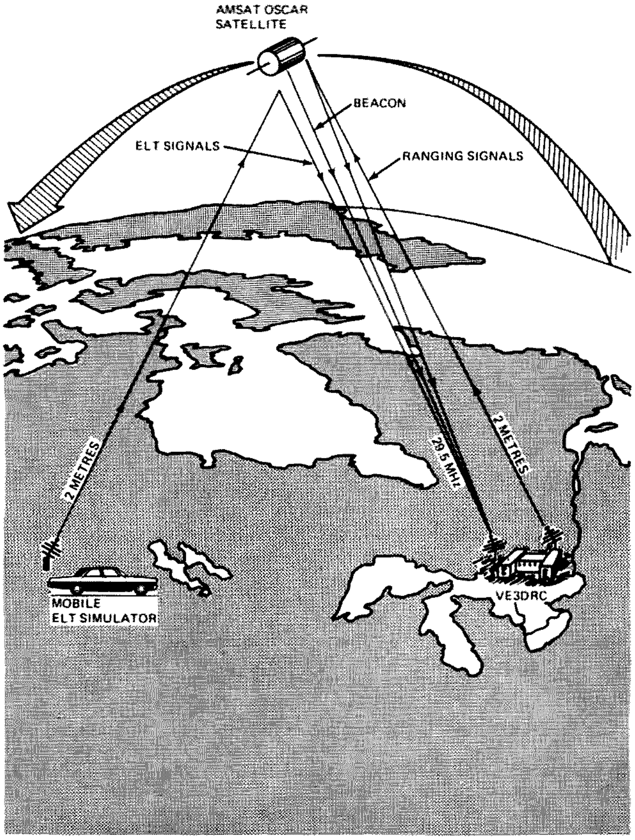
Hardware costs for the first

resources and building one more low orbit satellite (known as AMSAT-OSCAR D until launch). AMSAT-OSCAR D (or A-O-D) is a joint effort of the Japanese AMSAT Association, Project OSCAR, and the ARRL, all working closely in cooperation with AMSAT. AMSAT-OSCAR D is presently scheduled for launch in late 1977, and is primarily intended for continuing support of the educational program. Once the spacecraft is launched and in orbit, it will become AMSAT-OSCAR 8 and will be considered to be in the public domain, so that anyone can use it for communications purposes. The ARRL will then become responsible for all the operations management aspects of the satellite. To ensure operation consistent with the design of the spacecraft, AMSAT will act as technical consultants for the operations management of AMSAT-OSCAR 8 during its active lifetime. The ARRL will also pay AMSAT the sum of $50,000 to partially reimburse AMSAT for the development and construction costs of the spacecraft. Space satellites are not cheap. AMSAT-OSCAR 7 cost in the neighborhood of $60,000, but a similar commercial communications spacecraft could have cost $2,000,000.

AMSAT also has a policy of not obsoleting equipment. AMSAT-OSCAR 6 carried a 145.9/29.5 MHz transponder. AMSAT-OSCAR 7 introduced a UHF/VHF transponder on 432/145.9 MHz. This transponder, designated as MODE "B" (145.9/29.5 became MODE A), clearly demonstrates the superior capabilities of VHF for amateur satellite transponders. The mode B link on AMSAT-OSCAR 7 is clearly superior to the mode A links of AMSAT-OSCARs 6 and 7. AMSAT-OSCAR D will also carry a mode A transponder and a new mode J transponder (built in Japan) on 145.9/435.15 MHz. Similarly, the first of the AMSAT-Phase III spacecraft will carry two transponders, utilizing modes A and J. Thus, as amateurs become more interested in satellite communications and obtain equipment, they can be sure that their investment will not become obsolete with the passing of any one spacecraft.

The AMSAT-Phase III spacecraft will be accessible with full quieting SSB or CW signals by any amateur radio station using an output power of the order of 50 Watts, and small, rooftop, TV-style antennas. Thus, any apartment dweller with a balcony having some northern exposure will be able to work the world. In fact, the performance of this equipment communicating through an AMSAT-Phase III spacecraft will usually be superior to a kW-quad combination on the HF bands.

Amateur spacecraft have long passed the days when launches were made available because the spacecraft were there, or to demonstrate that hams could do it too. There are now many spacecraft competing for launch opportunities. AMSAT thus has to show how the piggyback launch can be implemented for a minimum of cost to the launching agency, and also show cause as to why a spacecraft should even be carried aloft in the first place. Thus the OSCAR series spacecraft have also been used for scientific and public service demonstrations of communications capabilities. There have been educational transmissions to introduce the space sciences to students in classrooms, and demonstrations of an emergency crashed aircraft locating technique in Canada and the USA, which has shown that it is possible to pinpoint the position of a simulated crash site



Conception of the emergency locator experiment used for locating crash sites. The computer interface was located at VE3DRC. Tests showed that the crash could be pinpointed to within a few miles of the actual site.

AMSAT-Phase III spacecraft are estimated at $200,000 (a government or commercial spacecraft providing similar performance would cost millions).

How can you help? First of all you can become a member of AMSAT. Dues are only $10 per year. If you are already a member (and even if you are not), you can become a life member for a donation of at least S100. You will then receive the *AMSAT Newsletter*, a quarterly publication devoted to amateur satellite communications. It contains details about existing, future and planned spacecraft. It contains operating news and acts as a forum for communicators. You can also encourage your local radio club to become a member society at $20 per year ($200 life).

You can also help the AMSAT-Phase III program financially by sponsoring part of the satellite. You can sponsor any number of solar cells ($10 each), battery cells ($200 each), solar panels (S2,000 each), transponders ($5,000 each), an onboard microcomputer ($8,000), or a rocket motor ($10,000). All donations including the $100 life membership donations are tax deductible under section 170 of the IRS Code. All sponsors will receive a certificate suitable for framing acknowledging their contribution. A plaque honoring for posterity contributors of $1,000 or more will be carried on the spacecraft in orbit around the Earth, and contributors will receive a replica of the plaque as a momento.

If you are willing to contribute time or money and would like to get involved in bringing a new era to amateur radio, join AMSAT's team. For further information about all aspects of AMSAT and the ongoing amateur radio satellite communications program, write to me, Joe Kasser G3ZCZ/W3, c/o AMSAT, Box 27, Washington DC 20044.

CHICAGO FM CLUB HOSTS OSCAR NET

The Chicago FM Club has begun holding a weekly OSCAR net on its two meter 16/76 repeater. The net, hosted by Ralph Wallio K9JPR, disseminates late information gathered from low band OSCAR nets meeting earlier in the evening, and rebroadcasts them at 9:00 pm Chicago time on Tuesdays. Ralph also gives the OSCAR 6 and 7 orbit times for the Chicago area for the coming week, and answers questions concerning the satellites' operations.

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

IARS/CHC/FHC/HTH QSO PARTY

Starts: 2300 GMT Friday, June 3
Ends: 0000 GMT Monday, June 6

An SASE to K6BX will bring detailed information. Contest is open to all amateurs and SWLs worldwide. Same station may be worked on each band and mode; SSB and AM are different modes.

EXCHANGE:

QSO number, RS(T), name, CHC/FHC number, US state and county or similar division. Nonmembers send HTH instead of CHC/FHC number.

SCORING:

CHCers – score 1 point per QSO with other CHCers, 2 points per QSO with HTHers; 1 additional point if YL, B/P, FHC, Novice, CHC-200, Merit or Club station, or if on VHF/UHF; double above points if QSO is outside own country. HTHers – contacts with other HTHers count 1 point, with CHCers count 3 points. Rest same as above. SWLs – use above depending on whether CHC member or not.

MULTIPLIERS:

Each different continent, country, ITU zone, and US state counted only once.

FINAL SCORE:

Multiplier times total QSO points is final score. Multi-operator stations divide score by number of operators.

FREQUENCIES (for US and DX as allowed):

CW – 3575, 3710, 7070, 7125, 14075, 21075, 21090, 21140, 28090, 28125. Phone – 3770, 3775, 3790, 3943, 3960, 7070, 7090, 7210, 7260, 7275, 14320, 14340, 21360, 21440, 28620.

AWARDS:

Hundreds of certificates and trophies in all categories and divisions are awarded. An SASE will bring further information from K6BX. Send all requests and logs to: International Amateur Radio Society, K6BX, PO Box 385, Bonita CA 92002. Logs should be mailed within 15 days after the close of the QSO Party.

CALENDAR

June 3-6	IARS/CHC/FHC/HTH QSO Party
June 4-5	Minnesota State QSO Party
June 4-5	SOWP QSO Party
June 11-13	ARRL VHF QSO Party
June 18-20	West Virginia QSO Party
June 25-26	ARRL Field Day
July 2-3	QRP – Summer – Contest
July 4	ARRL Straight Key Night
July 9-10	IARU Radiosport Championship
July 16-17	Apollo II 8th Anniversary Contest
July 16-17	10-10 Net Summer QSO Party
Aug 20-21	New Jersey QSO Party
Aug 20-21	Worldwide SARTG RTTY Contest
Sept 10-11	Washington State QSO Party
Sept 10-11	ARRL VHF QSO Party
Sept 24-25	Delta QSO Party
Oct 1	Open CD Party – CW
Oct 15-16	Open CD Party – Phone
Oct 15-17	Manitoba QSO Party
Nov 5-6	ARRL Sweepstakes – CW
Nov 12-13	IPA Contest
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Nov 19-20	WWDXA Internation CW Contestst
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

MINNESOTA QSO PARTY

Starts: 1800 June 4
Ends: 2359 GMT June 5

Sponsored by the Heartland Amateur Radio Club, Staples High School. No restrictions as to mode or operating time, all bands 80-10 mtrs. Only one transmitter allowed in operation at one time; no crossband contacts. Novices compete against Novices, Techs against Techs. Net QSOs are not valid. Please do not interfere with nets or traffic sessions.

EXCHANGE:

RS(T), county (MN only), ARRL section or country (others).

FREQUENCIES (+/- 5 kHz):

Phone: 3910, 7235, 14280, 21365, 28525. CW: 3525, 7035, 14035, 21035, 28035. Novice/Tech: 3725, 7125, 21125, 28125.

SCORING:

One point per QSO, 2 points if on CW, 5 points if Novice or Tech. (Note: Novices and Techs must identify their license class each QSO, such as WBØXXX/N, or /T.) WBØTTZ, the HARC station, counts 10 points per QSO per band. MN stations multiply number of ARRL sections plus DX countries (W/VE excluded) times QSO points. Others multiply QSO points by number of MN counties (max. 87). Phone and CW are one contest – please score as such.

ENTRIES/AWARDS:

Details and log sheets available after May 10 upon receipt of an SASE. Stations making 50 or more QSOs must include a check sheet for each band and mode used. Logs must include date/time in GMT, band, mode, and exchanges. Certificates to state winners as well as high Novice and Tech scorers in USA and DX stations. MN stations must have 10 QSOs from a county for county awards. SASE required for return of awards and summary. Usual disqualification criteria. Logs must be postmarked by July 2nd. Send logs to: HARC, c/o Steven J. Gardner WBØMAO, PO Box 261, Staples MN 56479.

SOWP QSO PARTY

Starts: 0000 GMT June 4
Ends: 2400 GMT June 5

The Society of Wireless Pioneers, SOWP, will hold their 2nd annual CW QSO Party with a certificate issued to all participating members who contact 10 or more fellow members during the event.

FREQUENCIES:

55 kHz up from low end of each band. Novices should try the middle of each band.

EXCHANGES:

SOWP identification numbers as minimum, other optional.

ENTRIES/CERTIFICATES:

Members desiring a certificate are required to submit a listing of contacts made with call, member's number, and time of contact. All entries should be mailed to: Pete Fernandez W4SM, VP for Awards, 129 Hialeah Road, Greenville SC 29607. Include an SASE and mail no later than June 20th.

ARRL VHF QSO PARTY

Starts: 1900 GMT Saturday, June 11
Ends: 0600 GMT Monday, June 13

Check the May issue of QST for any last minute changes!

Entrants may operate no more than 28 of the 35 hours during the contest period. The seven hours off-time must be taken in increments of 30 minutes or more. Listening time counts as operating time. All contacts must be made on amateur bands above 50 MHz using authorized modes. Fixed, portable, or mobile operation under one call, from one location only, is permitted. Any transmitter used to contact a station may not be later

used to contact another station during the contest period with any other callsign. Contacts made by retransmitting either or both stations (such as repeaters) do not count for contest purposes. Each contact exchange must be acknowledged by both operators before either may claim contact points. A one-way confirmed contact does not count.

EXCHANGE:

Exchange simply ARRL section.

SCORING:

On 50 or 144 MHz count 1 point per contact; on 220 or 420 MHz count 2 points per contact; on higher UHF bands count 3 points per contact. Final score is then the total QSO points multiplied by the number of different bands for additional credits, but crossband contacts are not allowed. Also, aircraft mobile stations cannot be counted for section multipliers.

ENTRIES:

All logs must be postmarked no later than July 7th and sent to: ARRL, 225 Main Street, Newington CT 06111. Logs and entry forms are available through this same address; please include an SASE. Usual awards will be issued and the standard disqualification rules will apply.

WEST VIRGINIA QSO PARTY

Starts: 2300 GMT Saturday, June 18
Ends 2300 GMT Monday, June 20

All amateurs are invited to participate in the QSO Party sponsored by the West Virginia State Amateur Radio Council. There are no operating time limits during the contest period. The same station may be worked on different bands for additional points, but only once per band regardless of mode. West Virginia stations may work each other.

FREQUENCIES:

35 kHz up from the bottom edge of each CW band and 10 kHz inside the general portion of each phone band.

EXCHANGE:

QSO number; RS(T); and county (if WVA), state or country.

SCORING:

A power multiplier will be allowed as follows: 200 Watts or less dc input = 1.5; over 200 Watts dc input = 1.0. Out-of-state stations determine their score by multiplying the number of QSOs times the number of different West Virginia counties worked (55 max.). This total is then multiplied by the power multiplier as defined above for the total score. West Virginia stations multiply the total number of QSOs by the sum of the different WVA counties, US states, and ARRL countries worked. This result is then multiplied by the power multiplier to determine the final score.

AWARDS:

To be eligible for an award, a station may have only one unassisted operator. Awards will be issued to the highest scoring WVA station, 1st runner up in WVA, 2nd runner up in state and the highest scoring station in each state and country. Decisions of the Contest Committee of the West Virginia State Amateur Radio Council will be final.

LOGS/ENTRIES:

Logs must indicate date, time, QSO number, callsign, QSO number received, signal reports, and county, state or country of the station worked. Indicate the mode and band also. Logs should be sent to: West Virginia QSO Party, PO Box 299, Dunbar, West Virginia 25064. Logs should be received no later than July 16th, and no logs will be returned.

ARRL FIELD DAY

Starts: 1800 GMT Saturday, June 25
Ends: 2100 GMT Sunday, Juna 26

Rules are generally lengthy (2 pages in *QST*); please refer to the May issue of *QST* for detailed information and for any changes since last year's rules. Briefly, the general rules are as follows:

The contest is open to all amateurs within the ARRL sections; foreign stations may be contacted for credit but are not eligible to compete. Each entry will be classified by type of operation: Class A — club group set up specifically for Field Day operation operating portable without commercial power; Class B — non-club stations set up portable without commercial power; Class C — mobile stations; Class D — fixed stations using commercial power; Class E — fixed stations using emergency power for transmitters and receivers.

All entries will further be classified by the number of transmitters utilized. Class A and B stations not beginning to set up before 1800 GMT on Saturday may operate the entire contest period. All others may not operate more than 24 hours total. Each station may be worked once on each band; voice and CW are considered different bands (all voice contacts are equivalent and RTTY = CW).

Class A, B, and C stations may contact anyone, but classes D and E must contact only Class A, B, or C.

EXCHANGE:

RS(T) and ARRL section or country.

SCORING:

Phone contacts count 1 point each and CW contacts count 2 points each. Final score is sum of QSO points times multiplier for highest power used at any time during the contest period, plus bonus points. Power multipliers: Multiply by 5 if 10 Watts or less dc input power and non-commercial main power source or motor driven generator; multiply by 2 if less than 200 Watts; multiply by 1 if over 200 Watts up to 1 kW; multiply by Ø if over 1 kW (note — dc power on SSB is half PEP power). Bonuses: (only for Class A or B stations) 100 points for 100% emergency power; 100 points for "natural" powered contact (only one QSO req'd); 50 points for public relations; 50 points for message origination for SCM or SEC; 5 points for each message received and relayed during FD period up to a maximum of 50 points; 50 points for completing at least one QSO on CW via OSCAR.

ENTRIES:

Standard disqualification rules apply. All entries should be sent to: ARRL, 225 Main Street, Newington CT 06111. Official log and entry forms are available from the same address for an SASE.

SARTG ACTIVITY TEST

1815 to 1930 GMT, last Wednesday of each month during 1977

FREQUENCY:

3.6 MHz (RTTY).

EXCHANGE:

RST and QSO number from 001 each month.

POINTS:

Bulletin station counts 2 pts., all other contacts with Scandinavian stations count 2 points.

ENTRIES/AWARDS:

Logs should be sent not later than 8 days after test to: Einar M. Thomassen LA1LN, Radyrvegen 30, N 3900 Porsgrunn, Norway. Results will be published in the monthly *SARTG Bulletin* and the year's result will be calculated according to the best 9 of 12 possible rounds. Diplomas will be given to the 5 best stations! Note: The bulletin station is currently LA3S, but may be changing callsign!

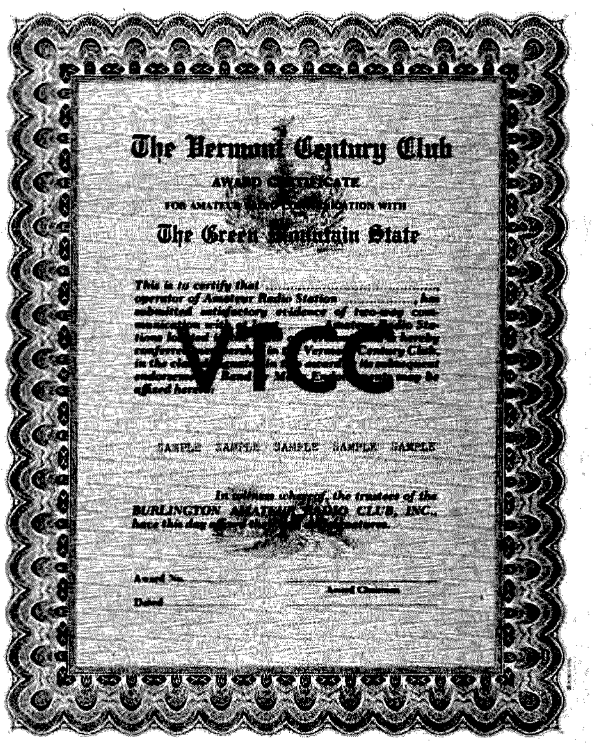
WORKED SCANDINAVIAN AMATEUR TELETYPERS

Offered by the SARTG for 2 Watt RTTY contacts with the following number of Scandinavian stations: Scandinavian stations — 25 (general), 50 (bronze ribbon), 75 (silver ribbon), 100 (gold ribbon); European stations — 16 (g.), 35 (b.r.), 50 (s.r.), 75 (g.r.); other countries — 8 (g.), 15 (b.r.), 25 (s.r.), 50 (g.r.).

All bands may be used. QSL cards for general class and bronze and silver ribbons are not necessary — just list calls, dates, and times of contacts. For gold ribbon it is essential to have contacts with the following prefixes: LA, SM, OH, TF, OX, OY, OZ. Reference to SARTG contest logs or photocopies of 7 QSL cards is sufficient. Fees are 10 IRCs for general class and 6 for ribbons. Applications should be addressed to: Carl Jensen OZ2CJ, Meisnersgade 5, Randers, Denmark.

VERMONT CENTURY CLUB AWARD

In celebration of VT's bicentennial, the Burlington ARC has reinstated the VT Century Club Award that was first issued in 1966. The award is available to any amateur for confirmed 2-way contacts with VT stations. Contacts may be on any HF band on any mode. The award will be issued for an indefinite period, with all contacts made during 1977 and later applying for the award. The basic award certificate will be issued for working 10 different VT stations. Seals for working 25, 50, 75, and 100 additional stations (10 initial contacts count as part of first 25 total). Applicants should submit list of calls in alphabetical order, showing city, date, band, and mode for each worked. Those sending in lists for higher class endorsements should indicate which seal is desired. QSLs must be in your possession, but should not be submitted. Instead, a written certification of the above list by another amateur will be accepted as satisfactory proof. The award chairman reserves the right to inspect any or all of the QSLs. The fee is $2.00 for US stations or equivalent for DX. Make check or money order payable to the Burlington Amateur Radio Club, Inc. No fees for higher class seals, but an SASE must be included. Send all applications or inquiries to: The Burlington ARC, VTCC Award Manager, PO Box 312, Burlington VT 05402.



Rod Hallen WA7NEV
P.O. Box 73
Tombstone AZ 85638

Uncle Sam's Surplus List

- - and how to get on it

Each month, the United States Government auctions off tons of surplus supplies and equipment through its Defense Property Disposal Service. DPDS is Uncle Sam's abbreviation. Examples of the types of materials involved include: scrap metals, fire control equipment, aircraft and aircraft components, naval ships, railway equipment, motor vehicles and components, wood and metal working equipment, refrigeration and air conditioning equipment, heating and plumbing equipment, tools, electrical and electronic equipment (1. communications, 2. electrical parts, 3. computers and peripherals, 4. lighting and alarm systems), medical and laboratory equipment, photographic equipment, home and office furniture and supplies, appliances, AND SO MUCH MORE!!

Much of the merchandise offered for bid is declared surplus because of a lack of need for it on the government's part rather than because it is worn out. Most of it is in fair or better condition and has usually been well maintained. These auctions are open to all and most of them are conducted by mail. Bids are usually a penny or two on a dollar's original value. Auctions are held for every United States Military Installation in the world, so there is sure to be one or more near you.

Getting on the Bidders Mailing List

In order to be placed on the Official Bidders Mailing List, it is necessary to apply to the Defense Property Disposal Service. The DPDS address and a suggested form will be found at the end of this article. Upon receipt of your request, the DPDS will send out an official application blank plus booklets explaining how to buy, what classes of materials are generally available, and what the rules are. You choose the type(s) of equipment you are interested in and the locations you are willing to pick up from if your bids are successful. The merchandise is broken down into classes and the areas are usually states.

When this application blank is returned to DPDS, your name will be placed on the Official Bidders Mailing List, and each time that some material that you want is available at locations that you have chosen, you will receive a bid catalog. Depending on the number of classes that you are listed for, it is possible to get quite a few catalogs each month.

Here's how it works: Say you are interested in aircraft components and electrical and electronic equipment in California. Each time that a catalog is issued that includes either of these two categories and some of which is in California, you will receive a copy. It may also include material you are not looking for or locations outside of California, but that is OK. You bid on what you want, when it is located where you want it!

Let's Look at the Catalog

These usually cover a broad category: aircraft or automotive or electronics, for example, and a group of contiguous states. All material is always available for inspection before bidding; therefore, the first item in the catalog is a list of the military installations involved and the names and telephone numbers of persons to contact for information and inspection. It is not necessary that you inspect before bidding, but it is recommended, especially on large bids.

Next, the equipment to be auctioned off is listed and described. Its specific location on the military installation is given and how it is packaged. Its condition is stated as poor, fair, good, or excellent, and whether it is used or unused. Its total weight and original cost are given. Some items are sold by lot, some by weight, and some per each. You bid accordingly.

After all of the merchandise to be auctioned has been listed, general bidding information is covered, as well as information on loading. Generally the government will load heavy bulky items, but not always.

Some bids require a 20% deposit, and when this is the case, it will be clearly stated. Of course, if yours is not the high bid, your deposit will be returned. It is entirely possible that only part of your bid will be successful if you bid on more than one item.

Each catalog has a bid opening date and time and all bids must be received before that date and time to be considered. If you are notified that your bid has been accepted, you will be expected to pay the remainder owed and remove your merchandise within a period of time stated in the catalog.

Remaining on the Bidders List

It is necessary to bid at least once every five catalogs in a given class to remain automatically on the Official Bidders Mailing List. However, you can continue your

name on the list by simply requesting that it remain there. Here's how that works: The DPDS will indicate on a catalog mailing label that they are about to drop your name from the bidders list for lack of activity. Included in each catalog is a renewal form that you fill in and mail back to DPDS. You're now good for another five months. You can continue this way indefinitely, but bidding is more fun. It's easier than it sounds.

Items purchased can be for your own personal use or for resale. For instance: 200 VHF radios bought at $2 each and sold at $20 each would make a nice profit. Most items are sold in quantity and the price per each is low, regardless of the original cost or present value. This could make for a pleasant and beneficial part time business.

That's it! It's easy! It could be profitable! Good luck! ■

Request for Department of Defense Surplus Bidders Application

Fill out the form below or a copy of the same information and send to:

DOD Surplus Sales
P.O. Box 1370
Battle Creek MI 49016

- -

Request for Department of Defense Surplus property Bidders application.

NAME

STREET ADDRESS OR PO BOX

CITY STATE ZIP CODE

Social Events

SCARBOROUGH, ONTARIO
JUNE 3-5

The Scarborough Amateur Radio Club invites you to the ARRL 1977 National Convention held on June 3-5, 1977 at the Sheraton Centre Hotel. There will be special programs for ladies and children, exhibition of world's leading ham equipment, contests, awards, Q.C.W.A. luncheon, royal order of the Wouff Hong, microprocessor forums, outstanding speakers and forums, and a CLARA luncheon. Saturday nite there will be a memorable dinner and dance. For further details write: '77 ARRL National Convention, P.O. Box 1011, Station "C", Scarborough, Ontario M1H 2Z4.

WENATCHEE WA
JUNE 4-5

The Apple City Amateur Radio Club of Wenatchee, Washington will sponsor the 6th Annual Central Washington Hamfest on Saturday and Sunday, June 4 and 5, 1977, at the park at Rocky Reach Dam, located 7 miles north of Wenatchee. Commercial exhibits, swap and shop tables, free trailer and tent space with electrical hookups. Banquet Saturday evening at 6 pm at the Columbia Hotel. Park will be open 2 pm Friday. Hamfest registration $3, XYL-YLs $1, banquet $3.75. Talk-in 146.07/67 WR7ADX, 146.760, 3.960. For more information write or call Apple City Amateur Radio Club, 919 N. Woodward Dr., Wenatchee WA 98801, (509) 662-8466.

ROME NY
JUNE 5

The 25th Annual Rome Ham Family Day will be held June 5, 1977 at the Beeches, Rt. 26, Rome, New York. There will be interesting programs for everyone including the XYL and children. There will be a giant flea market and 5000 square feet of air conditioned indoor display area featuring equipment displays, contests, xcvr checks, door prizes, speakers, etc. For more info write PO Box 721, Rome NY 13440.

CLEVELAND OH
JUNE 10-12

Computerest '77 will be held Friday, June 10, 4 pm to 10 pm; Saturday, June 11, 9 am to 7 pm; and Sunday, June 12, 10 am to 3 pm at the Bond Court Hotel, 777 St. Clair Avenue, Cleveland, Ohio. $2.00 per ticket. Your one ticket admits you to everything, including manufacturer's exhibits, MACC Club displays, flea market, seminars and tech sessions, and of course, prizes, games, demonstrations and good times. For more info send an SASE to Midwest Affiliation of Computer Clubs, PO Box 83, Brecksville OH 44141.

HERNANDO MS
JUNE 11-12

The Chickasaw Amateur Radio Association, Inc., "CARA," of Hernando, Mississippi presents its annual Tri-State Hamfest June 11-12, 1977 at the National Guard Armory in Hernando, Mississippi, 20 miles south of Memphis, TN on Interstate 55. Plenty of parking area with camping sites. Tables available at $2.00. Doors open 12:00 to 6:00 Saturday, June 11th, and 8:00 to 4:00 Sunday, June 12th. Prizes, food, and beverages. Talk-in on 146.31/91, 146.52, and 3987.5. For further information write CARA, PO Box 2, ATTN: R. Gates, Hernando MS 38632.

JEFFERSON CITY MO
JUNE 12

The Missouri Single Sideband Net Annual Picnic will be held June 12, 1977 beginning at 9 am in the Shelter House, Memorial Park, Jefferson City MO. Covered dish dinner, beverages furnished, lots of prizes. Donation $1.00 at the door. Talk-in 94/94. For more information contact WBØFND, Rt. 4, Box 886, Warrensburg MO 64093.

AKRON OH
JUNE 12

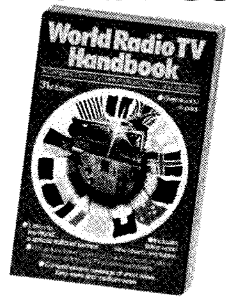
The Goodyear Amateur Radio Club of Akron, Ohio will hold its 10th Annual Hamfest and Family Picnic on June 12, 1977 at Wingfoot Lake Park between the hours of 10 am and 6 pm. The park is located southeast of Akron on County Road 87 near Route 43. Ample parking, rain shelters, picnic facilities, kids' play areas and refreshment stands. The flea market/swap shop space is free with the admission ticket. Gear displays, prizes, etc. Sorry — no overnight parking or swimming. Mobile check-in on 04/64. Family donation $2 advance, $2.50 at gate. For more info contact Don Rogers WA8SXJ, 161 S. Hawkins Ave., Akron, Ohio 44313. Phone: (216) 864-3665.

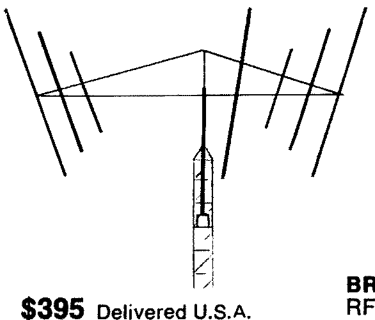
NEWBERRY MI
JUNE 12

The Tahquamenon Amateur Radio Society swap and shop will be held Sunday, June 12, 10 am to 6 pm at the Pentland Township Hall, 3 miles south of Newberry and 2 miles west on highway M-28. Refreshments at the site, ample parking, campsites available at a nominal fee. Reg. $2 at the door. Drawings and door prize. Many free family passes for tours in the famous Tahquamenon area. Many other prizes. Talk-in on 25-85, 28-88 52 & 94 simplex. Correspondence W8GBR.

ATLANTA GA
JUNE 18-19

The 49th Annual Atlanta HamFestival and 1977 Georgia ARRL





Convention will be held June 18 and 19, 1977 in Atlanta at the Downtown Marriott Hotel (rooms: $18 single, $24 double). This year's show includes 120 commercial booths, a 250+ car covered flea market and swapshop, more than 50 technical forums, and $6,000 worth of prizes. Advance registration is $3 individual and $5 family; at the door, $4 individual and $5 family. A preregistration package will be mailed on May 1st to all who have attended the HamFestival within the past three years; if you have not received a package by May 10th, you may write to Atlanta HamFestival, 53 Old Stone Mill Road, Marietta GA 30067 or call (404) 971-HAMS anytime day or night. Doors open at 9 am Saturday and Sunday.

CHAMBERLAIN SD
JUNE 18-19

The Medicine Butte Radio Association and Rosebud Amateur Radio Club will sponsor the South Dakota Ham-vention this year in Chamberlain SD on June 18-19.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	14	7	7	7	14	14	14	14A	14A	14
AUSTRALIA	14	14	7A	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	7A	7	7	7	7	7	7A	14	14	14
INDIA	7	7B	7B	7B	7B	7B	14	14	14	14	7A	7
JAPAN	14	14	7	7	7	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7	7B	7B	7B	7B	7B	7	7	7	7A	14
PUERTO RICO	14	7	7	7	7	7	7	7	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	14	14	14	14	14	7	7
U.S.S.R.	7	7	7	7	7	7	7A	14	14	14	14	7A
WEST COAST	14	14	7A	7	7	7	7	7A	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	14	7	7	7	7A	14	14	14	14	14
AUSTRALIA	14	14	14	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7A	7A	14	14	14
HAWAII	14	14	14	7A	7	7	7	7	7A	14	14	14
INDIA	7A	7	7B	7B	7B	7B	7B	7A	14	14	14	7A
JAPAN	14	14	14	7	7	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	7	7	7	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7A	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	7B	7A	14	14	7	7
U.S.S.R.	7	7	7	7	7	7	7	7	14	14	7A	7A

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	14	7A	7	7	7	7A	14	14	14	14
AUSTRALIA	14A	14A	14A	14	7A	7	7	7	7	7	14	14
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7	7A	7A	14	14
HAWAII	14	14A	14A	14	14	7	7	7	7A	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7	7	7	7	14
JAPAN	14	14	14	14	14	7	7	7	7	14	14	14
MEXICO	14	14	7	7	7	7	7	7	7	14	14	14
PHILIPPINES	14	14	14	14	14	7B	7	7	7	14	14	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	7B	7B	7A	14	7A	7
U.S.S.R.	7	7	7	7	7	7	7	7	14	14	7A	7A
EAST COAST	14	14	7A	7	7	7	7	7A	14	14	14	14

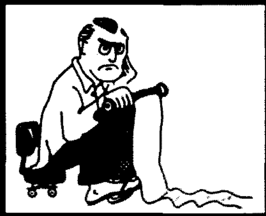
A = Next higher frequency may also be useful
B = Difficult circuit this period
DX = VHF DX
F = Fair
G = Good
P = Poor

1977 JUNE 1977

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F	3 G	4 G
5 G	6 G	7 G	8 G	9 F	10 F	11 G
12 G	13 G	14 G	15 G	16 F	17 F	18 G/DX
19 G/DX	20 G/DX	21 P	22 F	23 G	24 G	25 F
26 P	27 F	28 F	29 F	30 F		

73 AMATEUR RADIO

JULY 1977
$2.00



...de W2NSD/1

EDITORIAL BY WAYNE GREEN

WHEN THE JAMMER HITS

One of these days, unless the laws of chance have been repealed, your repeater is going to be the target of a persistent kerchunker or even a dedicated jammer, complete with a four letter vocabulary which would be *more fitting to the current run of* movies than to amateur radio. Outside of panic, what should you do?

The first thing, obviously, is to make some tapes and get together with the FCC. Horsepucky. Leave the FCC alone — they are not anxious to hear from you and would prefer not to be bothered. No, the first thing to do is give a big yawn and try to get some sleep. If, after a few days, the chap shows better than average stamina and keeps on messing things up, despite every effort of the repeater users to totally ignore him, then it's time to swing vigorously into phase two . . . a little longer nap, possibly with a dash of television viewing to break the monotony.

Okay. I can see you are determined to let this bugger get under your skin and you want action and you want it right now. Well, sigh, how about making up a couple of direction-finding loops and learning how to use them? Yes, I know the FCC can do this, but they are busy. Do it yourself and learn something. Two fellows with direction-finders can get a good idea of where the miseries are originating, and you can close in. Once you've located the jerk, you have to figure what to do about him. No, you can't do that.

Look on the bright side . . . fox hunting is a lot of fun and the exercise will be excellent for the club. The fact is *that your club should be ready for* this and have some practice before the fan gets hit. Get some transmitter hunts organized so the equipment will be ready to use and a few of the fellows will know how to use it.

The FCC has some direction-finding (DF) equipment which will give the bearing of a transmitter within a second. Now that amateurs have discovered microcomputers, perhaps it is time that we developed some of the same hardware. You can bet that the pages of *73* are open to any good DF articles and will make it worthwhile for fellows who dream up some good DF techniques.

One technique, which I've mentioned before, but of which little has been written, is one which examines the leading or trailing edge of a transmitter's carrier and puts it on a scope. My understanding is that every transmitter is a little bit different . . . that each rig has its own kerchunkprint. This means that when *someone tries to transmit without his* call, you can check out his kerchunkprint and compare that with some later time when he is just using the repeater to talk and gives his call.

Let's get busy with fox hunting circuits and apply some digital techniques to them which will make instant DF possible. And let's not forget to write it up!

NEW ORLEANS HAMFEST/COMPUTERFEST

The 1976 show came off so well that the New Orleans group has gotten bigger digs for this year. It's going to be at the Hilton Inn in Kenner this year, right across from the New Orleans International Airport. The dates are September 24-25th. Info can be had by writing box 10111, Jefferson LA 70181. Unfortunately, this is *the same weekend as a hamfest in* Hartford, so I'll have to miss New Orleans . . . perhaps the dates will not coincide next year . . . New Orleans is quite an attraction and I hate to miss it.

MAKE A MILLION

Forgive my enthusiasm, but every now and then a brilliant idea comes along and gets me all excited. Perhaps someone reading this magazine is looking around for an idea for a product which will sell like crazy, which wouldn't be very expensive to make, and which just about everyone needs. I have such a product in mind. It's so simple I don't know why it isn't available.

The chances are good that you are a coffee drinker . . . or at least tea? You may just drink it at dinner, but you are probably more like the rest of us in that you have several cups through the day. Most businessmen have coffee every now and then to keep the wheels churning. And how many of you don't have a mug on the operating desk with an inch of cold coffee in it?

Cold coffee . . . that's what did it to me. I was deep in a contact with a friend in Spain and I absentmindedly picked up my cup and took a swig of cold coffee. Iced coffee is something else . . . I can drink that, but cold coffee is an abomination and I came to my senses with a shock as the vile stuff hit my taste buds.

Someone is going to design a simple mug with a heater and thermostat built in to keep coffee warm. It can sit in a holder with the power transformer built in, making contact when you put the cup down . . . something like the rechargeable soldering irons, only without batteries. The electrical contact shoes can be built into the *bottom of the mug and the mating* spring contact in the holder. Will you

Continued on page 174

The New Orleans Hamfest/Computerfest.

Briefs

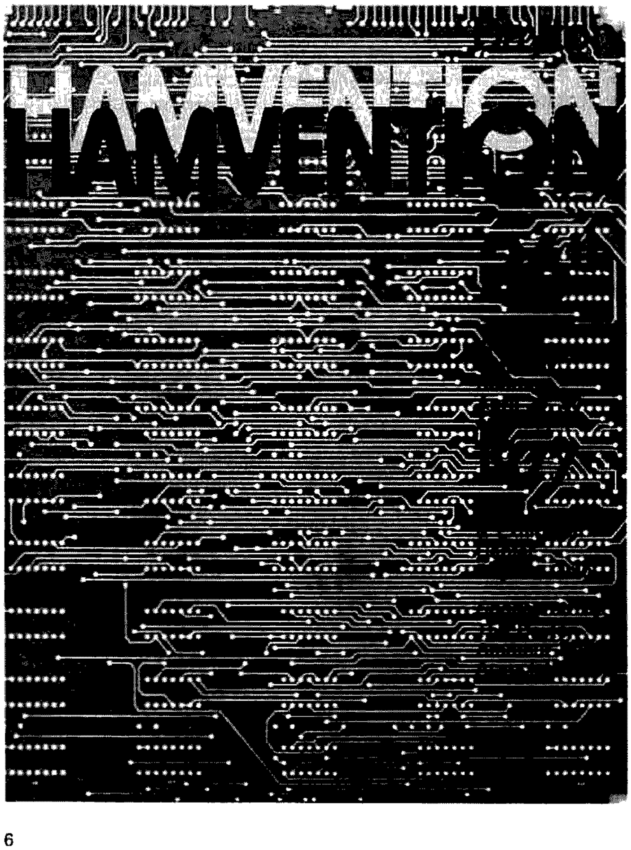
Compiled by Warren Elly WA1GUD

Got a good ham radio news story? Drop us a line, or call it in, and take home the 73 publication of your choice, provided we publish your news tip. Be sure to specify which book you want. OK?

It seems that "confidential document" Jack Anderson referred to in his national attack on ham radio (see *73* for June) came from the Electronics Industries Association (EIA). Southwest ARRL director John Griggs had quite a bit to say both about the EIA and Anderson during a talk at the Poinsettia ARC in California.

Anderson himself backed down a bit in his column published during the week of April 25th, claiming he never intended to attack hams. "We merely pointed out," Anderson wrote, "that the airwaves belong to the public, that there are far more citizens using CBs than ham equipment and that some of the federal regulators were hams." Anderson extensively quoted Senator Barry Goldwater K7UGA in the follow-up column, reprinted here from the *Washington Post.* "Goldwater complained that the CB enthusiasts often operate without a license and amplify their transmitters beyond the 5 Watt limit. They have also abused the system, he charged, in complete objection to all concepts of decency and gentlemanliness on the air. While this doesn't apply across the board, there are enough offenders that, I don't care how many frequencies they have, they are slowly going to destroy their own function. Many of these CBers never use their callsigns or their names. There are many who use profanity and what they discuss should never be carried on any airwaves. In many cities, prostitutes use these frequencies to solicit business, and I could go on and on." Concluded the senator, "I think I can safely say, Jack, that the amateurs throughout the years have contributed more to the art of communications than all of the so-called experts in the field. Our frequencies have been diminishing, not increasing. We have great pride in our craft."

Shortly after the second Anderson column appeared, an ARRL official told *73* that the Anderson situation was "under control." He went on to say that the author of the original story was now taking a Novice license course and was greatly interested in ham radio. We were unable to confirm that through a call to Anderson's Washington office, but we did learn that the original column had already been added to the EIA's battery of handouts promoting additional frequencies for CB. Official ARRL reaction to the Anderson mess came in two steps during late April. First, a directive to all League officials to "stand by" while headquarters found out how the column was written in the first place. Then, two weeks later, word came that the League has taken a strong step to offset the bad PR . . . a new award for any amateur whose response to the Anderson column was published or publicized. It's called the "Amateur Radio Promotion" award and is available only to League members.



Dayton's official attendance figure came in at 16,290, according to Dayton Amateur Radio Club officials. Well over 1,500 attended the Saturday night banquet, which featured NBC correspondent Roy Neal K6DUE, and a Special Event Achievement Award to the Pack Rat's Colombian EME DXpedition as HK1TL. At the AMSAT seminar, W8DX won a Special Communications Recognition Certificate for his long service to the OSCAR program. At the ARRL forum, President Harry Dannals W2HD raised a few eyebrows with news that the League may send a representative to Washington (this on the heels of similar discussions at a meeting of ARMA, the manufacturer's association). The League is apparently changing its long controversial stand that General Counsel Robert Booth, based in Washington, was all the representation that the ARRL needed in the capital. ARMA meanwhile voted to put the question of a Washington lobbyist to a committee, with a report upcoming at a future meeting.

A federal grand jury has indicted the head of the FCC's Gettysburg Special Licensing Division on bribery charges. According to a US Attorney connected with the case, Richard C. Zeigler's indictment was the result of an FBI investigation conducted in several US cities over a three month period. Zeigler is accused in the indictment of accepting four separate $100 bribes from amateurs seeking 1 x 2 (two letter) callsigns. US Attorney David Queen refused to name the amateurs, or comment beyond the indictment, but it was learned that Zeigler pleaded not guilty at his arraignment and posted $5000 bail. If convicted, Zeigler could receive 15 years in prison and $25,000 in fines *for each of the four* alleged violations. Zeigler's trial was expected to get underway in early June. Zeigler himself could not be reached for comment, and officials in the FCC's Personal Radio Division in Washington refused comment.

The Japanese government subsidizes the Japanese electronics industry — that was the ruling of a US Customs Court in mid-April, and it may have far-reaching implications for amateur gear (not to mention automobiles, TV sets, and hi-fi equipment). By court order the US government was told to raise import duties on Japanese imports, but, with billions of dollars at stake (not to mention the balance of payments situation), the appeals from Japanese interests are expected to tie up the case for years, if not kill it outright. An American TV manufacturer brought the court case, but business observers are not exactly "bullish" on its implications — since Japan (and other countries likely to be affected) are certain to retaliate with higher duty on American products, should the court order withstand the appeals.

No sign of the licensing boom slowing down . . . Gettysburg reports another record month in March, with the amateur population passing the 300,000 mark for the first time ever! Amateurs, then, have increased their numbers by over 35,000 in the last 12 months. Indications are that the growth will continue, with 350,000 licensees expected on the FCC computer by 1978.

CW comprehension exams should be in effect everywhere by the time this issue of *73* reaches you. The long delay in start-up was blamed on contract problems with contractors paid to produce the tapes and duplicates for each field office. FCC officials say test runs of the exams in

By Saturday afternoon the Hara was adrift in a sea of cars. For miles in every direction latecomers parked along the highways. Those lucky enough to make it through the 3-hour traffic jam gladly paid their parking fees.

the Washington DC office showed an 80 percent pass rate, compared to less than 50 percent for the old exams. Several who had taken the comp exams told us in Dayton that the new tests were actually harder . . . but FCC spokesmen countered that it was probably just their reaction to a new way of doing things.

The Illinois Attorney General's probe into the activities of Irael Treger (Trigger Electronics) has taken another turn . . . at deadline Treger was being held on $25,000 bond in the Cook County Jail. According to Deputy AG John McPhee, evidence was presented to the judge in Treger's consumer fraud case that Treger was planning to leave Illinois. On a writ of no exeat, Treger was arrested by local police. He was ill at the time of his arrest, and was taken first to Cook County Hospital. Treger, unable to post the bond, was then transferred to the County Jail Hospital. McPhee continues to process the fraud complaints against Treger, which reportedly amount to between $15,000 and $20,000. Trigger Electronics has been closed for some weeks now, after the landlord evicted Treger for failure to pay his rent. The eviction followed a court injunction barring Trigger from mailing catalogs or advertising, after the IL AG's office presented evidence that alleged the company was taking orders without inventory, and refusing to make refunds.

The president of H. F. International, John Randall, has refused to testify in an FCC hearing called to revoke his CB license. According to an FCC spokesperson, Randall was one of 21 HFers ordered to show cause why their CB licenses should not be revoked due to their involvement in HF International, an organization of pseudohams operating between 11 and 10 meters with amateur equipment, high power, and big antennas. Known as "Jack HF 61," Randall was charged with various violations of the FCC rules and Communications Act of 1934. The FCC alleged he had assigned call letters to CB operators for use instead of their FCC callsigns, that he had allegedly formulated rules instructing the unlicensed pseudohams to operate illegally on frequencies assigned to the Industrial and Business Radio services. The FCC notice also contended that Randall had published and sold lists which contained HF numbers, first names, and states of the pseudohams, thus avoiding FCC identification of their CB calls or locations. Randall refused to answer any of the FCC's questions, taking the 5th amendment instead. "Applicant therefore respectfully asserts his privilege against self-incrimination and his privilege not to give evidence against himself as set forth in the Constitution of the US and in particular the 5th Amendment thereto." Hearing Judge Walter C. Miller allowed Randall his right to remain silent, but added that a determination would come whether Randall had abused the Commission's rules by refusing to answer. In other words, Judge Miller would get his answers when the case reached the hearing stage. But before that could happen, Randall withdrew his application for renewal of his CB license. FCC officials say they have searched the files for an amateur license, and are sure Randall doesn't hold one. In all, 21 HFers were ordered to show cause why their licenses should not be revoked. Several will be going to hearing before this issue gets to you, and at least one of them has been refused a ham ticket by the FCC. That case came in Alabama, when a former CBer (whose license had been revoked for numerous violations) applied for an amateur license but failed to appear for a hearing called to air the FCC's objections to giving him one. As one FCC staffer put it, "Every now and then we get lucky, but for every one we catch there seem to be a hundred more."

The fourth notice on WARC has been released by now, although its significance to amateurs is limited. Number five is the big one, and we expect to have details in our next issue. FCC spokesmen say it will be released around the first of June, and it will be a critical point for amateurs, since it could be the last allocations chart produced by the FCC prior to the 1979 WARC conference. Notice number four relates largely to technical matters, such as how to designate a given emission and so on. The two inch thick fifth notice was due before the Commission just as this issue was going to press.

The antenna/zoning case of Hank Greenberg W2LTP (May *73*) has become snarled in the kind of local politics New Jersey is famous for. Greenberg attorney Elson Kendal W2INL has moved for dismissal of the case, charging Cranford area officials with destroying records and intimidating witnesses subpoenaed by the defense. Kendal says the tension surrounding the case proved too much for Greenberg, who was hospitalized in late April with a heart condition. His release (and a final session of the Union County Court hearing Greenberg's appeal) was expected at deadline . . . but Kendal fully expects a further appeal, possibly in the form of a jury trial. Greenberg, in the midst of the zoning dispute over erection of four telephone pole antenna supports, attracted national publicity for his role in the rescue of a ship sinking in the Caribbean with nine persons aboard. As for the fund drive organized in Hank's behalf, several hundred dollars have been collected thus far. Sid Lieberman WA2FXB, the organizer of the drive, says the fund is currently $4500 in the hole, with New Jersey amateurs the major factor missing! Lieberman told *73* that had surprised him, since he felt hams closest to the case would be the most willing to help out. As for the ARRL, Lieberman says the League has flatly refused to cooperate in the Greenberg case, other than to offer minimal advice. The address for contributions is The Amateur Radio Legal Defense Fund for the Benefit of Hank Greenberg W2LTP (ARLDF/W2LTP), Midlantic National Bank/Raritan Valley, PO Box 996, Edison NJ 08817, Attention Mr. S.J. Lieberman WA2FXB.

Although a Federal court decision is preventing it from collecting license fees, the FCC continues to spend

money. There is no solution to the fee problem in sight, but the need for more funding hasn't faded. In 1977, the FCC budget came in at over $55 million, but FCC officials have now requested an additional $1.6 million. A Washington spokesman told *73* the prime problem is the CB crunch – not only in new license applications, but in the cost of field operations teams tracking down illegal CB operators. There is also the cost of lab work, which has increased dramatically with the 40 channel changeover and adaption of new performance specifications. Congressional sources, though, are not so anxious to accept the FCC's judgment on the budget. As one House Appropriations Committee source put it, "The bureaucracy has to stop someplace . . . and it is not only the FCC that has some trimming to do . . ." The 1978 FCC budget request totaled nearly $60 million, but that may not be enough – a supplemental request is already in the works according to committee sources.

Much has been said and written about Texas, and the extraordinary lengths to which Texans will go to be "biggest." But the testimony of The American Radio Council, in support of Texas House Bill #1440, offers a view rarely seen of the RFI/TVI situation. Before the House Committee on Business and Industry, the ARC argued that all TV sets ought to be filtered to reject unwanted signals. (That's the thrust of bill #1440.)

"Consider, if you will, the

The Dayton flea market at its peak on Saturday . . . fleas as far as the eye can see.

The Sea-Q-DX Convention, set for July 29-31, is being held in Seattle. It is a combined affair, with the Northwest Division ARRL, QCWA National, Northwest Computer Club, and AF MARS Region 5 conferences all rolled into one event. 73 publisher Wayne Green will be featured speaker at the QCWA Luncheon.

following facts: (1) By FCC estimates, there are now 23,000,000 CB radios in use in the US. In 1958, there were basically none. (2) The State of Texas has over 1,500,000 CB radios in use today, using the FCC 'rule of thumb' of 2.5 CB radios per licensed CBer. (3) There are over 800,000 licensed CBers in the State of Texas, which leads the country in CB radio saturation. Texas has 50% more Citizens Band radio stations than the next largest state (California). Yet Texas has only 50% of the population of California. (4) Nationwide, the FCC received 40,000 RFI complaints from consumers in 1974. Of these 40,000 complaints, 36,000 of them would never have come to the FCC's attention if the manufacturers had corrected design deficiencies in their home entertainment products at the time of manufacture. They expect 200,000 such complaints this year!"

The ARC's testimony went on to say interference has reached crisis proportions in Texas. As for the alternatives to requiring built-in filters, a former FCC engineer-in-charge was quoted as saying, "To require a radio operator stay off the air under such circumstances is similar to requiring a motorist to stay off the highway because another motorist with no brakes is using it!"

The Amateur Radio Manufacturer's Association (ARMA) held a meeting at Dayton to discuss the new FCC radiation limits and pending dockets on linear amplifiers and type acceptance. But the thrust of the session was Docket 20777 and the effect of the new harmonic limits on the ham radio business.

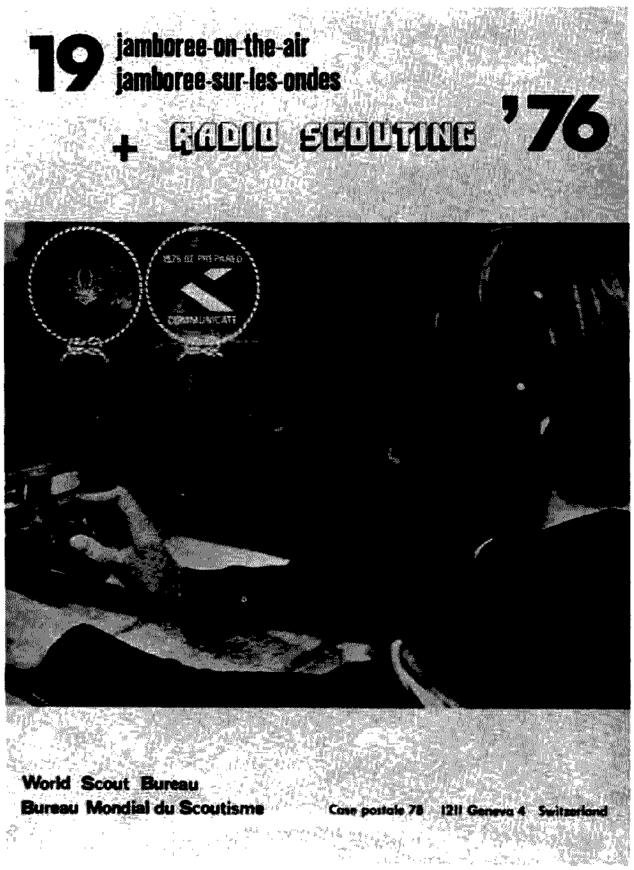
ARMA's hope is to grandfather existing gear, and the gear already on the production line or waiting for sale on dealers' shelves. January 1, 1978, is the retail cutoff date requested by ARMA, with an April 15, 1977, cutoff for manufacturing purposes.

As portrayed at the ARMA meeting in Dayton, the 20777 specifications came as a result of two distinct but related pressures. The first is the ITU international radio regulations, the basis of the upcoming 1979 WARC frequency allocations conference. It was felt in Washington, said ARMA's Bob Levine, that we must enforce the ITU limits here at home in order to have any right to limit the importation of amps considered illegal by American regulations. That's the second pressure point . . . information from various government agencies that huge shipments of broadband amps manufactured in Mexico, Korea, and Taiwan were headed for US markets. The new harmonic and spurious limits, then, were aimed at blocking further importation of "black box" amplifiers. Until now, the ARMA members were told, most bogus "black box" amps were manufactured here in the US, and it was the threat of thousands more coming in from abroad that forced the FCC's hand. Where all this leaves the American manufacturer of legal amateur radio equipment remains to be seen.

At deadline, the FCC had not acted on ARMA's grandfather clause proposal. ARMA itself was suffering growing pains, taking on new members and forming committees to deal with both pending and yet to be announced FCC proposals. Type acceptance is the prime fear, with most manufacturers convinced it will only raise prices and end up hurting the consumer.

The feeling is that anything – even 20777 – is better than type acceptance. The question is whether ARMA, or anyone in the industry, can find a better answer to the FCC's dilemma with the out-of-band pseudo-hams, the so-called HFers. And time, at this writing, is running out.

What can you do about supporting Senator Goldwater's RFI bill now before the Congress? Write your senator in support of the legislation which now has reached the Senate Commerce, Science and Transportation Committee. Of special interest are the members of the committee, whose home constituents carry some weight. The members include: Warren Magnuson (WA), the chairman, Howard Cannon (NV), Russell Long (LA), Ernest Hollings (SC), Daniel Inouye (HI), Adlai Stevenson (IL), Wendell Ford (KY), James Pearson (KS), Robert Griffin (MI), Ted Stevens (AK), John Durkin (NH), Edward Zorinsky (NE), Donald Riegle (MI), John Melcher (MT), Barry Goldwater (AZ), Bob Packwood (OR), Harrison Schmitt (NM), and John Danforth (MO). If you live in any of those states you are in a good position to urge an early hearing on the bill and have some positive effect on its progress through Congress. At deadline no hearing had yet been scheduled.



Twenty-five years ago in Norway, a man named Les Mitchell decided to add a dimension to scouting. Amateur radio was the natural choice due to its accessibility by scout troops around the world. An annual international event grew out of Mitchell's efforts, known as the Jamboree on the Air. And the 1976 version set new records for participation, with over 12,000 stations on the air representing nearly every country that embraces scouting. Here in the US, the BSA (Boy Scouts of America) fielded over a thousand stations, ranging from complex multi-operator setups at BSA headquarters in New Jersey, to deep woods portable operations in the Pacific Northwest. The idea is to demonstrate ham radio, while at the same time promoting scout friendship among the millions of scouts around the world. As one organizer put it after overseeing the operation of AC1NRG at Meriden, Connecticut, "The scouts traded information about their projects, made contacts to trade patches, but one thing seemed to always arise – they wanted to know who the other guy on the radio thought would win the World Series." Condensed from the *Report of the Nineteenth Jamboree On The Air*, World Scout Bureau, Geneva, Switzerland.

The debate over business use of repeaters continues . . . this latest word comes right from the FCC, via *The Hilltopper*, bulletin of the Tompkins County ARC, Lansing NY. (Anyone who disagrees with this should contact FCC Rules and Legal Branch chief John Johnson in Washington DC, since these are his interpretations.)

In considering the legality of a transmission, you first have to consider if there is a third party involved in any manner (i.e., someone besides the two amateur operators who are talking to each other). If no third party is involved, and providing an amateur is not regularly engaged in buying or selling radio equipment for a living, two amateur operators may consummate a sale of a piece of radio equipment without violation of regulations. However, Mr. Johnson "recommends" that actual prices not be discussed.

An amateur not regularly engaged in buying and selling radio equipment may also inform other amateurs during a net that he has a certain piece of equipment for sale or trade, but again, it is "recommended" that exact price not be discussed. Now, this is all changed if the two amateurs are handling this traffic to or for any person except themselves.

No third party traffic may be handled if either operator or any other person derives monetary gain from the transaction. One amateur asks another amateur to call or contact a hamburger stand ordering burgers, fries, etc. . . . Mr. Johnson replied that although the call seems innocent enough, a third party (the hamburger stand) has a monetary consideration and the call is interpreted as not permitted. Calls to commercial establishments are permitted providing that the purpose of the call involves, at least in part, the welfare of a person or persons. A nonroutine call to a commercial establishment such as to a motel while traveling in another city to find a room is permitted.

In other words, if you are sort of desperate, such as needing a part for a stalled car out on the highway, or a wrecker to tow you into town, it is all right to pass such a call by amateur radio. However, if you made a call just to find a particular color of seat covers, the call would not be permitted. The crucial key as to whether a third party call or message is permitted depends on how desperate the situation is concerning the welfare of one or more persons. Apparently, the discussion of price of the article or service should be avoided. The writer realizes that this is most difficult to decide, what is welfare and what is not (reminds one of the definition of "sin"), but these are the only guidelines we have been able to get from the FCC. Thanks to W5EKP.

The folks who really got CB going – the truck drivers – may well get a new phase of the personal communications boom going. That's the illegal use of amateur VHF gear to escape the QRM on 27 MHz. A number of

clubs have reported that truckers are buying 2m rigs and gathering on 146.58 MHz, CB handles and all! WBØECX, via *Grid Leak*, reports he's on the lookout for bogus calls in the Denver area, after a check by area amateurs came up with 75 suspected phony calls in less than a day of casual monitoring. Thanks to *Grid Leak*, bulletin of the Pueblo Ham Club, Pueblo CO.

From club bulletins comes the news that 10m intruders are a growing problem. Several clubs report discussions on the topic, but most stopped short of any concrete action, choosing instead to "express our concerns to the ARRL." FCC officials are anxious for reports on the intruder problem both on HF and VHF, with your district engineer topping the list of where to send the information.

Illinois is the latest state to add anti-scanner laws. But amateurs are exempt in the final version of the legislation, largely through the work of statewide amateur clubs and organizations. The law bans the use of VHF and UHF monitors and transmitters in cars, unless the operator holds an FCC license (amateur or commercial). Most states with scanner laws on the books do exempt amateurs, but the best advice is to carry a photocopy of both the law and your license, to prove your point to law enforcement authorities. The Illinois law was expected to take effect October 1st, but will have to be added to the scores of other laws needing revision should the CB band be moved into the VHF/UHF region.

Tests are supposed to begin next fall on the new early warning over-the-horizon radar under construction in Maine by GE. The 39 million dollar system features 100 mile spacing between transmitter and receiver, a "footprint" of 1 million square miles in area, a transmitting antenna measuring 2,276 feet wide and 135 feet high, and 21 transmitters, rated at 100 kW each. Seven of them are to be used at a time over frequencies ranging from 5 to 30 MHz. *Electronics* magazine also reports that the beam can be scanned in azimuth and range simply by shifting frequency. The receive end has a 5,816 foot antenna, and will relay 96 three stage superheterodyne receivers to processors, and then into the Air Force radar system. Big Noise, anyone?

Another 10m beacon has been established here in the US. It's N4RD at Englewood FL on 28.075 MHz, full time. Power is 45 Watts output to a ground plane antenna. Owner/operator Robert Davis K4BRD says he's received over 100 QSLs since putting the beacon on the air at noon April 3rd. "This project was first conceived about a year ago," Davis told *73*. "I was listening on the 10m band and it was completely dead. I tuned down to the CB band, and it was very active. I realize that there is a difference in propagation between 11m and 10m, but it did not seem possible that there was that much difference. I came to the conclusion that no one was transmitting on ten. But how many were listening? What would be the result if there were a beacon on 10m? If the beacon was heard by someone, perhaps if they called CQ they could make a contact." Davis then found out that the IARU supervises beacons internationally, and he was assigned his frequency after contacting the coordinator in London, England. N4RD is home brew, with a Morse identifier. Other US 10m beacons include WA1IOB in Massachusetts on 29.150 MHz. For other beacon stations see May *73*, page 13.

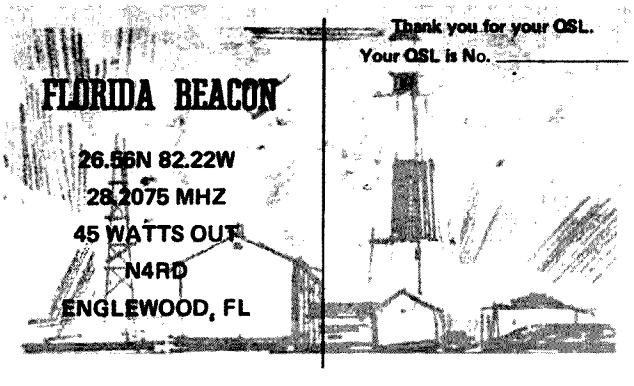
New Hampshire and Massachusetts are not exactly the best of neighbors. NH Governor Meldrim Thomson regularly criticizes the "mess" south of his state's border, while Massachusetts officials are quick to point out the lack of services available to New Hampshire residents compared to those offered in their state. A real war is underway between the two states over lotteries, liquor stores, horse and dog racing, and a half dozen other perennial issues, all debated over the Boston TV stations both states share. New Hampshire, says Governor Thomson, will not take a back seat to anyone . . . and he especially means Massachusetts. With that background in mind, it won't be hard to understand the logic of a bill introduced in the current session of the New Hampshire legislature, to specifically allow the use of microphones while mobile. Massachusetts ("Briefs," April *73*) has a little known law banning operation of motor vehicles without both hands on the wheel. At deadline the NH bill was before the house transportation committee. Anyone for a radiotelegraph endorsement? Thanks to WA1YEG.

With thanks to the never tiring editor of the *West Coast DX Bulletin*, here are a few tidbits from the DX world. The logs, equipment, and QSLs of D2ASW were confiscated by the Angolan authorities, and the operator headed for Portugal in quite a hurry . . . all this in light of recent problems in Angola. In Dahomey, 9G1JN ran into problems trying to get a TY license . . . seems a coup attempt may be responsible. W6YO appeared for 24 hours from Pitcairn on a CW only visit. Many CW DX types reportedly were grumbling about too much rag chewing and not enough QSOing. CEØAE, faced with rig problems, got a new Atlas onto Easter Island via W6YO, who's returning the original for factory repair. It seems Atlas played a big role in forwarding the replacement pending arrival of the ailing unit. A late March fire destroyed the Central Bureau of VERON at Arnhem in the Netherlands. Some records and subscription lists were lost, so those receiving *DX-Press* or awaiting correspondence are asked to write VERON, Box 1166, Arnhem, The Netherlands.

At deadline: The FCC approved a 30 day extension for comments on dockets 21116 (the proposed ban on linears capable of 24-32 MHz) and 21117 (type acceptance of ham gear). It was also reported that the manufacturer's association bid to enact a grandfather clause covering docket 20777 (bandwidth) was near approval.

Little reaction has been forthcoming on the disturbing suggestion in the book *The Real Spy World* by Miles Copeland, a former CIA organizer, that amateur transmissions are sometimes used for clandestine intelligence operations. He suggests that high speed "squirt" or "screech" signals are sometimes played in the background of ordinary ham radio messages. Copeland claims that squirt recordings "are still used to good effect on ham radio transmissions." It is hoped that if the CIA or any other organizations have ever used amateur radio in this way, the practice has long ceased. Reprinted from *The Indian Radio Amateur*, New Delhi.

George Bailey W2KH, a communications pioneer and a former ARRL President, died in Nashville TN last December at age 89. Bailey was the first American ham to be heard in Europe on the old 5m band. Bailey was instrumental in organizing the US scientific and engineering effort for WWII. He directed the Signal Corps,



N4RD's QSL — another beacon to help predict 10m openings.

and was a founding father of the IEEE. As an amateur, Bailey was first to hear news of a sinking steamship, the *Viking*, which blew off course off Newfoundland in March, 1931. He also received first news of the Long Beach CA earthquake in March of 1933. Reprinted from the *IEEE Journal*.

One of the men who pioneered in the field of transducer design, Richard J. Billette, has died after more than twenty years of work in solid state engineering. He was 45.

Before helping to found National Semiconductor Corporation's transducer group in 1972, Mr. Billette spent one year in India establishing a technical school under the auspices of Dunwoodie Institute, Minneapolis, where he taught engineering. Prior to that, he held an influential position in the transducer activities of Honeywell's solid state electronics center in Minneapolis.

Mr. Billette held a key transducer circuit patent, and an important transducer application patent (flow meter) stemming from his work at National, in addition to a number of previous patents from Honeywell. A tireless and prolific worker, Mr. Billette was responsible for conceiving and implementing many new transducer concepts, features and applications. (Transducer devices are fairly recent electronic advances, which act as sensors to provide pressure readings and other important sense inputs for computer based systems. They have uses in many automotive, avionic and process control applications. They are said to "transform a computer into a robot," because they provide necessary external information for artificial intelligence, functioning as the "eyes," "ears," and "fingertips" of the computer.) Thanks to National Semiconductor Corporation.

Electrical storms, next to Murphy, are one of the amateur's worst enemies. Take the case of a Long Beach CA ham, as reported in the Long Beach *Independent*. "A lightning bolt struck the roof antenna of a ham radio set at the Long Beach home of Frederick Fowler. The roof and attic burst into flames. Fire Capt. Ralph Wallace said two engine companies and a ladder truck went to the Fowler home and extinguished the blaze in 15 minutes. He said Fowler

and his wife were not operating any electrical equipment and consequently were not injured, but the house 'looked like a machine gun had ripped through it.' Electrical sockets, light fixtures and a doorbell button were blown apart, Wallace said. Metal corners used to hold the plaster during construction were electrified and bent, knocking plaster all over, he added, and the concussion moved a couch several feet. Part of the cedar shingle roof and part of the attic were destroyed, with damage estimated at $6,000. Fowler's radio set, however, was unplugged and was not damaged." How many of us would be able to say the same thing if an intense electrical storm hit our home QTH? Thanks to James Ross, Long Beach CA.

There are antennas, and then there are antennas, but we'd be hard pressed to do LU7MAL one better! Mel's Mendoza diggings include the six element 20m beam pictured here, on a 65 foot boom. According to Al OA4XX, who sent along the pictures, Mel started out with separate five and seven element arrays for comparison purposes, and discovered that although he didn't gain much on the transmit side between the two antennas, the big gain was on the receive end. Ultimately a six element antenna was decided on and constructed. One of the best points about the array is the way it folds over for adjustment and tuning. What's more, the antenna can be locked up in any direction to counter high winds, a major concern in maintaining large arrays anywhere, but especially near the Andes Mountains where Mel lives. Judging by the photos, the USA does not have the only claim to the "big gun" factor in the Americas. The rig at LU7MAL is as ultimate as the antenna farm, with full legal power and a well-known signal at contest time. Thanks to OA4XX.

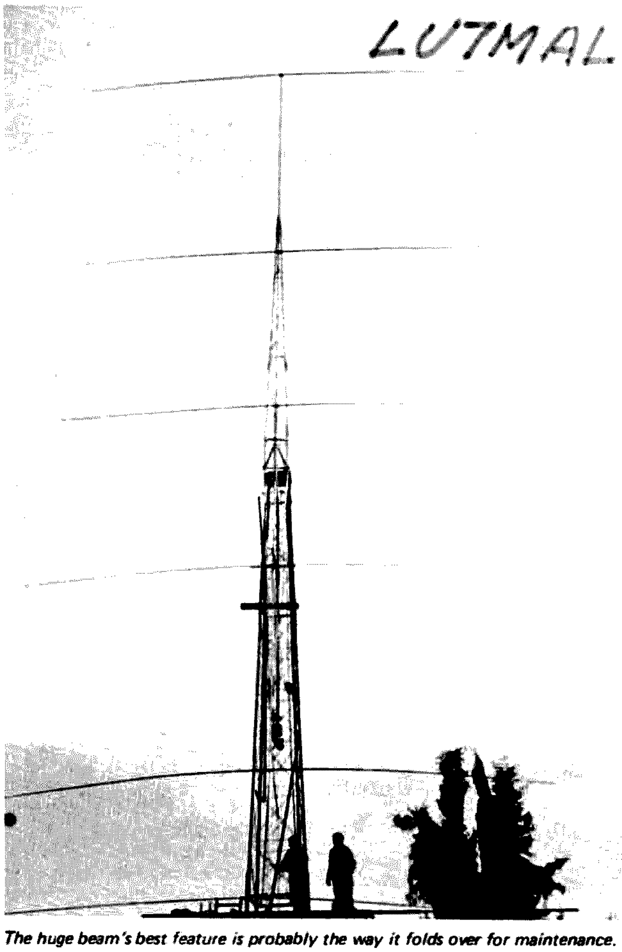
Local ham radio operators and the Coast Guard teamed up to rescue the 37-foot sailing sloop *Porsoius* when it lost steerage 25 miles off Ocean Park in the Pacific Ocean.

Lyle Clark W7RDR, Chuck Laird W7BCJ, and Jay Shepherd W7FBM combined their skills and equipment to locate the boat when it was discovered that the exact location was in doubt.

The story started when Laird and other operators were talking, using the Astoria WA repeater after a routine emergency drill on the radios.

The talk was interrupted when Bill Blaker WA6MUY, aboard the stricken vessel, called for Coast Guard assistance.

Laird set up a direct communications link with Air Astoria. The hams determined the boat's location and a helicopter was dispatched to find it.



The huge beam's best feature is probably the way it folds over for maintenance.

It was located at 12:02 am within four miles of the position determined by radio triangulation. A Coast Guard spokesman said drift could easily account for that.

Three hours later the motor lifeboat 44304 skippered by BM-2 Simonsen arrived on scene and took the vessel under tow. The 52-foot *Triumph* was dispatched, took over the tow, and just after noon Tuesday the *Porsoius* was safely moored in Ilwaco harbor.

The *Porsoius*, with three persons aboard, had a line foul the rudder, causing it to fall into the prop. The boat was dead in the water. Thanks to W7UFL (reprinted from the *Chinook Observer*, Long Beach WA).

Units of the Dallas TX County RACES played a key role in handling last February's railroad tank car explosion and fire. Within 15 minutes of the first explosion, the local net was activated and 56 units were available for crowd control, traffic duty, and communications. A command post was set up beside Dallas police headquarters, with information relayed to a half dozen police departments, fire departments and other emergency agencies. When officials thought a third rail car loaded with polyvinyl chloride might explode and spread toxic fumes, they needed to know the wind speed and direction and were surprised to find a meteorologist in the National Weather Service Office at Fort Worth monitoring the RACES net and ready with the answer. RACES personnel also manned barricades and set out flares, thus freeing many officers to return to their patrol duties. CB REACT teams also worked with the disaster team, manning barricades on the outer perimeter and urging the public to keep away via channels 9 and 19. Interestingly enough, the same Dallas County RACES group first spotted and tracked a major tornado that hit Dallas last May. Reprinted from *In the DARC*, a monthly publication of the Dallas Amateur Radio Club, Dallas TX.

The Pueblo (CO) Ham Club won some great PR with the news it would help the National Weather Service track tornadoes and other weather emergencies. An article in the *Pueblo Star Journal* reported a demonstration by the club, organized to show NWS officials 2m coverage on a volunteer basis. Fifty stations checked in, from as far away as Denver (110 miles), and the reaction was enthusiastic – the chief weather officer said he was amazed at how readily the amateurs responded to the practice alert. He went on to ask for the Pueblo club's help on a permanent basis. The club will maintain the weather watch 24 hours per day, seven days a week. Thanks to the PHC PR staff.

There's more feedback on amateur emergency efforts during this past winter's worst – WØSIN reports that the "Springs Repeater" near Colorado Springs was in action around the clock during the blizzard of late March under the direction of WØPT. A 75 meter link was maintained by KØCNV. Thanks to WØSIN.

There are two sides to every story, and the CB story is no different. The following appeared in the North Manchester IN News-Journal, *for Monday, March 18th. – Ed.*

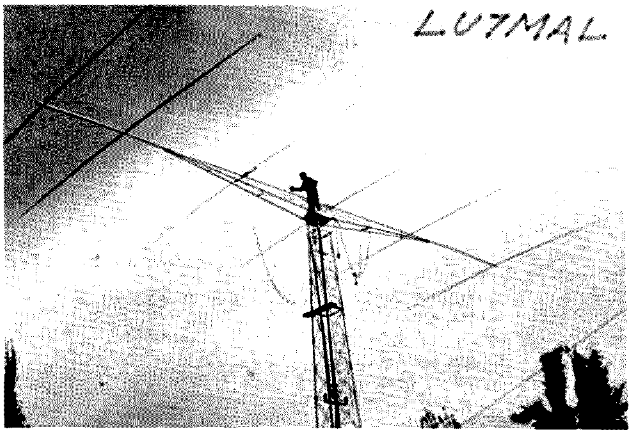
Pleasant Township Fire Department has answered its last anonymous CB fire alarm, according to Capt. Jesse Trickle of the Pleasant force.

Pleasant volunteers decided to crack down on false alarms received by CB radio after taking two false calls Friday from CBers. Trickle said the department would no longer respond to fire alarms reported over CB radio unless the caller gives his name, address, and call letters.

Friday's runs brought to seven the number of false calls received over the CB airways by Pleasant Township this year and has resulted in the wasting of over 100 gallons of gasoline as well as the time of the volunteers.

Trickle reported that Friday's calls were reporting fires on SR 15 and at the Laketon Refinery. Firemen were told that an 18 wheeler was on fire on SR 15 but nothing was found.

When firemen returned, they received another call that said the



Six elements on a 65 foot boom for 20m – that's the reason for such an outstanding signal from LU7MAL.

previous report was a mistake and there was a fire at the Laketon Refinery. Firemen went to the Refinery only to find the same thing as they had on SR 15. Thanks to WB9VKI.

A new blockbusting phenomenon is reported in certain Texas towns, where "FOR SALE" signs proliferate wherever the hated 11 meter ground plane dominates a local rooftop. Vigilante counter measures reportedly used by an aroused citizenry range from tape recording the offending transmission and giving it back to the CB neighbor via 150 Watts of stereo audio through an open 3 am window, to putting a straight pin through the offender's coax, and waiting for him to turn on his linear. Thanks WA6NCX, W6NIR, and *PAARA Graphs*, bulletin of the Palo Alta CA ARA.

The Environmental Protection Agency in Washington DC is considering a regulation to limit the height of all self-supporting towers less than 2.5 square feet (base cross section) to 34 feet.

It seems that free-standing towers experience wind shear effects which shake the towers. It also seems that, especially in the late spring and summer, this shaking is transmitted to the surrounding earth. The vibrations disturb earthworms, causing them to come to the surface (often during the hottest part of the day). Exposure of the earthworm to the sun's direct rays causes them to die from sunstroke. Earthworms are very important facets of the ecology — hence the EPA's concern. Thanks to the Cascades Amateur Radio Society *Action Mini-Mag*, Jackson MI.

Many of us dream of the ultimate station, but few of us ever seem to get that far. One who has is Ted Gamlin K1VBL of Chester NH. The photos show only a portion of Ted's multi-op setup, from the antenna farm viewpoint. Since Ted took these pictures, the winter of '77 has done its dirty work, and the big 165-foot tower (which supported a six element 20m beam and the stationmaster for Ted's 220 MHz DXalert repeater) came down. Also lost on at least two occasions was the 4 element 40m yagi, but not before the station, signing W1RR, put in a strong showing in the ARRL DX contest. Now that the warmer weather has arrived, Ted is busily rebuilding, spreading out the towers and in general beefing up the system for next winter . . . and the next contest season.

This is, of course, the Silver Jubilee of the reign of Queen Elizabeth II. And, not unlike the American Bicentennial which preceded it, the Jubilee means special calls for amateurs. A "GE" prefix is substituted for the normal one, at the individual amateur's option. The event lasts from 0001 GMT June 4th through 2359 GMT on June 12th, but it isn't being received with exactly open arms among English hams. A report in *Mobile News*, the Journal of the Amateur Radio Mobile Society, put it this way — "Obviously, if this nonsense is adopted, nobody will have a clue what country they are working. When poor Arthur Milne G2MI read this out on the 80m bulletin, he couldn't help muttering about the confusion it would cause to the QSL bureau. We can only hope that this one will go off like the proverbial damp squib, as did the American Bicentennial calls which were utterly confusing."

An FCC news release says alien hams gaining American citizenship must take the American amateur exams to continue operating. That applies even when the old license is still in effect. However, aliens will be able to keep their US calls granted initially under reciprocal agreement.

Canadians planning to operate in the US must first obtain form 410 from the FCC. Reports that current reciprocal agreements between the two countries allow "instant" operation on either side of the border are simply untrue. Operation without authorization may be in the cards in the future, however, since both the FCC and the Canadian DOC have reportedly agreed on it, but a treaty has not yet been signed. Thanks to *Transborder*, bulletin of the International Repeater Group, Fredericton NB.

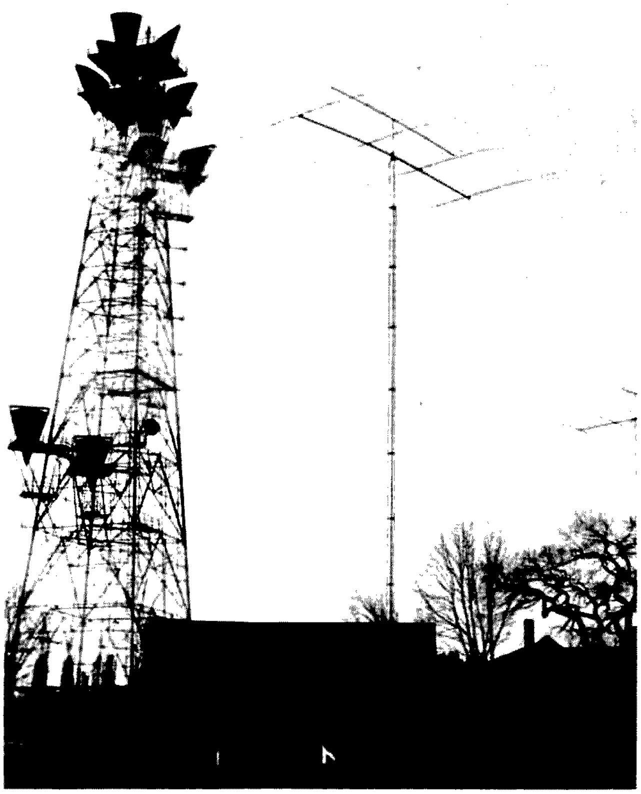
A Wayne King special feature in the Sunday *New York Times* gives us some insights into a few of the 100,000 complaints from the public received by the FCC in 1976. They represent some of the more fascinating items of RFI.

The strident tones of "jelly belly" startling a poor housewife as she opened her electronic oven . . . A character called "rubber ducky" shouting, "I'm comin' home, warm up the bean pot, honey" just as the minister was closing the coffin during funeral services . . . As another pastor said, "forgive us our trespasses," one "dragon lady" in less than dulcet tones came bleeding through the PA speakers with "That's a big 10-4, good buddy," — such ain't the way to perorate the Lord's prayer.

A raucous "hey, what say, good buddy" ruined the romantic moment for a Houston couple who were theretofore using to best advantage the soft music on their stereo. A Dallas police chief was equally upset when his electric organ started talking with a trucker's twang, even though the switch was off, and a southern chanteuse named Cheryl Russell found herself suddenly off-key and mentally anguished when her night club mike talked back to her. The New Mexico Cooperative Interference Committee investigated 11 meter signals which drove a local citizen to a psychiatrist — the fillings in his teeth were picking up more than one good buddy. CBers trying to get 9 pounds out of a 5 pound Tiger 23 have caused widespread havoc with electronic controls on fuel injection systems ranging from spitting VWs to sputtering Mercedes.

The FCC announces publication of a new 35 page booklet, "How To Resolve Radio-TV Interference Problems." It will be available from the GPO beginning in late June, for $1.50.

The K1VBL antenna farm last fall. Since the picture was taken, winter has done its dirty work, taking out the largest tower and forcing a rebuilding program this spring.



As is obvious from this shot, K1VBL let Ma Bell do his site research work for him. Most contestors are by now aware that it's paying off.

booklet includes interference information on TVs, BC radios, telephones, stereo systems, and other electronic devices.

Amateurs everywhere owe Fred Maia W5UTT a vote of thanks. Maia was a major contributor to the successful introduction of an RFI bill in this year's session of the Texas legislature. The RFI bill's introduction followed withdrawal of a measure that would have set criminal penalties on interference cases, strictly from the ham's or CBer's point of view. The new bill would force the installation of interference filters on TV sets at the dealer level, and place either a $100 fine or actual damages (whichever is greater) for interference caused by the lack of a filter. But the Texas amateurs and their supporters did not stop there. A section was added to the bill suspending normal legislative procedures to allow for early action and an immediate effective date for the new law upon passage!

The CB problem in Australia has become so bad that the state police can stop and search any vehicle suspected of carrying illegal 27 MHz equipment. All amateurs in Australia are advised by *Amateur Radio* magazine to carry their license or a photocopy of it with them. It is also required that they carry their license renewal certificate and a log book. Amateurs are further instructed to remove their mobile gear if they lend their car to spouses or friends, so the driver does not get booked for illegal possession of radio transmitting gear.

In "Briefs" in the May issue (page 40), an item appears which gives a false impression of the facts. It says, "A licensed amateur . . . was fined $100 . . . for inadvertent jamming of radio and TV shows . . . for which he could have been fined a maximum of $1600."

The facts are that damages of $25 each were awarded to four neighbors who had sued the user of a CB station for $400 damages each because, for about a year, despite repeated complaint, their radio and TV reception had been marred by a "strange voice" which intruded "at all hours of the day and evening."

In Canada, the Radio Regulations still forbid the use of CB for "transmissions of a frivolous nature" and "a communication used in itself as a diversionary or recreational activity," but in fact these prohibitions are not enforced. But another provision says, "no station . . . shall be operated so as to cause interference to any licensed radio station or a private receiving station." The sensible ham or CBer operates his gear with discretion, knowing that there is a fine and debatable line between his right to operate and the right of his neighbors to enjoy their listening and viewing.

The court case which ended in the judgment against the CBer was argued around the principle that the exercise of an act of ownership is subject to the exercise of the same right for neighboring owners. It was found that "the owner of such a device is responsible for its injudicious use if such use causes inconvenience to others. The theory of misuse of right must be applied here. The fact that one exercises a right does not mean that one may thoughtlessly, albeit without malice, interfere with others in the exercise of their rights."

Another interesting reference is to the possiblity of high pass filter protection on the TV sets. "It is false to claim that the owners of television sets should provide their sets with special filters, since the use of a television set is not regulated to the same extent as that of a CB device. Thus, the intangible damages incurred by the applicant must not be given any less weight because he did not provide his own television set with special filters." Thanks to VE7BS.

Amateur Radio News Service

We've heard about the ATV madness sweeping the country, but things are clearly getting out of handl Consider the proposal of some Baltimore (MD) ATVers, as published tongue-in-cheek in *The Milliwatt*, bulletin of the Baltimore Radio Amateur Television Society (BRATS). "Have you noticed that most commercial TV stations stop transmitting at night? Apparently they are not interested in using their spectrum 24 hours a day. Tell you what. When they go off, allow the hams to transmit ATV on those unused channels. Betcha dollars to donuts ATV would fill up those unused channels fast and attract more viewers than those moldy all-night movies. BRATS hereby announces its preliminary plan for channel 11 input, channel 2 output, ATV repeater for Baltimore." Thanks to K3SVC.

The Amateur Radio News Service was founded many years ago as a result of a need for the exchange of ideas among and between those radio amateurs concerned with club newsletters and public relations. In the newsletter field, ARNS attempts to cover all aspects of producing and mailing a club paper. To one entering the field it soon becomes evident that producing a club paper is somewhat of a unique process, primarily because standard practices of printing will not necessarily apply. The publisher seldom has equipment available and in many cases must operate without any equipment at all! Few club paper editors have had any experience in the field. It has been demonstrated that, through information available through the Amateur Radio News Service, a new paper editor can easily surmount many of the problems involved in producing a club paper.

The monthly publication, *The ARNS Bulletin*, contains in each issue helpful hints for producing the paper. Currently each issue contains an installment of the booklet "The Club Paper," bringing the publication up to date. These installments cover all aspects of producing a club paper, from the origin of the text to finally placing the papers in the mail. When completed, each member will receive a copy.

ARNS numbers among its members many professionals possessing expertise in almost any subject of producing a paper. Thus the newcomer has access to a recognized expert who can answer almost any question relative to producing a club paper. Because of the improvement in the club paper and since the editor has access to continuing information, most clubs pay the nominal cost of the editor's membership in the Amateur Radio News Service.

In the Public Relations field the Amateur Radio News Service endeavors to cover suggestions for operating in the public relations field, including types of items to be submitted to the media. Again, ARNS has among its members many who are professional public relations individuals, and each member has access to information available from them.

The Amateur Radio News Service has members in many foreign countries. It is a service for amateur radio editors and does not issue "news" items as such. However, each issue of *The ARNS Bulletin* contains quotes from other club papers which can be copied for use in any club paper. Thanks to W9MOL and WA3HEN.

For those interested in building the TV game circuit presented in the Oct., 1976, issue of *73* ("Hey, Look What My Daddy Built!"), and have either had trouble finding the AY-3-8500-1 chip or did not want to spring for the $35, we have good news! Poly Paks now has the chip listed on the front page of its newest (221) catalog, for $14.95. We thought this might make some of you happy. – WB1ASL.

Hams have come up with some ingenious uses for beeps. LIMARC, the Long Island Mobile Amateur Radio Club, uses a beep to tell you when you have paused long enough between transmissions for the machine to recycle. When you hear the beep, start talking.

Vancouver's VE7RPT machine beeps users when their regular power has ceased and emergency battery power is being used. Dave Williams VE7MQ says that the battery supply gives full emergency capabilities, but only for a finite duration. "If the beep tone is on," he writes in the *British Columbia FM Communication Association Bulletin*, "please be exceedingly brief, or better yet, limit your use to emergency traffic."

The Miami Valley FM Association *FM Scanner* reports that their 04/64 machine emits a double beep if an emergency is in progress. Monitoring stations are instructed to stand by and listen when the double beep is heard. Net control will then ask for check-ins if needed.

A wide area communications system, which has received FCC authorization, will consist of 6 or 7 strategically located repeater stations capable of retransmitting signals from weak stations, such as HTs, throughout the 30,000 square mile area around Kansas City. Each of the linked repeaters can be tone or carrier accessed as desired by the control operator. The repeaters may also be operated independently without interference between terminals. A complex set of commands will be given by the headquarters communications center (WØSHQ), which can monitor traffic on each repeater. A minicomputer, located at headquarters, controls the entire system.

The Association of Saint's Church Radio Amateurs, headquartered in Independence MO, says that the system is the only one outside of the western US to have such a large coverage area. Mountain-based repeaters in the west easily provide 200 mile coverage, while plains states have no such height advantage.

Congratulations are in order to the Cuyahoga ARS of Cleveland OH, after providing assistance to the local American Cancer Society during its annual fund drive. Mobile stations were provided by the local club, whose members delivered 365 cubic feet of literature and informational packets to zone captains for distribution throughout Cuyahoga County. Thirteen locals participated, along with a prospective amateur (a security guard at the Cancer Society headquarters building) who gave up a day off to join the hams! Thanks to WA8GEO.

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

Official logs, check sheets, and summary sheets for the CAN-AM Championship Contest may be obtained from CANADX, Box 717, Station Q, Toronto, Ontario M4T 2N7, Canada. Include a large SASE for samples. Full rules for this contest will appear in the next issue!

QRP SUMMER CONTEST
Starts: 1500 GMT
Saturday, July 2
Ends: 1500 GMT
Sunday, July 3

The contest is organized by the DL Activity Group-CW. Work 15 hours maximum during the 24 hour contest period, with no more than two pause periods. Select up to 5 bands from 160 to 10 meters. General call is "CQ QRP TEST." A station is not handicapped if CO/VXO control *and* VFO control are used on the same band or the input power of a commercial rig is reduced to below 2.5 Watts. QRO stations — same rules, but work only QRP stations and sign ". . ./QRO"; scoring is the same.

EXCHANGE:

RST, QSO number, and input (1 to 9). Add "x" if transmitter is CO or VXO controlled. Example — 579 000/8x.

SCORING:

QSOs with all stations are valid unless running QRO; then only QSOs with QRP stations count. Contacts with your own country count 1 point, own continent = 2 points, DX = 3 points, and score 3 additional points for a QSO with another QRP station. Score additional handicaps as follows: 1 handicap point for each station using below 3.5 Watts input or crystal controlled transmitter. Maximum handicap is 4 for any QSO. Both stations multiply QSO points times the handicap points plus one (QSO pts x 5 max) to find total QSO points for that contact. Multipliers are as follows: own continent = 1, DX = 2 points per band and country according to latest DXCC list, but call areas in JA, PY, VE, VK, W, and ZS count extra. Final score is total QSO points (including handicap pts) times the total multiplier.

ENTRIES:

Send entry including a "mini-log" to Hartmut Weber DJ7ST, D-3201 Holle, Kleine Ohe 5, Fed. Rep. of Germany. Logs should be postmarked no later than Feb. 15.

ARRL STRAIGHT KEY NIGHT

Complete rules in June issue of *QST!*

If similar to last year, starts 0100 GMT July 3rd and ends 0700 GMT July 4th. Send "SKN" instead of "RST" during QSOs to identify contest stations. Try 60 to 80 kHz up from bottom edge of the band. After contest period, send a list of calls of the stations contacted during the contest period plus your vote for the best fist heard. All entries should be addressed to ARRL, 225 Main St., Newington CT 06111.

APOLLO II 8th ANNIVERSARY CONTEST
July 16 to 17
6 pm to 9 pm local time

Use all VHF/UHF bands, all modes — except repeaters!

Power classes as follows: Class I — 100 to 300 Watts input; Class II — 25 to 100; Class III — 5 to 25; Class IV — 1 to 5. Special XYL class — any power permitted. Club class — aggregated scores.

SCORING:

Each completed contact counts 2 points. Same station may be reworked on different mode and/or band for additional 2 point scores. Each different zip code worked will count as 1 multiplier; like zip codes worked will not be counted as a multiplier.

AWARDS/ENTRIES:

Trophy plaque to highest score in each power class and XYL and Club classes. Space Net certificates to second and third places in all classes. All logs to be postmarked no later than Aug. 10, 1977, to: VHF Space Center, Box 15, Sumterville FL 33585.

TEN-TEN INTERNATIONAL NET SUMMER QSO PARTY
Starts: 0000 GMT July 16
Ends: 2400 GMT July 17

The contest is open to all amateurs, but only members are eligible for awards. All contacts must be made on 10 meters, but any mode may be used.

EXCHANGE:

Name, QTH, and 10-10 number.

SCORING:

Score 1 point per contact and add 1 point if with a 10-10 member (max. 2 pts per QSO). Give name of your chapter for chapter credit.

AWARDS:

1st and 2nd place certificates for each US Dist, KH6, KL7, VE districts, Central America and Caribbean, South America, Europe, Africa and South Atlantic, Asia and North Pacific, Australia-New Zealand and South Pacific.

ENTRIES:

Members only send logs to Grace Dunlap K5MRU/Ø, Box 13, Rand CO 80473 no later than Aug. 31, 1977. Results will be published in the Fall Bulletin. Special certificates for all CW scores and if 10 or more logs are received from Novice members.

CW COUNTY HUNTERS CONTEST
Starts: 0000 GMT July 23
Ends: 0600 GMT July 25

The CW County Hunters Net invites all amateurs to participate in the 1977 CW Contest with all mobile and

CALENDAR

July 2-3	QRP — Summer — Contest
July 4	ARRL Straight Key Night
July 9-10	IARU Radiosport Championship
July 16-17	Apollo II 8th Anniversary Contest
July 16-17	10-10 Net Summer QSO Party
July 23-25	CW County Hunters Contest
Aug 20-21	New Jersey QSO Party
Aug 20-21	Worldwide SARTG RTTY Contest
Aug 20-22	CAN-AM Championship Contest
Aug 27-28	All Asian Phone Contest
Sept 10-11	Washington State QSO Party
Sept 10-11	ARRL VHF QSO Party
Sept 24-25	Delta QSO Party
Oct 1	Open CD Party — CW
Oct 15-16	Open CD Party — Phone
Oct 15-17	Manitoba QSO Party
Nov 5-6	ARRL Sweepstakes — CW
Nov 12-13	IPA Contest
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes — Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 3-4	TOPS CW Contest
Dec 10-11	ARRL 10 Meter Contest

RESULTS

RESULTS OF THE TEN-TEN INTERNATIONAL NET WINTER QSO PARTY

WA1UAD	323/610
WA1STR	304/566
K9EGA/2	398/729
WB2MAN	248/461
K3LYW	478/872
W3RJ	240/434
W4MNZ	491/942
WB4CHK	401/748
WA5JDU	560/1029
WB5EHF	456/860
WA6UZA	376/698
WA6NAU	289/520
K7PXI	345/650
WA7BPF	299/553
WB8FAG	456/835
W8DMY	294/552
**W9NIN	315/586
WA9IXF	205/393
W9BPU	208/392
WBØQHV	710/1308
WBØCEI	396/733
KH6IAA	435/796
KH6ILF	374/665
VE2DZO	78/109
VE2XL	30/53
**VE3AHN	152/223
VE4VV	71/136
VE4UO	7/12
VE6BCC	13/23
VE7CNY	181/326
VE7DHE	121/217
HP1GD	175/334
LU7FAG	287/531
CE3EZ	266/480
VK4JP	58/89
VK4AMO	54/79
JA3XOG	52/79
JA9NGS	47/73

**Multi-operator station.

Ten-Ten Net Chapters:

Southern New England	7614/14,426
Gateway (Missouri)	5683/11,010
Cincinnati Area Ten Tuners	4920/9,374
Colorado	3316/6,251
Bay Area (Cal.)	3242/6,137

portable operation in less active counties welcomed and encouraged. General call "CQ CH." Stations may be worked once per band and again if the station has changed counties. Portable/mobile stations changing counties during the contest may repeat contacts for QSO points. Stations on county lines give and receive only one number per QSO but count each county for a multiplier.

EXCHANGE:

QSO number, category (P = portable, M = mobile), RST, state-province-country, and county (for US stations).

FREQUENCIES:

3575, 7055, 14070, 21070, 28070.

SCORING:

QSOs with fixed station count 1 point, portable/mobile stations = 3 pts; multiply QSO points times number of US counties worked. Mobiles/portables calculate their score on the basis of total contacts within a state.

AWARDS:

Certificates awarded in three categories: F — Highest fixed or fixed portable in each state, province, and country with 1,000 or more points; P — Highest station operating portable (not normal point of operation) with 1,000 or more points; M — Highest mobile in each state operating from 3 or more counties with a minimum of 10 QSOs per county.

Trophies to highest single operator station in categories P and M. Additional awards where deemed appropriate.

ENTRIES:

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO pts, location, and claimed score. All entries with 100 or more QSOs *must include a check sheet* of counties worked or be disqualified from receiving awards. Enclose large SASE if results desired. Logs must be postmarked by Sept. 1 and sent to: CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 673 Bruce St., Fond du Lac WI 54935.

TENTH ANNIVERSARY JERUSALEM AWARD

The Jerusalem Award Committee announces the creation of a new certificate to commemorate the tenth anniversary of the unification of Jerusalem. The certificate will be made available to both amateurs and SWLs. To qualify, contact 8 amateur stations in Israel, with at least 3 of them located in Jerusalem, the capital. All contacts must be made in the year 1977! Have log entries certified by another radio amateur and send log extracts along with 10 IRCs to: Jerusalem Award, PO Box 4079, Jerusalem 91 040, Israel.

Also of note: The requirements for the regular Jerusalem award have been changed to require contacts with 8 stations in Israel, with 3 in Jerusalem. The address is the same as shown above.

IARU RADIOSPORT CHAMPIONSHIP

Complete rules in the June '77 issue of *QST!*

Oscar Orbits

Oscar 6 Orbital Information

Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
NA 21530 BTN	1	0021:23	67.1
N 21543	2	0116:19	80.9
NA 21555 BTN	3	0016:15	65.9
N 21568	4	0111:11	79.6
NA 21580 BTN	5	0011:07	64.6
NA 21593 BTN	6	0106:02	78.4
N 21605	7	0005:58	63.4
NA 21618 BTN	8	0100:54	77.1
N 21630	9	0000:50	62.1
NA 21643 BTN	10	0055:45	75.9
N 21656	11	0150:41	89.6
NA 21668 BTN	12	0050:37	74.7
NA 21681 BTN	13	0145:33	88.4
N 21693	14	0045:29	73.4
NA 21706 BTN	15	0140:24	87.2
N 21718	16	0040:20	72.2
NA 21731 BTN	17	0135:16	85.9
N 21743	18	0035:12	70.9
NA 21756 BTN	19	0130:08	84.7
NA 21768 BTN	20	0030:04	69.7
N 21781	21	0124:59	83.4
NA 21793 BTN	22	0024:55	68.4
N 21806	23	0119:51	82.2
NA 21818 BTN	24	0019:47	67.2
N 21831	25	0114:42	80.9
NA 21843 BTN	26	0014:38	65.9
NA 21856 BTN	27	0109:34	79.7
N 21868	28	0009:30	64.7
NA 21881 BTN	29	0104:26	78.4
N 21893	30	0004:22	63.4
NA 21906 BTN	31	0059:17	77.2

Oscar 7 Orbital Information

Orbit	Date (July)	Time (GMT)	Lnogitude of Eq. Crossing °W
12006 B	1	0050:11	66.1
12019 A	2	0144:28	79.7
12031 B	3	0043:48	64.5
12044 A	4	0138:05	78.1
12056 B	5	0037:26	63.0
12069 AX	6	0131:43	76.6
12081 B	7	0031:04	61.4
12094 A	8	0125:21	75.0
12106 B	9	0024:41	59.8
12119 A	10	0118:59	73.4
12131 BQ	11	0018:19	58.3
12144 A	12	0112:36	71.8
12156 BX	13	0011:57	56.7
12169 A	14	0106:14	70.3
12181 B	15	0005:34	55.1
12194 A	16	0059:52	68.7
12207 B	17	0154:09	82.3
12219 A	18	0053:29	67.1
12232 B	19	0147:47	80.7
12244 AX	20	0047:07	65.5
12257 B	21	0141:24	79.1
12269 A	22	0040:45	64.0
12282 B	23	0135:02	77.6
12294 A	24	0034:22	62.4
12307 BQ	25	0128:40	76.0
12319 A	26	0028:00	60.8
12332 BX	27	0122:17	74.4
12344 A	28	0021:38	59.3
12357 B	29	0115:55	72.8
12369 A	30	0015:16	57.7
12382 B	31	0109:33	71.3

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.
OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.
Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

Corrections

Thank you very much for printing my crystal checker circuit on page 164 of the April, 1977, issue of your great magazine. There is only one small error in the schematic. Due to a misprint (I hope), the transistor part number reads 50011. It should be S0011. I think that whoever builds the circuit will understand the error.

John Mairs WD4CEA
Springfield VA

I have had considerable mail response on my article that was in the May, 1977, issue of *73*, "All-Electronic SELCAL." I have one thing to say: "These hams who are supposed to be dummies can really pick out the errors." It has been brought to my attention that all the 5 volt power leads to the 7473 flip-flops have been reversed. That would be IC1, 2, 3, 4 and 5. Also, Q1 and Q2 have been labeled incorrectly — they should be reversed. These are all my errors; I should have caught them but did not. You did make one error, and that is that resistor R3, which goes to the collector of the 2N706 and got its base driven from input 15, should also be connected to the vertical line that goes past it on the right-hand side (to the manual reset button).

A. Sperduti WB2MPZ
Hamburg NY

My apologies to those people who have had problems with the "NASA-type Beeper" in the January 1977 issue. The value of C5 which determines the tone of the beep should be .01 uF instead of the .001 called for. The .001 produces a beep of around 10 kHz — high enough that most people thought that the circuit was not working at all. With this change, a 1 kHz tone is produced.

Also, in Fig. 2, the ground pin of U1 is labeled GND but not connected to ground, which it, of course, should be. Fig. 1 is correct as shown.

Bob Shattuck WB3GCP
Gillett PA

This note is to advise you that there is an error in the text that accompanies the circuit I sent you for the Circuits^2 section of *73* which appeared in the April, 1977 issue, page 164. The schematic is correct as printed, but the fuse rating should be less than the current rating of the SCR. This is so that the fuse will blow before the rating of the SCR is exceeded. If the SCR's rating was exceeded, the SCR would be destroyed, of course.

I thought that you would like to be advised of this error. Thank you.

Paul Hurm WB8CLF
Seven Mile OH

I was very pleased to see my circuit published in the April issue of *73*. However, I must point out a mistake. The 470k resistor on the output of the op amp in series with the bipolar LED is incorrect. The value which I originally used was 470 Ohms.

Michael Black VE2BVW
Montreal, Quebec

Tracking the Hamburglar

RIPPED OFF: In Jersey City NJ, Regency HR-212 #24-01529 with 34-94, 52-52, 28-88, 73-73, 37-97, 31-91, 94-94, 58-58 and 55-55. Duplex transmit and receive. Jack Smith WB2CDL, 53 Orange Ave., Staten Island NY 10302.

LETTERS

NOT SURE

Last year I saw an article in your magazine (I think it was your magazine, but I'm not sure) which interested me very much, but I have forgotten what it was. I wrote the name of the article in my notebook after I had read it, but I have lost the notebook.

I have also lost the magazine which the article was in. Will you please send me another copy of the magazine, if it was your magazine?

Wayne Schuler EP2US
Tehran Iran

P.S. Keep up the good work . . . whatever it is you do.

Try the Guide to Periodical Literature, *Wayne. Perhaps you'll find a reference to your missing article! — Ed.*

HARMONY

I harmonize with your February 1977 *73* editorial. But I cannot sing, so I yodel. I am heart hurt over the ARRL *QST* format, monstrosity advertisements, miniscule matter of direct interest to me (licensed since 1935 — W6MMZ and KL7DG only calls — past 12 years with FCC Monitoring, Anchorage). I am an ARRL member and once served as Alaska SCM. Recently I subscribed to *Sky and Telescope* in place of renewing *QST*.

Enclosed is a copy of my QRPp 27 meter band proposal which *Worldradio* carried for me but *QST* would not print. Can you give this idea some emphasis? FCC has not yet responded to my proposal of January 7, 1977, but I am braced for a long wait in this quarter.

John P. Trent KL7DG
Anchorage AK

I am proposing shared use of 11.300 to 11.325 MHz by very low power A-1 emission only for the Amateur Radio Service with the Aeronautical Mobile Service on a shared non-interference basis, worldwide.

Power limit for the Amateur Radio Service would be 5 Watts input. This would provide better than 15 dB protection in all areas of the world.

This proposal has been prepared in an original and 19 copies in response to Docket No. 20271 dated 6 December 1976 which treats WARC-79 allocations with the binding effect of treaty to signatory countries until the year 2000.

In this Docket No. 20271, the Amateur Service is marked for a reduction of its 15 meter allocation by 250 kHz shaved off the top of this band and reallocated to the Maritime Mobile Service. This is a significant loss of frequencies not entirely offset by proposing the addition of 50 kHz to the bottom of the 20 and 40 meter bands and the establishment of 160 to 190 kHz low frequency band for amateurs.

For more than a decade, the 11.300 to 11.325 MHz section has been observed by me. I have noted quite limited use of these frequencies by the Aeronautical Mobile (R) Service. On a nightly basis, unlicensed Chinese fishing boats with spurious A-1 emission use the 11.300 to 11.325 MHz frequencies for navigation and commercial fish catch information.

Insertion of a vaccine type active amateur on very low power will serve to develop thousands of intruder watchers to assure the band purity for primary use by Aeronautical Mobile Service.

John Trent KL7DG

HIGH STANDARDS

First of all, I would like to congratulate you for the fine efforts that you have put into amateur radio and also *73 Magazine*. I do not always agree with you, nor do I enjoy computer articles, but it is impossible to please all of us.

Being from Canada, perhaps it is wrong for me to criticize the FCC license standards, but I feel it is wrong to keep lowering the high standards of amateur radio to accommodate a small group of lazy individuals who cannot be bothered to put forth a reasonable amount of time and effort to become amateurs. I for one am not against a Novice class license, as it provides valuable on-the-air experience, but I do feel that the present code and theory tests are too relaxed (with the recent power increases). If the present trend continues, all we will get out of this is a glorified Citizens Band, which I am sure no serious amateur ever wants to see. The present rules which allow a person to go from Novice to Extra class in almost no time at all are wrong, as a lot of extra studying does not make up for time-tested experience.

The majority of amateurs are far too eager to get onto voice. Anyone can learn how to talk into a mike. It's done every day by common people, but it takes a good amateur to become proficient in CW. Tune across the CW portion and see how much really good CW you can find. Sure, there's a lot of speed, improper spacing or none at all, and Es and Rs sent like Fs. CW is nothing to be ashamed of — it was the beginning of amateur radio.

The benefit of properly conducted code and theory classes, along with good study material, cannot be overemphasized. The *73* code tapes and study guides are excellent, whether you are just starting out or are planning to upgrade your license.

I would like to explain what a Canadian amateur has to do to get his first license. First of all, there are only two classes: Amateur and Advanced. The first item is the following seven diagrams: (1) an AM and CW amateur receiver; (2) an AM and CW amateur transmitter; (3) a full wave tube-type or solid state power supply and necessary filters; (4) an overmodulation indicator; (5) a series or parallel wave trap; (6) a frequency measuring device (100 kHz crystal calibrator); and (7) a key click filter. A pass mark of 50% on diagrams is required. The theory exam consists of 50 questions, 25 on theory and 25 on rules and regulations. There are 4 different exams for those who write in groups, so the person beside you will get a different exam. The pass mark on theory exam is 70%. Many of the questions on our first exam appear on your Advanced or Extra class exam. The code exam is 10 wpm on both send and receive, and lasts for three minutes. The pass mark is 100%.

Our first license allows us to go on any portion of any of the HF amateur bands, but with CW privileges only. We are allowed voice on 6m and above. After six months we may apply for a 10m voice endorsement, but we must send in our logbook so that the DOC can be sure we have enough hours logged before it is approved.

Before we are allowed to write the Advanced exam, we must have held the first license for at least one year. The Advanced consists of a more stringent theory exam and a 15 wpm code exam (both send and receive, again for three minutes).

Power limits are 1000 Watts input for both classes, but on 160 and 432 there is considerably less allowed.

Garry Miller VE6AKW
Redcliff, Alberta
Canada

THE AVERAGE

I have been reading your magazine for about a year now, and overall I am very pleased with it. The articles are broad in scope and cater to many varied interests. However, from my own point of view, perhaps I can offer some constructive criticism.

I consider myself to be typical of the "average" ham. My station is fairly modest, and I operate SSB and CW, although I do have a desire to branch out into other areas. The trouble is, I really haven't seen the type of introductory articles in *73* that are both informative and easy to read. The articles I have seen are either at one extreme or the other: so basic that they offer virtually no concrete information, or so technical as to be above my head. I guess I'm referring specifically to RTTY and SSTV. Many excellent articles regarding other areas have appeared. How about some intro articles or even a series for guys like me?

You get input to your magazine from people like me who take the time to write. But what about all the other "silent" pens out there? Have you ever considered printing a detachable survey in an issue of *73*? I think there are a lot of guys out there who would like to see some really practical articles, e.g., how to build a steel tower using readily available materials, beam construction, etc.

I've been tempted to write a couple myself, but don't really know how to go about getting them published. So much for my criticisms. Regarding yours (of the ARRL), I think that while at times it is outspoken and unfounded, it *is* necessary. The ARRL *could* use some changes, and someone has to speak out. As an ARRL member, I can't recall them asking me if it was OK to build that new wing on their building. Perhaps the funds could have been put to better use elsewhere.

Maybe you don't agree with some of my ideas, but I think it is important that you get as much feedback about *73* and amateur radio as possible. And seriously, have you ever considered starting an organization analogous to the ARRL?

Gregg Corsello WB3CDK
Pittsburgh PA

Check our new "RTTY LOOP" column for beginning info, Gregg. — Ed.

RISQUÉ

A great deal has been published in *73* and several other amateur magazines concerning improper operation, questionable conduct, and risqué comments on the ham bands. However, a major problem has been ignored, or forgotten.

I have been a ham for almost a decade, and have heard just about everything on the bands, including a favorite (?) station in Newington CT, which choses to jump right on the West Virginia phone net, the night following the disaster in that area, only to announce, over the net control, that the frequency, 3990 kHz, was an emergency frequency. This is almost minor, though, compared with the problem of prospective hams being driven away by the "ham in a rut." Such operators consist of people like one I spoke with on the air the other night, who kept referring to "we" ("we are studying for our doctorate . . . we have been licensed for fifteen years," and so on). I honestly believed that the person with him (his wife) was also a ham, and was also studying for a doctorate. He sounded upset when I congratulated him and his wife on their achievement, as he must have thought everyone knew that "we" means "I".

Boy, am I weird!

Other all-time greats include "XYL" (how would a male operator like to be called XYM?), and the assumption that all hams are OMs. My wife Nancy recently received her Novice ticket, and has received subscription offers from *QST* and *Ham Radio* which opened with "Dear OM." Her name is not usually used to name anything but women or girls, right? And then they have the nerve to expect her to subscribe? Those letters were promptly filed, not by a person who objects to being called a person's wife, but by a lady who objects to being called "OM."

Then there is the usual "Hi-hi" which is often used for a laugh on phone. If a person responded to a joke while talking with you in person by saying "Hi-hi" you may be tempted to call for the men in the white uniforms. It is also rare that you hear a contact (pronounced kyoo-soh) which does not contain at least ten "Rah-gers," or *someone* saying "ahhhhhhhhhhhh," while trying to think of something else to say.

Nobody should be expected to use perfect grammar at all times, but if you record your half of your next few contacts on tape, you may find that you may be boring other people into oblivion! I tried this method, and cured myself of saying "uhh" (too many "uhhs" can drive a prospective ham away forever). I have heard from many a Novice who could not understand why the clichés used on the air have to be used at all. Do they?

Jerry E. Falletta WA2DWN
Elmira NY

No! You said it, Jerry. Unfortunately, many of the old CW timesavers have been applied to phone where they lose all their value. Let's speak English. — Ed.

KNEE JERK

How about a reasonable approach to the CB problem? At least they could try it while holding off a little while on the linear ban. I hope you will push this or some reasonable alternative.

Roger H. Taylor K9ALD
Champaign IL

Federal Communications Commission
Washington DC

Gentlemen:

I seldom write to any government agency, but your proposal for a ban on linear amplifiers capable of operating at 27 MHz, and for type acceptance of amateur equipment, has got to be one of the poorest thought-out regulations ever conceived. Let me point out a few of the negative aspects and then go on to make a much more workable suggestion.

First of all, you are punishing, both economically and otherwise, a large group of innocent people, namely amateur radio operators, for the law-breaking activities of an entirely different group of people. You would also be perpetrating a serious negative effect on the various purposes of amateur radio, particularly Sec. 97.1b, and many of your previously restrictive regulations have made it difficult enough for amateurs to live up to that section. Despite this, virtually every major advance in the communications art has come from amateur radio, as you well know. Don't hamper us even more.

Your proposal is a typical "knee jerk" bureaucratic reaction to public and congressional pressure to do something even if it is wrong and shows a real lack of understanding of human psychology and the facts of life, as many of your past decisions have also shown (such as the $20 CB fee that started the mass illegal operations on CB). Your proposal will do nothing to solve the problem that now exists or affect it for the next ten years at least. There are millions of linears now in existence and in the hands of CB operators. You will simply put many more people to work in their basements turning out bootleg amplifiers. Your proposal will have the same success as prohibition — for the same reason. Many CB operators use high power amateur equipment without linears anyway, and if you think that type acceptance of equipment will prevent modification, regardless of any laws passed, you have your head in the sand and no real appreciation of the technical competence and ingenuity of the American people.

Your limited resources have already forced the abandonment of some type acceptance for CB. Why on earth do you want to add even more of a load when you can't handle what you have got already? There is a much simpler way. Make detection and punishment for illegal operations much more probable, in the following manner. Since it is in the interest of the broadcasting industry to eliminate unlawful interference, ask their cooperation in making a few "public service" announcements, briefly stating why it is in the public interest to maintain legal, proper, and interference-free use of the public airways for everyone's benefit. Give a toll-free number for people to call to report interference, and ask them to give as much information as possible. A few of these announcements, which you could start next week, would drastically reduce the problems immediately. Just the knowledge that the FCC was really serious about stopping it, and the availability of a number that would be used to pinpoint illegal operation, would have real effectiveness. Your publicized raids have had a real effect already. Use psychology to help you, instead of trying to row upstream against it. If I knew that every time I fired up an illegal transmitter several people within a block of me were going to tell the FCC where I was (within a few hundred feet), do you seriously think I would do so?

This is a real opportunity for a government bureau to show both Congress and the American people that they can act quickly and effectively against a real problem by enlisting the aid and cooperation of the people, rather than taking many months to impose ever more restrictive and unworkable regulations. The cost to both the government and the public would be minimal. Certainly the broadcast industry would be willing to carry a public service announcement by the FCC which regulates them and is definitely in their own interest at no cost to the government. Abraham Lincoln said that the government should do nothing for the people that they can do for themselves. It is about time the government realized the wisdom and value of that statement. The political benefits from this approach and the publicity from a visible cooperative effort between a government agency and the public can't help but benefit both. If you really want the interference problem solved in the foreseeable future, this is a swift and sure way to do it while punishing *only* those who are guilty. The publicity and fear of detection alone would stop over 90% of it and make the rest of your cleanup job infinitely easier.

Somewhat along the same lines, the opening of ten meters to the Technician license would strongly encourage the transfer of the millions of CB operators who are now becoming interested in radio communication to join the ranks of the amateurs. The jump from nothing to the General class license is just too big for most of them. There is no logical reason to restrict ten meters, now relatively empty, to General class licensees, with millions of people wanting to use it if they had a fighting chance of earning a license to do so. Amateur radio has shown a tremendous ability to be self-policing and there is something about earning that license that makes people want to use their privileges properly. You brought in incentive licensing, which has stymied amateur growth for 10 years; now use that concept in a positive way by making it easier and more attractive to those who are interested in long distance amateur operation to get started in the type of operation they desire on the (near) frequencies they are used to using. You started this whole CB mess and have compounded the problems with some very unwise and short-sighted decisions. *Don't punish the wrong people with even more of the same.*

Roger H. Taylor W9ALD
Champaign IL

UPSALA QUAD

When building a boomless, 3 band, single feeder quad, I faced the following problems:

1. Element lengths had to be adjustable, which meant adjustable fastening points on the spreaders (no stubs were used).
2. Because of the complex geometry caused by the common feedpoint, the corner points of the elements also had to be adjustable in order to divide stress between elements and assure a perfect quad shape.

As most magazine quad designs were found to use very primitive

methods for element fastening, I found I had to work out my own solution. The following points should be noted:

1. A hose clamp allows sliding the element along the spreader.
2. The element is made from soft plastic-covered stranded wire that slides, when necessary, relative to the piece of copperless glass/epoxy board.
3. A small stainless steel shackle (can be obtained from distributors of yachting equipment) allows complete removal of the element.

Erik Basilier SM5ASO
Florag. 15
S-752 28 Upsala
Sweden

EXPEDIENCE

Two articles in March *73* concerning MARS have caught my eye.

In the first, by Marc I. Leavey WA3AJR-ACM3AJR, it appears that Dr. Leavey is either not very familiar with Air Force MARS callsigns, or that Air Force MARS has made an error in mine. And I'm relatively certain that the latter is not the case.

Having been the Air Force State MARS Director for Kansas at the time the callsign changes were made, I became fairly familiar with them. AF MARS callsigns formerly were:

Prefix	Air Force
Wn	AFn
Kn	AFAn
WAn	AFBn
WBn	AFCn
WNn (Novice)	AFNn

When changed to the three letter prefix, the callsigns became:

Wn	AFWn
Kn	AFAn
WAn	AFBn
WBn	AFCn
WBn (Novice)	AFCn (Novice)

The most expedient route, that involving the least additional paperwork, was to change the Wn call to AFWn. During a time when paper costs have been rapidly increasing, Air Force MARS should be commended for its insight.

Novice calls remained unchanged until the FCC began issuing them WBn calls, at which time they also became AFCn.

In the second article, where it is stated, "There is a place where Tech-

nician class licensees can operate SSB on HF, and where Novices can operate voice on 2 meter FM," just what is there to prevent a Novice from now operating SSB on HF? I think that he may in Air Force MARS.

Further in this article, extra privileges, distinctive callsigns, and access to surplus equipment are alluded to. But if a potential member signs up in MARS solely to obtain excess property, he just may find himself storing excess government junk along with that that he can use. For in the past, some items have come out in that condition. Steps have been taken to rectify this situation, so it should be better in the future.

One final thought. The address given for further information is that of Army MARS only. Perhaps you should dig out the addresses for the other MARS services also, and present them. The AF MARS address is Command MARS Director, Hq AFCS/DOYR, Richards-Gebaur AFB MO 64030.

D. M. Casselman
WAØGSY/AFBØGSY
Conway Springs KS

KEYER UPDATE

You may be interested in the enclosed comments on "Build the World's Simplest Keyer." Re your May article, "Stop Timeouts!", I hope that you can join with us in trying to kill the idea of "10 minute timers." What the timer says is, "You just broke a regulation!" Better to set them at 8 minutes or 9 minutes. Of course, the timer with readout partially fixes this.

Another problem is short transmissions, since the other guy might take over and still be sending when your ID is due. Therefore, it is always best to give one sign when turning over. Also, note that phonetics generally are necessary with phone, to prevent misunderstanding the call.

E. H. Conklin K6KA
La Canada CA

Andy Ring
Yarmouth ME

I was interested in your article in *73 Magazine* (May). It may be that it can be simplified some more, and improved.

I note the relay, which is a "no-no" in CW because of the mushy key clicks when one gets contact bounce in them. Note *73* for September, 1965, ("Der Kleiner Keyer," by E. L. Klein). He simply used a PNP transistor, handling 150 volts, and keyed the transmitter grid circuit directly, with no relay. Cheaper than the relay, too!

Next, there are four pots. That makes it both complicated and expensive. For one thing, one might get rid of the "weight control," as being undesirable. Second, it may be possible to use only one pot to control both the dot and dash sides, possibly by using the right capacitors for the dots and dashes and the one pot. It appears that there are some alternatives to the second (dash) 555. One is to make it simply fill in the space between dots, as "Der Kleiner Keyer" does with a flip-flop. It seems that it can be arranged. The other alternative is to dispense with the 555 and use a flip-flop to do the filling in, with no adjustments at all.

As to VR1, it may not be required. I don't use any in the Kleiner keyer. If one uses a bridge rectifier and a 6.3 volt transformer, if available, one comes up with a pretty fair voltage to operate the keyer if no VR is used. The possible shortcoming might be not having completion of a suitable space after each dot or dash. Where there is a free running MV, this may be almost automatic, of course, within a letter. So putting in something for space between letters may be a complication.

You might look at the combination ICs which include a multivibrator. They may handle most of the keyer in one piece without a lot of external parts, if you find the right thing. It might be best to look at the CMOS availability anyhow, in order to cut the power drain down so far that you can go to a battery and throw away the on/off switch, remembering that the 2N398B keyer transistor runs off the exciter grid current, and does not get any power from the keyer.

E. H. Conklin K6KA

MORE TECH DEBATE

I am writing regarding the letter in your Feb. '77 issue, "Tech Relax," from L. N. Thompson. I apparently missed your editorial on the subject, but agree strongly with Mr. Thompson.

I feel that Technicians should be allowed use of SSB phone privileges on some parts of the 10-160 meter HF bands. If not, then I believe that the current 13 wpm code standard for General class should be reduced to 10 wpm. I have written the ARRL and the Chief of the Personal Radio Division concerning the above.

I urge everyone who feels that the present 13 wpm code speed is too high for the General license and that Technicians should be granted some SSB phone privileges on the HF bands to write the FCC and their congressmen and senators. I personally am sick and tired of hearing the older hams make statements like, "If they want higher privileges, let them work for them like we did." No wonder there is such a high dropout rate of Novices and Techs. No wonder so many Techs get on 2m FM and stay there. I admit that 2 meters is a busy band, but I have yet to hear it sounding like the CB frequencies — so that is no excuse for denying HF SSB phone privileges to Technicians!

Most of us have spent a lot of money on our hobby and equipment only to be denied use of it because of snobbish and archaic standards established many years ago.

Although my subscription just started this year, I am renewing for another year. Keep up the good work and the excellent articles.

John A. Magness III WD4BVU
Murray KY

"Kitty" is WBØDQW's latest ham convert.

KITTY

Enclosed are some photos which may be of interest to you. As you can see, my recruiting efforts for amateur radio do not stop at human beings. Kitty didn't think much of the key, though.

Thanks for your fine magazine. Keep up the good work!

Neil Preston WBØDQW
Kansas City MO

HEX TO BINARY

Small point, but I'm curious why Joe Larson's letter (page 116, Feb. *73*) misquotes the figures he is using for illustration. Joffe's article uses the expression "3A7B"/Decimal 14971 (page 94, Holiday issue). Larson quotes this as "39BD"/Decimal 14781. Larson's points are well made, especially the conversion from hex to binary.

Bill Straley
Campbellsville KY

NO PR-40?

WA4KDC's operating system appearing in the March, 1977, I/O section of *73 Magazine* is fantastic! The only problem is that although everyone should have it, not everyone does have a PR-40 printer.

I thought you would be interested to know how I slightly modified the program to allow printout on my Teletype. The modification consists of modifying addresses beginning at 01EE with the following:

01EE BD E1D1
01F1 33
01F2 FE A014
01F5 39

Jim Huffman WA7SCB
Hufco, Inc.
Provo UT

EARTHQUAKE

On the evening of Saturday the 5th of March, I assisted people searching for relatives in Romania during the recent earthquake there.

I wish to remark here that besides all kinds of complaints about the traffic on the upper part of the European 80 meter band, the traffic was handled in a very efficient way, with little amateur QRM. Everyone requested to stand by or QSY did so in the best possible way.

The network established traffic between Western European and Israeli stations, via Daniel YO8AHL in Iassy (located about 500 km north of Bucharest), to Bucharest, the capital city, where other amateurs and what was left of the telephone system did the rest. Also, I would like to thank the Yugoslavian stations that gave me assistance in finding the Romanian emergency network's frequency.

Jac Lirola F6CVU
Truchtersheim
France

THE HFERS

One of the acknowledged factors in the increasing proliferation of the so-called "Hfers" is the easy availability, without challenge, of amateur equipment to non-amateur persons. This accessibility has led to serious talk, even a Notice of Proposed Rule Making, of banning the sale of linear amplifiers capable of operation between 25 and 35 MHz.

It seems, therefore, that because of a few unscrupulous dealers eager to make a quick buck, many amateurs may either be unable to buy a 10 meter linear, or will have to pay a higher price to offset type acceptance costs. At least one dealer in Chicago and one in Milwaukee have no interest in whether a potential customer is or is not a licensed amateur. Spectronics in Chicago, on the other hand, states quite clearly, in ads and in their store, "No call, no sale."

It makes me proud that Art Householder and company have chosen to eschew a few extra sales to help preserve the integrity of the hobby. And, he enjoys my business as a result. My challenge to you is to do your part in preserving the integrity of the hobby by tightening up your already comprehensive advertising policy to refuse space to those dealers who do not restrict sales of amateur transmitting equipment to licensed

amateurs.

Word of mouth is a pretty effective policing system (witness Trigger), and any advertiser not living up to the rules would be quickly exposed. Remember — today the linears, tomorrow the transceivers.

Rod Peterson WB9UQX
Carol Stream IL

THE NEW BREED

I am writing this letter to you and to those who would submit construction articles to you in the future. I would like to think that I am speaking for several thousand newcomers to amateur radio as well. Most of us cannot read schematics. Most of us do not have "junk boxes" stuffed with scrap suitable for use in construction projects. And many of us do not have a fully equipped machine shop at our disposal. The nearest electronic parts supplier is usually a Radio Shack store. And, we do not appreciate being referred to as the new breed of ham who buys his rig and plugs it in, but with such poorly illustrated construction articles, you don't leave us much choice. If a picture is worth a thousand words, then many of the projects could be shortened with the insertion of pictures showing the parts layout.

So please help us gain the expertise you have by submitting and publishing complete photos of your projects, parts lists, and suppliers of parts. Please be accurate in your details.

Think back to when you were a newcomer to amateur radio and help us get off to the right start.

John A. Magness III WD4BVU
Murray KY

P.S. I would like to buy any back issues you may still have. Please send list and price.

Right on, John. Old-timers, take note! Check any recent issue of 73 for a list of back issues. — Ed.

THE FAMILY

I just finished reading "HAM vs CB" in the May W2NSD/1 editorial. I am one of the many hams who came here through the CB *family*, as you called it. I received my membership papers to the family in February, 1976, and by March was so discouraged with the situation that I immediately contacted the Bluegrass Amateur Radio Club to get information on a Novice class they were holding. By July I held WA4RUW with Novice privileges. It's nearly a year later, and I am still a Novice, but I don't want to get back on 11 meters just to operate phone. You feel that CB is in a different family and hams have no business messing in those affairs — I agree partially. But when I go down to 10 meters to look for a rare 10m QSO, all I find is "Harry Top" talking to "Junk Yard Dog," on 28.169 MHz! Do you still feel like we shouldn't mess in those affairs? Being an ex-CBer, I used the old tactic of more power and zero beat, and started calling CQ on frequency. The reaction was surprising — more power and four letter words! The two handles used are fictitious, but the incidents are true. With 11 and 10 meters so close, CB is a close cousin to ham, and I feel there are some family affairs we need to concern ourselves with.

Bob Cornett WA4RUW
Lexington KY

11M TO 10M

I read with great pleasure the article by Bob Wilder ("CB to 10 . . . A Legal Alternative," May, 1977), and strongly endorse his plea to encourage the use of CB transceivers on ten meters. I would, however, suggest one major consideration which I think should be worthy of serious thought, at least as a viable alternative: the use of an external transverter, rather than internal modification. A number of transverter articles for VHF bands have been published. The advantages of this approach are numerous: no modifications to the CB set to destroy its resalability; no tampering with the transmitter section rendering the set illegal for further CB use; simple external switching would provide alternate CB or ten meter use. The band plan suggested by Bob Wilder would still maintain its integrity, as the heterodyning transverter would still provide the ten kHz incremental tuning which he suggests. A standardized (hint to prospective manufacturers) transverter would be applicable to any CB transceiver, and complicated internal synthesizer formulas would no longer be a consideration. See you on ten!

Bob Grove WA4PYQ
Davie FL

OSCAR ORBITS

A common assumption regarding the OSCAR satellites is that the period (time of one orbit) and increment (number of degrees west the satellite appears to move) both remain constant. Several programs appearing in *73 Magazine* recently use this principle to calculate the position of the satellites by inputting a starting position (equatorial crossing point) and time, and incrementing the constant interval for the succeeding orbits.

I wrote a simple BASIC program to do exactly this, and everything looked fine until I ran out the calculations to the end of the year (4500 or so orbits). There was a small but appreciable error which I couldn't account for when I compared my results with the book of orbital times published by Skip Reymann W6PAJ. This book was compiled from data computed by Tom Clark WA3LND, so I wrote him. To quote his note to me, "Since the period and orbital longitude increment are *not* constant, . . . I provided W6PAJ with weekly period/longitude increment data, but he chose to print one value for the year."

So, programmers beware — your results will be close, and will be usable, but they won't be entirely correct.

Warren Munro KH6GSH
Aiea HI

CHEAPER THAN EVER

I have subscribed to *73* for about four months now, and I have come to conclude that it is the best amateur radio magazine on the market. When I pick up a magazine, I expect to see articles that I can get some good reading out of and that I can learn a thing or two from.

I really enjoy your I/O section and I hope it will stay the way it is even though the new magazine *Kilobaud* has come out. I really wish I could subscribe to *KB* but my budget doesn't allow it.

I am really interested in WA0TSY's idea about converting CBs to 10 meters, since I used to be an avid CBer and have some equipment around that I am willing to make the switch with. I hope others will see this idea so that it may catch on, as CBs are cheaper than ever, and this would be an economical way to get on 10 meters. Maybe you could include some articles on this idea and conversion details in your upcoming issues of *73*.

John H. Peeler WA4UYI
Denver TN

They have started coming, John. See last month's issue. — Ed.

PC REFORM

A hearty "well done" to your staff for the articles on printed circuitry! I just had a chance to finish reading both of them and I must say I wish I could have read these articles three years ago when I started working with printed circuitry. I had to develop my own methods and spend an indecent amount of money to get good results. Your readers may not realize how difficult it normally is to get good information on PC fabrication. The majority of the trade manuals are as vague on such items as exposure times and others as a politician is on political reform. And many magazine articles leave out critical information, to boot! Thanks again for putting a light at the end of the tunnel!

I can't resist putting my two cents worth in. If you are working with PC fabrication for the first time, follow each step carefully and use fresh materials. Then, after you are successful, you can take shortcuts. If you start with the shortcuts, you will probably end up with a bad board and no idea of what went wrong. And that means confusion!

If you have a problem with the resist washing off the board during the

see page 205

etching process, this means either that the copper was too dirty or the copper was too smooth. You can often solve this problem on the next try by drying the exposed and developed board in a warm oven. Once the moisture evaporates, the resist tends to stick tight. Try it!

Let me wrap this thing up by quoting a phrase I heard from many a PC professional fabricator: "You can't make PCs for under about $100,000!"

Gary McClellan
General Manager
McClellan and Company
La Habra CA

THE RUB

I enjoy the contents of *73* except for one thing. Whenever *QST* is mentioned, it usually gets its nose rubbed in the dirt. Doing that does not help your magazine. If anything, it detracts from your publication. Perhaps jealousy is the motive? Why not improve your own magazine by omitting the derogatory remarks about *QST*?

David Keith WB0GUE
Marble Rock IA

None of the other publications seem to have any opinion at all, David. If your only suggestion for improving 73 is the elimination of controversy, I guess we are doing pretty well. — Ed.

KUDOS 1

While I am spending postage to write about another matter, I thought I would let you know about the quick efficient service that Hamtronics, Trevose PA provides — time after time!

Edwin Steeble K3IXD
Glenwood MD

KUDOS 2

I bought a Gold Line coax switch at a local radio store only to find out that it didn't have a connection on position number two. So I wrote Gold Line a letter explaining the difficulty. A few days later I received a new switch from them, postpaid. Just thought that I would let you in on it, and the other readers, too.

Dan Renfro WA4PXV
Mt. Pleasant NC

BE MY GUEST
visiting views from around the globe

Dayton: Reporter's Notebook

"It was the ham radio event of the year in several ways — the new growth of the hobby was obvious . . ."

Dayton 1977 was the biggest yet, with thousands more than the organizers expected. At deadline, the estimate of attendance was well over 16,000, although ticket numbers higher than that were heard over the hamvention PA during the closing hours. It was the ham radio event of the year in several ways — the growth of the hobby was obvious as crowds six and seven deep kept the booths busy most of the day Saturday. A three hour traffic jam around the Hara Arena earlier in the day forecast the afternoon crunch. Dayton's flea market was everything it was promised to be . . . acres and acres, with waiting lines in the early hours. (The local repeaters had warned in advance that flea market types better get plenty of sleep Friday night, so they could get a good spot or catch some good deals.) They opened the flea market doors at 6 am both Saturday and Sunday!

There were over a hundred exhibitors. Many said there were more dealers than manufacturers this year, showing less new equipment than expected. Dentron Radio, for example, put off introduction of their new transceivers until fall, while Drake was ready with their new UV-3 triband VHF/UHF transceiver. The radio offers a fully synthesized FM system covering 2m, 220 MHz, and 450 MHz, 25 Watts output, plus a variety of accessories. The unit can be separated from the power supply and main section, for remoting the control head. The Drake uses a PLL system for frequency control, with digital readout. There was also the return of the Signal One transceiver, from yet another manufacturer, Signal One Corporation. The price is up to $3999.95, but company representatives say the new CX-11A is totally redesigned (although the appearance of the rig remains much the same).

One of the Dayton VIPs was Carl Mosley of Mosley Antenna fame.

There were also the new CIR transceivers, which feature digital tuning of the 80 through 10m bands. Two switches control frequency, one a fast attack, the other a slow scan rate. The size is very small, considering the fact that the Astro 200 is rated at 100 Watts output. Accessories include a station operating console, speaker, and ac supply (the CIR normally runs on 12 to 14 V dc). CushCraft introduced a new line of HF trap vertical antennas, while Dentron showed a new 1200 Watt HF amplifier (half the MLA-2500 package, but without 160m coverage) and a new tuner to match the MLA series, complete with built-in 250 W dummy load and twin front panel wattmeters for continuous monitoring of forward and reflected power.

Among the more interesting accessories introduced at Dayton was RF Engineering's DFD-100 digital frequency display for use with Collins, Drake, Kenwood, Atlas, and Swan equipment. Readout is accurate to the nearest 100 Hz without band switching or mode switching. Hookup is easy, especially for Drake or Collins gear where the necessary frequencies are available at the back panel of the radio. Spectronics showed a unique outboard device for the popular Icom 22S 2m rig. It's called the Specscan, and it does a score of things, including full scan of the 146-147 MHz band in 15 kHz steps and VARI-SCAN™ which allows full scanning control of the scan rate in either direction. Power consumption is less than 500 mA, and automatic channel lockout lets you scan past any portion of the band. All this can be done without major surgery or giving up normal operation of the 22S.

Heath had a prototype of their new CW transmitter, which matches the HR-1680 receiver, while KLM was showing off their newly acquired 6m SSB rig, a National (of Japan) import. It is similar in style to the Hy-Gain 3750 HF transceiver, which is also made by National in Japan. Atlas, aside from enjoying the high demand for their popular 210X and 215X transceivers, showed their new 350-XL transceiver, although they were not expected to be available until early summer. Robot kept a crowd with videotape of NBC correspondent (and hamvention banquet speaker) Roy Neal K6DUE explaining SSTV to a national TV audience via a Today Show segment last winter. The story covered the N6V operation during the Mariner mission to Mars and marked the first time that both ends of an amateur QSO were broadcast live on national TV. Kenwood kept everybody wondering how they could afford a new TS-820 transceiver. The icing on the cake was Saturday's visit of Neil Rapp WB9VPG, the world's youngest licensed ham. Kenwood had given Neil a TS-520 for his 6th birthday, and his appearance at the Kenwood booth only added to the crunch around the company's display.

On the whole, dealers outnumbered manufacturers, and it was clearly a buyer's market. Prices were slashed early, with some dealers complaining that it would have been better to stay home and sell their goods without the pressure of the price cuts. There were also grumblings about the hours booths were open, as many exhibitors returned to their motels with sore feet and mild cases of exhaustion each night of the hamvention. While the exhibitors were resting, convention goers were treated to dozens of informal gatherings, ranging from the annual "FM Bash," to an ATVers' session. The parties went well into the night.

The forums were well attended, with something for everyone. The biggest turnout was, of course, for the FCC forum, which proved to be a bit disappointing. FCC Personal Radio Chief John Johnston did not take questions, presumably because of that Federal Court ruling on the Commission's alleged failure to follow its own rule making procedures. The ruling ("Briefs," June *73*) limits informal comments, such as hamfest bull sessions, without a written record for the appropriate public file.

In his talk, Johnston was strongly critical of high power amplifiers, knocking *QST* for publishing a recent construction article on the subject, and terming "brazen" the sale of a 10,000 Watt linear in the hamvention flea market. Johnston was preaching QRP, and, in light of the Carter Administration's energy proposals, his warning that "the day of the over-powered bully operator" must be numbered rang especially true. (Full details of the FCC forum can be found elsewhere in this issue.)

On WARC, amateur radio advisory

"A big part of the Dayton story was what happened outside the Hara, on the roads into the city, along the interstates and in the air terminals, where amateurs flocked for transportation to Ohio . . ."

committee chairman Peter Hurd K4NSS presented a half hour long explanation of what the frequency conference is all about and how the US is preparing for it. Hurd was thin on details about what is actually happening, although there were some hints — his reference to the Jack Anderson column, and the "tremendous interest" of the civil sector in the rf spectrum as a "gold mine" over the long term. (Hurd told the forum that the Anderson column could be traced to those same interests.)

He also warned that there had been a lack of reaction to the WARC proposals. "The concrete is beginning to harden on these proposals," Hurd said, "and comments are very important." Hurd identified the key issues ahead as a definition of what criteria would be acceptable for sharing bands, and what to do about 220 MHz. "The committee would appreciate your input on why we need 220 MHz," he said, "and why we can't share it with Class E CB."

As for keeping frequencies, Hurd showed several charts illustrating how amateur radio's position has changed over the years. In 1935, for example, the amateur population dominated the stations on the air in the US, whereas there is but a small percentage of hams (as compared to other users) on the air today. Hurd put the

"I nearly drove off the road on the way home, when Dave WD8CYV drove by on his motorcycle holding both hands in the air and showing the classic 52 signal . . ."

committee's feelings this way: "We're not on the air because of numbers, but rather because of the quality of the service we provide."

He went on to warn that we have to grow up into the 10 GHz band and beyond, to look 20 years down the road and plan for the future of amateur radio. "It's a long-term investment," said Hurd, "with the viability of today's bands limited to a very real point by how convinced the decision-makers are as to how well we're using those frequencies." Hurd did not appear optimistic, in great contrast to the League official who was telling convention-goers that "WARC and Jack Anderson are under control . . . we're right on top of it . . ." Hurd's advice to amateurs worried about WARC? "Remember that every frequency is an international one — whether it be 2m or 20m, the internationals are listening." Hurd pointed out that foreign governments maintain offices in major US cities, thus opening the door to reports home on the use of virtually every band. He also noted that the next step in WARC would be the release of a 5th notice from the FCC, due out by late May.

A big part of the Dayton story was what happened outside the Hara, on the roads into the city, along the interstates and in the air terminals, where amateurs flocked for transportation to Ohio. On Interstate 90, horns would turn to CW, with "52 . . . 52," or a simple "73" exchanged as hams passed. I nearly drove off the road on the way home, as Dave WD8CYV drove by on his motorcycle holding both hands in the air and showing the classic 52 signal! But it wasn't all fun on the highways home, as one group met disaster near Philadelphia. Driving in a sports car, they mixed it up with some big trucks, reportedly killing the driver and seriously injuring two passengers.

Dayton, the city, lived up to what was advertised — the Air Force Museum was super, the motels were generally good, and the town does shut down tight promptly at 6 pm (or shortly thereafter). Getting dinner after a day's work at the hamvention proved to be pretty rough. The first night we got hopelessly lost without a radio (better not take it, I was advised, since it will probably get ripped off),

and the second night we waited in line at a restaurant for nearly an hour before catching on to the fact that the hostess needed $25 or $30 stuffed in her hand before we could get seated. We left instead.

The hamvention itself seemed to have outgrown its bounds . . . the traffic was intense, the hours long, and the crowd huge. It looks like the Dayton club is going to consider moving from the Hara next year, possibly to a fairgrounds nearby. But Dayton is still the biggest . . . it was great fun, although it may just be getting too big for its own good.

Warren Elly WA1GUD
Assistant Editor

Dayton: FCC Forum

If there was a theme in the FCC forum at Dayton, it was probably QRP. Personal Radio Chief John Johnston K3BNS offered some strong words about high power operation, even going so far as to criticize the ARRL for publishing a recent linear amplifier construction article in *QST*. Johnston warned that the day of the "overpowered bully operator" must come to an end, with more work on QRP and developing new ways to measure power. He called the search for new power-measuring devices the greatest contribution amateurs could make to the state of the art.

With FCC staffers taking notes on the sidelines, Johnston came as close as possible to covering recent rule making proposals, without crossing the line on *ex parte* comments as prohibited in a recent federal court decision. ("Briefs," June *73*.) He said the FCC staff had been "under the gun" to deregulate amateur radio by Commission order. In fact, said Johnston, that was his first job after taking over as Personal Radio Division chief. Noting that 1976 marked the relaxation of more regulations affecting the amateur service than any other single year in history, Johnston said amateur radio had turned around, with more growth than the Gettysburg FCC staff can handle.

The growth has created new problems, according to Johnston, problems that are so serious that the licensing structure of amateur radio may have to be changed as a practical matter. License applications were up 50 percent last year, at a rate of around 12,000 per month . . . that's four thousand more applications than the Gettysburg staff can be expected to process. This year applications are arriving at *3 times* the rate that Gettysburg can handle, and 13 staffers have been moved from the CB section to cover the amateur overflow. That brought applause at the Dayton forum, but Johnston cautioned that it was not exactly something to cheer about since he'd be forced by budget considerations to put the 13 workers back on CB tickets in early June.

The licensing boom may be great for ham radio, but it represents a serious emergency for the FCC. Counting repeater applications alone, there is a backlog of over 1300 waiting for callsigns. A closed season has been called on secondary station licenses, and the Commission is looking at the Novice class license as a time-consuming wrench in the works. As Johnston put it, "Amateur applications must drop off, or classes of license will have to be simplified to increase production." "Otherwise," he added, "we will sink in a sea of applications and complaints." Ironically, at that point in the forum the lights went out. Johnston remarked that he couldn't even read the jokes . . . but what he was saying was no joking matter.

The Gettysburg computer was portrayed as a red tape monster, requiring 40 different programs just to grant one amateur license! In the case of Novice tickets, the granting of a license is only the last step in a complicated process which includes checking the credentials of volunteeer examiners, certification of code proficiency, mailing of the written exam, plus keeping track of the exam papers until they are returned. Johnston put it bluntly, saying that Gettysburg soon won't be able to do both the Novice applications and all the other classes. A new computer (and the associated programs) are due next year to replace the rental unit currently in use, and some innovations are possible (like 1 x 3 for Advanced class), but the backlog remains.

Then it was on to the latest bombshell from Washington — the first new regulations from Docket 20777 (bandwidth). Johnston explained that the new limits (40 dB below 30 MHz, 60 dB above) on harmonics and spurs were a reflection of international agreements designed to replace the old "according to good engineering practice" provisions of the current rules. Johnston contends that most manufacturers can meet the new specifications with current equipment, but he warned that it was high time for amateur radio operators to start putting higher technical standards on their equipment and operations. Johnston noted that there had been several petitions for reconsideration from the ARRL and manufacturers claiming severe business consequences, but he did not speculate on how successful the delay tactics would be. (At a meeting of ARMA, the Amateur Radio Manufacturer's Association, President Dennis Had ruled out any postponement, pointing instead to an ARMA-proposed grandfather clause designed to ease the impact of 20777.)

On callsigns, Johnston told the crowd that all W/K 1 x 2 calls were gone in the 4th and 6th districts. What Johnston did not volunteer (or did not know at the time) was that the chief of the FCC's Special Licensing Division in Gettysburg had been indicted on four bribery counts for allegedly taking $100 payments in exchange for 1 x 2 amateur calls. (See "Briefs," this issue.) Johnston, noting that all Extra class licensees will be eligible for 1 x 2s in July '77, said that the major problem in the phased changeover had been allowing people to choose their own calls. Many inter-

preted that to mean no more listings of first, second, or third choices for future callsign availabilities.

Johnston also spoke about the long-awaited comprehensive code exams, which FCC officials assure us are in effect by now at all offices. At Dayton, the word was that all district engineers would be using the new multiple choice CW tests within "days."

"The Gettysburg computer was portrayed as a red tape monster, requiring 40 different programs just to grant one amateur license . . ."

There were no questions asked of Johnston, as has been traditional at Dayton, but he did remain after the forum to field some from individuals. Overall, the FCC's most important man (from an amateur view) left quite a few questions unanswered, at least from the podium. But there were enough strong statements in his remarks to give you the feeling that deregulation and more changes in the amateur service can't be far away. Prime targets seem to be power amplifiers and the licensing structure.

Warren Elly WA1GUD
Assistant Editor

De WA3ETD

PERSONAL SAFETY

More and more hams are becoming active on UHF. If you don't believe it, check out the advertising in the pages of *73.* KLM and VHF Engineering are two notable firms that deal almost exclusively in VHF and UHF gear. The number of outfits that provide some sort of 2m gear is amazing. It has been said that at least fifty percent of the active amateur population is on 2m; I don't doubt it for one moment. The trend in the VHF/UHF tinkerers' community is to reach higher and higher in frequency. At least one progressive company, Microwave Associates, has responded by providing a specially designed microwave transceiver for the ham market. (The product is the 10.5 GHz Gunnplexer, discussed in May's New Products section.) If you are not an OSCAR satellite fan, listen in on the 2m downlink some evening if you have a tunable rig for two meters. Any old omnidirectional antenna will do — those Mode B signals are pretty strong! After chastising yourself for not being on OSCAR, recall that each of those two meter signals was the result of a 432 MHz uplink signal, and if 432 is not UHF, I don't know what is! Many OSCAR users probably do not consider themselves UHF enthusiasts, and are more concerned with the communications aspect of their hobby. The point of all this is that daily more and more hams are using UHF. This trend will most certainly continue as more manufacturers jump into the ring. And don't forget the new OSCAR launch this fall — the one with a 2m uplink and 435 MHz downlink — the first bird to actually use an amateur satellite frequency!

As with any new band, there are precautions to observe. Remember the first time you were on two, and ran 250 feet of war surplus RG-58 up to the old horizontal beam? Didn't get too far, huh! Not only does UHF have its share of technical problems, but also there are questions of personal safety that must be observed.

Most hams have seen or used the now familiar "microwave oven," a device that uses high frequency energy to heat organic material from the "inside out." The relationship between heating effect and rf frequency is not agreed upon by the experts, but one thing is for sure — UHF energy from an amateur transmitter in the 420 MHz band and up can be dangerous in some instances. The problem results when tissues are heated by the radiation faster than can be compensated for by normal blood flow. The eyes are particularly sensitive to UHF radiation. The experts also do not agree on what "power density" can cause damage to human tissue and at what frequency the power must be applied, etc. Industry currently accepts a standard stating that a power density of 10 mW/cm^2 is safe, that is, at the point of exposure the amount of energy passing through a square centimeter in space is less than 10 mW. There has been considerable pressure from medical and research groups to lower that figure, as there has been evidence that eye damage can occur at considerably lower power densities. No one knows for sure. For additional information concerning the effects of microwave radiation and research into the problem, refer to an excellent series, "Microwaves," by Paul Brodeur, that appeared in the Dec. 13 and Dec. 20, 1976, issues of *The New Yorker* magazine. Back to amateur transmitters!

It should be obvious that any amateur UHF transmitter capable of generating power is potentially dangerous. Power density is enhanced by beam antenna systems, dishes, horns, or whatever device is employed to focus the transmitted signal. One should never needlessly expose oneself to UHF radiation. Do not stand in front of a beam operating at 420 MHz and especially avoid exposing the head. Under no circumstances look into the end of a horn or waveguide antenna while the transmitter is operating. Why take a chance when so little is known about the subject of heating and neurological effects?

Microwave Associates Gunnplexers are bound to become increasingly popular. I have been doing considerable experimenting with a pair of these devices and employ a simple method to avoid exposure. The mobile "radar detectors" which are currently transcending CB radios in popularity are broadband devices and will respond with a whistle or whine to almost *any* microwave radiation below 20 GHz. I keep an el-cheapo variety detector activated in the room when experimenting with Gunnplexers, and does it go off when the 'plexer is fired up! It sure keeps me aware when microwaves are present, even though the devices are "aimed" away from myself and anyone else around. One night, Rich Force WB1ASL, *73*'s publications editor, and myself ran a test with a Gunnplexer and the radar detector. The detector went off at distances over 200 yards away from the source of microwaves, and I ran out of space to back up. If you don't feel like springing for a detector, build a simple device using a UHF diode — be smart!

DOES THE FCC KNOW ABOUT MICROWAVES?

A silly question, you say! I received a call late last Friday from a concerned research group on the West Coast. It is common knowledge that a new Citizens Band is proposed for the 900 MHz region. (Microwave ovens function with energy in that band!) Some people are concerned that personal safety may not be the ultimate goal of the Personal Communications Department (FCC). Imagine running 100 Watts into a well-designed beam at 900 MHz. Could get warm, and that's what we are concerned about!

This morning I called Personal Communications Engineering and talked to Mr. Will McGibbon. It turns out that the Chief Engineer, Mr. Ray Spence, was concerned enough with the problem of biological radiation effects that he asked Mr. McGibbon to research the problem. The FCC is well aware of potential problems, and I was assured that the biological question will be addressed before any new bands are opened for public use. There are tons of literature and reports to wade through, culminating in an international convention to be held this fall. Hopefully the question of "radiation standards" will be resolved. There is considerable evidence that the 10 mW/cm^2 standard may be unsafe, although much of the supporting research was conducted by the Russians. Many of the experiments have not been able to be duplicated. I am personally interested in this subject. All UHF experimenters should be. This column will pass along information as it becomes available, but for a primer, try *The New Yorker* articles.

AUTHORS TAKE NOTE

The editorial staff at *73* is busier than ever! Everyone on the *73* end of things has at least two functions, ranging all the way from "pasting up" articles to insuring that authors get paid for their work as fast as possible. The phone also rings several times a day with calls from authors wondering what the situation is with their articles. Possibly a bit of explanation about our system will be helpful at this time.

Articles arrive at a rate of four or five a day, on the average, and are opened and dated by me. Hopefully, within the week they are read, and, if accepted, priced. Rejected articles are immediately returned with no funny business. At the time of acceptance I fill out and mail a postcard indicating acceptance. The card states that "a check and author's proofs are forthcoming." It should say ". . . forthcoming in four to six weeks," as our production and financial people work on a monthly cycle. Once the card is received, you can expect a check in about a month, maybe sooner if it's the end of our cycle, and author's proof sheets, which indicate how your article will look in print. It is very important to carefully check the proof sheets for errors, especially in the schematics and diagrams. Your integrity is at stake as well as ours! Please do not phone two weeks after sending your article wondering why your check has not been mailed — it's on the way! As you know, *73* pays authors upon acceptance, which is unusual in this field. We try our best to publish all material as space permits!

Writing for *73* is easy and fun! There is no better way to partially finance your hobby and become published at the same time! If you have been sitting on a pet project, let us know about it — share your inventiveness with others. Send an SASE for a copy of "How To Write For *73*," which outlines the rules to follow when preparing your manuscript. Please, NO handwritten material. If you can't type, have your article typed — it's cheap. After reading for six or eight hours every day, you would understand why typing is important — thanks!

COMPUTERMANIA

The biggest hobby computer trade show of them all is being held on August 25-27. The place is the Commonwealth Pier in Boston. Sponsored by *Kilobaud* (you have a subscription, right?), the show will cater to microcomputer hobbyists, calculator freaks, the mini crowd, and the small businessman requiring an insight into small systems. All the micro systems will be represented on the exhibit floor, and a steady stream of forums and demos by the manufacturers will be offered to keep you posted on the micro industry. Mark your calendar, and stay tuned to *73* for information as it becomes available.

John Molnar WA3ETD
Executive Editor

Jim Beedle W9NIN and Art Reis WB9YOB have prepared a guide on how to write your congressmen and senators in support of the Goldwater RFI Bill, and its counterpart in the house. They suggest you handwrite your letters, be concise, and stick to just one issue — S-864. See "Briefs" for a listing of key senators. — Ed.

Make S-864 Law!

WHY S-864 MUST BE MADE LAW

I. Constitutional Reasons. The Constitution was designed, among other reasons, to protect what the Declaration of Independence referred to as "certain inalienable rights," including the rights to "Life, Liberty, and the Pursuit of Happiness." And, the First Amendment goes a long way toward fulfilling that protection. Precedent and common sense have further established that "one's rights end where another's nose begins."

As long as the activities of one are not at fault in denying the rights of others, as mentioned above, there is nothing truly illegal about them. Specifically, amateur radio operators and Citizens Banders, as long as their transmitting equipment is designed, adjusted, and filtered properly for the prevention of RFI, have every Constitutional right to be on the air. Likewise, their neighbor has every right to watch his TV or listen to the radio or stereo in peace, as long as he doesn't infringe on the rights of others (i.e., too loud for the neighbors). However, the makers of such home electronic equipment have misused their right to pursue their happiness by making their wares as cheaply and as shoddily as possible in certain respects, while selling them for whatever the market will bear. This is not inherently evil, except insofar as their pursuit of happiness infringes upon the rights of both the consumer and the radio operator/hobbyist to enjoy their separate avocations in peace and harmony in the same neighborhood. Then it's time to do something about it. With 20 million CB sets and 300,000 amateur radio sets out there, they have to put them somewhere. And that includes your neighborhood. The personal communications explosion says it loud and clear: The time is now to clean it up!

II. The Government. It's time to save the FCC. Like many Federal agencies, the FCC is underfunded, understaffed, and overworked. In 1974, the Commission received over 40,000 RFI complaints from consumers. When these were carefully analyzed, ninety percent were found to be the fault of the design and/or construction of the equipment interfered with, and not of the transmitters involved. In 1977, the FCC expects to receive 200,000 of these complaints. Considering how small the Commission's kitty is, couldn't some of that be used for better purposes than chasing down RFI complaints? We think so.

III. The Consumer. Joe Consumer is a babe in the woods on this issue, and in one major respect, he is being ripped off. But, unfortunately, he is blaming the wrong guy. When Joe spends a lot of his hard-earned money on a new TV, stereo, or whatever, he almost expects that it be made by God, and that it is perfect. Well, we have news. It is not. If the amateur radio or CB buff down the street tears up the picture and/or sound, Joe Consumer's logic says: "It didn't happen before he got on the air. It must be his fault." Joe doesn't know what makes his little box work. All he cares about is whether the picture or sound is there, in good quality. He doesn't realize that it takes something else besides what meets the eye or ear to make his equipment a truly quality device. But, for the money that they've just extracted from him, the manufacturer of that equipment should have seen to that end of it, so that Joe won't have to worry about it. We think that it's time he did.

Oh, yes, the television manufacturers have long offered filters, free, to anyone with a TVI problem. But they've never made any publicity about it, so chances are good that Joe knows nothing about it, or how to get such a filter. If in the off chance he does get the filter, then why does Joe have to pay the $20 or so installation fee, after shelling out all that other dough to get the set in the first place? And what if the problem were caused by lack of shielding, which a filter can't fix? What does all this tell you about how the manufacturers feel about their products? And, what about the RFI problems of other types of consumer electronic equipment? What's being done for the consumer by them? Do you see why we're fighting to make the manufacturers clean up their act, before the consumer buys it?

IV. Radio Operator/Hobbyist. He's in the vise here. When he operates, even if he's clean, he's hated by someone in his neighborhood. Joe Consumer casts him as the villain in this game, when 90% of the time he's not. Bill Operator may not be interfering with his own TV or stereo (which can prove that he's "clean"), but that cuts no mustard with Joe Consumer down the street. If this sort of thing keeps up, Bill Operator may face some nasty situations, such as vandalism against his equipment, or worse, local nuisance ordinances, local tower bans, or a total ban on his operations by local authorities. And, nine chances out of ten, it's not his fault. It's not fair, and we believe that a court test would eventually support Bill's right to operate in peace. But, must we go through that? No . . . not if S-864 passes.

V. The Manufacturer. At least one manufacturer now puts a high pass filter at the front end of its TV sets. Hurray for them, whoever they are. But, for the rest, it's still business as usual. Not that any of them haven't done something about this. Another major TV manufacturer has researched the cost per degree of RFI protection built into a TV set. Our sources tell us that it comes out to about a dollar a set. Obviously, that makes such protection economically feasible for Joe Consumer. So, why don't they? Because they haven't been told to, yet!

Over the past few years, metal shielding has disappeared from the American TV set. Its place has been taken by plastic. Couple this with the coming of the transistor, which is much more RFI-prone than vacuum tubes, and you have a major RFI problem. Add in poorly designed circuitry, built only with low cost in mind, without the proper design to get rid of strong adjacent local signals (such as Bill Operator), and maybe an old, corroded antenna with lead-in, and you have the makings of disaster. Period.

You know, there are other countries that don't put up with this sort of situation. Japan and Germany require that all home entertainment equipment made for domestic sale be RFI resistant. There, the RFI problem is but a tiny fraction of what it is in this country. And the cost to the consumer is little more than it is here. If it works there, it will work here.

And the manufacturers know that. And they will continue to fight such improvements, just as they did in 1964, when the All-Channel Set Law was being debated. The manufacturers screamed that the prices of TVs would be pushed out of sight if the law passed. It did pass; the price rise was very moderate. The situation is no different here, with S-864. Only the stakes are higher. So, why not support it?

VI. The Broadcaster. Jim Broadcaster is involved in this fight from several angles. The low band VHF TV broadcaster, particularly, has a problem with local signals from six meter amateur radio operations, and in some cases, signals from the FM broadcast band may wipe him out. If a certain TV's i-f stage is unshielded, a strong local signal may enter there and wipe out all reception of all TV channels. AM broadcasters get it from two directions. Spurious radiation given off by nearby TV sets operating with poorly designed sweep circuitry and wide-open cabinets clobber their signals in the fringe areas of their coverage — or even closer in. Meanwhile, the AMer himself may interfere with a PA system being used near his transmitter site.

All broadcasters are affected if the radios or TVs receiving their stations are blown away by a strong local signal coming into the audio stages of the receiver. Then the local signal will wipe out the broadcaster's audio, and Joe Consumer may end up playing cribbage rather than listening to your ad messages.

A major problem for the AM broadcaster is industrial noise, and we believe now that much of it is caused by radio frequency emissions from home TV sets. It never occurred to you, did it?

Remember: As long as the amateur radio operator or CBer is running a "clean" rig, he is not the one to be condemned. Go after the guy who built the TV, stereo, whatever is being interfered with. He's ripping you off! Support S-864.

WHAT BILL S-864 IS

It is simply an amendment to the Communications Act of 1934, which allows the FCC to set standards for the manufacture of consumer electronic equipment, with regard to its susceptibility to interference from nearby transmitters which are properly licensed, designed, and operated. That means that the passage of this legislation into law is only the first of two steps needed to make this whole problem of RFI go away. Later, we will offer, in petition form, a set of standards for the FCC's consideration, and again we will ask your support to put an end to this problem once and for all.

TO ALL AMATEUR RADIO OPERATORS AND CBERS

S-864 must become law if we are to remove a major threat to both personal communications and the right to view and listen in this country. Therefore, you are strongly urged to (1) write your representatives in Washington, demanding their support of Bill S-864 and its House counterpart. Feel quite free to use any and all arguments used here. Your own words will help. And (2) pass this information on to a friend, neighbor, or relative.

Remember, if you don't support this legislation, and it fails, and you later have an interference problem with your new, TV, stereo, amateur or CB rig, you have no one but yourself to blame. Don't put it off, write to your elected representatives now!

Jim Beedle W9NIN
Hanover Park IL
Art Reis WB9YOB
Wonder Lake IL

Continued

The Duty

With news of a US Customs Court decision ordering higher import duties on Japanese imports (see "Briefs"), the stage has been set for another round in the debate over foreign manufactured electronics goods. But not all American companies favor higher import duties, especially those who use foreign components, as illustrated by this news release from National Semiconductor. — Ed.

Mr. E. Floyd Kvamme, vice president and general manager of National Semiconductor Corporation's semiconductor division, appeared in Washington on March 15, 1977 to testify at US International Trade Commission hearings. The ITC is conducting an investigation for Congress regarding the possible economic repercussions of a proposed duty on imports of digital watches and components.

Mr. Kvamme spoke on behalf of the Western Electronics Manufacturers Association (WEMA), a trade association of firms that account for most of the high technology semiconductor devices used in digital watches as well as in computers and modern electronic products. National is a Santa Clara, California based company that is one of the largest manufacturers of both semiconductors and of the finished watches.

The bills under consideration by Congress would more than triple the duties on digital watch components assembled for American manufacturers at offshore locations. "Both the conventional watch industry and the new digital timepiece industry sustain US production and employment by shifting certain activities offshore," Mr. Kvamme said.

According to WEMA, the levy on imports of the solid state watch modules used in digital watch manufacture is supported chiefly by US companies that make conventional (non-digital) watches. They favor the tariff increases to protect themselves against stiffening competition from increasingly popular low priced digital watches. Because of lower production costs, many American semiconductor and digital watch manufacturers have located some assembly operations in plants in the Far East. Mr. Kvamme characterized the situation as "a marketing problem between different segments of the US timekeeping industry," rather than a straightforward case of foreign manufacturers flooding the US with cheap products.

If the tariffs were increased, the US companies would probably be forced to close these offshore plants, and the growing availability of inexpensive digital watches would be reversed. Adverse economic effects would be triggered, culminating in the loss of thousands of jobs in the US semiconductor and electronic watch industries.

"In 1976, the US semiconductor industry recorded annual sales of $3.4 billion and employed over 100,000 people. The manufacture of integrated circuits and displays in the US together with the final assembly of digital time-pieces in this country will, and in fact has, provided new employment opportunities for thousands of Americans. If HR 14600 were enacted, however, not only would new job opportunities be lost, but existing jobs would disappear."

Mr. Kvamme pointed out that many of the electronic circuits and numeric displays used in foreign made watches and other electronic products are produced by US firms such as National Semiconductor. One danger of the proposed import duty is that it would probably cause a retaliatory reaction from foreign countries who are now heavy importers of both digital watches and electronic parts from the US. Many foreign governments are trying to encourage the development of their own semiconductor industries.

"US companies, if allowed to compete fairly on the international scene, are expected to increase their market share during the remainder of this decade to 68% of the market, or $7.2 billion."

Mr. Kvamme noted that the low prices of digital watches (about 75% of all solid state watches sold for under $25) allowed the US to capture about three-fourths of the world's market for digital watches in 1976. He predicted that the demand for digital watches would be about two and a half times as great by the end of the decade, resulting in a significant increase in jobs.

The overwhelming supremacy of American electronic circuitry in the world market has resulted in a highly favorable trade balance for the US semiconductor industry. The US posted a trade deficit of $5.9 billion in 1976.

"The semiconductor industry, if allowed to operate with maximum freedom from artificial trade barriers, could change the American watch industry from one that operates with an unfavorable balance of trade to one with a favorable trade balance."

Mr. Kvamme concluded by saying that the proposed tariffs would "hamper a growing and dynamic US industry, will result in higher prices for the US consumer, and will produce retaliation on the part of our foreign trading partners. It will result in the loss of both existing and future US jobs."

National Semiconductor
Santa Clara CA

Breakdown

"Breakdown in communications" is a catch phrase heard about all sectors of life. Is it afflicting hams? As you listen to your favorite band the QRM may immediately convince you that more and more people are talking. Are they enjoying it less and less? Since the breakdown in communications in families, between husbands and wives, among friends and in various other parts of society is mentioned so often, it is no wonder that many hams are feeling unsatisfied with their QSOs. And that other demon, the "generation gap," takes its toll here, too. Oldtimers (of whom there are thousands) feel uneasy talking with someone whom they feel knows everything about solid state and computers but really has no love of ham radio because he knows nothing about the old days of homemade equipment, class B modulators, Super Gainer receivers and wire antennas. The younger ham (of whom there are also thousands) feels uncomfortable talking with someone who yearns for the golden days of the '30s.

The ham population is further fragmentized by special interests: TV, phone, CW, RTTY, FM, phone patching, DXing, etc. This is clearly indicated by band subdivisions if one is blind to the poorly concealed contempt that some members of one group often have for members of another group. The barriers are also noted by the various closed repeaters as well as the many nets that occupy the lower bands. The unwary intruder is often told to get out much as a bouncer would throw out a stranger at a Frank Sinatra wedding.

While the modern situation is much more complex, its roots are found in the special interests which were felt from the very beginning of ham radio. There were those who enjoyed rag chewing and it didn't matter much if their Ford-coil spark set only reached the guy on the other side of town. The distance, or DX, mattered very much to others. Their thrills were measured by the mile. Still others felt guilty if they were not of public service, and their pleasure was handling messages free of charge.

Seeing that there have been different aspects with varying appeals from the start, does this mean the FM repeater man, for example, and the lower band DX fan will never have much in common? Not necessarily. But neither does it mean that we are all going to develop an overwhelming interest in one mode of transmission and one amateur band. What is possible, and what our goal should be, is better communications between hams as humans, as people, better communications involving the individual as a person.

Communications is an art, it is said. It basically means expressing yourself and your ideas clearly to another. Sometimes, of course, we do not want to express ourselves too vividly. Guests are invited into the living room, so to speak, but not into the rest of the house. Guests are envious of the new furniture (the new radio equipment) a fellow ham has just bought, but the host doesn't say he still owes ten payments on it or that he and his wife had a terrible family fight because he bought it. But what about the things we *do* want to express?

Enthusiasm is the best vehicle to get them to their target. There is no other ingredient which will so help us get to the heart and mind of our fellow man. It views things through the eyes of a child, and with the heart of a lover. It acts as a self-releasing power and helps focus the entire force of personality on a subject. It lifts your listener into the clouds with you and makes him see the thrills, mystery, romance and fascination which has captured you. It transports your audience from the humdrum into a new world of wonder — your world.

But remember that communication is a two-way road. It is not an attempt to impress another with how great you are or with the expensive equipment you are using. Let's say, for a ham, it's an invitation to another person to share some delights, to have some fun together for a few minutes. Its aim is to encourage two people of similar interests to confide in one another and get to know one another, to build friendship, to create what the Greeks called phileo, fraternal love.

Sincerity comes into the picture, too, then. This helps us to see that the enthusiasm mentioned is not the empty backslapping of a high pressure salesman which perhaps has its parallel in the fancy warm phrases of friendship printed on some QSL cards. If it really was a pleasure to talk with another ham, let us be sincere enough to *write* it on our QSL cards rather than have it printed. Don't the Christmas and birthday cards that you appreciate the most have a hand-written line or two on them? Don't those few phrases truly mean more to the recipient than whether the card cost

twenty cents or a dollar?

Stereotyped QSOs have been condemned so many times in so many columns in ham magazines that only a few words are necessary here. What is bad is not necessarily that we say more or less the same thing to each new station with which we talk. What is bad is that we say the same thing everyone else is saying. How boring if the fellow you're talking with at the moment says essentially the same thing the two dozen hams before him said! Let's spice things up with a little originality.

Yes, of course we generally discuss the same things. We all sob over the poor band conditions, mention the equipment we're using and the antenna we have. So, where's the originality? Well, suppose you find out the other fellow is using the same kind of equipment you are. Why not tell him if you've had a problem, what the symptoms were, how you identified the bad component, and so on. This little bit of information is sure to interest him, and he'll tell you if he's had the same problem or a different one and perhaps pass along something that can help you. Or, have you used the equipment in an unusual situation? Is there some feature of the gear you particularly enjoy? Or something that annoys you?

Other ideas? Well, is your shack in an unusual location or an unusual room in the house? Are you using an alternate source of energy to power your rig? Made any modifications to your equipment you're happy about? Helped anyone get his ticket? Offered to give a talk on ham radio to the local grade or high school and had any takers? Any results? Other hobbies in the family? Your occupation?

With the transistorized preamplifiers available, some hams are using antique microphones, and anyone can use an antique telegraph key. If you enjoy such things, let the other fellow know about it. How you got interested, how old the antique is, who used it before – is it all original, etc. If you have a conversation piece in your shack, then talk about it.

Regardless of where you live, mention it by name as well as saying near such and such large city. Many people travel extensively these days. I was talking recently with a Kentucky ham and had to ask three times where he lived. Finally he confessed, "Pikeville." He was amazed that I had visited there several times, and we had quite a talk. Another fellow was in Crossville, Tennessee, but I learned this only by being insistent. Neither of these men could believe that a ham in Peru could be interested in their exact location. On the other hand, I am surprised at how many I talk with who have visited Arequipa. Those who have always tell me about it and ask what part of town I live in, and we usually have a nice visit. Did you know that Arequipa is 450 years old? Has one of the oldest medical universities in this part of the world? Enjoys a climate unsurpassed anywhere?

How old is *your* town? What made people settle there? What are the main industries? Were you born there or did you move there? Would you like to leave? Why? Where do you want to go? Why? Besides the temperature, what else can you say about the weather? Is it raining? Is that good? How is the weather affecting your lawn or garden? What do you see from your window?

What about your family? Do you mention them on the air? A fellow down here in South America was telling me about his equipment one morning when he interrupted himself. He was back in just a moment saying, "That was my wife. I'm always up before her and at my radio. Then when she gets up she fixes me a cup of coffee and brings it to me and gives me a kiss. We've been married 20 years, and she kisses me good morning every day." I felt I had been admitted into the family circle, and that I knew him better. I complimented him on such a loving companion, and we enjoyed a chat about marriage. When we signed off he left me wondering what I'm doing wrong that I don't get a kiss every morning. I'll never forget him.

Some hams on the air for years seem to still have a bit of "mike fright." Perhaps it is because they have concentrated on the technical things of life and are unsure of their grammar and pronunciation. My advice to them is to forget it and enjoy talking. Dizzy Dean was a huge success as a baseball TV play-by-play announcer partly because of the things he did to our language. "He slud into third" was the first expression that caused comment. Later he varied "slud" with "slood" and then one afternoon he came up with, "The trouble with them boys is, they ain't got no spart." When the color man asked at the end of the game for an explanation, Dizzy said, "Spart is pretty much the same as fight or pep or gumption. Like the 'Spart of St. Louis,' that plane that Lindberg flowed to Europe in." If you enjoy something as much as Dizzy Dean loved baseball, your language will not matter much. People will be thrilled to hear you talk about it.

A word of caution for DX contacts. Remember that for most of those operators English is a second language. Speak slowly and distinctly. This is more understandable for them at any time and is more intelligible under poor conditions. Avoid slang and idiomatic expressions and keep it simple.

Your accent shows up on CW as well as phone. I will always remember the Novice I worked on 15. His Morse was about the worst I have ever been able to copy. Of course, he wanted a QSL. I slowly sent him the suggestion that he slow down, that he should try to improve his code and told him I would like to have a couple of IRCs for the airmail QSL. He sent me a hot letter telling me he could send better than he could receive and that he had a certificate for copying W1AW at 20 wpm. He further thought I was a crumb for asking for two IRCs for the QSL. He concluded by stating that the keyer he was using was out of adjustment, and if the code he sent was not readable, it wasn't his fault!

So, if you're on CW, whatever you are using to send with, be sure it is properly adjusted and that you feel comfortable with it. And if you're on phone, turn your mike off before you clear your throat, cough, sneeze or shout at the kids in the other room.

A comment about profanity might be in order. It is against the law, in the first place. And it is a sad commentary on a man's masculinity when he feels that he must show it by his choice (?) of words. But considering that a night doesn't pass without some of these words being heard on TV, perhaps it is too much to suggest that they be eliminated. But if one has to work one or two into every transmission, I personally can not help but feel that he has a limited vocabulary. Sometimes, perhaps, nothing else fits. Anyone who enjoyed the hours long movie "Gone With The Wind" could not help leaving profoundly impressed by Clark Gable's concluding word. Would the FCC, then, overlook every four to six hours one really appropriate "damn"?

Listening is the other half of conversation which, together with talking, makes up communication. If no one listens, it is useless to talk, a point not always realized by those talking. And listening doesn't just mean separating the words from the QRM. It involves understanding or interpreting both the literal meaning of the words as well as the speaker's intention. If someone says to you, "Why you old son of a gun!" the phrase is an insult, but the warmth and affection in the voice indicates exactly the opposite.

Most people, including hams, are not very good listeners. We generally talk more than we listen. And while we're supposed to be listening, most of us are making mental notes preparing something to say just as soon as the other fellow shuts up and gives us the chance. Learning to really listen is not difficult, just rare. Usually considered a passive thing as when listening to some favorite music, listening should be a quite active thing . . . as a real jazz buff carries the melody in his head while listening to the group improvise with various counterpoints, themes and melodies. A stream of words entering our ears must be interpreted not only by our minds as to literal meaning, but by our hearts, too, for the often more important meaning. How close can you come to what the other fellow is really trying to say? Speech is often full of symbols, and the well-trained listener can identify them immediately. The aim of careful listening is to actively seek to discover how the other fellow feels about what he is talking about and what kind of person he is.

And how do you conclude a contact? If you listen, you'll see that many hesitate, stumble, tie the ribbons on, have a final and then a final-final, all giving the feeling they want to sign off but don't want to offend the listener. Have you noticed the same tendency among some of the guests who visit in your home? They get ready to leave, get to the door, and then stand there talking for fifteen minutes. Let's learn something from the "good buddies" on CB. When they say, "I'm gone," they are *gone*. So, let's not rush, let's say what we want to, let's give the other fellow a chance to talk and really listen to him, but when we sign off, let's shut up and not drag it out like a soft-hearted lover who has decided to break it off but then can't bring himself to say the fatal words and keeps on talking, talking, talking. I'm gone.

George Brumley OA6CV
Arequipa, Peru

Mauritius

Pete Smith K4FOK has recently completed a DXpedition to Africa that was intended to put Zambia on the air in a big way. But it was not to be . . . as we learn from Pete himself, via the West Coast DX Bulletin. *– Ed.*

As must be abundantly clear by now, I did not get on from Zambia. My application for a license was turned down with the explanation that the Zambian government does not license foreign amateurs for stays of less than one year. My appeals of this decision, and requests for any sort of temporary permission to operate, went quite high up . . . but were all denied.

Anyway, on to Mauritius where it was a different story. I was issued 3B8DT, largely on the strength of my US license, though, as I understand it, the Mauritian authorities appreciate it if the foreign applicant has some sort of Commonwealth license. I would certainly have a UK reciprocal license

in hand if I were doing it again.

I was able to set up at a beautiful hotel on the northwest coast of the island, with a clear shot toward the US. Unfortunately, I did not arrive until late on March 17th, had business all day (the 18th), and finally got back and fired up the equipment for the first time after midnight (local time) — about 2000Z on March 18th.

The first twelve hours of the ARRL DX Test were an utter disaster with something like seven contacts, but things picked up after that. Good conditions on 15, fair on 20, and 40/80 mostly not so hot as much of the time I was in daylight and the QRN was over S9. I think I shook a few people in the waning hours of the contest answering their CQs on forty.

The total reads 583 US contest QSOs without duplicates. There were about 15 with the West Coast and about 500 with non-US stations, these during periods when the bands were not open to the states. All but thirty of the QSOs were CW. Unhappily, I had to pack the gear and head for home on March 21st, and I did not get the chance for the phone operation I would have liked to have had.

Although I was unable to get on from 7Q7 Malawi, and had understood that all operation there had been suspended back in June 1975, while listening one evening on twenty I heard 7Q7LW working through a pile of JAs. She gave a box number in Zomba as address, and there was no reason to think that she was not genuine.

Thanks to the Northern California DX Foundation for equipment and other assistance, including QSLing. The DX Foundation tells me that they intend to QSL every contact through bureaus as soon as the QSL cards are ready.

Pete Smith K4FOK/3B8DT
Reston VA

Pitch

In light of recent efforts by Jack Anderson to discredit ham radio, many amateurs replied with the other point of view in letters and telegrams to their congressmen and hometown newspapers. Some, like Larry Schwartz WB3DBI, took another route — in this case a high school newspaper. — Ed.

Last year, over 6,000,000 new CBers received their licenses, bringing their total number to over 8,000,000. But throughout the US there exists another group of radio operators.

In contrast, they form a much smaller group, about 300,000. Whereas CBers run four Watts of power, these people legally run as much as 2000.

CBers operate on 40 channels while the other operators have literally thousands. While most CB equipment costs between $100 and $300, the other group can pay this price or invest thousands of dollars in a station. The Federal Communications Commission (FCC) also permits this other group to construct their own equipment if they so desire.

Who are these other people? They form a group of radio operators commonly known as "hams." Hams communicate all over the world using Morse code, voice, and Teletype. The FCC even allows hams to use television to communicate. Additionally, where facilities permit, hams can use their radios to place local phone calls while remaining in their cars.

With all of these privileges, why doesn't everyone become a ham? Mr. Donald Smith, an electronics teacher and a ham radio operator, explained, "Ham radio shows technical knowledge and not everybody has the desire to go into it."

To qualify as a ham, one must first pass a Morse code test and then pass a test dealing with electronics and radio law. Passing tests of greater difficulty qualifies the applicant to operate at more frequencies. Put another way, they receive a larger portion of the radio spectrum.

Junior Ari Hirschman, a ham radio operator, told why he got started: "I liked the feeling that I would be able to talk over such long distances and sometimes be able to do it with equipment I built myself. I also like the technical aspects involved."

Sophomore Paul Schmidt, also a ham, gained an interest in ham from his brother. "When I first became interested, I hardly knew anything about radio and it sounded like a neat idea."

Paul said that recently on the air he met somebody who challenged him to chess. The whole game was conducted over the radio.

Hams also perform many public services. During the Guatemala earthquake in 1976, hams went into action. Hams flew to Guatemala and, using their equipment, sent reports back to the US about the situation there. Many times during a parade hams will monitor the parade route and keep in touch with the police.

Hams also form many on-the-air groups. These groups may handle and relay messages, such as those during a disaster. The groups may also discuss electronics or play games. Many hams even do their homework over the air.

Recently, courses for people interested in studying for their ham licenses have grown. The Montgomery (MD) County Department of Recreation offers courses providing the electronic theory needed to pass a ham test. Interested persons should phone 468-4050.

Larry Schwartz WB3DBI
Bethesda MD

Reprinted from Pitch, *published by Walter Johnson High School, Bethesda MD.*

Respect

Your personal help is requested in achieving more harmony in our overcrowded 20 meter phone band. Working DX is the major interest of many worldwide amateurs — SSTV, net operation (handling important and vital traffic), and, then too, just plain rag chewing enjoyed by many, many hams.

Let's examine the space allocated for SSB on 20 meters — 14,200 to 14,350 kHz. Yes, only 150 kHz! It is a well-known fact that most DX is worked at the low end of the band, 14,200 kHz and up. Let's arbitrarily suggest 10% of the 150 kHz for DX. This would give the DXers 14,200 to 14,215 kHz. The 14,230 kHz + or - 3 or 4 kHz is the SSTV area. How about 10% for nets and traffic? This group is pretty well established in the area 14,300 to 14,315 kHz.

Irate SSTV, DX, net and rag chewers continually harass SSTV, DX, net and rag chewers with carriers, tapes, CQs and other noises. Effective, yes, but definitely not the answer to the problem. The resulting QRM renders the frequency useless to all, and everyone loses. Tempers flare, anger, irritation and frustration prevail. Our hobby is degraded. This could all be avoided if amateurs used better judgment in selecting the proper frequencies for SSTV, DX, nets and rag chewing.

You will note that I said above "arbitrarily" when I suggested the frequencies for the various groups. You could never reach a definite agreement among all the hams on 20 meter phone, but this could be a start!

Henry Luhrman W4PZV
W Palm Beach FL

Reprinted from The Mike and Key, *bulletin of the Greater Cincinnati ARA, Cincinnati OH.*

Eye Bank

In the United States, eye banks are served by a network of volunteer ham radio operators. Three hundred and sixty-five days every year without a holiday, this rapid nationwide network stands ready to flash the news of emergency requests for eyes, and where eyes are available.

In emergencies, from fire, a laboratory explosion, an auto accident, certain acute infections, where immediate corneal transplants are necessary, the Eye Bank Emergency Radio Network serves as a means of saving the eyesight of hundreds of people. It assures that a donor's eyes will be rushed anywhere that an emergency exists.

The Eye Emergency Net, a true public service net, has been in continuous operation for almost fourteen years through the untiring efforts of a distinguished and highly dedicated group of amateur radio operators.

Briefly stated, the purpose of the Eye Emergency Net is to handle information regarding the need for and the availability of human eyes for emergency corneal surgery for the various eye banks throughout the country. In accordance with this simple purpose of trying to be of assistance in preventing the loss of sight in an emergency situation, it has been decided that henceforth only emergency needs for eyes and the availability of eyes will be listed and carried on the several Eye Emergency Nets by the net control operators.

Each amateur radio operator is requested to so inform the eye bank he or she represents of this policy of listing only emergency needs and/or the availability of eyes. This will improve the efficiency of the Eye Emergency Nets and will eliminate needless repetition of unnecessary and

useless information as has crept into the operation in the past. Naturally, each amateur radio operator should keep in close contact with his or her eye bank to keep them informed of emergencies listed and/or availabilities. In this manner we can carry out our avowed purpose of helping to save sight in emergencies and, in addition, operate more efficiently with less time occupying crowded radio frequencies.

The policy stated on this page is to aquaint my fellow amateurs with the Eye Emergency Net. I am a net member representing the Midsouth Eye Bank of Memphis, Tennessee. There are several nets which meet every day of the week, every week of the year. The only exception is the first one, which doesn't meet on the weekend. (All times are EDST.) 0600-3970 kHz; 0645-3970 kHz; 0800-7294 kHz; 1845-7294 kHz; and at 1900-3970 kHz. I check into the net that meets at 0645 on 3970 kHz. I have found that I can meet this net and be on the road to work by 0700. It only lasts about five or ten minutes. I also call the eye bank and leave a message with the answering service as to the need or the availability of donor eyes. All this and I am still on the road to work by 0700 and usually earlier than that. As you can see, the net is quick and to the point, and serves a great need to the Eye Banks of America. Can you find five or ten minutes in your busy schedule to help a person to gain back his eyesight? If not, close your eyes and walk to the refrigerator, pour yourself a glass of milk, then turn on the TV, sit back and relax.

Guy Speck WA4WHQ
Memphis TN

Reprinted from Telstar, *bulletin of the Memphis Pioneer ARC.*

see page 200

Light

A recent editorial in the March, 1977, issue of *Ham Radio* magazine caused me so much pain that I feel compelled to take pen in hand and do something about it. The author has a good topic (the 40th anniversary of the invention of the klystron) and he traces its development in a well-informed manner. His summary and call to action, however, fall far short of what could be a noble point. The editorial writer calls for more activity on the microwave frequencies to protect our allocations in light of WARC '79. This conclusion is less than worthy for three reasons. First, nobody in positions of importance would know, nor would they care, if amateur activity on 10 GHz increased ten times over. Secondly, the contribution the amateur service could make to the microwave state of the art is nil. Finally, the people who might spend their time working on amateur microwave could make a very important name for amateur radio. They could make a name that would be heard and recognized where it matters.

The microwave frequencies are familiar and well-known territory to military and commercial communicators. The frequency congestion in some parts of the country makes the California two meter repeater problem look like the wide open spaces. Millions of people daily talk over long and short distances on 15 GHz and up without causing any excitement. Digitized transmission systems are becoming the rule and are replacing the old analog modulated networks. It is not in the best interest of a vibrant and progressive amateur radio service to try to duplicate the plumbing and hardware developed so well so long ago. The fourteenth inventor of the wheel probably got very little notice. There is nothing much for us in the microwave frequencies. There is not much utility, no new ground to be plowed, no records to be set, nothing but a lost wandering in a wasteland full of funny machine shop products.

Now that I have alienated everybody who even knows what a klystron is, here is where I propose we put our efforts. We must skip around everything that is too high for coax and keep going. Go up to the new communications ground where the future is full of real frontiers. Go up to where new developments and uses are waiting to bring riches to individuals and pride to amateur radio. Go up to light!

The use of light for communications is just passing out of its infancy. Its first real steps were recently taken when the Bell System began using a light pipe to connect switching facilities in Chicago. Amateur use of light for communications can follow two very important parallel paths.

When amateurs think of using light for communications, they naturally think about transmission systems. This means shooting a light beam to some other guy and modulating it in some way. It does not necessarily mean relatively expensive lasers and high voltage power supplies. Light can be reflected, for instance. Sunlight for reflection is plentiful and free. The same hams who can design a moonbounce array can certainly figure out a cheap and easy way of modulating a reflected beam. Clouds might be a problem, but we have lived with the ionosphere all of these years, so what are a few clouds?

Light as a transmission system is certainly line of sight (unless you bounce it, that is). There are probably more and better ways to bounce a light beam than a microwave beam. They just need to be developed. Instead of a repeater on a mountaintop, how about a mirror? Want to talk to somebody? Just kerchunk the mirror. Not as good as two meters for mobile, probably, but a whole lot better than 10 GHz. On field day you could rent one of those searchlights they use at shopping center openings! Moonbounce is still a good bet, too. During the day your moonbounce reflector could probably provide hot water for your house. (Please don't write to me and tell me you can't reflect light off the moon. I'll have a whole generation of song writers ready to pounce on you.)

Along with light as a transmission system, there is another path that amateurs can explore which will be far in advance of available commercial systems. Light can be filtered, chopped, amplified, heterodyned, attenuated, modulated, and detected (and just about anything else that can be done to rf). It is not, however, inherently leaky. When contained in a glass or plastic light pipe, it is immune to electromagnetic hum, crosstalk, rf feedback, etc. Light pipes can be driven by our everyday friend, the LED. Light can be used, then, at lower level stages instead of af or rf to generate and process signals that can use rf, af, or light as a transmission system at higher stages. What I'm suggesting is that your Sooper Blinker 20 meter SSB rig of 1982 might very well use light starting right at the microphone to generate and process the audio that would eventually modulate the 14 MHz rf stage. Why? Because sand (glass) is cheaper than copper ore. Light needs less shielding and is less troubled by ground loops, etc. All sorts of neat processing can be done with the spectrum available.

This means that amateurs who don't want to use light as a transmission system can still experiment with and develop very important techniques in their own shacks. This activity is very much in keeping with the historic experimental tradition of amateur radio. The size and cost are low, and the potential is enormous.

I call on the gadget lovers and tinkerers in amateur radio to get with it. Quit trying to interface your SSTV to your microprocessor, let microwaves cook baked potatoes, and move up to light. *73 Magazine* has led the way in slow scan, 2 meter FM, and microcomputers. It is now time to start sending in articles on the newest and grandest development yet. Do you see the light?

Capt. Frank J. Derfler K9KIC
APO San Francisco

HRO

In 1978, hams all over the world will witness an event that will bring them undreamed-of fame – The Ham Radio Olympics. The HRO will accomplish what years of public relations could not, making ham radio a respected household word throughout the world, in Africa as well as in California.

Since 1979 will be the decisive year for ham radio, in the World Administrative Radio Conference (WARC) which will meet to decide what frequencies ham will use, the HRO will come at just the right time. The good press the HRO will obtain, and the national prestige it will engender, will carry over into the WARC and we will see countries competing with each other to get the best deal for ham radio.

Later this year, the International Amateur Radio Union will proclaim 1978 the year of the HRO and will notify all the governments which it represents. A committee will meet in Geneva to make simple preparations. What the committee will have to work out is what kind of events will not favor large countries and power amplifiers. There will be events of skill, perhaps tests of code reception and transmission, total number of contacts, longest distance per Watt on each band, or the ability to work through a satellite.

After the week or so of competition, the committee will convene, report on what they heard, and vote. They will present awards to the winning hams and their countries.

It will take a lot of work and much organizing, but we can do it. 1978 will be a year for all hams to remember, the year of the Ham Radio Olympics, the year ham radio became the "in" thing, the year governments started favoring ham radio, the year before the WARC when hams came out with far more than even the ARRL dreamed of asking for.

Gabriel Gargiulo WA1GFJ
East Hartford CT

Ham Help

A few years ago I ran across a construction project in the library of a fellow ham. Now we cannot locate the project, but if my memory serves me correctly, I think it may have been in one of your publications. I would appreciate your help in locating it.

The project was a solid state device to track thunderstorms. This is the solid state version of an original article, "An Electronic Storm Finder," which first appeared in "The Amateur Scientist" column in *Scientific American*, May, 1963, p. 167.

Jared A. Ketner WAØQWU
506 E. 14th
Wahoo NE 68066

I require a schematic diagram and alignment procedures for a Hallicrafters "Skyrider 23" receiver. The manufacturer says it's out of print. Many thanks.

J. Sutherland
P.O. Box 210
Hampton, N.B.
Canada E0G 1Z0

I am writing to try and find something about a new animal we are all beginning to know if not love: interfacing. I wish to develop a teletype system for my shack that is as noise-free as possible. I live in military quarters here in Germany and complaints about RFI are bad enough without having the neighbors complaining about the noise of TTY machines. I am also trying to keep the cost of the whole thing within a military salary type budget. This obviously knocks out HAL products.

I would like to develop the system around an AFSK type demod. This will prevent extensive modifications to the radio equipment. Now comes the interfacing problem. I have been faithfully reading all the I/O articles and the ham TTY articles, and hopefully have developed a vague reading knowledge of the medium. I have also seen that most of the different systems would be totally incompatible with each other. ASCII-to-Baudot/Baudot-to-ASCII converters look great to tie a computer to a TTY machine, but will they tie an ASCII encoded keyboard to a TTY demod? Will they tie the demod to an ASCII video character display?

What I would really like to know: Have you any suggestions for kits that would be compatible and not overly expensive? I'm not trying to force a manufacturer's recommendation from you. I realize that you have to maintain a fair outlook towards them all. I'm merely trying to keep from a lot of experimentation with some rather expensive devices that might not like one another at all. My working knowledge of digital circuitry is limited to the speed keyer and digital counter level. I haven't dived into LAI circuitry at all as of yet. I do see a computer in the future, but it is a financially far future.

If I haven't completely confused you by now, I hope you have something which will point me in the right direction. I will be QRV for any suggestions to keep the old TT-15 from keeping the neighbors awake.

Sgt. Anton M. Giroux
DA1NF/WB4ART
HHT 2nd ACR
APO NY 09093

I am an ardent home brewer and lover of CW. Since reading about the attributes of the FYO key, I have become interested in attempting to build or buy one. Could you or any of the readers of *73* assist me in this effort, such as pictures of an FYO or perhaps a source of the key itself? Thank you.

Bob Best WB1AQM
Pine Tree Rd., RR #2
Coventry RI 02816

I would like to get in touch with other hams who read science fiction literature . . . such as Clarke, Asimov, Heinlein, etc.

Neil Preston WBØDQW
7024 Bales
Kansas City MO 64132

WANTED: Hams near Chicago to form a DX and Contest Club — Novices to Extras wanted. Please contact me for information.

Randy Terborg WB9SAD
10137 Kostner
Oak Lawn IL 60453

WANTED: A manual and/or schematic for an Ameco 2 and 6 meter transmitter, model TX-62. I could either purchase the manual or make a copy of it, then return it to the owner. Any help would be appreciated.

Charles Dedon WA5WZI
Rt. 1A, Box 500
Walker LA 70785

Even though I am not (and cannot become) an amateur, due to disability in my hands, I do read your magazine. I teach electronics free to any young person who is really interested, enough to give up an hour or two a day. We use mostly surplus material to build projects, and have great difficulty in getting data on much of it.

Can anyone provide addresses or sources where we might obtain data on integrated circuits, nixie tubes, or related components? For instance, we have a 12 tube readout, alphanumeric, which we would like to use, but can find no information on.

The tubes are 13 pin (5 in front, 6 in back, a blue sleeved lead on each side). Monogram on back: ISE-DG12C-HB:D. ICs: DP4, DN2, HD3107DM, M5B201, M5B205, M5B207, and one M5B212, with associated transistors, diodes, and resistors, which we do have data on.

On the board are these numbers: HEC 011 EPA, 504-PCB-B, and 13925-H. Please send any information.

Edwin O. Griffith
614 E. Court
Montpelier OH 43543

RTTY Loop

This month we are going to discover just how Teletype is sent. For the purposes of this discussion, forget all you know about radio. During the next few minutes, the only way to get information from point A to point B is by stringing wires. You'll see why later. Now let's look into non-voice communication systems.

I am here, and you are there, and I want you to get me a hamburger. So I string a wire from me to you and connect a switch, battery, and bell. See Fig. 1. We agree that one ring means "hamburger," two means "7-Up," and three is for "french fries." What do we do for chicken soup? Clearly this system is limited, and some encoding form is needed. Obviously, that is what alphabetic codes, such as Samuel F. B. Morse's, do. But this type of system did not lend itself to automated systems in the PICE (pre-integrated circuit era). We need a way to send each letter and figure from me to you and have a machine interpret it.

Fig. 1.

Refer to Fig. 2. Twenty-six buttons, plus any figures or punctuation, are at my station. Each of these buttons (arrange them in a keyboard if it will make you happy) is connected to a long wire which spans the gap 'twixt you and me. At your end, each wire feeds an electromagnet with some linkages resembling an electric typewriter. I hit the "Q", the "Q" wire is energized, your "Q" magnet pulls in, and a "Q" is typed. Add some means of returning the carriage (CAR RET) and feeding paper (LINE FEED) and you have a workable system. (These two are also abbreviated CR and LF.)

But wait a minute. You have to string more than 30 wires who knows how far just to do this. If you will pardon a bit of borrowed terminology from the computer folks, this is a "parallel" system. That is, all wires (bits) are there (read) at the same time. All we have to do is convert this to a serial system and send each bit sequentially, and then we can go back to one wire between stations.

Take a glance at Fig. 3. Now we have added a motor-driven selector switch to each station. Now when you push a button, two things happen: The clutch engages and a "START" pulse is sent, and the appropriate letter pulse is sent at the correct time. At the other end, the "START" pulse engages the clutch, and, since the motors are turning at *exactly* the same speed, when the pulse for the letter sent arrives, the receiving selector switch will be at the appropriate

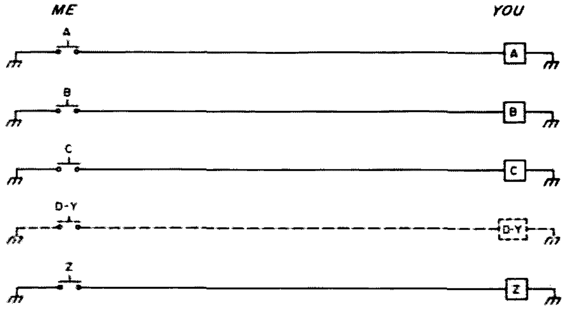


Fig. 2.

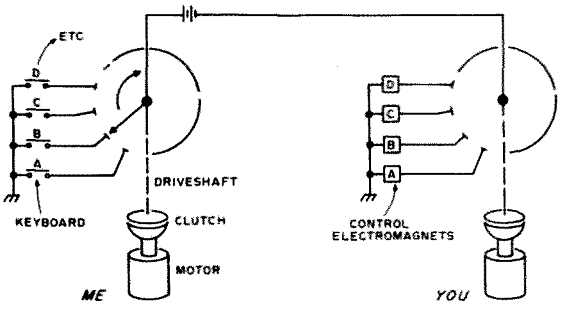


Fig. 3.

terminal to activate the corresponding magnet. Neat, huh?

Only one problem. Just to send the letters of the alphabet, you need 26 pulses plus the START and STOP pulses. Twenty-eight bits! At, let's say, 25 ms per bit, a reasonable speed, it would take almost ¾ of a second to send each letter. That works out to around fifteen words per minute. There has got to be a better way. There is . . .

Take five bits and encode them in a binary progression. This gives 2^5 or 32 possible characters. To get more, without using more bits, use both upper and lower case. Fig. 4 shows one possible scheme. Now, reduce the switching of Fig. 3 to send just five bits plus a start and stop, and you can send whatever you want, with 22 ms pulses, at 60 words per minute. Make the pulses shorter and you can send faster, and this really works!

To make it practical, when you push a key on the keyboard, mechanical linkages set up the appropriate five-bit code, which is then scanned by the motor-driven switch and sent down the line. A selector magnet driven off that line pulls levers in as a toothed wheel allows brief samples of each pulse interval. The received letter is sequentially encoded and, at the conclusion, read out in parallel form. Levers and trip hammers are set, and the proper key is struck on the platen. For the computer buffs out there, note that the characters are first generated in *parallel*, converted to *serial* for transmission, then received *serially*, and reconverted to *parallel*.

BINARY	LC	UC	BINARY	LC	UC	BINARY	LC	UC	BINARY	LC	UC
00000*	BL	BL	01000*	LF	LF	10000	E	3	11000	A	–
00001	T	5	01001	L	)	10001	Z	"	11001	W	2
00010*	CR	CR	01010	R	4	10010	D	$	11010*	J	'
00011	0	9	01011	G	&	10011	B	?	11011*	FG	FG
00100*	SP	SP	01100	I	8	10100*	S	BE	11100	U	7
00101*	H		01101	P	Ø	10101	Y	6	11101	Q	1
00110	N	,	01110	C	:	10110	F	!	11110	K	(
00111	M	.	01111	V	;	10111	X	/	11111*	LT	LT

**Notes on individual codes:*

00000 – BLANK, cycles machine in open condition. Will shut down machine in some loops.
00010 – CARRIAGE RETURN, usually abbreviated CR or CAR RET, returns type basket to left hand margin.
00100 – SPACE, advances typing basket one space without printing.
00101 – H, in upper case may be £ (pounds sterling) or STOP. This, used as stop key in some circuits, has no radio use.
01000 – LINE FEED, usually abbreviated LF, advances one line of paper.
10100 – S, upper case usually BELL, which rings a loud bell in the machine. Some machines type ' instead, and use upper case J for BELL.
11010 – J, upper case ' (apostrophe). See note for 10100, above.
11011 – FIGURES, usually abbreviated FIGS, puts machine in upper case.
11111 – LETTERS, usually abbreviated LTRS, puts machine in lower case.

Fig. 4. Binary Teletype Code.

A common problem for RTTY operators involves the mechanical speed of Teletype equipment on each end of the "loop." Again referring to Fig. 3, it can be seen that the receiving machine must be in the "start" position when the transmitter sends a start pulse. Imagine for a moment what would happen if the two machines were not synchronized to each other! Most likely, an invalid "garbage" character would be printed, which is exactly what happens when RTTY is transmitted over a noisy path. Some method of insuring machine synchronization is required, and fortunately the problem is easy to solve. The power company maintains close watch over the frequency of our line current, and, while voltage may vary considerably, the frequency is always very close to 60 Hz. This fact is employed to our advantage in most TTY machines. The motors that drive the mechanical linkages in the machines are usually "synchronous" motors; that is, their speed is a function of power supply frequency, not voltage. Most synchronous motors will maintain speed over a wide voltage range, although their torque suffers at voltages much below 100. Thus, when the TTY machines at both ends of a path are driven by synchronous motors from the power line, they are automatically "in step" with each other. True, there are adjustments on all machines that can cause misprinting. These will be discussed at a later time. The moral of the story is to be sure that any surplus machine you purchase has a synchronous motor. This fact can be verified by checking the information plate on the motor. It should say "synchronous." Avoid machines with "shunt" or "series" motors. Usually they are not worth the effort, no matter how attractive the price. These machines are synchronized by mechanical governors and springs that are never accurate over the long term. Many military machines fall into this category, as they were designed for field ac/dc usage. Pass them up if anything else is available! Future columns will describe the equipment available for beginning RTTY applications.

Hopefully you are now aware of the "mechanics" of Teletype transmission and reception. The next step is to eliminate the wires between the transmitting and receiving stations. After all, the "R" in RTTY stands for radio. Next month's column will outline the encoding and transmission of TTY pulses over radio.

Marc I. Leavey M.D. WA3AJR
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Looking West

Bill Pasternak WA6ITF
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Newhall CA 91321

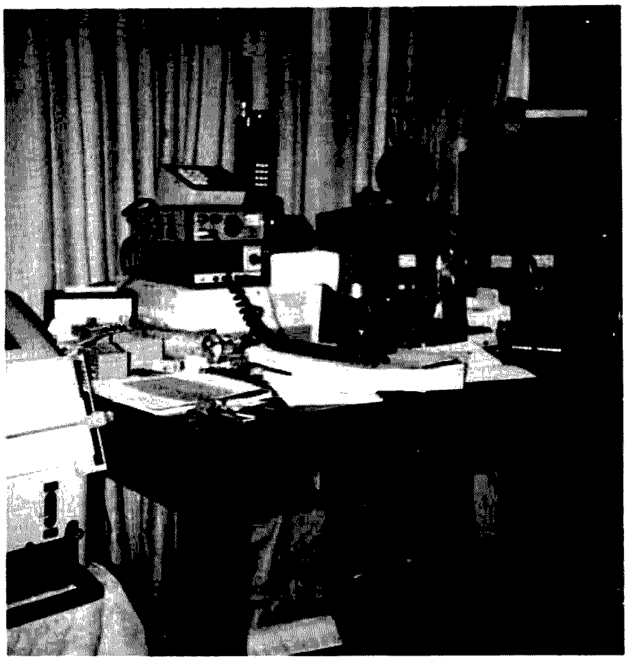
LINKING AMERICA

Just another normal Sunday evening on .01/.61 in Los Angeles. Let's see. There was myself, Mary WA6LUC, "Uncle" Earl WB6MUQ, Doug K4SWJ and Bill WB2RXQ, to name but a few. Why should this be of note? Well, you see, Doug and the rest of the "4 landers" were in Atlanta, and Bill RXQ and the rest of the "W2" stations were in Staten Island, New York (and we must not forget that fine group of "1's" on the WR1ABB system near Boston). Not exactly what one thinks of as your average "run of the mill" evening QSO on a local two meter system. In reality, though, it's not your average two meter anything.

What it was and continues to be is a project in repeater interlinking spearheaded by Sam Davis WA1GQY/WB6GDM. Not long ago, Sam placed into operation what he calls his "magic talking box," better known as the WR6AYY 220 repeater/remote system. He got the idea that there was more that could be done with it than just talk locally. Heck, why not link it to another machine in another part of the country and let the people in both places rap with one another for a while? Since Doug had been a popular resident member of the L.A. repeater fraternity when he lived out here, the first choice was evident: a link to Atlanta. However, we thought that using AYY (a private 220 system with a dozen or so members) might not be as much fun as having access to this link from a major high traffic open machine. Since AYY was a remote base as well as a repeater, it would be easy to tie it to virtually any two meter system. That's how WR6AUD (WR6ABB) got involved.

At about 7:00 pm on Sunday, May 2, 1977, a group of W4's suddenly appeared on 146.61 in L.A. They could easily be talked to by transmitting on 146.01. Involved in the linkup were the aforementioned WR6AYY, WR6AUD and WR1ABB, as well as WR4AAE (Atlanta) and WR2ADP (New York). I only wish there were room to list everyone who took part, but space restrictions force me to limit kudos to Bill Helfand WA6JEU of PARC (for his technological wizardry), Mary Stocksdale WA6LUC (who spent about four hours as "emcee" here in Los Angeles, keeping the whole show moving along), and Sam Davis WA1GQY. Sam's "let's do it" attitude had the effect of uniting an entire continent via amateur FM relay com-

The WR6AYY "Magic Talking Box," with its creator, Sam Davis WA1GQY/WB6GDM. Photo by Norm Smith WB6DGF.



Linking America's "control central," at the home of Sam Davis WA1GQY/ WB6GDM. Photo by Norm Smith WB6DGF.

munication, with a slight help and a large phone bill from Ma Bell. When I asked Sam why he did it, he simply answered, "It was fun."

If you happen to have such a system, that "wants to get involved" and also happens to have autopatch facilities, you might drop a line to Linking America, c/o Sam Davis WA1GQY/WB6GDM, PO Box 1502, Sun Valley CA 91352. Who knows? If you do, one of these Sunday evenings we might get a chance to QSO as well.

REPEATER APPRECIATION WEEK

After the storm: Contrary to what you may have read elsewhere, the event previously described in this column in detail has had a profound and lasting effect on overall repeater operation in this area. Now that enough time has passed to really evaluate it, I have to reach the conclusion that the prime reason for its overwhelming success is that none of us, myself included, ever wants to have to live through another such repeaterless time.

In the basin, the day of the repeater hog and abuser is waning. It is giving way slowly but steadily to the day of the good guy, the average "Joe Ham" who was for a long while the target of the abusive minority that had almost made "repeater life" untenable. Repeater Appreciation Week changed all this, however. It made old "Joe" aware of the fact that if the privilege granted him by his peers was to continue, then he would have to take on the most important burdens of all — setting the best possible example for the rest of the amateur community, and being his own "repeater cop" when necessary.

To cite one example, six months ago it was quite common to hear a bunch of people rattling off about some unknown poor "flake" who had gotten his jollies by jamming or harassing a given system. Nowadays, about the only time you hear such a complaint is at off-the-air meetings. Not that all the on-the-air jammer recognition has abated, but the unofficial word seems to have proliferated enough that most people know these days that if you want to really frustrate a jammer, foul mouth or sickie, the best way to accomplish this is to totally ignore his existence. I'm willing to bet that there is more complaining going on on the telephone on this topic these days than on the air.

In the years I have been writing Looking West, no topic has brought the mail load that this one has. In fact, some has come from as far away as Germany, which at least lets me know that this column gets read. In general, responses from densely populated areas were positive on the action taken by the "Ad Hoc Committee for Open Repeater Appreciation," while those from less populous parts of the country went as far as to say (in certain instances) that the overall deterioration level we had described could not possibly have existed. Some said that no matter how bad things had become, no one had the "right" to take away the repeaters. A few went so far as to say that, whether supported or not, the repeaters belonged to the people who used them. Therefore, they reasoned, the licensees should be prepared to take anything that comes. Most, however, cited the whole affair as being not only a shame to have happen in the first place, but also a "blot" on the overall face of the amateur service. Having personally lived through the period of decay, the action itself, and the subsequent revitalization now going on, I could not agree more with this last view.

Another interesting point is that, with few exceptions, those responding negatively gave little or nothing in the way of counterproposals that could have been attempted before any such drastic action was taken. Most negative comments were just that — negative on the basis of "right to operate," or to the effect that "something else" should have been done. Never could we figure out what this elusive "something else" was, however. Many letters claimed that I had not been objective enough in my reporting on this topic and had given too much column space to the "positive results" (while downplaying the negative aspects). To this I can only say that we judged by what we heard on the air, and never once did a confirmed, "self-professed" bad guy, "repeater hog," or "jammer" call us on the phone to complain.

I had hoped to be able to reproduce a few of the comments and responses received. However, due to space limitations and the desire to avoid repetition of things already discussed, I think it best to put this one to rest with the following summary. For us, the concept of "Repeater Appreciation Week" did work. It did have what has turned out to be a long-lasting positive effect. It did lead to "cleaner" overall area operation in general, although we are still far from being the "world's showplace." If we ever were able to achieve the status of "showplace," I suspect that it would probably make for a rather lifeless, sterile, and uninteresting format of operation. While such might be welcomed by some, to the vast majority of local amateurs a totally sterile atmosphere would in itself create another form of decay: attrition of both amateur relay communication and the numbers in our ranks. We can afford to lose the bad guys, the troublemakers, foul mouths and the like, but losing the good people, those who appreciate what others have done for them and show that appreciation through due respect for their fellow men, we cannot tolerate.

In essence, we are again climbing the ladder. We are looking for a happy medium some place in between, a place that fits and suits the lifestyle that is Southern California. This time we are aware of the pitfalls that mistakes lead to. I suspect that this awareness is the insight we need to reach the "happy medium" we are striving to attain. If we fall along the way, we will only have ourselves to blame.

To those who have asked if I recommend action such as this to others, I respond by placing the responsibility for finding this answer back on their shoulders. Because it worked for us does not mean that it is the ultimate answer to all the problems plaguing open repeaters everywhere. You alone can judge the degree of the problems in your area. You alone can determine if all other avenues have been attempted to correct these problems and if taking drastic action, such as holding a "Repeater Appreciation Week" in your area, will solve anything. It is not a solution in itself but only another tool in attaining a one. I sincerely hope that you never find yourselves having to implement such drastic action as was seen here in January. Be wary; the fact that it helped us does not guarantee that it will work for you. Use your own individual and collective judgments.

THE WAY UP NORTH: THE CENTRAL VALLEY IS ALIVE, WELL AND ON TWO METERS

Another subject that has brought a heck of a lot of mail, mostly from the Central Valley area of California, was part one of my November '76 trip to Northern California and the San Francisco area. It seems that I may have hurt a lot of people's feelings in the Central Valley by not mentioning the activity I found there. To those I may have offended, I apologize; to those that were kind enough to write me with updated activity information, I say thank you; to those who spent many paragraphs berating my ownership and use of a CB radio, I have nothing to say whatsoever. Correction: To the latter group I suggest that energies could be better spent in more constructive ways than tirades against CB. Sure, it has its problems, and true, it's not "ham radio" type communications, and yes, there can indeed be a language barrier. I have come to the conclusion that in a crowded urban area such as L.A., the lower 23 are usually so crowded as to be useless, with the possible exception of channel 9. However, once out of a city like L.A. (with its massive numbers of spectrum users) and "on the road," you won't find me making any long trip without one. Enough on this, though: Let's get into the activity we found heading north on I-5, and fill in the material supplied on what we missed heading south on 101.

After running out of the range of the Los Angeles area systems our Denshi radio was crystalled for, our first interesting encounter came on that popular channel pair of .28/.88. Thanks to Ken WA6TCP, we were provided with the following information about WR6AIF (and a rather enjoyable 25 minute QSO, as well). WR6AIF is a wide coverage open system located atop a 5700' "bump" known as Blue Ridge, which, for those of you trying to pinpoint these things on a topographic map, is about 22 miles east of the city of Visalia. The system runs about 40 Watts erp, is open carrier squelch access, and is owned and sponsored by the Tulare County Amateur Radio Club, Inc. One of the nicest things about it was the totally relaxed atmosphere we found.

The timeout timer is approximately two minutes and forty-five seconds, so it is quite easy to compose your thoughts as you proceed with a QSO. Ken says that while it's usually a fairly quiet daytime operation, weekends, holidays and evenings the system really comes alive and a QSO is not hard to come by. In our case, we were weekday travelers, but found no problem finding a friendly hello on WR6AIF. If you are in the area and

see a sign marked Exeter or Visalia, you might give a call on .28/.88. I suspect that the ensuing QSO will be one you will enjoy.

A little farther up I-5, just past junction 44, we found ourselves in QSO with Dick W6OV via the WR6ACU repeater located at about the 4000' level at Meadow Lakes. ACU is, according to the latest NARC listings, one of three open .34/.94 repeaters in their jurisdictional coordination area (along with three others which are tone access). Meadow Lakes is located just north-east of Fresno, and is the kind of vantage point that gives ACU good coverage over most of the Central Valley, from an area just north of Bakersfield to the intersection of Route 580. That, friends, is what we call coverage. While I did not have .31/.91 in my radio, Dick informed us that WR6ACE (located atop McKittrick) had similar wide coverage characteristics. Again, the kind of welcome we found on ACU was outstanding, and causes me to wonder a bit about stories we hear from time to time about a traveler in a given area "getting run off a repeater" because he did not belong to the "in crowd." We were strangers on a heck of a lot of systems on our trip, and never once were we made to feel unwelcome anywhere. If these things do happen, it's surely not in the Central Valley or San Francisco area.

Once north of ACU's area of service, we began the normal ritual of running through our 10 repeater pairs. As we came to .01/.61, we found ourselves eavesdropping on a rather interesting QSO on the WR6AFA repeater. I like a good technical discussion, so after a few minutes we made our presence known. We soon found ourselves in QSO with AFA's owner, Steve WA6SBM. We never did ask Steve where AFA was located. However, we accessed it about the time we ran out of ACU, and were with it for about an hour (until Steve informed us that we might be at a point where we could gain acquisition of WR6ACV near Stockton).

It turns out that Steve is one of the "new pioneers" of VHF up there. He already has in the works a 220 system (that will be on the "low .34/.94" pair), a UHF system, and a six meter system (that he plans to link to another six meter system running in the Marin area). He plans a few autopatches in this web of rf as well. Steve was a veritable gold mine of information, and since our QSO took place about five months ago, a lot of what he described to me as being a part of the future may have already come to pass. A word of thanks to Ray WB6GUK, who sort of got placed on the sidelines as Steve and I rambled on. One of these days I've got to make this trip again, if for no other reason than to see how much of Steve's major undertaking has been accomplished to date. I found myself that fascinated.

I wanted to get hold of my buddy Dave WB6IRL who lives in the Stockton area. That part of the world is serviced quite well from the .28/.88 WR6ACV repeater atop Mt. Oso. Dave and I first met at a training session here in L.A. being given by the company we both worked for at that time. At any rate, after finding that we could work into Mt. Oso, we gave Dave a call and were surprised to get a response from his XYL (who we did not know had obtained her ticket). We were informed that Dave was out at the moment, and that as soon as he returned he would be summoned to the magic talking radio. A while later, just as we were leaving ACV's service area, we did manage a few minutes with Dave (which were continued the following evening via landline).

I-5 sort of skirts the prime coverage area of WR6ACV. However, with nominal power and a good receiver it is possible to work this system over a good number of miles. In most places, our 12 Watts and 5/8 wave GAM were more than sufficient. ACV is a system-designed repeater, in that it is one where if you can hear it, you can work it. Conversely, if the road takes a dip and you go away for a few minutes, you won't hear it either. In practice, this is considered proper overall system design, and is exactly what those involved in commercial land mobile service strive to attain. We finally lost ACV altogether as we started the "big climb up the hill" that leads down into the "City by the Bay." In the interim, however, we had a chance to chat with Dave, Joyce, and a large number of other super people who make WR6ACV their home.

Since we have already covered much of the activity we found in the Bay area in a previous column, let's say a quick farewell to the Golden Gate and start south via Highway 101. Heading south in the rain, we found a rather interesting QSO on WR6ABM. As we found out from our QSO, ABM is an open wide coverage repeater located in the Oakland area, designed to serve both the San Francisco Bay area and the Sacramento Valley. From what we noted, ABM fulfills its task quite well; we found ourselves able to access it for almost two solid hours. As usual, those we met on the air were warm, friendly, and always eager to give us any information we found ourselves in need of. When questions were asked about the system, there was always a sense of pride obvious in the response.

ABM seemed to be the home of the two meter SSB enthusiasts. Those whom I QSOed with were quite interested in finding out about SSB activity in the L.A. area (the number of people using that mode, the times they operated, and the most popular calling frequencies). We tried our best to supply the requested information, and I can only hope that a few good QSOs occurred consequently. It seems that SSB is going like wildfire up there, so if you are into that mode, you might give a listen down near the low end near 145 if you think you are within earshot of San Francisco (especially during that summer phenomenon known as VHF skip). Remember, for the past two summers running, Hawaii has been worked from L.A. on both FM and SSB. Why not San Francisco to who knows where? As you read this in July, the "season" is here, so if it's going to happen, it's probably now or never. Not that it be "E" or "F2" necessarily. Many of the most knowledgeable have come to the conclusion that the Hawaii to L.A. thing was ducting.

We were on .16/.76 and hunting for a place to eat when we became part of an existing QSO on WR6ADE. Almost immediately, a very warm welcome came our way from Dave WB6KHP, who informed us that ADE was located on Mt. Chual in the Santa Cruz Mountains, approximately halfway between San Jose and Santa Cruz. There is a definite order of responsibility among those who operate ADE. For the repeater to be operational, there must be a control station present. ADE has two control levels (as explained to me). At all times, a primary control station is monitoring the system (as Dave said, there are usually three or four). There is also a secondary level of control, and a secondary level control operator must be present and obvious or the system reverts away from open access. Therefore, as I understand it, ADE operates as an open system when both levels of control and responsibility are present, and as a limited access system at other times.

Hospitality on ADE? During the QSO I had with Dick, Ian, and the rest of the ADE people, a fellow Angelino, Jesse W6BFO, came on channel needing a phone call to the San Jose area. Ian had to leave, so Dave took secondary control and waited for Jesse to reach a point where he was solid into ADE. Then, using the ADE autopatch facility, Dave handled Jesse's traffic. Sitting back and listening to the patch, I was reminded again of what our hobby/service is really all about. While it was noted that the ADE autopatch is normally limited to use by their group, it is my opinion that their willingness to share with an outsider is really a positive statement for a rather fine group of fellow amateurs. We had reached a restaurant by the time the patch was completed, so we said our "73s" to both Dave and Jesse. Dave reverted the system to primary control, and Sharon and I went to lunch. At least I thought that's what had happened.

Some twenty minutes later, when we again took to the road, we found that WR6ADE was still up and that Jesse was in QSO with Al W6MEO. Heavens . . . was all of L.A. up here this evening? As I found out, as I left for lunch, Al, who had been up north, was en route back to L.A. about 15 minutes or so ahead of me. Another secondary control station had taken over, in order to enable Jesse and Al to continue their QSO. That's just another touch of the hospitality afforded by the WR6ADE group. Soon, however, as we drove south near Soledad, we found ourselves leaving the service area of WR6ADE.

From that point until we reached the area of San Luis Obispo, our 12 Watts and 12 channels proved futile, except for a few quick .94 simplex QSOs with fellow transients. We did finally manage to get in touch with Al, who by now was about a half hour in the lead, and decided that dinner was in order. We met at a Denny's along the road and took an hour's break from the concrete and asphalt to renew an old friendship.

According to some of the letters we received, we should have been able to be in almost constant repeater contact. However, such was not the case. To this day I can't tell you why. The following letter from Ernie WB6HJW, very indicative of some of the mail that part one of this story brought, is probably the most up-to-date info available on activity in that area.

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Dear Bill:

Just a short letter to let you know that amateur radio is alive and well in the Santa Maria area, despite what you indicate in your April column.

In Santa Maria we have a repeater (WR6AHZ, on 147.81/.21) which has been in operation since 1974. WR6ASW, 146.34/.94, is now located on a hilltop south of Santa Maria, although I believe it was at ground level when you made your trek north. WR6AEL, 146.22/.82, is located on Cuesta Grade (north of San Luis Obispo) and covers from Camp Roberts to Buellton. WR6ADS, 146.16/.76, is on the campus at Cal Poly (San Luis Obispo). WR6AVI, 147.72/.12, is on Harris Grade, near Lompoc, covers from San Luis Obispo to south of Buellton, and has been on since 1973 (formerly as WR6AEB). WR6AFI, 147.60/.00, is on Broadcast Peak above Santa Barbara, and covers from Paso Robles to the Mexican border (of course, not solidly).

WR6AHZ has autopatch into Nipomo, Arroyo Grande, Grover City, Pismo Beach, San Luis Obispo, Avila Beach, Baywood Park, and Los Osos. WR6ASW has autopatch into Santa Maria, Guadalupe, Nipomo, and Los Alamos. WR6AVI has autopatch into Lompoc and Vandenberg Air Force Base.

There are other repeaters in the Santa Barbara area (on 146.31/.91 and 146.19/.79) which are accessible south of Gaviota.

All repeaters in San Luis Obispo and Santa Barbara counties are open, and persons passing through the area are welcome to use them. Repeater use is monitored by control stations, but I have never heard any control operator interfere with any amateur's lawful use of a repeater. Most area repeaters are on 24 hours a day.

I hope on your next trip north (maybe for the Southwestern Division ARRL Convention to be held in Santa Maria, Oct. 7-8-9) that you find this area more hospitable on two meters and that you won't have to resort to CB to talk to someone. With almost 200 amateurs in the area on two meters, the repeaters are jumping.

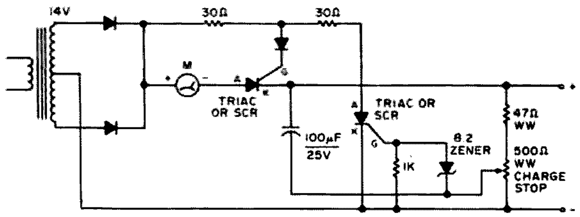
Ernie Kapphahn WB6HJW
Santa Maria CA

We wish to express our gratitude to

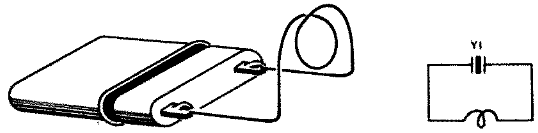
Continued on page 167.

Circuits²

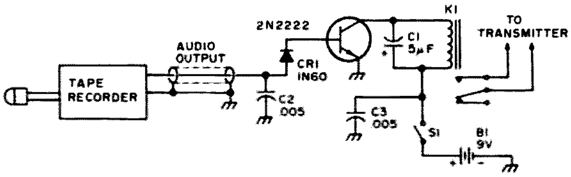
Want a free copy of any 73 publication? Sure you do. Just send in your favorite circuit, or even one that you don't especially like. If we print it, you take home the book of your choice. Just be sure to specify which book you want. OK?



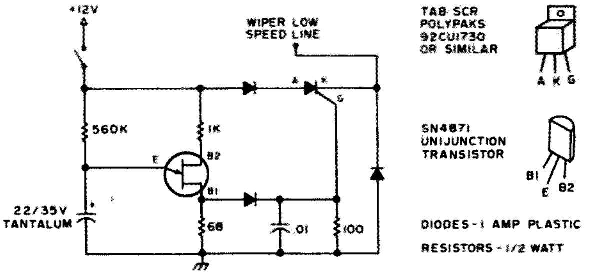
An automatic shutoff battery charger which will not dry out batteries. Must be adjusted by setting 500 Ohm resistor while attached to a fully charged battery. Thanks to W6ZNX.



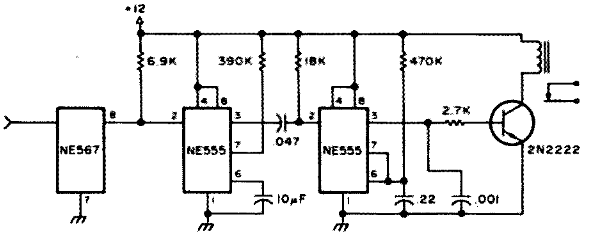
The simplest circuit yet for checking crystals. Attach a one-turn coil to a crystal socket and plug in the crystal. A grid dip meter coupled to this turn will dip at the resonant frequency. Thanks to W5QFH.



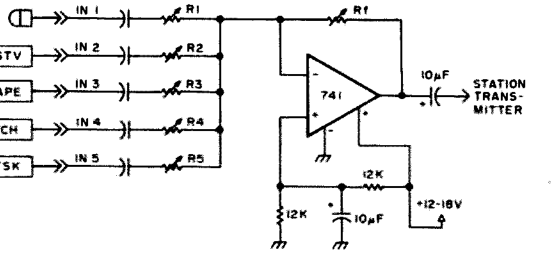
The tightwad special keyer memory for contest types needing memory for CQs and so on, but unwilling to assemble the conventional type. Construction and operation are simple, but be sure to keep stray rf out of the system through shielding. An audio oscillator is keyed into the microphone of the recorder and put on tape. Then the recorder is rewound and played into the circuit. Sensitivity is adjusted at the output of the recorder. Thanks to WB8TSY.



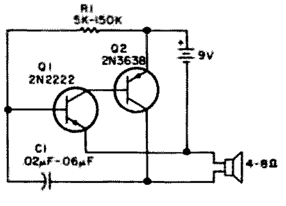
A good way to set your windshield wipers on an interval circuit. Only two connections to the car's wiper control, plus ground, are required. Variable control can be accomplished by substituting a 500k pot in series with a 100k fixed resistor in place of the 560k. Thanks to VE3OE.



This circuit was designed to give about eight seconds worth of delay after a reset tone is applied to the control receiver of a remote base. A tone can be applied for 1 or 2 seconds without appearing on the transmitter output. Thanks to W7CJB.

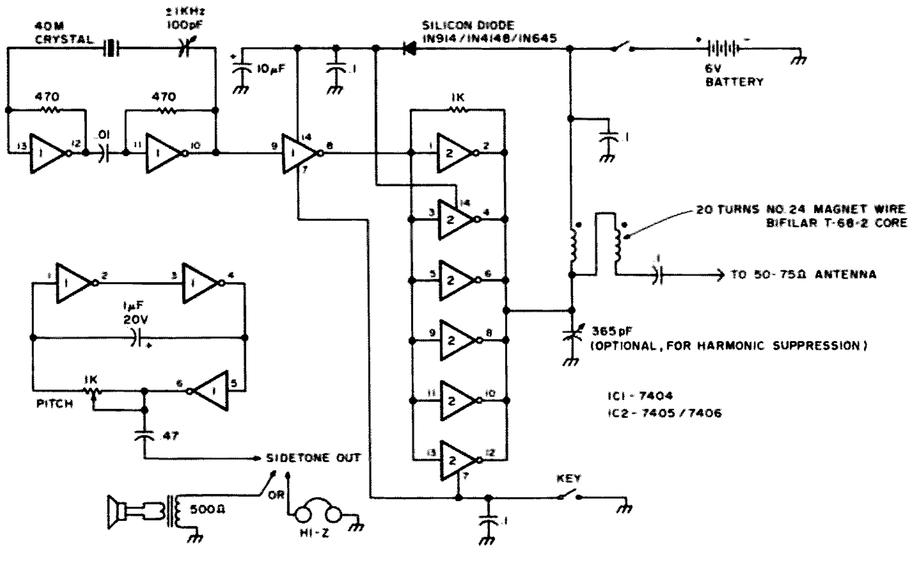


Here's a good way to input several audio sources to your station transmitter. It's an op amp in the "summing amplifier" mode. Overall gain is set by Rf while individual inputs are adjusted by their respective controls. Thanks to K7HKL.

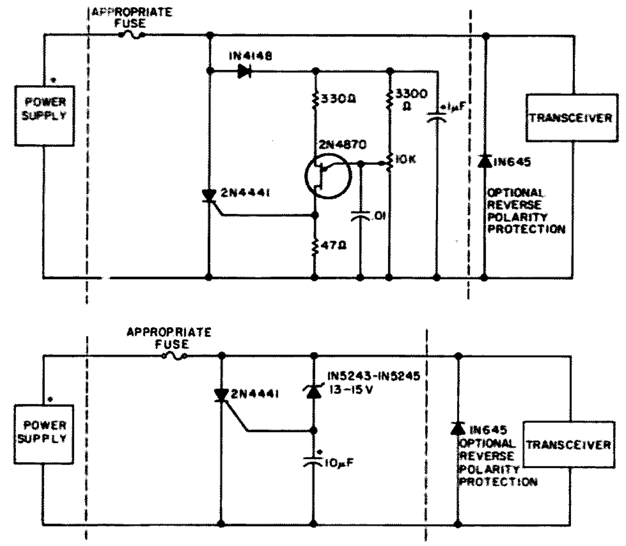


A good audio oscillator circuit. Almost any transistors will work, while R1 and C1 will vary the tone. The circuit has been used to find the correct pins on unknown transistors and as a simple test for good or bad. Thanks to M. S. Reid WA3JEF.

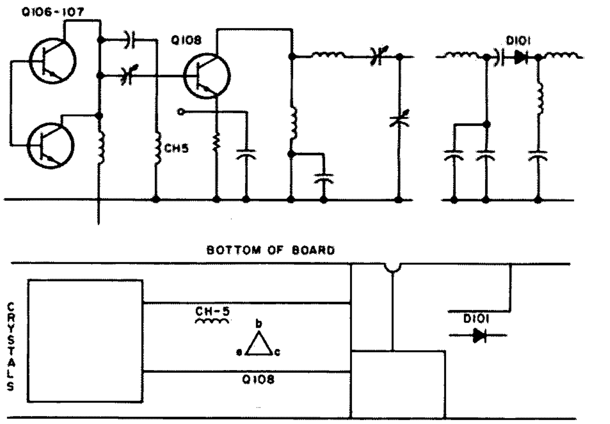
News? We need input, and one of the best sources is the club newsletter. Got one? We reiterate our longstanding offer of a free subscription to 73 or Kilobaud in exchange for a spot on your ham or computer club newsletter mailing list. Deal?



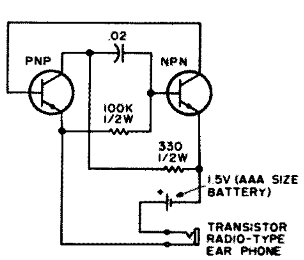
A super cheap 40m CW transmitter with sidetone monitor. Rf output is about 250 mW, and the cost should be under $5. Thanks to WB4CTC.



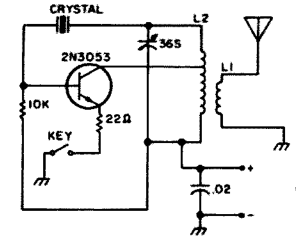
A way to avoid grief when using 12 V.power supplies with mobile transceivers. Most p.s. circuits leave room for a short circuit failure of the series pass transistor, which will do a job on your rig! Here are two crowbar circuits which will deliver protection by clamping the power line and blowing the fuse within microseconds of the beginning of an overvoltage condition. The idea here is to incorporate the crowbar directly into your transceiver, thus protecting the radio wherever you go with it. The chief difference between the two circuits is that the less complex of the two leaves you at the mercy of component tolerances for the exact trigger level, while the other includes a unijunction trigger to permit precise setting of the operating point. Thanks to W1DGD.



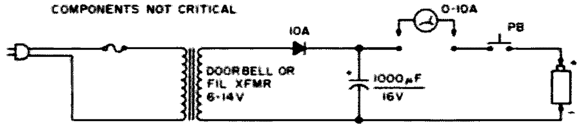
Wilson 1402 HT modification for those experiencing problems with diode D101. First replace choke 5 with a 100 Ohm resistor, then add a 25 pF capacitor from the base of Q108 to ground, and finally replace diode D101 with a jumper wire. Thanks to W8URX, through the LEARA Newsletter, *CA.*



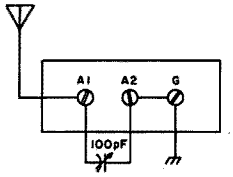
The simplest transistor checker yet! Choose a general purpose PNP/NPN and construct in a plastic box or small container. Color code the transistor and its socket. To check a suspect device: no tone, ng; low tone or chirp, so-so; steady tone, OK. A great circuit for matching transistors. Thanks to Bill Wentzel W3GWA.



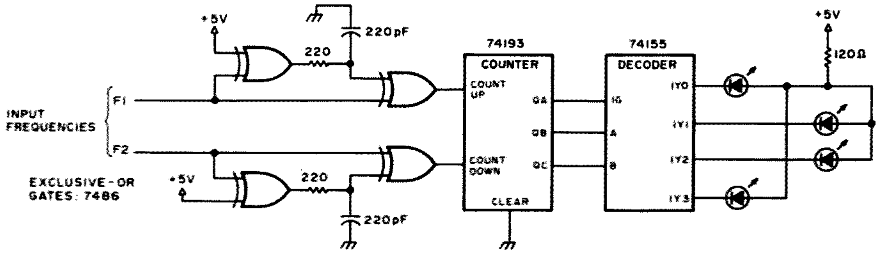
Another QRP transmitter, this time using a 2N3053 and fundamental crystals. Runs about 2 Watts output. Thanks to WB6OMV.



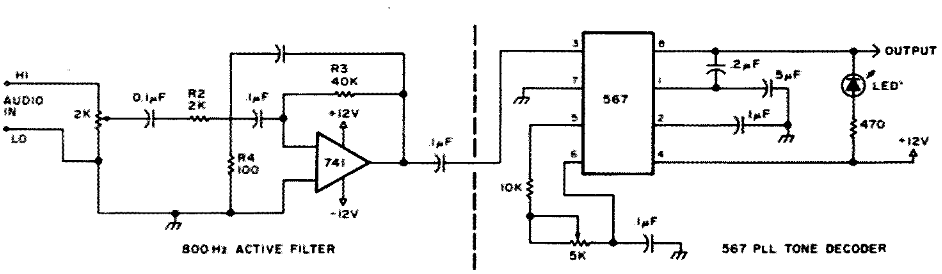
The nicad zapper used to restore dead or bum nicads. To operate, connect nicad to output and press button for 3 seconds. Thanks to K6JQD.



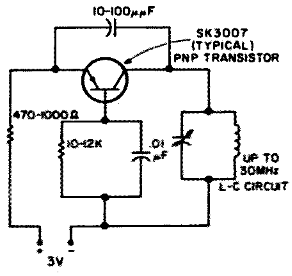
Many low-priced receivers for the 160-10m amateur bands do not have an antenna trimmer control. To peak up reception on your favorite band, mount a small variable capacitor (100 or 140 pF) at the antenna terminals on the rear of the receiver, as shown. Tune the capacitor for a maximum reading on the S-meter. For a more permanent arrangement, the capacitor may be mounted inside the receiver cabinet and tuned from the front panel by an extension shaft and knob. Thanks to W3WTO.



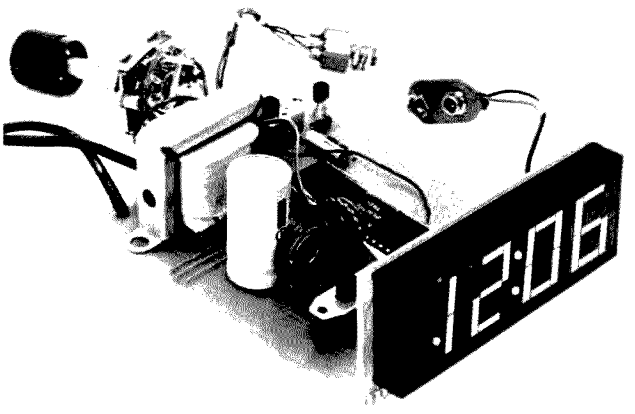
This circuit uses LEDs to display the beat frequency of two-tone oscillators. Only one LED is on at a time, and the apparent rotation of the dot is an exact indication of the beat frequency. When f1 is greater than f2, a dot of light rotates clockwise; when f1 is less than f2, the dot rotates counterclockwise; and when f1 equals f2, there is no rotation. Thanks to WB8TFN.



Here's a Morse code decoder for the handicapped. It will copy very weak signals due to the narrow bandpass of the active filter on the PLL input. This can be powered by two 9 volt transistor batteries. Thanks to WA5SWM/5.



An rf oscillator useful up to 30 MHz. An SK 3007 PNP transistor is recommended. Thanks to WA5RON.



The Fairchild 0100 clock/calendar Technology Kit™.

electronics Division of Fairchild Camera and Instrument Corporation.

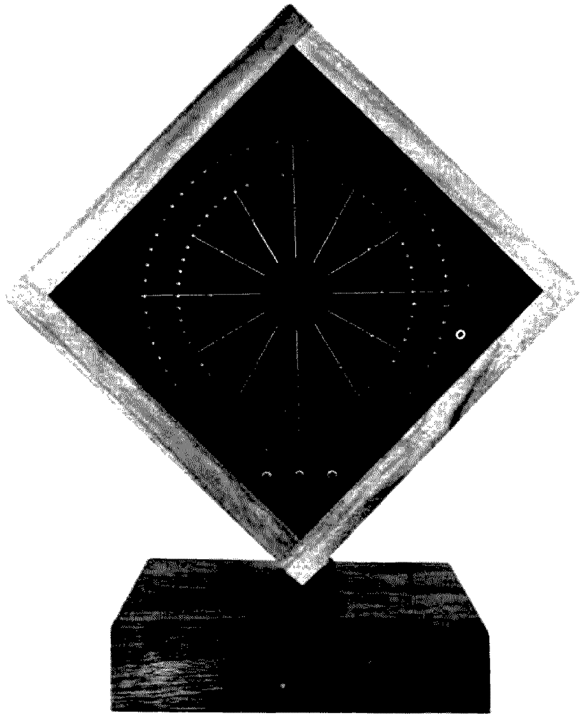
The 0100 alarm clock/calendar features an .8 inch, 3½ digit LED display with am/pm indicator. The clock, which displays time for eight seconds and date for two seconds, has connections for radio applications and may be connected to a nine volt battery.

The 0101 wall clock uses a 2½ inch, 6 digit LED display comprised of 175 LED lamps. The display, visible at up to 50 feet under normal conditions, alternates between time and date. If desired, constant time or date readout can be selected. The wall clock can also be connected to a radio with direct current for an external speaker, and contains programmable alarm features. *Fairchild Camera and Instrument Corporation, 4001 Miranda Ave., Palo Alto CA 94303.*

NEW AMELECT CLOCK

A new, revolutionary concept of displaying the time of day by means of the position of illuminated light emitting diodes (LEDs) in three concentric rings on a mirror-like acrylic face has been announced by Amelect, Inc.

These clocks, three years under development, are available in four styles and several kinds of solid hardwoods: walnut, mahogany, maple, cherry, and light and dark oak. The modern clock face is made of 1/8" acrylic with scribed markings to identify time positions. There are no moving parts, gears, motor, or hands. An outer ring of sixty lamps indicates seconds, and each successive illumination takes place at one second intervals. The middle ring of sixty lamps indicates minutes and changes each time the sixtieth second is illiminated. The inside ring of twelve lamps indicates hours and changes when the sixtieth minute lamp is illuminated. Actual time is shown by position of the three lamps that are illuminated at the given instant of reading. *Amelect Inc., P.O. Box 367, Goodland IN 47948.*



The Amelect CL 7401A with base.

NEW VHF ENGINEERING 30 AMP POWER SUPPLY

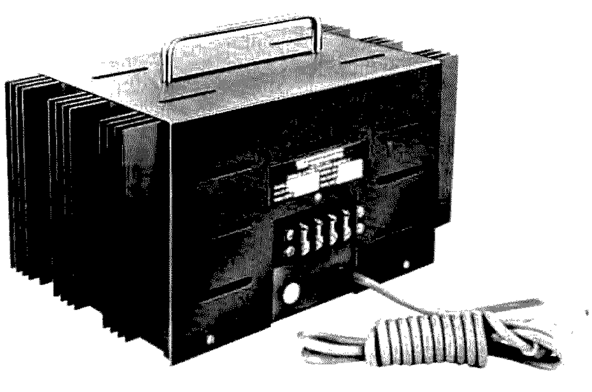
The PS-3012, a high current, 13.8 V regulated power supply originally designed for commercial two-way radio applications, is now being introduced into the amateur market by VHF Engineering of Binghamton NY. This power supply has been designed for demanding commercial applications through the use of a heavy duty transformer, dual heat sinks, and ruggedized case. The PS-3012 delivers 30 Amps at a 50% duty cycle, and 20 Amps at a continuous duty cycle.

The PS-3012 is available for $239.95 as a wired and tested unit from *VHF Engineering, 320 Water St., Binghamton NY 13902.* A rack mounted version is available as an option.

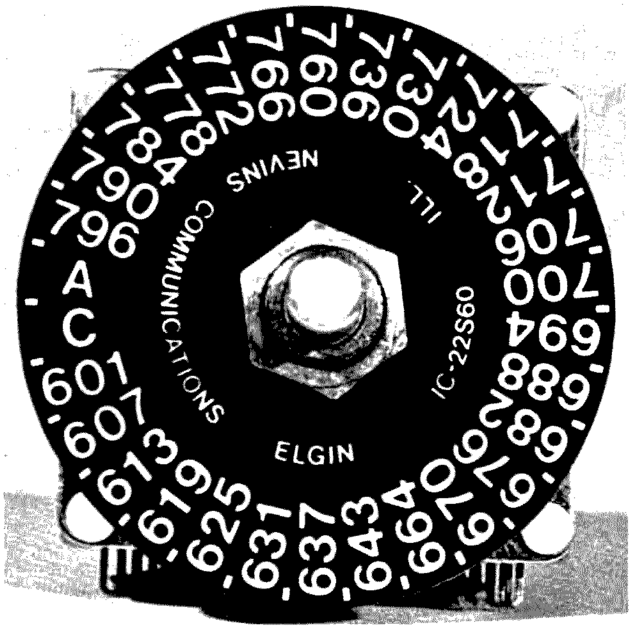
VIP-60 CONVERSION KIT

Valley Instrument Products of Bartlett IL has introduced a new programming device for the popular Icom 22S 2m transceiver. The VIP-60 conversion kit offers 56 preprogrammed frequencies, including all standard repeater channels, plus any four additional frequencies you choose. *Valley Instrument Products, P.O. Box 339, Bartlett IL 60103.*

Continued on page 106



The VHF Engineering PS-3012.



The Valley Instrument Products VIP-60 conversion kit for the Icom 22S.

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Motorcycle Mobile

- - combining summer pastimes

The great outdoors. The clean air. You, riding off down the road, the wind in your face, on your trusty motorcycle heading off into the sunset. Ah, freedom! But the specter of a chain breaking, plugs fouling, or a tire going flat and you twenty miles from nowhere looms nearby. Anyway, riding around with all that freedom is lonely. There's no one to talk to. Even if you are with a group of people communication is limited to waving arms and sign language. There is a better way! Whether it be CB, HF, or two meter FM, motorcycle mobile is the answer to getting more fun from your bike.

First you have to decide what type of rig you are going to use. Unless your motorcycle has the battery and electrical system of a Harley-Davidson, you are limited to the many transistorized mobile or portable radios on the market.

The obvious answer is the handie-talkie. It's nice and small, very portable, has its own power supply, and is hand-held. Wait a minute! How are we going to go down the road using only one hand to operate the bike?

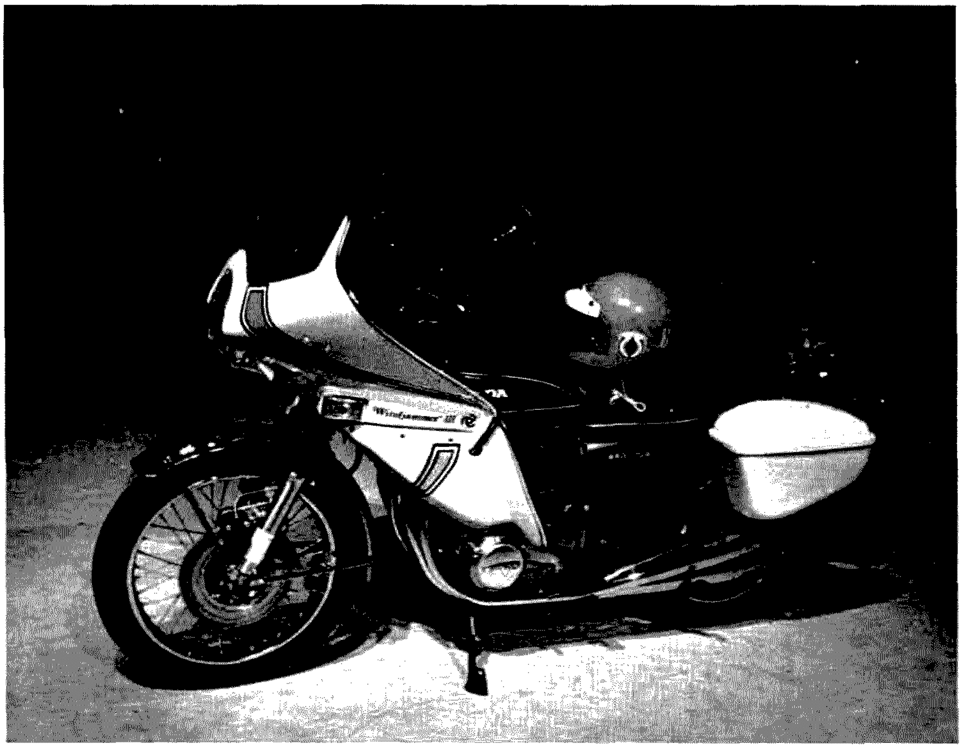
Well, maybe you could use a belt clip and some sort of external microphone/speaker combination like the law enforcement motormen use. This is OK if you don't mind your \$200-\$400 talkie flapping about on your hip, exposed to the elements (maybe bouncing down the road behind you?) plus the extra cash for buying the external microphone/speaker box. Anyway, how are you going to key the thing while under way? It looks like the obvious answer needs some rethinking.

OK, how about using that larger mobile rig? Well this, believe it or not, has got possibilities. The next question is, where am I going to put it?

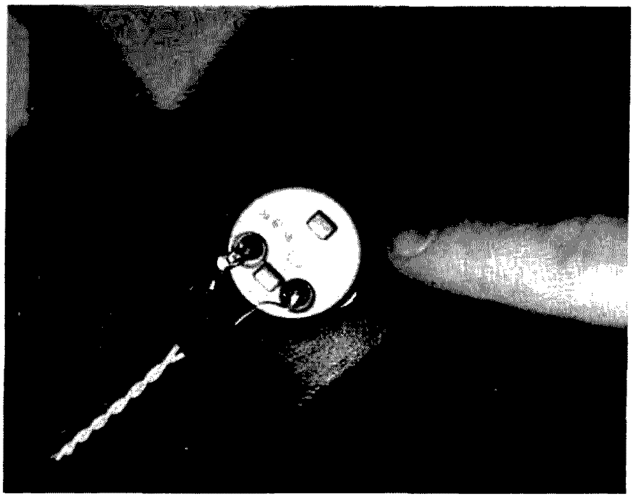
It has got to be handy, so some place up front would be nice. Putting the rig on the handle bars might work, but you would have to fabricate some sort of exotic mount for it, not to mention covering up the instruments (in the case of the speedometer, this would be costly) and adding extra mass to the front fork assembly which could be dangerous to the bike's handling characteristics.

A tank bag would work fine. This is a bag (approximately 12" x 8" x 8") of leather or vinyl material that straps on top of the gas tank. The bottom is padded so it won't scratch your paint job and the whole bag unbuckles in seconds so you can take it with you. It was designed for carrying one or two changes of clothes with you on a short trip. It is usually waterproof too. The cost is about \$40.

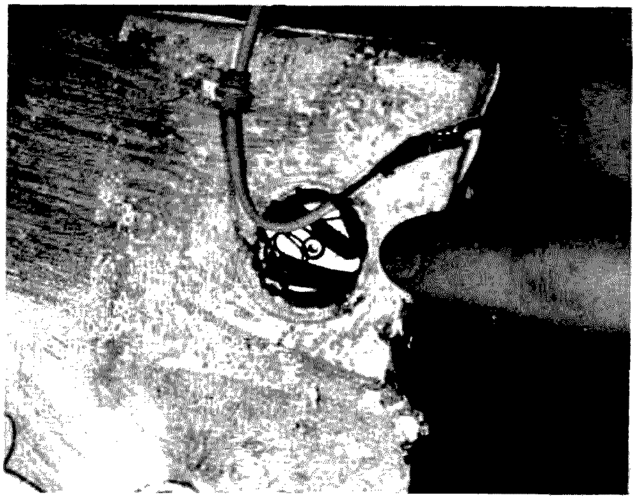
The best alternative is the space inside of a good frame-mount fairing. A fairing is a combination windshield/cowling protective device made from ABS plastic or fiberglass, which protects the rider and bike from the elements and road hazards. One week after I had bought a new 550 four cylinder Honda with a Windjammer fairing, a curb that was lurking in the dark jumped out in front of me. I broke the windshield in the resulting crash. The windshield had to be replaced, but the fairing, which was just a little



Motorcycle mobile — note connecting cord from helmet.



Rear view of front crash padding removed from helmet showing rear of microphone.



Styrofoam helmet liner showing earphone and cord detail.

bit scratched, had saved me and, more importantly, my new motorcycle from any damage. So at about $300 they are worth the money. Besides, the fairing has lots of storage space inside which is protected from the elements. Most mobile rigs will easily slide into one side of a fairing leaving still more room for extra microphones, headsets, and rain gear.

Now that we have the rig attached to the machine, how do we use it? First, we will have to make some sort of arrangement for a speaker. You may be able to use the rig's internal speaker if it's on the front or top of the rig and you are using a tank bag. If this is not the case, then an external speaker jack must be installed in the radio.

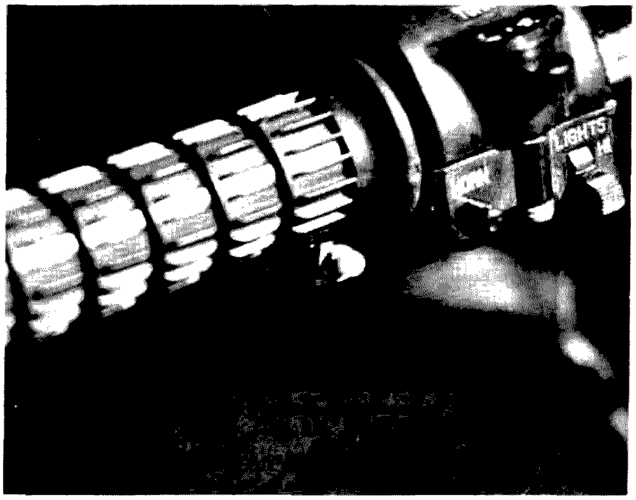
Now you have a couple of options: a speaker mounted on the handle bars, or an earphone/headset under your helmet. I went the speaker route first. It worked all right, but the rig has to be turned up so loud to override the sound of the motor, wind noise, and the natural attenuation of my helmet, that late at night I was in danger of being cited for disturbing the peace. Next, I tried a transistor radio earplug. This only had two problems: The audio quality was nonexistent, and I did not like the feeling of that "thing" in my ear. I then decided to modify my helmet. I will get into the helmet modification a little later.

After solving the speaker problem, the microphone problem is next. If you are using any helmet other than a full coverage type (one that comes down in front of your mouth and chin with a large slot for you to see out of), you can use a hand-held microphone with good success. Just drape it over the handle bars and (unless you want to use the clutch lever) pick it up, put it under your face shield and talk. The face shield really cuts down on the amount of wind noise that gets picked up by the microphone. Working the microphone close to your mouth helps, too. (You won't have any choice if the microphone is between you and the faceshield.) Using the hand-held microphone also eliminates the push-to-talk switch (PTT) problem that we are about to run into.

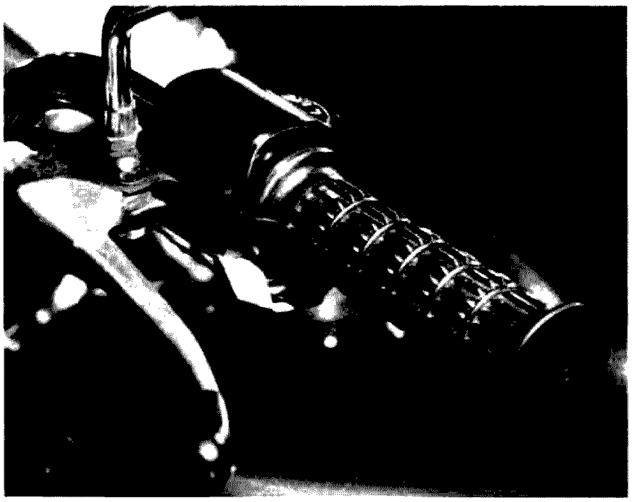
If we do not use the standard microphones, then we have a few problems: Where are we going to put the PTT, and how are we going to hang the microphone in front of our mouth for hands-off operation? Now we get into how to modify your helmet.

All good helmets have lots of crash padding inside. Usually it's styrofoam and foam rubber. The main protection over the head is the one half to one inch thick styrofoam. Foam rubber is sometimes used in front of the mouth in full coverage helmets and in a few other places such as around the ears. What most people don't know is that you can take the padding completely out of the fiberglass or plastic shell of the helmet. The padding is generally in two pieces, split from front to back down the middle. The crack may be covered up by a small decorative strip and/or a piece of foam rubber. Now comes the fun! You have to work one of the styrofoam halves out of the helmet shell. If you are careful and persistent, you will emerge victorious in this little bout with your helmet. The liner will be a bit stubborn, possibly because some of the cheaper helmets may use a little rubber cement to hold it inside the shell, but forge ahead! Remember, if it's a cheap helmet, they are too cheap to use a lot of glue on it.

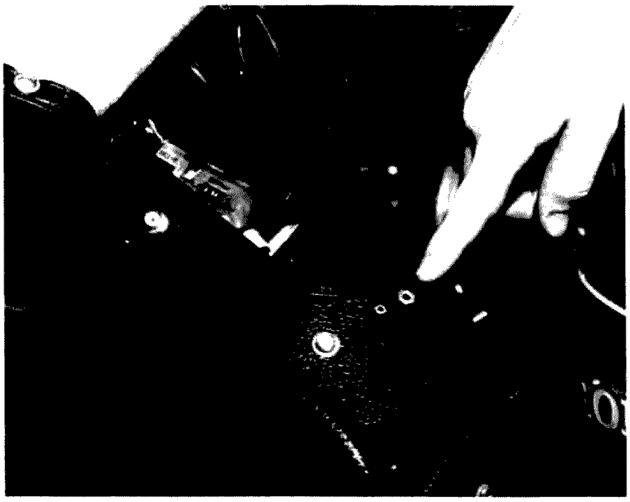
Once you get the first half out the other side will probably fall out. Now you can start the real modifying. I took an old headset that had a boom microphone on it and canabalized it. The earphone element was about 1.5 inches in diameter and about ½ inch thick. I then cut a hole in the styrofoam next to my ear and pushed the element into the hole. Since my element used a plastic membrane for its



PTT switch and bracket. Front view.



PTT switch and bracket. Rear view.

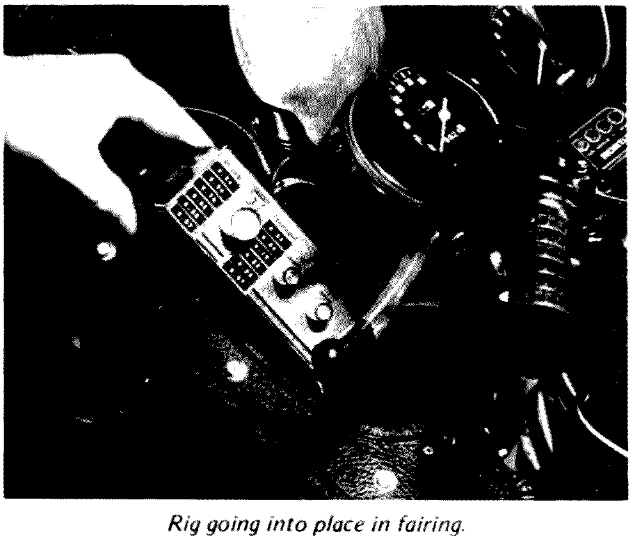


Helmet jacks mounted in fairing.

diaphragm, I put a hard plastic cover over it. The guard was a retaining cover from an old telephone type carbon microphone on a boom that telephone operators used to use. It just happened to fit over my earphone element. Anything that has holes in it that will prevent damage to the diaphragm can be used. I then ran the wires out the back of the liner. First, though, you can use a razor blade to cut a shallow trough in the styrofoam (the side that will contact the hard shell of the helmet) for the routing of the microphone and earpiece wires out of the helmet.

If you have a full coverage helmet, you can use the same procedure to mount a microphone element in the padding in the front of the helmet. For all other types of helmets you must make up some sort of microphone boom. The boom can be made with brass tubing from a hobby shop (approximately 1/8 inch diameter) bent into a smooth, gentle curve. The end of the boom where the wires come out can be epoxied into the styrofoam after a suitable trough has been notched out for it. Be careful about using glues on styrofoam. It may melt. Rubber cement may be better than epoxy.

Finding a suitable microphone element was the hardest part of the project. I had a small dynamic microphone element that came out of an old headset that I had salvaged the earphone and cord from, but the element was bad. After scrounging in many other people's junk boxes to no avail, I finally went to the local Radio Shack. There I found brand new replacement CB microphones (dynamic and ceramic) for only $8, which was about $3 to $4 cheaper than the replacement element I could get for my Sure microphone. Also, the element in the microphone from Radio Shack was only about ¾ of an inch in diameter. This would fit very nicely into the crash padding in the front of my helmet.



Rig going into place in fairing.

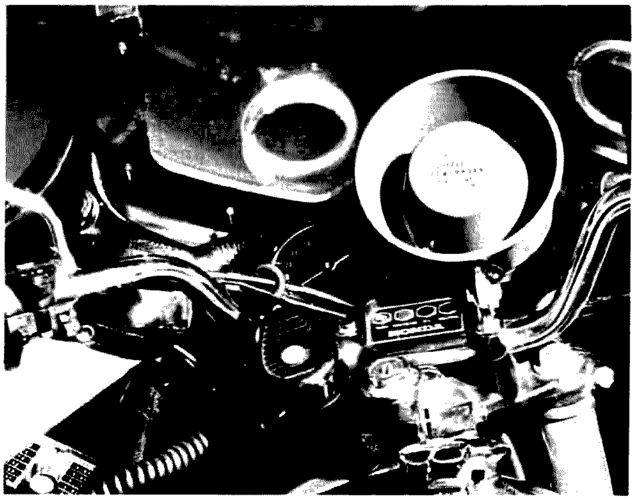
After you get all the elements in place in the crash padding, use some duct tape to keep it all from falling out before you get the liner back inside the helmet. Now all that's left is to put a jack in the fairing for the helmet to plug into and, oh yes, the PTT switch.

I tried two methods for PTT. The first is usable but is almost like using a hand-held microphone. I epoxied a small push-button normally open switch (five for $2 at Radio Shack) into an inverted cover that screws over a ¼ inch phone jack, and ran the wires out the smaller opening in the opposite end. I would then attempt to grab this assembly while motoring around town. I never realized that it was so small. After about two weeks of attempted use with this PTT, I found the better way. I built a small bracket out of aluminum and mounted the switch and bracket to a handy screw in the left-hand grip assembly on the handle bars. The switch is conveniently located right next to the horn button and can be easily actuated by the thumb on my left hand.

The last two items are the easiest. We have to have power for the rig, and we need a place for the antenna. If your motorcycle has a twelve volt battery, you have it made. Just run two wires from the battery to the rig. I would suggest running two wires rather than relying on the frame ground for your dc return. This keeps things nice and direct and avoids any intermittent ground problems cropping up later. Also check to make sure that your motorcycle electrical system ground is the same polarity as your rig. Motorcycles are not all standard twelve volt negative ground systems, and if this is different from your rig, you may pick up problems through the coax braid which will be grounded to the motorcycle chassis at the antenna mount.

The antenna mount I used was nothing more than some aluminum stock drilled and bent to mount on the rear fender attached to the rear tail light assembly. An

Antenna mounting bracket detail.



First try at going mobile — external speaker and hand-held microphone.

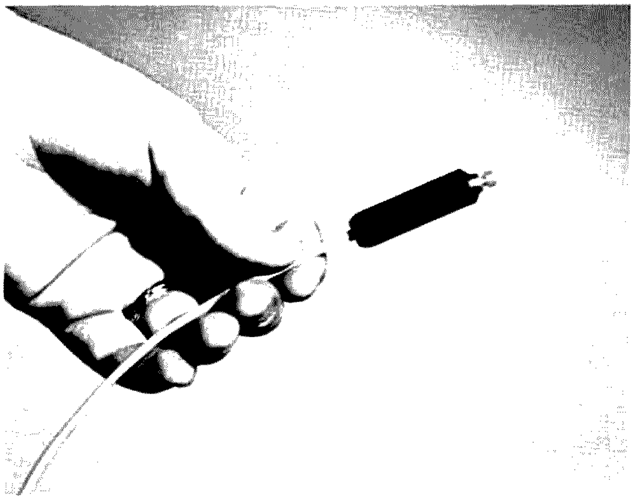
SO-239 chassis connector was mounted in the bracket. This way I can use either the traditional 1/4 wave whip in a PL-259 or the home brew 5/8 wave antenna which also ends in the same type connector. (See *73 Magazine*, "5/8 Wave Power for your HT," May, 1976, page 118.) If you then want to park the bike and not advertise the fact that you have a radio on board the antenna is easily removed. The battery wires and antenna coax are easily routed under the seat and gas tank and brought out from under the tank at some convenient spot. If you want to you can use tape or plastic cable ties to hold the wires in place as they go along the frame members. This will keep the wires off the hot engine and also keep them from getting pinched under the rubber supports of the seat and tank.

Now that you are ready to ride off in a cloud of dust, let me add a few words about operation of radios and motorcycle electrical systems. Most motorcycle electrical systems are marginal in capacity. You may find that you may have to be less long-winded than normal when operating motorcycle mobile to keep from running the battery down, depending, of course, on how much current your rig draws. I am currently using an HR 2 and have not had any problems keeping the battery charged due to the radio. However, my quartz headlight and extra marker lights in the fairing make me recharge the battery about every 3-4 weeks of constant use.

Also, a word about ignition noise. My Honda 550 four cylinder is very noisy electrically. Although it came with swamping resistors in the spark plug caps and I shielded the high voltage wires and coils, none of this had any effect on reducing the noise. I found out that Honda Fours have a very peculiar high voltage system. The ignition coil secondaries are not grounded on one side like they are in a car. They put two spark plugs in series with each other so the spark goes from the tip of one plug to ground, through ground to the other plug and then jumps to the tip of the second plug returning to the coil. So, the problem is that the engine case is a radiator rather than a shield for the spark. The only way I can see around this problem is to use four coils, one per plug, and ground one side of each secondary. Most of the time the ignition noise is down to a comfortable listening level as long as the repeater's signal strength is fairly high. However, when you're trying to receive weak signals the ignition noise can be fierce. Honda Twins (two cylinder engines) are not set up this way. They have a separate coil for each plug. If you experience problems, check your manual to see what kind of system you have. If it can be shielded, do it. Don't forget to add resistor caps and plugs along with any shielding you do, if the engine is not already equipped with them. After adding your improvements, you can use your rig or a transistor AM radio as an rf sniffer to check your thoroughness. Please take note: If your engine performance deteriorates after installing resistor caps or plugs, you may have to go back to the original equipment. Remember, motorcycle electrical systems are marginal. This includes the ignition system, too.

I have been operating motorcycle mobile for about eight months now with good success. Most stations I talk to can't tell the difference between me operating on the motorcycle and other people operating in cars. Frequently, surprised people ask me to repeat what I said when I sign with "Motorcycle Mobile." Then I am usually deluged with all sorts of questions about how other people can do it also.

Now you are ready to enjoy two loves at the same time, radio and motorcycling. I hope this will encourage you to take the plunge and become one of the few stations identifying with motorcycle mobile. ■



First external PTT switch. Hand-held, no bracket.

Inside the Bird

-- a wattmeter exposed

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Did you ever wonder how the Bird wattmeter does its thing? I did, after butting my head trying to get a Bendix directional coupler to operate at a power level far beyond its specs. So I started hunting for every piece of design information I could lay my hands on. I found out that the information was not only difficult to find, but also very sketchy when found.

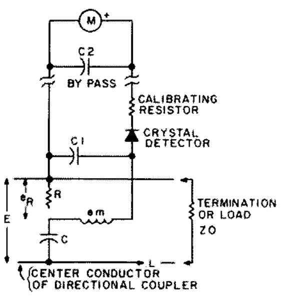

Fig. 1.

The Bird Model 43 wattmeter consists of three main sections: a directional coupler, a detector, and a calibrated readout. Let's start with the unit's readout, which is a very high quality 30 uA (microampere) meter. The meter face is kept simple by having only three basic scales: zero to 25, 50, and 100. The plug-in detectors of varied frequency and power ranges are all made in multiples and divisions of these scales. The meter incorporates about three feet of shielded cable and thus can be separated from the main frame for remote viewing.

The detectors are made to plug into the main frame or housing so that they couple to the center conductor of the directional coupler in a precise fashion for just the right amount of coupling for the specified power rating. The plug-in detectors have precision contacts that connect mechanically to the meter section. By rotating the detector 180° in its socket, one can take both a forward and reverse power reading. By applying the two readings into a simple formula, one derives vswr (the voltage standing wave ratio) on the transmission line:

$$\rho = \frac{1+\sqrt{\emptyset}}{1-\sqrt{\emptyset}} \quad \text{and } \emptyset = \left[\frac{\rho-1}{\rho+1}\right]^2$$

where ρ = vswr and $\emptyset = P_r/P_f$.

I knew that would scare some of you! But look at the formula again with an open mind this time, and see how really simple the formula is. Let's look at $\emptyset$. This is nothing more than the Greek letter "phi" that says the following relates to some voltage, magnetic flux, or angle relationship, and the symbol is easier to use than the equation it represents. In this case, $\emptyset$ or phi is equal to P_r/P_f. P_r is the reverse power reading and P_f is the forward reading. The forward reading is that which you get when the arrow on the detector plug is pointing in the direction of the antenna. And reverse power is that reading when you turn the plug 180° so that the arrow is pointing to the generator or source.

Now, with your calculator, take the forward reading, e.g., 50 Watts, and place it into the denominator (the divisor in the formula). Take the reverse reading, e.g., 5 Watts, and put it into the numerator. We now have $\emptyset$ = 5/50 or .1. Now let's take the rest of the formula or rho resistivity:

$$\rho = \frac{1+\sqrt{.1}}{1-\sqrt{.1}}$$

Take your calculator again and find that $\sqrt{.1}$ = .32. If you can't believe that, multiply .32 by itself and find that it equals .1. ρ=1+.32/1-.32 or 1.32/.68, which equals 1.94, which is the vswr, 1.94 to 1 or roughly 2/1.

Now that you are convinced that you can easily find vswr by measuring two powers, it's even easier to just refer to the curves furnished with the instrument. Then there are no mathematical calculations whatever. But now you know. Let's go on. The detector probe couples to a 50 Ohm cavity, the dimensions of which have been calculated by the relationships of the outside diameter of the center conductor to the inside diameter of the cavity, e.g., Z = 138 log (d_1/d_2). The formula is more involved where the dielectric is other than air.

The cavity in this case is a thruline lumped constant directional coupler; the detector probe or sensor extracts a sample of rf energy

from the line in either a forward or reflected direction. Fig. 1 is a representation of the sensor makeup. It can be likened to an AM detector receiving a CW signal. The signal is rectified and the dc actuates the meter readout.

Basically, the sensor is comprised of a resistor R and a loop of wire which couples to the cavity conductor by mutual inductance M. When the plug faces the forward direction, M is positive. Rotating the plug 180°, M becomes negative.

The capacity between the junction of the resistor R and loop M and the center conductor of the line section makes up the capacity component C. The loop, being a small fraction of a wavelength, will discriminate between the forward and reflected waves.

Looking again at Fig. 1, C and R make up a voltage dividing network. M is the mutual inductance between the loop and the line section center conductor. E is the voltage between the center and outer conductors of the line section. I is the current in the line.

The voltage and power sensitivity are proportional to the distance between the coupling loop and the line section center conductor. Now, looking at the transmission line, the voltage "E" at any point on this line is equal to the sum of the (f) forward and (r) reflected voltage, $E_f + E_r$, and the current "I" is $(E_f/Z_o)-(E_r/Z_o)$. Since the reflected wave travels in the opposite direction, $I_r = E_r/Z_o$,

$$e_{\rightarrow} = j\omega M \left(\frac{E}{Z_o} + I\right)$$

$$= j\omega M \left\{\frac{E_f + E_r}{Z_o} + \frac{E_f - E_r}{Z_o}\right\}$$

$$= \frac{j\omega M}{Z_o} \quad (2\,E_f)$$

and turning the element toward the source, it becomes:

$$e_{\leftarrow} = j\omega M \left(\frac{E}{Z_o} - I\right)$$

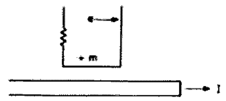

Fig. 2. Element in forward direction.

$$= j\omega M \left\{\frac{E_f + E_r}{Z_o} - \frac{E_f - E_r}{Z_o}\right\}$$

$$= \frac{j\omega M}{Z_o} \quad (2\,E_r)$$

The "j" term simply means that the pickup voltage and current is 90 degrees out of phase with the line voltage and current.

The two formulas show that the rf output voltage from the sensing element is directional and proportional to the voltage in the line due to either the forward or reflected wave. It is also directly proportional to $\omega = 2\pi f$. In order to make it frequency independent, we terminate e in a capacitive reactance which is inversely proportional to ω. The voltage across this capacitor is rectified, filtered, and displayed on the meter scale, calibrated in Watts.

Previously, we stated that E at any point on a line is equal to the sum of the forward and reflected voltage on a flat line (one terminated into its characteristic impedance or one with unity standing wave ratio). The voltage at any point on this line will be equal, as there is no reflected wave ($E = e_f + e_r$). This makes sense as the line is a flat 50 Ohms at any point along its length. If this is so, then the current will also remain constant. From this, the power at any point is equal to $I^2R = IXE$.

However, the line is not always terminated into its characteristic impedance, as some of us well know by past experience. This tells us that on such an improperly terminated line, not only E but also I will vary. Because the wattmeter sensing element's loop M length is a small fraction of a wavelength, we can sample the vswr at any point on the line; both forward and

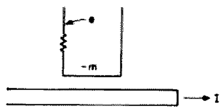

Fig. 3. Element in reverse direction.

reverse current are sampled at the same point and $E = e_f + e_r$. Have I convinced you? I can hear the opposition already.

True, some of you have made measurements on UHF and in essence can show that I and E did not remain constant on your supposedly properly terminated line. I hope you did not use 80' to 100' of RG-58/U. There is a logical explanation for this. At the higher frequencies, it is necessary to use low loss line. If not, the losses in the line will produce data that can give you the impression that you have a well-matched load at the antenna end. 100' of RG-58/U has approximately 3 dB of loss at 150 MHz. Only ½ the power gets up to the antenna, and if the antenna does not look like the feedline, what is reflected is attenuated by 3 dB on the way back. By the time it gets to the source and to the point where you are making the measurement, everything looks rosy. In this case, you might take a second measurement at the antenna end (between the feedline and the antenna). The difference between the power measured at the source and at the load will tell you the loss of power in the line.

Sometimes it is easier to find lower loss 70Ω coax than the comparable 50Ω line. I use CATV semi-rigid and rigid 70Ω line which has a fraction of the loss of RG-8/U at UHF. Before concluding, there is another point of interest to many using a 50Ω Bird and 70Ω or 90Ω coaxial lines. With certain limitations, good results may be obtained on 70 Ohm coaxial cable with a 50 Ohm wattmeter. The insertion of a Bird Mod 43 thruline wattmeter in a line adds 4 inches of 50 Ohm air line plus connectors into the system. This will change the load on the transmitter from its original condition without the meter.

Even on 50 Ohm systems above 100 MHz where the vswr is above 1.5, removing the wattmeter will cause a change. This is so because changing the length of line between a mismatched load and the source transforms the impedance of the load as seen at the source. If the adjustments for maximum energy transfer were made with a feedthru wattmeter in place, removing the meter afterwards will change the conditions. However, conditions on a line repeat themselves every ½ wavelength. The conditions on the line with the wattmeter inserted can be duplicated when the meter is removed by inserting an additional length of coax along with the meter, the total length of 50Ω coax and wattmeter equaling ½ wavelength. Be sure to take the velocity factor (dielectric constant) of the coax and connectors into consideration, removing both meter and added line section as one unit after all adjustments have been completed.

Another interesting method which I use (fully described by WB4KSS in the May, 1975, issue of *Ham Radio*, entitled, "Measuring Complex Impedance with an SWR Bridge") utilizes a double data system of measurements and a computer set of readouts made from a series of Smith chart plots. This method is especially good when using a 50Ω bridge and transmission lines of higher impedance.

Many hams now possess the treasured 50Ω wattmeter. With a little understanding of its abdominal functions, you should be able to find more uses for it than just measuring the output power of your transmitter. More power to you! ■

References

Watts News from Bird — Vol. 1, No. 2, Jan., 1964; Vol. 2, No. 2, Mar.-Apr., 1965; Vol. 4, No. 1, Jan.-Feb., 1967.

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Introducing Autotrak!

-- digital antenna tracking system

It has been a long time (over two years) since the big winter wind (I swear it was Murphy's big mouth) took down our first EME array attempt. The horizontal boom (40' tower) was too weak, the drive system left a lot to be desired in the elevation mode and was not too great in azimuth mode either, and so on. Oh well, live and learn.

In this article I hope to point out some of the corrections for any of you enterprising large array freaks like me, and also explain the most advanced — and in the future useful — piece of electronics added while we were down and muttering through the chill of two winters.

The electronics improvement I'm referring to is the Autotrak. If you are not interested in the EME work, don't stop reading now. How about all of you OSCAR fans? Want to track that little devil automatically so you can concentrate on making contacts and not have to grow six hands? Read on. Also, how about you die-hard contest ops? This unit will swing the beam around to precise headings on any preset timetable, and you choose the timetable!

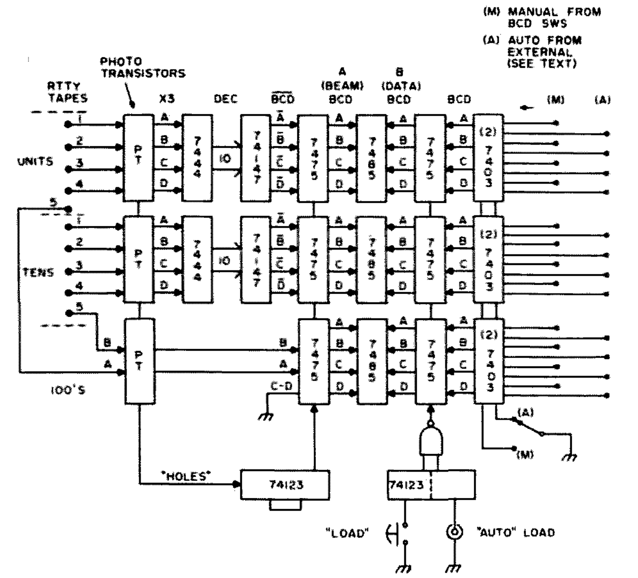

Fig. 1. Autotrak block diagram shown for azimuth (3 digits). Delete 100s for elevation. Elevation note: 5th line holes used for determining north or south quadrants in elevation (- or +). See schematic for details.

The antenna array here is an el-az type driven in elevation and azimuth, not a polar mount. This makes it a little tougher to track celestial objects (i.e., the moon), but it is much easier for satellites, tropo, etc. To give you some idea of our setup, there are sixteen 11 element Cushcraft modified 147-11 yagis mounted for horizontal polarization, approximately 1 wavelength apart from each other in both horizontal and vertical dimensions. This gives an overall array size of approximately 36' wide (tower), 20' top to bottom (vertical masts), and 12' deep (antenna booms). Big, in other words! This leads to special problems, but none that can't be overcome with a machine shop, super mechanical ability, or a Jeep engine for a rotor. The azimuth drive is handled by the old-time ham's workhorse — the prop-pitch motor ($3.00 at hamfest), the transformer for its power ($1.00 as a military surplus battery charger transformer — tapped input, tapped output, 20 Amps — hamfest), shaft coupler to absorb shaft misalignment (3/4" plywood doughnut and 1" x 3/16" flat steel — big oversize flexible coupler — hardware store parts), 4 heavy duty wheels for a lazy Susan type arrangement on top that allows rotary motion in azimuth (scrapped off factory package cart with 3' x 5' bed, 4" wheels with roller bearings, super heavy duty, and free), constructed wooden "doghouse" that tower lays in on 4 more of the cart wheels (plywood, well varnished and painted — wood *can* survive outdoors if you do it right). So much for azimuth.

Elevation is accomplished by building up a triangular tower (ours is Spaulding HDX) so it is circular in two places (more 3/4" plywood, double thickness) and putting 1" x 3/16" strap steel around it to form 2 metal rim "wheels" spaced just barely wider than the doghouse width. More package cart wheels are used as "bearings" (4), and the tower rotates along its own centerline. Therefore, anything attached to vertical booms running 10' above and 10' below the tower horizontal centerline remains in balance as the whole tower is rotated. This means you only have to overcome the metal rim "wheels" to package cart "bearings" friction. To do this and get the kind of resolution you need, use a pair of RCA through type rotors mounted horizontally to the back floor of the doghouse with a 1¼" o.d. waterpipe between them and through both. This becomes the drive "drum" for aircraft cable drive that push-pull drives a drum built around the center of the tower in the doghouse. This drum is constructed much like the tower metal rim "wheels." Two wooden discs form the outside edges and cable "guides," and ¼" x 20 3" long bolts are passed

between them from alternate sides every 2" on a diameter that just touches the three tower legs. The wooden guide edges are made 1" larger than the bolt circle to hold the cables on the bolt circle. The bolts themselves are covered by another piece of 1" x 3/16" strap steel formed into a drum over the bolts. Cables are fed 1 turn around the drum and then to the pipe drive drum. One cable goes one direction around the drum and the same way around the drive drum (pipe). The other cable goes the opposite way, for a push-pull action. Sufficient cable turns are placed around the drive drum to allow the tower to turn through a full 180°, or full front over top to full rear. This allows full 360° azimuth and 180° elevation coverage, but only requires the actual azimuth to turn 180°, east through south to west. West through north to east is taken care of by bringing the elevation up from 0° through 90° and on over into the north quadrants. Some may question the inverted horizontal polarization. One, we don't see any difference at all in the tests we ran. Two, very little work will be done in the north quadrants anyway except for initial North Star sighting and original bearing calibration.

This has been a rough detail of what we run, and an article will follow describing things in detail with (hopefully) many pictures, but you can see the problems with steering and tracking such a large array with such narrow beamwidths, both horizontal and vertical. You can't imagine how small that moon can be until you go looking on a cloudy night when visual tracking is out.

This brings us to our answer to steering this whole beast. The electronic tracking control is all TTL IC type quite common nowadays, and cheap! First, I'll try to describe it in function and peripheral equipment, and then by circuits.

In general, from the antenna end, two paper or mylar RTTY type "tapes" mount to a round clear plastic cake pan that is mounted to the azimuth shaft. These tapes are easily done by yourself or a fellow amateur with RTTY gear. They are punched using the Baudot holes, but the code is *not* Baudot. It requires all 5 holes for one number in Baudot, or 15 holes (three tapes) for the azimuth readings. I devised a "fake" code table that will allow you to punch the two tapes using the letters common on the "green keys," but the holes that result are later read as follows. One tape (top in our case) is called units and represents the ones of degrees on lines one to four. The hole code if you read it as line 1 = A, line 2 = B, line 3 = C, and line 4 = D, is really Excess 3 gray code. The advantage is that as each number changes up or down a degree at a time, only one A, B, C, or D line changes, unlike BCD or binary where many often do (i.e., in BCD 7 to 8 transition, all four change!). This helps in error reading reduction, settling time, etc., and much more than we can go into here. It works much better, ok?

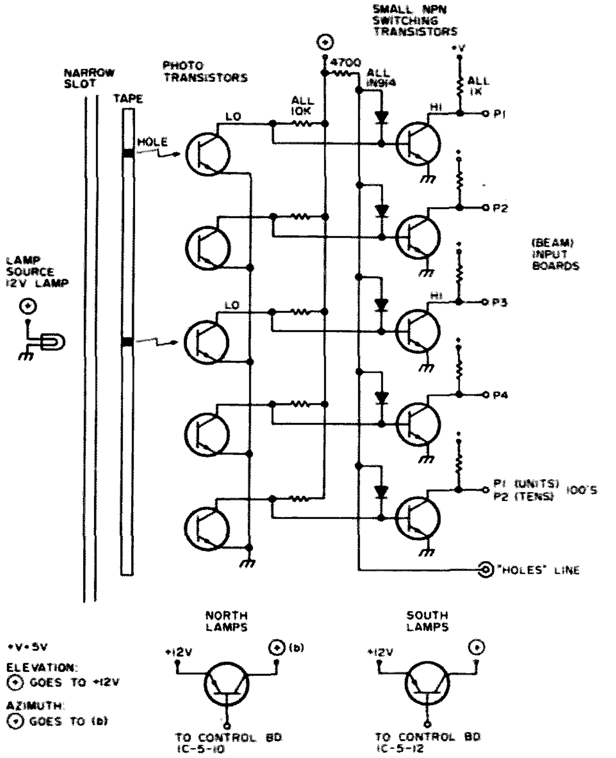

Fig. 2. Lamps and photo transistor "readers," 6 for full system: 2 elevation, 2 north quadrant az, 2 south quadrant az.

These tapes are fastened to the clear cake pan rim or side walls and are read by a lamp source on the inside and a phototransistor type pickup outside (5 per tape, see detail).

The second tape is called a tens tape and lines one to four carry the 10s of degrees in Excess 3 gray code much like the units tape, but the preparation or encoding is *quite* different. We manage to "fake" the two tapes into taking care of the three digits

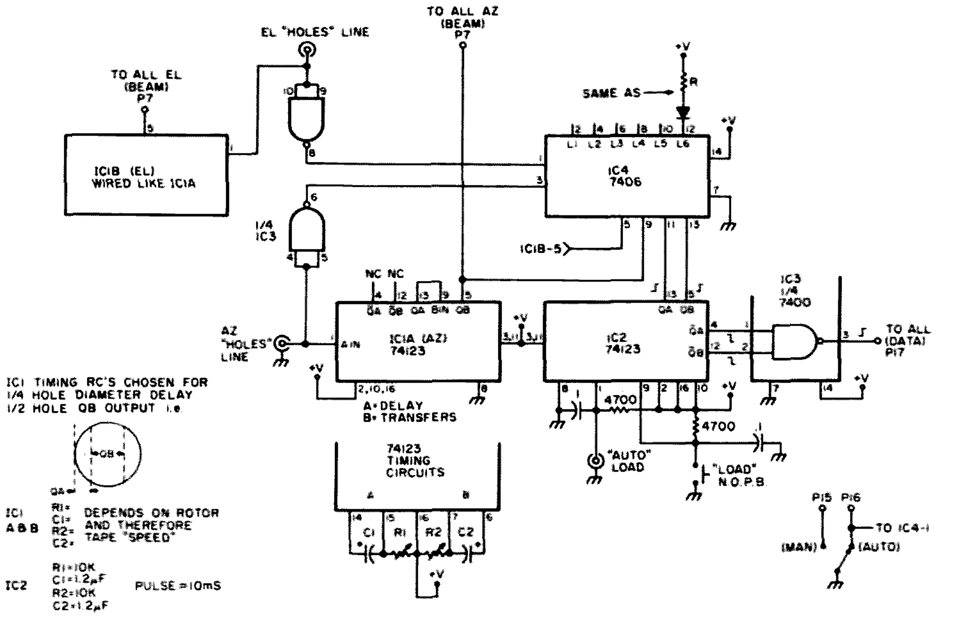

Fig. 3. Control and status board and front panel, part 1. L1 — holes detected, el; L2 — holes detected, az; L3 — beam input transfer, el; L4 — beam input transfer, az; L5 — auto-load; L6 — load. R to suit LED I limits (<40 mA).

by using the fifth line of the Baudot tapes to carry the 0-1-2-3 figures of 100s of degrees.

This is done as follows: On degrees 000 to 099, the Baudot letter is used that cuts the proper gray code on tape one and proper gray code on tape two on lines 1 to 4 respectively, and yet does not punch a hole on line 5 of either tape. Or, line 5 of each tape is a blank (no hole) (0,0), or B = 0, A = 0, decimal zero.

On degrees 100 to 199, the Baudot letter is chosen on the units tape that causes the proper gray code for units, but adds a hole in the fifth line. The tens tape is punched using the same letter system of 000 to 099 degrees using no line 5 hole. Or, line 5 on tape units is a hole, and tape two tens is blank (no hole) (0,1), or B = 0, A = 1, a decimal one (C and D are understood zero and are not needed to represent any number from zero to four).

On degrees 200 to 299, the fifth line hole combination reverses (1,0), or B = 1, A = 0, a decimal two.

On degrees 300 to 360 (399 possible numbers, but only 360 degrees), both tapes have the fifth line hole (1,1), or B = 1, A = 1, a decimal three.

You may now have noted the output from the fifth lines are the 100s information in direct BCD code. It seems to be OK here since the transitions only occur infrequently and at three places in the entire 360 degrees (099 to 100, etc.).

To use the gray codes from the 1s and 10s, you must convert it to BCD for use in TTL comparators. I use SN7444 gray code to decimal ICs to do this, then use SN74147 ICs to go from decimal to $\overline{\text{BCD}}$. This $\overline{\text{BCD}}$ is fed to the inverted arrangement shown in the SN7475 latches, and when the transfer line goes high, it is transferred to the A0 to A3 inputs of the 7485 comparators as BCD, right side up. More on the transfer lines later. The 100s of azimuth are fed directly to the 7475s, then 7485s. All azimuth 7475 transfer lines are tied together.

From the data input end, let's cover the manual mode first. This is a mode where you can enter a "go to" degrees command via a set of 5 thumbwheel BCD output switches like many synthesized 2m rigs now have. The outputs of the first three switches (azimuth) are gated through manual/automatic gates to 7475 latches. The transfer lines of these latches are fed from one half of a dual one-shot 74123. That half is fed by a panel pushbutton marked "load." To use this mode, information is put into the switch in decimal form the way you think for 100s, 10s, and 1s of degrees, the manual/automatic (man/auto) is placed in manual, and the "load" switch is momentarily depressed. The one-shot puts a nice clean high pulse on the transfer lines, and the gate information fed into the manual (M) gates is transferred to the 7475s and held there. That's all there is to it.

A brief word of explanation is in order here. Since all of our towerhouse gear is remote controlled by wire from my basement, the only time the system does not then go immediately into search or motion automatically is when the power off switch is placed to off. *Any* other time the antenna position information (BEAM) does not agree with the output information from the man/auto side 7475s

Azimuth Units Tape

Key Sequence — Insert no extra keys, spaces, or blanks.

#

1. (001 to 010 degrees) Type the sequence:
   I U S SPACE N F K C R LINE FEED
2. (011 to 090 degrees) Repeat sequence 1 eight times:
3. (091 to 100 degrees) Type the sequence:
   I U S SPACE N F K C R L
4. (101 to 110 degrees) Type the sequence:
   P Q Y H M X LTRS V G L
5. (111 to 190 degrees) Repeat sequence 4 eight times:
6. (191 to 200 degrees) Type the sequence:
   P Q Y H M X LTRS V G LF
7. (201 to 210 degrees) Type the sequence:
   I U S SPACE N F K C R LF
8. (211 to 290 degrees) Repeat sequence 7 eight times:
9. (291 to 300 degrees) Type the sequence:
   I U S SPACE N F K C R L
10. (301 to 310 degrees) Type the sequence:
   P Q Y H M X LTRS V G L
11. (311 to 360 degrees) Repeat sequence 10 five times:

Azimuth Tens Tape

12. (001 to 009 degrees) Type: LINE FEED (9 times)
13. (010 to 019 degrees) Type: I (10 times)
14. (020 to 029 degrees) Type: U (10 times)
15. (030 to 039 degrees) Type: S (10 times)
16. (040 to 049 degrees) Type: SPACE (10 times)
17. (050 to 059 degrees) Type: N (10 times)
18. (060 to 069 degrees) Type: F (10 times)
19. (070 to 079 degrees) Type: K (10 times)
20. (080 to 089 degrees) Type: C (10 times)
21. (090 to 099 degrees) Type: R (10 times)
22. (100 to 109 degrees) Type: LINE FEED (10 times)
23. (110 to 119 degrees) Repeat #13
24. (120 to 129 degrees) Repeat #14
25. (130 to 139 degrees) Repeat #15
26. (140 to 149 degrees) Repeat #16
27. (150 to 159 degrees) Repeat #17
28. (160 to 169 degrees) Repeat #18
29. (170 to 179 degrees) Repeat #19
30. (180 to 189 degrees) Repeat #20
31. (190 to 199 degrees) Repeat #21
32. (200 to 209 degrees) Type: L (10 times)
33. (210 to 219 degrees) Type: P (10 times)
34. (220 to 229 degrees) Type: Q (10 times)
35. (230 to 239 degrees) Type: Y (10 times)
36. (240 to 249 degrees) Type: H (10 times)
37. (250 to 259 degrees) Type: M (10 times)
38. (260 to 269 degrees) Type: X (10 times)
39. (270 to 279 degrees) Type: LTRS (10 times)
40. (280 to 289 degrees) Type: V (10 times)
41. (290 to 299 degrees) Type: G (10 times)
42. (300 to 309 degrees) Repeat #32
43. (310 to 319 degrees) Repeat #33
44. (320 to 329 degrees) Repeat #34
45. (330 to 339 degrees) Repeat #35
46. (340 to 349 degrees) Repeat #36
47. (350 to 359 degrees) Repeat #37
48. (360 degrees) Type X (one time)

Table 1.

Elevation Units Tape

#

1. (001 to 090) Same as azimuth units 001 to 090.
2. (-089 to -080) Type the sequence:
   G V LTRS X M H Y Q P L
3. (-079 to -010) Repeat sequence 2 seven times:
4. (-009 to -001) Type the sequence:
   G V LTRS X M H Y Q P

Elevation Tens Tape

5. (001 to 090) Same as azimuth units 001 to 090.
6. (-089 to -080) Type: V (10 times)
7. (-079 to -070) Type: LTRS (10 times)
8. (-069 to -060) Type: X (10 times)
9. (-059 to -050) Type: M (10 times)
10. (-049 to -040) Type: H (10 times)
11. (-039 to -030) Type: Y (10 times)
12. (-029 to -020) Type: Q (10 times)
13. (-019 to -010) Type: P (10 times)
14. (-010 to -001) Type: L (9 times)

Table 2.

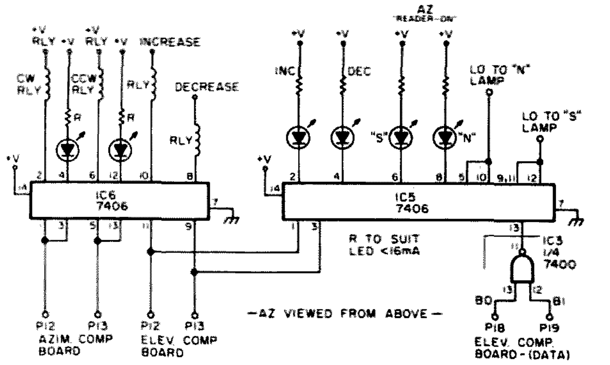

Fig. 4. Control, part 2, full system.

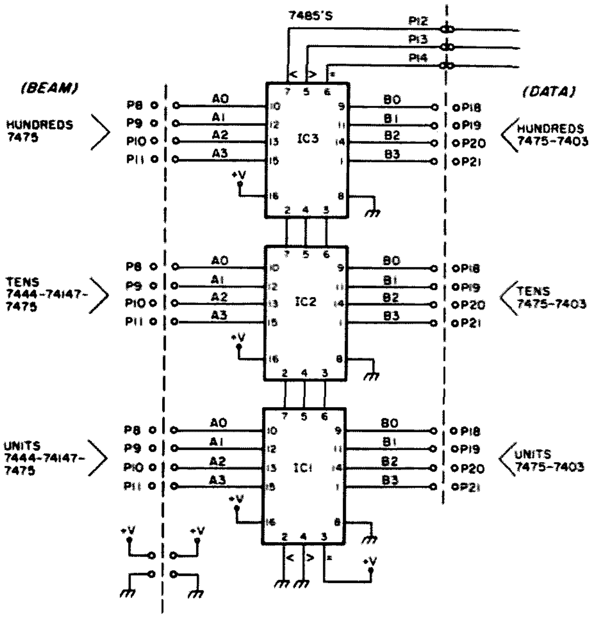

Fig. 5. Azimuth comparator module. Note: Elevation — same board; see "Comparator Operation — Elevation."

(DATA), the antennas move to correct this. Thus if for any reason (wind, etc.) the antennas move away by themselves, they are automatically correct as soon as the gray code error is noted — assuming the power is on. This neat feature has many side benefits. For instance, if you look back to the Nov., 1976, *73 Magazine*, page 84, article by me, you will see a wind indicator device whose output is in degrees and BCD code. That device was no accident, and if fed into the automatic inputs of this control unit, and the unit left in automatic mode and on, the beams will always face into the wind! In some parts of this country, that almost makes these two projects worthwhile on that reasoning alone. Our tower horizontal section is braced, etc., such that our best way is facing into the wind. I would advise, however, you only sample and compare 100s and 10s of degrees to keep the array from forever "hunting" and burning out motors, etc.

In the automatic mode, information (DATA) from the automatic mode gates (A) is routed to the data 7475s. It is transferred only when the transfer line is brought high. This is accomplished in the auto mode by any TTL level low applied to the auto-load input connector.

I failed to mention the single gate that allows tying both outputs of the 74123 to the latch line. I'm sure you are all doing your *73* reading and I/O homework, but since it is an inverted use of a NAND gate 7400, I'll explain. The inputs to either 74123 are low going transitions. This creates a pulse output determined by the RC chosen for each one-shot. You then use the normally high output of each 74123 to feed the 7400 inputs. Normal condition is (with no inputs) both 7400 inputs high, output or transfer line low, no transfer. If either input sees a low transition, the one-shot goes low, the 7400 output goes high, and transfer occurs.

Skipping where the automatic input (DATA) comes from for a minute, the auto transfer input in our case has several possibilities. Of course the "load" push-button is one of them, even if the man/auto switch is in auto. Another is an S.D. Sales 60 Hz timebase driving one of our older TTL real time clocks, and the 1 ppm, 1 p/2m, etc., lines brought out through a rotary switch (you obviously want new data faster, more often, on OSCAR than with EME) and a BNC jack over to the beam control (Autotrak) unit, which incidentally will be all buttoned up in a Drake TR-6 case when finished to match the rest of the console, to give you some idea of size. Another source for use on schedules, and for our eventual use remote from Indy stations and members of ECHO, is a set of 7485 comparators added to the old clock and four more BCD switches. You dial in a time in hours and minutes (4 digits — GMT) and at the appointed hour it turns on many things in the station via the A = B output (high) to the 6 inputs of a hex inverter/line driver IC whose outputs (low) do the controlling. One of these lines (low) turns on the antenna control, another "hits" the transfer line indirectly. Since these outputs are there for the full minute

1 = M = Hole **Track 1 = A, 2 = B, 3 = C, 4 = D.**

	X3 Gray Code D	C	B	A	Baudot Track 4	3	2	1	5	RTTY Letter
0	0	0	1	0	0	0	1	0	0	LINE FEED
					0	0	1	0	1	L
1	0	1	1	0	0	1	1	0	0	I
					0	1	1	0	1	P
2	0	1	1	1	0	1	1	1	0	U
					0	1	1	1	1	Q
3	0	1	0	1	0	1	0	1	0	$
					0	1	0	1	1	Y
4	0	1	0	0	0	1	0	0	0	SPACE
					0	1	0	0	1	H
5	1	1	0	0	1	1	0	0	0	N
					1	1	0	0	1	M
6	1	1	0	1	1	1	0	1	0	F
					1	1	0	1	1	X
7	1	1	1	1	1	1	1	1	0	K
					1	1	1	1	1	LTRS
8	1	1	1	0	1	1	1	0	0	C
					1	1	1	0	1	V
9	1	0	1	0	1	0	1	0	0	R
					1	0	1	0	1	G

Table 3. Baudot to X3 Gray Table.

the clock and switches agree, plenty of time is allowed for a positive control. A tape in our case (RTTY) is loaded into the tape reader and set on the first set of holes representing the 100s of degrees of azimuth. For your own information and for future articles, all of our data information will be in azimuth-elevation, 100s, 10s, 1s, 10s, 1s format, i.e., 10545 is 105 degrees azimuth and 45 degrees elevation.

A decoder for Baudot (numbers only) to BCD accepts the tape information in parallel from the reader, using the stop pulse to transfer to the next memory latch (digit). 7475s are used here also, but the data control unit is the subject of the next article, so more on it there. The control mode is as follows, however: (1) it is time to read tape – 1 ppm from clock, etc.; (2) This pulse turns on the tape reader FF and therefore the tape reader; (3) As long as there is tape in, reader tape advances, putting info into the latches; (4) When the fifth digit is loaded (az-el), a pulse is formed in the data control unit, resetting the tape reader FF, shutting off the tape reader, and the same pulse "hits" the (DATA) side 7475 transfer lines; (5) 7485s compare data and run beams to new headings as required.

You will no doubt realize, too, that a UART having ASCII output has lines 1 to 4 already in BCD code for numbers. You can now detect the serial stop pulse to advance the memory latches and have a keyboard input. Baudot owners can run in the FIGS mode into our control unit and do the same thing. You may recall my rotary dial decoder also in the Nov., 1976, *73 Magazine*, and it is mentioned in there the control device used here as a data control unit. It works very similarly to the dial decoder, since one was an outgrowth of the other.

Due to their general lack of use until recently in amateur

Table 4.

AZ Degrees	AZ Units 5th	AZ Tens 5th	EL Units 5th	EL Tens 5th	EL Degrees
001	I	LF			
002	U	LF			
003	S	LF	SAME AS	SAME AS	SAME AS
004	SP	LF	AZ	AZ	AZ
005	N	LF	TAPE	TAPE	TAPE
006	F	LF			
007	K	LF			
008	C	LF			
009	R	LF			
010	LF	I			
011	I	I			
012	U	I			
013	S	I			
014	SP	I			
015	N	I			
016	F	I			
017	K	I			
018	C	I			
019	R	I			
020	LF	U			
021-029	RPT I TO R SEQ.	U			
030	LF	S			
031-039	RPT I TO R SEQ.	S			
040	LF	SPACE			
041-049	RPT I TO R SEQ.	SPACE			
050	LF	N			
051-059	RPT I TO R SEQ.	N			
060	LF	F			060
061-069	RPT I TO R SEQ.	F			061-069
070	LF	K			070
071-079	RPT I TO R SEQ.	K			071-079
080	LF	C			080
081-089	RPT I TO R SEQ.	C			081-089
090	LF	R	LF	R	090
091	I	R	5thG	5th V	MINUS 89
092	U	R	V	V	MINUS 88
093	S	R	LTR	V	MINUS 87
094	SP	R	X	V	MINUS 86
095	N	R	M	V	MINUS 85
096	F	R	H	V	MINUS 84
097	K	R	Y	V	MINUS 83
098	C	R	Q	V	MINUS 82
099	R	R	P	V	MINUS 81
	5th HOLE	5th			
100	L	LF	L	V	-80
101	P	LF	G	LTR	-79
102	Q	LF	V	LTR	-78
103	Y	LF	LTR	LFT	-77
104	H	LF	X	LTR	-76
105	M	LF	M	LTR	-75
106	X	LF	H	LTR	-74
107	LTRS	LF	Y	LTR	-73
108	V	LF	Q	LTR	-72
109	G	LF	P	LTR	-71
110	L	I	L	LTR	070
111-119	RPT P TO G SEQ.	I	RPT G TO P SEQ.	X	069-061
120	L	U	L	X	060
121-129	RPT P TO G SEQ.	U	RPT G TO P SEQ.	M	059-051
130	L	S	L	M	050
131-139	RPT P TO G SEQ.	S	RPT G TO P SEQ.	H	049-041
140	L	SP	L	H	040
141-149	RPT P TO G SEQ.	SP	RPT G TO P SEQ.	Y	039-031
150	L	N	L	Y	030
151-159	RPT P TO G SEQ.	N	RPT G TO P SEQ.	Q	029-021
160	L	F	L	Q	020
161-169	RPT P TO G SEQ.	F	RPT G TO P SEQ.	P	019-011
170	L	K	L	P	010
171-179	RPT P TO G SEQ.	K	G	L	009
180	L	C	V	L	008
181-189	RPT P TO G SEQ.	C	LTR	L	007
190	L	R	X	L	006
191	P	R	M	L	005

192	Q	R
193	Y	R
194	H	R
195	M	R
196	X	R
197	LTRS	R
198	V	R
199	G	R
200	LF	L
201	I	L
202	U	L
203	S	L
204	SP	L
205	N	L
206	F	L
207	K	L
208	C	L
209	R	L
210	LF	P
211-219	RPT I TO R SEQ.	P
220	LF	Q
221-229	RPT I TO R SEQ.	Q
230	LF	Y
231-239	RPT I TO R SEQ.	Y
240	LF	H
241-249	RPT I TO R SEQ.	H
250	LF	M
251-259	RPT I TO R SEQ.	M
260	LF	X
261-269	RPT I TO R SEQ.	X
270	LF	LTR
271-279	RPT I TO R SEQ.	LTR
280	LF	V
281-289	RPT I TO R SEQ.	V
290	LF	G
291	I	G
292	U	G
293	S	G
294	SP	G
295	N	G
296	F	G
297	K	G
298	C	G
299	R	G
	5th	5th
300	L	L
301	P	L
302	Q	L
303	Y	L
304	H	L
305	M	L
306	X	L
307	LTR	L
308	V	L
309	G	L
310	L	P
311-319	RPT P TO G SEQ.	P
320	L	Q
321-329	RPT P TO G SEQ.	Q
330	L	Y
331-339	RPT P TO G SEQ.	Y
340	L	H
341-349	RPT P TO G SEQ.	H
350	L	M
351	P	M
352	Q	M
353	Y	M
354	H	M
355	M	M
356	X	M
357	LTR	M
358	V	M
359	G	M
360	L	X

END OF AZ TAPES

5th = no 5th hole.

H	L	004
Y	L	003
Q	L	002
P	L	001

END OF EL TAPES

gear, the 7485 may seem a bit strange to you. The cascade inputs on these devices work great, but be careful to hook up as shown with the LSB digit getting the hardwired inputs, and the outputs coming from the MSB digit (azimuth 100s, elevation 10s). Reverse it and you are in for some real surprises. When you are working the underside of a board, it is easy to transpose LSB and MSB digit. Please don't ask me how I know this so well — nobody's perfect!

The elevation works just the same way as azimuth with one less number to worry about. We use linear tapes punched the same as for azimuth; it's just easy to get them in the doghouse that way rather than around a drum. Same data table applies. The same decoding, comparing, data in, all works the same.

For those of you who have counter (digital counting, readout type) dials on your receivers now or are planning it, consider our much modified BC 348s for a minute. If we use a dc drive (sawtooth waveform) to control the varactor group to "scan" the receiver, something very similar to this article has proven very useful and will be an upcoming article when we get back to the Space Age Junque series. Meanwhile, I'll let you brave ones ponder it on your own.

One: thumbwheel switches for a BCD frequency input. Push the auto scan button and an FF starts the scan. The final 7485 comparator A = B output stops the scan at the desired dialed-in frequency.

Our system does not really use sawtooth scan, though it looks like it does. When the auto scan button is pushed

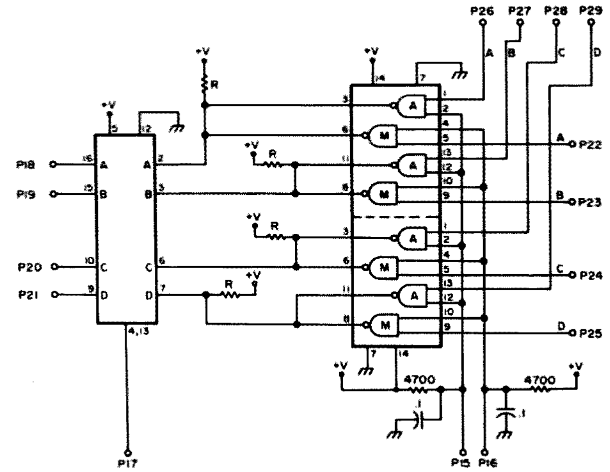

Fig. 6. Data input boards, 5 required. R = 1k.

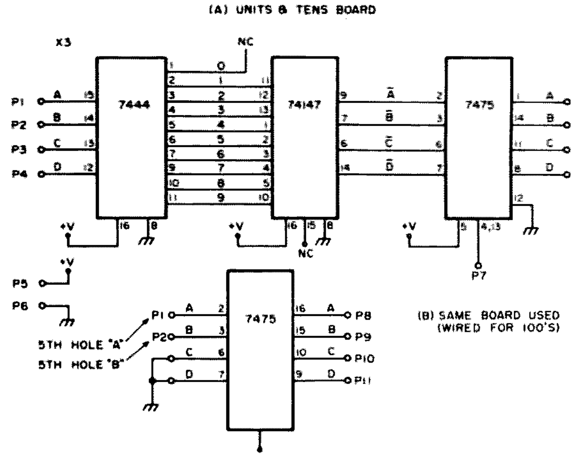

Fig. 7. Beam input boards. 4 wired (a) Az – 10s, 1s; El – 10s, 1s. 1 wired (b) Az – 100s.Ɔs.

(or is called up remotely from Indy), the FF for this starts the scan by turning on the "charge" switch (transistor) of a dc memory module similar to the RCA remote control memory modules of a couple of years ago. The memory output is 1 to 10 V dc and controls the frequency varactors. There *is* a counter on the BC 348 for a dial readout (348 rack mount, readout, control, master oscillator, etc., console mounted), and the counter begins to follow the frequency upward. Upper limit is a set of jumpers to hardwire upper and lower limit gates. A stop command, AFC zero crossing plus AGC (station heard), or output from counter = limit switches comparison in 7485s, will stop the up scan. In the first two cases it is stop and hold, and in the latter it tells the scan FF to reverse. The "discharge" switch in the dc memory module takes over and causes a downward scan with the same features. Keying of the transmitter will generate a stop command and hold followed by a one-shot delay in resuming after carrier drop (sense COR on incoming remote link receiver).

One more? OK, last one for now. Consider we have a receiver with a counter dial. Doesn't take much to have a receiver with digital AFC, does it? You can ponder that one awhile – it takes one more IC!

SASE if you have problems. This should reduce the Bufferin sales to OSCAR users. ■

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A Battery Voltage Monitor

-- how simple can an IC project get?

A device introduced by Litronix, Inc., has wide application as a voltage monitor in all types of battery-operated equipment. The RCL-400 Battery Status Indicator is a current-controlled LED which has a voltage sensing integrated circuit incorporated into a small LED package.

The only additional circuit component necessary to build a voltage monitor is a suitable zener diode, or string of forward biased diodes, to bring the device into its normal operating range. The RCL-400 is designed to turn *on* at 3 V and *off* at 2 V; thus normal operation can be provided by selecting Vz = Vcc - 3 V (See Fig. 1). When Vcc drops to Vz + 2 V, the LED is switched off by the internal IC voltage sensing circuit to give a low voltage indication. Since the device has a relatively constant current demand in the *on* region (~ 10 mA), the zener power rating need only be ¼ W for most battery-powered equipment. One precaution is necessary: You must be sure that the voltage across the LED does not exceed 5 V (its maximum rating).

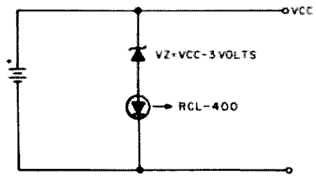

Fig. 1.

For low voltage IC circuits using a nominal 4.5 V battery pack, the required value of Vz is only 1.5 V. It is easy to obtain this value by simply substituting a pair of silicon diodes in series with the LED. ■

The Morse Clock

-- timely repeater ID

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A clock which sends the time of day in Morse code can be a useful addition to any modern repeater. Aside from providing mobiles with the correct time of day, the clock may be used to write the time of day on cassette tape for logging purposes when an autopatch or other event occurs. This article describes such a clock constructed for the WR1ADR 60/00 repeater in South Dartmouth, Massachusetts.

The Morse code clock has the following features:

1. Low chip count (17 ICs compared to 30 in previous designs).
2. Easy timesetting (hours fast, minutes fast and hold).
3. Variable code speed.
4. Six digit LED time display (impressive).
5. Protected against power failure (won't lose time).
6. Time may be sent to either 12- or 24-hour format.

Circuit Description

The heart of the Morse code clock is a National MM5318 PMOS clock chip (Fig. 2). This chip was designed to be used in a system which displays the time of day on a television screen. Unlike most other clock chips which have only multiplexed seven segment outputs, the 5318 has both seven segment and $\overline{BCD}$ outputs available. Furthermore, each digit (hours, tens-of-hours, etc.) may be selected for output by applying the proper code to the Dx, Dy and Dz digit select lines. This is ideal for application in the Morse code clock, since we want to be able to look at the digits one at a time in order to translate them into Morse and send them. The clock requires either a 50 or 60 Hz input signal. This may be obtained from either the power line or a crystal time base. (More on this later.) The clock chip will operate in either a twelve or twenty-four hour format and has leading zero blanking in the twelve hour mode.

The Design Technique

I decided that a straight-

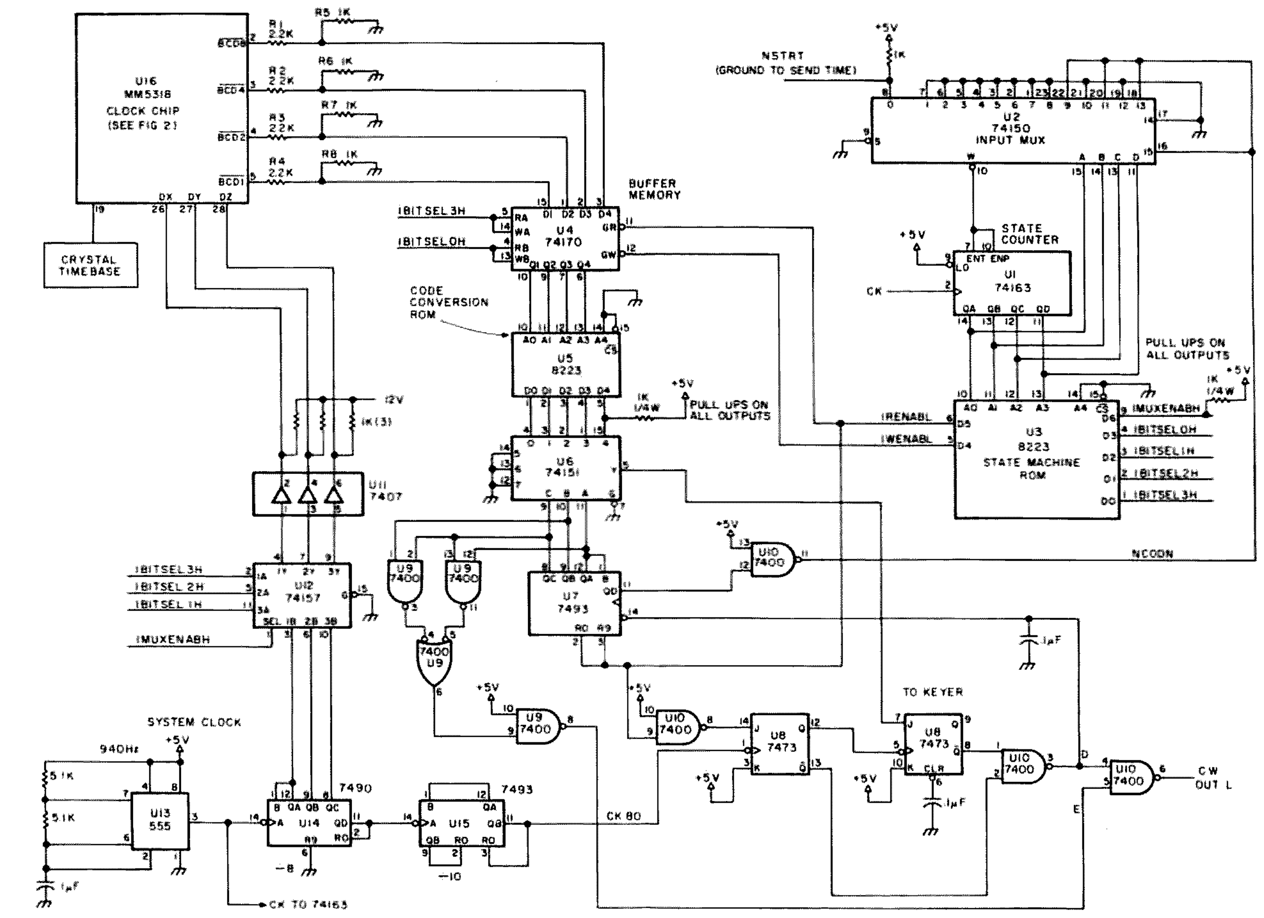

Fig. 1. Morse code clock.

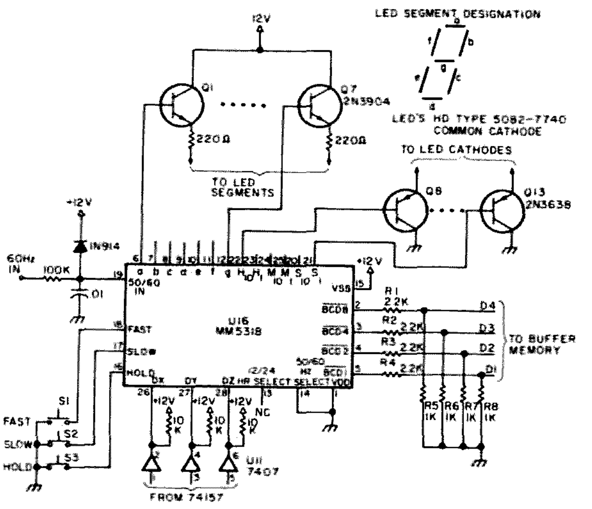

Fig. 2. Clock chip and display circuitry.

forward way to design the clock was to use the *algorithmic state machine* or ASM design technique. This is a very popular and powerful technique that is often used for the design of computer central processing units (CPUs).

The first step in the ASM technique is to decide exactly what you want the device to do. I did this in the *operational flow chart* of Fig. 3. Initially the clock sits with its seven segment display multiplexed and waits for a START signal. When it receives this signal, it rapidly stores the time of day in a buffer memory. It then reads the digits out of the buffer one at a time and sends them in Morse code. After the last digit has been sent, the display is again multiplexed and the clock waits for another START signal. The time of day must be rapidly read into the buffer because it is possible for the time of day to change while it is being sent. This could cause an error. Consider the case where the time changes from 2359 to 0000 after the first digit (the "2") had been sent! Rapidly loading the time into the buffer minimizes the chance of an error occurring.

Fig. 4 shows the *system block diagram* for the Morse code clock. A ROM centered state machine controller is driven by the system clock and controls three peripheral circuits. These are the clock chip and display, the buffer memory, and the BCD-to-Morse converter.

System Clock (U13, U14, U15)

The system clock is an LM555 timer IC wired as an astable multivibrator with a free running frequency of about 940 Hz. It is divided by a 7490 and 7493 counter (U14 and U15) to about 12 Hz for use in the BCD-to-Morse converter. The output lines of the 7490 (U14), which are varying at a 940 Hz rate, are used to multiplex the seven segment display when the clock is not sending the time.

The State Machine

The state machine controller is made up of U1, U2 and U3. These three chips control the operation of the rest of the circuit. U1, a 74163 4-bit synchronous counter, is the state counter. Its binary outputs determine the present state. There are sixteen possible states for this machine.

The state counter is driven by the system clock, but the only way to have it advance to the next (sequential) state is to have a logic "1" present on the 74163 enable inputs (ENT and ENP). The enable inputs are connected to the output of U2, a 74150 16-to-1 data selector. U2 is the input multiplexer. It acts like a single pole, 16-throw logic switch. The input select lines of U2 are connected to the state counter output lines, so that we look at a given input in each state. The way to advance to the next (sequential) state, then, is to have the selected input condition be true. (Note that the output of the 74150 is inverted, so for the output of the MUX to be true, or logic "1", the input must be false, or logic "0".)

U3, an 8223 32 x 8 ROM, is called the *state machine ROM*. Its address lines are connected to the state counter's output lines. In any state, the ROM may be programmed to generate any combination of eight possible outputs. (Only seven of the outputs were needed for the Morse code clock.) The ROM is simply a replacement for the combinational logic (NAND and NOR gates, etc.) which would be required to generate the outputs. The contents of the state machine ROM are shown in Fig. 5.

In a given state (as determined by the state counter output lines) certain outputs are issued from the state machine ROM and a given input condition is tested by the input MUX. If the condition is false, the machine remains in the present state and continues to issue the outputs required in that state. If the condition is true, the machine advances to the next sequential state on the next positive transition of the system clock. This is often represented graphically as in Fig. 6, which illustrates the case in which the machine waits in state A, corresponding to state counter output 0010, and issues output LITEON (which is active-high as indicated by the H prefix) until input PUSH goes to 0.

A little thought will reveal that this is a very powerful design technique. Since the outputs are programmed into ROM, they may be changed by merely reprogramming, without making any circuit

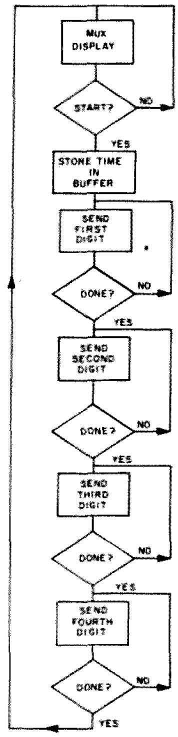

Fig. 3. Operational flowchart.

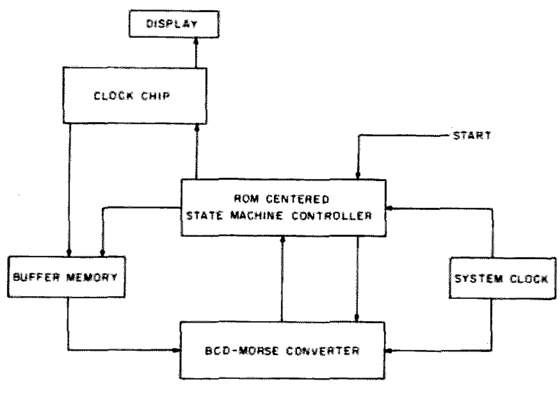

Fig. 4. System block diagram.

ROM Output Lines

STATE	IBITSEL3H	IBITSEL2H	IBITSEL1H	IBITSEL0H	IWENABL	IRENABL	IMUXENABH	COMMENTS
0000	1	1	1	0	1	1	1	wait for NSTRT, MUX display
0001	1	1	1	0	1	1	0	address 10s of hours
0010	1	1	1	0	0	1	0	write into buffer
0011	1	1	0	1	1	1	0	address 1s of hours
0100	1	1	0	1	0	1	0	write into buffer
0101	1	0	1	1	1	1	0	address 10s of minutes
0110	1	0	1	1	0	1	0	write into buffer
0111	0	0	1	0	1	1	0	address 1s of hours
1000	0	0	1	0	0	1	0	write into buffer
1001	1	1	1	0	1	0	0	send first digit (10s of hours)
1010	1	1	0	1	1	1	0	clear BCD-to-Morse converter
1011	1	1	0	1	1	0	0	send second digit (1s of hours)
1100	1	0	1	1	1	1	0	clear BCD-to-Morse converter
1101	1	0	1	1	1	0	0	send third digit (10s of minutes)
1110	0	0	1	0	1	1	0	clear BCD-to-Morse converter
1111	0	0	1	0	1	0	0	send fourth digit (minutes)

Fig. 5. Control ROM program.

changes.

Clock Chip and Display

The features of the MM5318 clock chip have already been described. U11, a 7407 high voltage open collector buffer, acts as an interface between the TTL and MOS logic levels for the clock chip Dx, Dy and Dz lines. U12, a 74157 quad 2-to-1 MUX, acts as a 4PDT logic switch and causes the binary code applied to the MM5318 digit select lines to come from either U14 (which causes the display to multiplex) or from the state machine ROM. The 74157 is also controlled by the state machine ROM. R1-R8 are voltage dividers and convert the MOS levels out of the clock chip to TTL levels. Transistors Q1-Q13 and associated resistors are used to interface the common-cathode LED display to the clock chip. Pin 19 of the clock chip is the 50/60 Hz input. For 60 Hz input, ground pin 14, for 50 Hz,

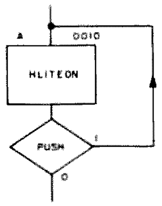

Fig. 6.

leave it open. If you choose to use a crystal timebase instead of stealing the 60 Hz from the power line, the 1N914 and RC network at pin 19 may be eliminated. The timebase I used was purchased from S. D. Sales and assembled according to their instructions. It was cheaper to buy the timebase from S. D. Sales than to build my own. S1-S3 are push-button switches which are used to set the time.

The Buffer Memory

U4, a 74170 4 x 4 register file, is used as the buffer memory for the time. The time of day output from the clock chip (in $\overline{BCD}$) is written into and read from the buffer memory under direct control of the state machine ROM.

$\overline{BCD}$-to-Morse Converter

The output of the buffer memory is connected to the address lines of U5, the 8223 code conversion ROM. This ROM converts $\overline{BCD}$ to an intermediate code in which a 0 represents a dit and a 1 a dah. The contents of the code conversion ROM are shown in Fig. 7. Note that the ROM will convert a blanked first digit (which occurs when the clock chip is in the twelve-hour mode) to a Morse code 0. Say, for example, that a "7" (1000 – remember, the BCD is inverted) is input to the ROM. 00011 will appear on the ROM output lines. With reference to the schematic and the timing diagram (Fig. 8), when the state machine brings RENABL low, U7, a 7493 counter, is enabled, and the 74151 MUX (U6) passes the least-significant bit of the ROM output (a "1" in this case). U8, a dual J-K flip-flop, and NAND gate U10 make up a variation of the well-known TO keyer. The "1" on the MUX output causes the TO keyer to send a dah. U7 clocks on the falling edge of the dah causing the MUX to select the next most significant bit of the ROM output. After the five bit ROM output has been scanned and sent, the MUX selects input lines 5, 6 and 7, which are hardwired to logic "0". This will cause three additional dits to be sent. U9, a 7400, blanks these dits and they form the space between numerals. After five code elements and a space have been sent, output NCODN goes low, signalling to the state machine that a complete Morse code numeral, including space, has been sent. The state machine may then bring RENABL high to reset the converter, present new $\overline{BCD}$ data (by changing the buffer memory address), and bring RENABL low to repeat the sequence.

In summary then, if $\overline{BCD}$ data is presented to the $\overline{BCD}$-to-Morse converter input and RENABL is taken low, the $\overline{BCD}$-to-Morse converter will generate the sequence of dits and dahs corresponding to the inputted data, a three dit space, and then signal that is is finished by taking NCODN low.

The ASM Chart

Fig. 9 shows the ASM chart for the Morse code clock. It shows all the states, the outputs issued in each state, and the inputs required to advance to the next state. If no input condition is shown in a given state, it is assumed that the machine advances to the next sequential state on the next positive transition of the system clock. A table of the state machine inputs and outputs is shown in Fig. 10.

Power Supply

The power supply for the Morse code clock is shown in Fig. 11. A 12.6 volt 1.2 Ampere transformer (from Radio Shack) is used in a full wave bridge to provide 12 volts for the display and the clock chip. An LM309K regulator (mounted on a heat sink) provides a regulated 5 volts for the TTL logic. Diodes D1 and D2 are used to automatically switch in a nicad pack if the power fails. Note that the nicads will reverse-bias D1, turning off the display when the power fails to conserve current. R1 is used to trickle charge the nicads and should be selected to provide the required charging current.

Construction Notes

The clock was built on a wire-wrap prototyping board. I like this method of construction because it allows me to test the circuit as I build and also allows for easy modification (and correction of mistakes!). The wire-wrap board was mounted in a 9" x 11" x 2" chassis along with the power supply and time

Digit	ROM Address	ROM Contents
0	1111	11111
1	1110	10000
2	1101	11100
3	1100	11000
4	1011	10000
5	1010	00000
6	1001	00001
7	1000	00011
8	0111	00111
9	0110	01111
blank	0000	11111

Fig. 7. Code conversion ROM contents.

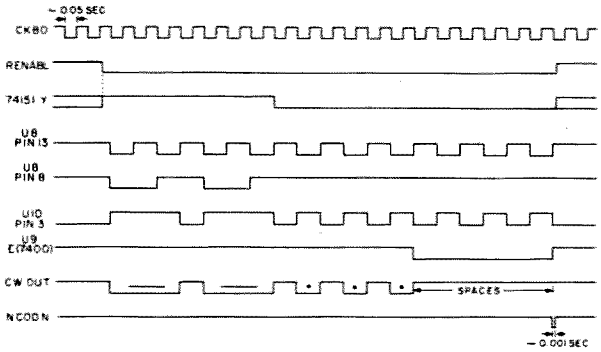

Fig. 8. BCD-Morse converter timing diagram.

setting buttons. The six digit LED display was mounted on the front panel of the repeater in an IEE six readout mounting bezel which was purchased from Tri-Tek. This bezel makes a very professional looking and reasonably inexpensive display. The LED display is connected to the clock with a 14 wire ribbon cable.

The clock tends to run quite warm (especially the ROMs and the Buffer Memory) so I punched six 1" holes around the perimeter of the chassis. The holes were covered with perforated aluminum to complete the shielding of the clock.

The clock chip and the chip in the crystal timebase are MOS devices and as such are susceptible to damage from static discharge. Handle them with care. Do not remove them from their protective packaging until ready to install them. Do not insert or remove them from the circuit with the power on. If you choose to solder these chips in, ground the tip of your soldering iron.

The programming procedure for the Signetics 8223 ROMs has been described many times before and will not be repeated here. The references at the end of the article should be consulted for the proper procedure.

Vcc was bypassed to ground with 0.01 uFd 50 volt ceramic capacitors at the rate of one capacitor for every three ICs. Do not omit the 0.1 uFd capacitor from pin 6 of U8 to ground. It performs a power-on reset for the flip-flop. The capacitor in the system clock circuit determines the system clock frequency and ultimately the CW speed. If a cheap ceramic capacitor is used here the CW speed will change as the clock heats up. I used a sealed mylar unit.

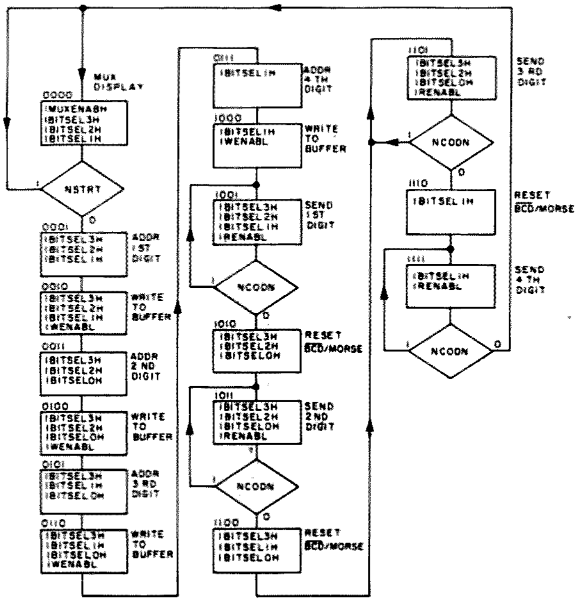

Fig. 9. Morse clock ASM chart.

Interfacing the Clock and Repeater

All interconnections between the clock and the repeater control logic are active-low. This allows the clock to be removed from the repeater without affecting the repeater logic.

Grounding input NSTRT will start the time sending cycle. NSTRT should return to 5 volts before the clock is finished sending the time or else it will repeat. In our repeater NSTRT comes from the touchtone™ decoder output. The clock is activated by a single touchtone digit.

Output IMUXENABH goes low during the time sending cycle and may be used to hold the repeater transmitter on.

CWOUTL is the active-low CW output from the clock. It may be used to drive an audio oscillator as shown in Fig. 12 if none is available in the repeater.

Push-button switches S1 and S2 cause the clock to advance one hour per second and one minute per second respectively. S3 will stop the clock for synchronization to the exact second with WWV or CHU.

When the clock is first powered up it may begin sending the time. It will cycle once and then stop. Also, all the digits in the display may not be illuminated. Merely advance the clock with S1 and S2 until all the digits light up. It is a good idea to cycle the clock through all 24 hours when first powering it up, since it is possible for it to count up to 30 hours the

State Machine Signals

OUTPUTS

IBITSEL3H IBITSEL2H IBITSEL1H IBITSELOH	select clock digit and buffer memory address
IWENABL	when low, writes time into buffer
IRENABL	when low, reads time from buffer and sends it in Morse
IMUNENABH	when high, causes LED display to multiplex, when low causes clock digit to be selected by IBITSELO-IBITSEL3

INPUTS

NSTRI	goes low to start time sending sequence
NCODN	goes low to indicate that a complete numeral and space have been sent in CW

Fig. 10.

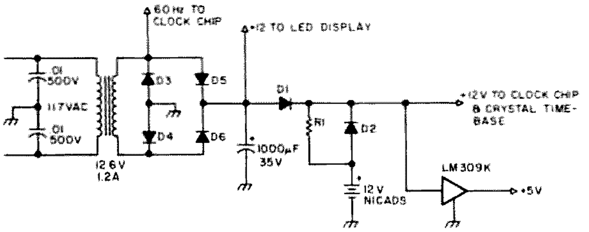

Fig. 11. Power supply.

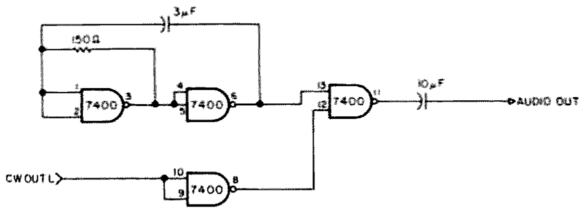

Fig. 12. Audio oscillator.

first time through.

Changing the CW Speed

The speed of the CW output is determined by the frequency of CK80, the input to the BCD-to-Morse converter. The output speed is equal to 1.2 times CK80, in wpm. CK80 in my clock is 940/80, or 11.75 Hz. The output speed is then 1.2 x 11.75, or 14.1 wpm.

CK80 *may* be varied by changing the value of the 0.1 uF capacitor in the system clock. This is not really a good idea, since the system clock is also used to multiplex the seven segment display, which will flicker if the multiplex frequency is too low. A better way to alter the CW speed is to change the division ratio of U15. Say, for example, that an output of 10 wpm is needed. CK80 must therefore be 10/1.2, or 8.33 Hz. This requires a division ratio in U15 of 94/8.33, of 11.28. If U15 is set to divide by 12 (by connecting pin 2 to pin 8 instead of pin 9), the output speed will be 9.4 wpm. The CW output speed may be varied from 9.4 wpm to over 100 wpm by merely changing the division ratio of U15.

Getting the Parts

At the time of writing, nearly all of the parts for the Morse code clock were available from James Electronics. I bought the HP 5082-7740 common cathode seven segment LED readouts and the crystal timebase from S. D. Sales. The chassis and other odds and ends were obtained locally.

Thanks to the ASM design, the Morse code clock worked immediately when powered up. It has been in operation at the WR1ADR 60/00 repeater in South Dartmouth MA for about six months without any problems. My thanks to K11BR and the rest of the crew at SEMARA for their cooperation and support. I will be glad to correspond about the Morse code clock or ASM design. An SASE would be appreciated. ■

References

1. C. R. Clare, *Designing Logic Systems Using State Machines*, McGraw-Hill.
2. R. Jaeger, "Microprogramming: A General Design Tool," *Computer Design*, August, 1974, p. 150.
3. J. B. Peatman, *The Design of Digital Systems*, McGraw-Hill.
4. L. I. Hutton, "Code Converter Using PROMs," *73 Magazine*, May, 1976, p. 84.
5. G. W. Kufchak, "The PROM Zapper," *73 Magazine*, September, 1976, p. 112.
6. B. D. Lichtenwalner, "The Computer QSO Machine," *73 Magazine*, January, 1976, p. 80.

Hunting Noise

- - with a grid dipper

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Noise external to receiving equipment can sometimes be difficult to pinpoint. A spectrum analyzer is beyond the reach of most amateurs. Here is a cheap substitute that has been proven.

Some time ago man-made interference was tearing up communications across a wide spectrum, seriously upsetting some military operations. Engineers tried to solve this with a spectrum analyzer and failed. As hams, a friend and myself were asked if we could solve this. A little thought as to why the engineers failed led us to the conclusion that their equipment was too sophisticated. I devised the idea of using my Heathkit grid dipper and a scope. The scope was hooked to the internal dipper diode and ground. At 2 MHz there was plenty of grass when the dipper coil was placed near any building wiring. Reducing the scope sensitivity, the grass was barely noticeable. We probed around. It didn't take long to locate a relay used for aircraft obstruction lights that was defective, with pitted chattering contacts.

Any battery operated dipper can be used. It can be hooked up to the audio section of a battery operated portable radio for use away from the shack. Make sure the dipper switch is in the diode position, so it is being used as a field strength meter. To hook the dipper up, solder one wire to the output side of the dipper diode and the other wire to ground. These wires go either to the scope vertical input or, in the case of a radio, to the volume control. Do not wire to the volume control center tap.

Tuning the dipper to harmonics, hunting parasitics, or debugging a transmitter is easy, too, since the scope gives an excellent visual display. ■

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CMOS Oscillators

-- practical techniques

Over the past few years, many articles have appeared in various electronics magazines dealing with the subject of oscillators and their applications. Of these articles, the majority have dealt primarily with transistor and TTL circuits.

While these devices have performed exceedingly well in many applications, there are other devices available that may be more suitable for certain applications. For example, CMOS devices perform well in low power circuits and can operate satisfactorily from a wide range of supply voltages (typically +3 to +15 volts). These two features make CMOS devices ideal for compact, low power, portable equipment capable of operating from a variety of power sources.

This article, then, is an attempt to provide basic application information on CMOS oscillator circuits as well as providing an overview of basic CMOS features and characteristics. As you will see, they are very versatile devices that are easy to use once you become accustomed to their peculiarities.

CMOS integrated logic circuits offer several distinct advantages over other logic families. Some of these advantages may be summarized in the following:

1. *High Noise Immunity*: To understand this characteristic, it will be necessary to refer to the transfer characteristic curve for a typical CMOS IC inverter. Fig. 1 shows this transfer characteristic, which is the relationship between the input and output voltages. Note that the output voltage is affected by a change in the input voltage only at the transfer point. The steepness of this curve also indicates that as the transfer point is reached, there is an abrupt change or a "toggling" of the output.

Usually, the transition voltage is specified to occur between 30% and 70% of the power supply voltage. Thus, for a 15 volt power supply, the input noise transient would have to exceed 4.5 volts for it to affect the output. This feature provides for very stable monostable multivibrator circuits where the CMOS device is used as a one shot trigger source.

2. *Low Power Requirements*: Almost everyone is now familiar with the low power consumption of CMOS devices. This feature is one of the primary considerations for using CMOS devices in digital watch circuits.

The CMOS family exhibits low power consumption due to the way the output transistors are connected — in series, so that power is consumed only during transistion states. All CMOS devices incorporate at least two MOS transistors in series — one p-channel and one n-channel. Consequently, only one transistor is turned on at a time and there is no direct path for current to flow. The only exception to this rule is during transition states, and then only for very short time periods. Fig. 2 is a diagram showing the output transistors.

Note that as the frequency of the oscillator circuit is increased, the conduction times also increase, so that power consumption is directly proportional to the operating frequency. Typical quiescent dissipation for an inverter, however, is less than 300 uW per package for a 10 volt supply (CD4009A).

3. *Wide Range of Power Supply Voltage*: Another fea-

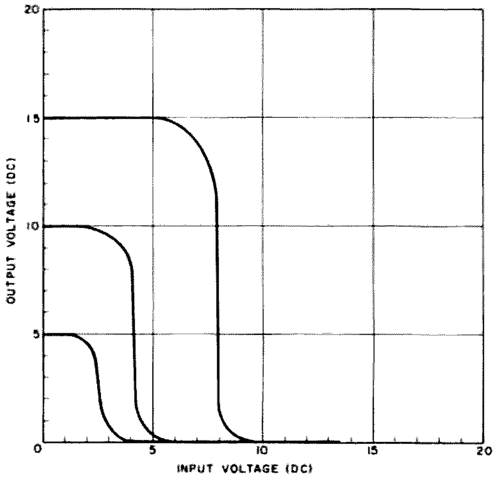

Fig. 1. Transfer characteristics for a typical CMOS inverter at 5V, 10V, and 15V.

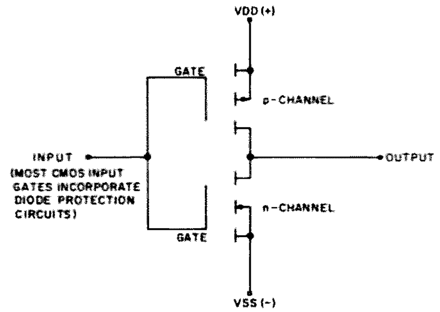

Fig. 2. Typical CMOS inverter stage (simplified). Except for short periods during switching of states, only one output transistor is on at a time. This results in extremely low power consumption.

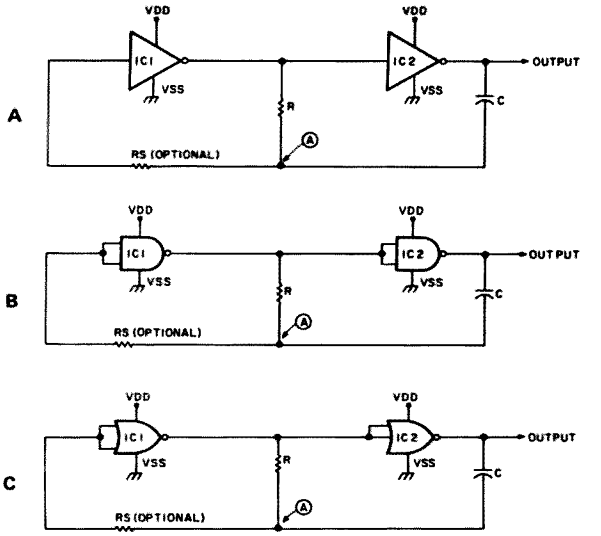

Fig. 3. Three typical CMOS astable multivibrator circuits. (a) CMOS inverter astable multivibrator. IC1, IC2 = 1/6 CD4069. (b) CMOS NAND astable multivibrator. IC1, IC2 = CD4011. (c) CMOS NOR astable multivibrator. IC1, IC2 = CD4001.

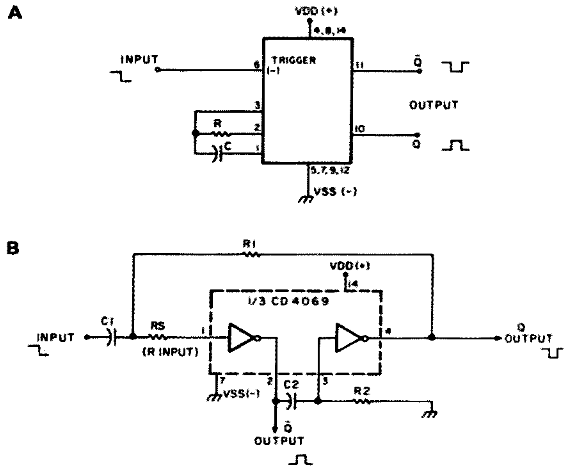

Fig. 4. Monostable multivibrator circuits for negative-going input pulses. (a) CD4047. (b) CD4069 (hex inverter).

ture that is unique to CMOS devices is the wide range of supply voltages over which they will perform satisfactorily. Typically, most manufacturers guarantee operation over a range of 3 volts to 15 volts. However, some versions will operate up to 18 volts. With this feature, it's not necessary to design well-regulated power supplies and, in most cases, batteries work just fine. Also, the voltage range makes CMOS devices ideal for automotive or mobile applications.

4. *Wide Temperature Range*: The usual package most hams or hobbyists will be working with is the dual-in-line plastic package (suffix AE or BE). This unit is suitable for a temperature range of -40°C to +85°C. The more expensive ceramic version (suffix AF or BF) will operate over a temperature range of -55°C to +125°C.

5. *High Input impedance*: The input gates of all CMOS devices have impedances on the order of 10^{12} Ohms. This results in extremely low input current requirements (typically ± 10 pA) and consequently very little loading on the input circuit. Another advantage resulting from this high input impedance is directly applicable to oscillator circuits. The high input impedance makes it possible to obtain large time constants without the use of large capacitors. This means that CMOS devices can provide cost and size reductions in most multivibrator circuits.

Before we get into some actual multivibrator applications, a word of caution is in order. Since an inverter functioning as an oscillator operates a considerable amount of time in the linear region of its transfer curve, some CMOS devices cannot withstand the high power dissipation. These devices include the CD4009A and CD4010A. Instead of using these devices, the CD4049 and CD4050 would make a better choice.

Astable Multivibrator Circuits

An astable multivibrator is basically an oscillator that generates a square wave output at a specific frequency. The frequency of the square wave may be determined by an RC circuit, crystal, or analog voltage.

Astable multivibrators may be constructed from a basic inverter IC or from NAND or NOR gates connected as inverters. Fig. 3 shows three basic types of astable RC multivibrators.

All CMOS gates have a built-in diode protection circuit to clamp large input voltages and prevent the gate from being destroyed. To minimize the effect of this input circuit on stability, a resistor (Rs) is connected from the timing circuit to the input of the first inverter. This, in effect, limits the current to the input gate.

In operation, the input of the first inverter is clamped at approximately Vdd or Vss, whichever is appropriate. At any particular instant, capacitor C will be charging or discharging through resistor R. When the capacitor is discharging, the voltage decays at point A until transfer occurs for inverter 1 and its output switches from zero level to the power supply voltage, causing the output of IC2 to switch from the power supply voltage to zero. When this occurs, capacitor C begins to charge. This continues until the voltage at point A builds to the transfer point. When this occurs, the output of IC1 switches to zero volts, causing the IC2 output to switch to the positive supply voltage. At this point, the cycle is ready to begin again.

The frequency of the square wave output will be dependent on the values chosen for R and C. Also, to limit current at the input gate of IC1, the rule of thumb is that Rs should be approximately twice the value of

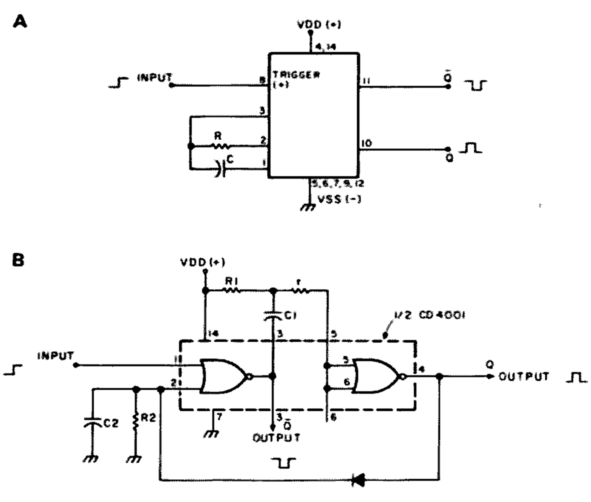

Fig. 5. Monostable multivibrator circuits for positive-going input pulses. (a) CD4047. (b) CD4001 two-input quad gate.

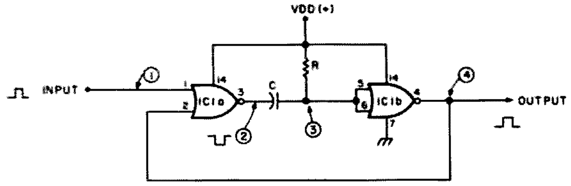

Fig. 6. Basic one-shot multivibrator circuit using two NOR gates. IC1a and IC1b = ½ CD4001.

resistor R.

Monostable Multivibrator Circuits

A monostable multivibrator is a logic circuit that generates, upon command, a single output pulse of set duration. It is commonly referred to as a "one-shot" multivibrator. There are monostable circuits that are triggered by a negative-going input pulse (Fig. 4), as well as circuits that are triggered by a positive-going pulse (Fig. 5). Both of these circuits may not be retriggered until they return to steady state conditions. Hence, they are often used to debounce mechanical switches in a variety of applications.

To understand how monostable multivibrators function, refer to the circuit shown in Fig. 6. This diagram shows two NOR gates from a quad CD4001 connected in series. This basic one-shot circuit operates with a single RC time constant. When a positive-going input pulse is applied to the input at 1, it causes the output of IC1a to go to ground potential (zero volts). This in effect grounds the input of IC1b until capacitor C charges up to the transfer level. During this timing period, the output of IC1b is at V+. When point 3 reaches the transfer level, the output of IC1b switches to zero, causing the input of IC1a to become zero. Assuming there is no input signal on the other input, the output of IC1a switches to V+ and the circuit is ready to be triggered again. It is important to note that this circuit, once triggered, is immune to further triggering (or noise) until the timing cycle is complete and the circuit is reset.

If the power source (V+) is greater than +5 volts, you may want to include a series resistor at IC1b to limit the input current at the gate.

CMOS Crystal Oscillators

CMOS devices make excellent and stable oscillators when a crystal is used as the frequency determining element. Fig. 7 shows several circuits for CMOS crystal oscillators using a variety of devices.

Generally, crystal oscillators using CMOS devices operate in the frequency range of 10 kHz up to a top limit around 10 MHz. For lower clock rates, the basic oscillator stage is connected to divider circuits until the correct clocking rate is achieved.

Voltage Controlled Oscillators

Previously, we discussed a type of oscillator whose frequency was determined by a fixed RC circuit. By changing the value of R (or C), the frequency of the oscillator will be varied proportionately.

A voltage controlled oscillator is merely a standard RC astable multivibrator in which the value of the resistor R is varied by a control voltage. Just how this is accomplished is illustrated in Fig. 8. "R" has been replaced by a semiconductor device whose resistance varies from 1k to 10k. These limits are determined by a parallel combination of R1 (10k) and the resistance of an n-channel device which varies from 1k ("on" state) to 10^9 Ohms ("off" state). The center frequency of the VCO may be determined by varying the value of capacitor C.

Phase Locked Loops

Using the VCO discussed above as the basic circuit, it's possible to build a phase locked loop (PLL) using CMOS devices. Suppose we could compare the output frequency of a VCO to a reference frequency and develop an error voltage with a magnitude proportional to the frequency deviation. If this error voltage was fed back to the input of the VCO, its output frequency could be corrected back to the reference frequency. In so doing, the two circuits would lock in phase at the reference frequency.

It is interesting to note that the CMOS family of devices has a phase locked loop element which is unique to the CMOS family – there is no TTL equivalent. This device is the CD4046 and a typical PLL circuit is shown in Fig. 9.

In this circuit, the minimum output frequency occurs when the input control voltage is at zero. When the input control voltage is at the power supply level, the output frequency is at a maximum.

Frequency Multipliers

In this application, CMOS devices may be used to build circuits that generate output signals having a frequency equal to a multiple of the input signal frequency.

An example of a multiply-by-two circuit is shown in Fig. 10. It's also possible to

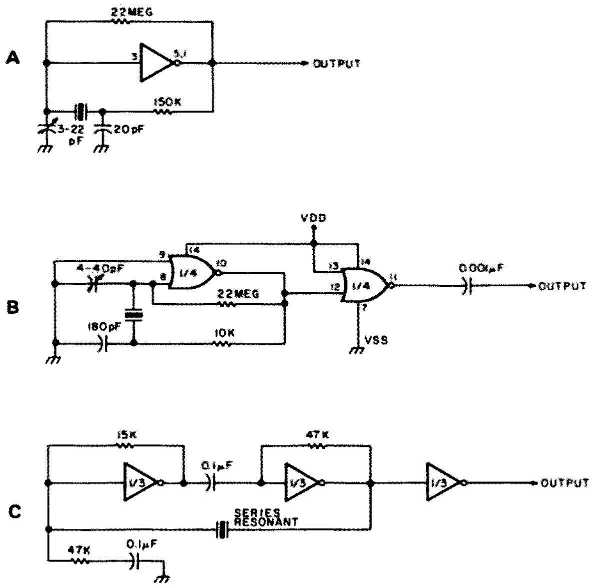

Fig. 7. CMOS crystal oscillators. (a) MC14007 or CD4007. Pin 7 – Vss. Pin 14 – Vdd. Note: Pins 5 and 1 must be connected together for proper operation. (b) CD4001. (c) CD4049.

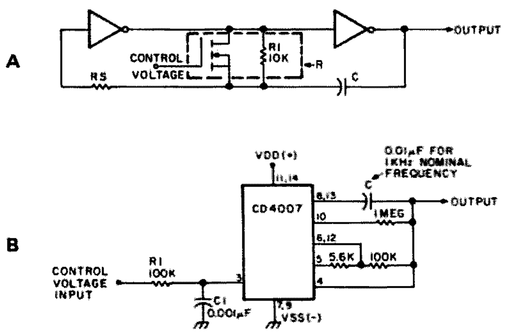

Fig. 8. CMOS voltage controlled oscillator. (a) Basic diagram, CD4007. (b) Practical circuit.

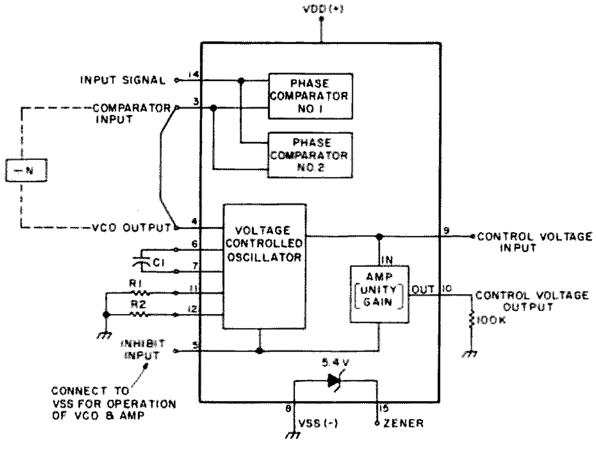

Fig. 9. CD4046 CMOS phase locked loop (PLL). For 1 kHz: R1 – 1 meg; R2 – 00; C1 – 0.01 uF.

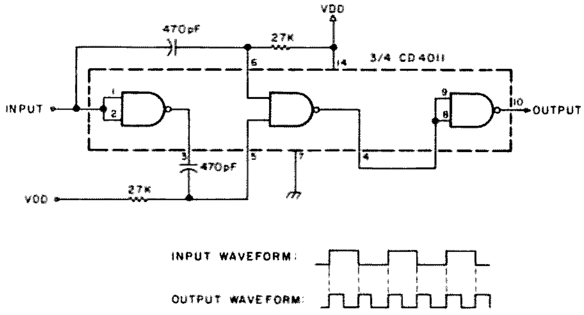

Fig. 10. CMOS multiply-by-two circuit.

build more sophisticated multiply-by-n circuits by using a PLL and a divide-by-n in the feedback circuit.

In the multiply-by-two circuit, two RC circuits are used with an inverter to produce negative pulses on one input of the NAND gate when the input goes positive. A second negative pulse occurs at the input of the other NAND gate when the input signal goes negative.

As with any two-input NAND gate, a negative pulse on *either* input gate causes the output to become positive. Hence, the output frequency will be twice the input frequency.

Additional Information

There are several sources of information available to you for further investigation of CMOS devices. The following publications will provide you with a wide range of reference information: "Understanding CMOS Integrated Circuits," R. Melen & H. Garland, (H.W. Sams); "COS/MOS Integrated Circuits," RCA Solid State; "MOS/CCD Data Book," Fairchild Semiconductor; "CMOS Integrated Circuits," National Semiconductor; "McMOS Handbook," Motorola.

In addition, the "Electronics Sourcebook" contains a handy index of industry application notes and publications relating to CMOS devices. It's available for $3.75 postpaid from Technical Publications, 1405 Richland Ave., Metairie, LA 70001.

I would be interested in hearing from readers who have unique applications for CMOS devices as described in this article. If there is enough response, there may be a follow-up article about CMOS devices in other applications. ■

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Paramus NJ 07652

A Dial for the FM-DX

-- in case the LEDs fail

Readers of *73* may be interested in a modification performed on my FM-DX. Recently I had one of the LEDs in the digital display go out on me, presenting the problem of guessing how to dial up frequencies.

While waiting for a new LED to arrive, I solved the guessing game by installing indexed knobs on the three selector switches. As the picture shows, with no LED display, it is now possible to dial up a frequency using only the knobs. This also helps when operating in direct sunlight.

The knobs used were obtained at Radio Shack (Cat. No. 274-413) and are numbered 0-9, exactly as needed for this application. The diameter of these knobs was too large, however, and required removal of approximately 1/8" from the outside edge. A little careful machining with a drill press and file corrected this problem.

Catalogs show other knobs available in smaller diameters which would be more suitable, but I had to act in haste for the immediate emergency. ■

Ralph E. Taggart WB8DQT
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Robot 400 Scan Converter Details

-- conventional TV as SSTV monitor

If you ask experienced SSTV operators what the major barrier to widespread acceptance of slow scan television might be, you will almost always get the same answer – the display system! Most amateurs are now familiar with the major aspects of the slow scan system first developed by Copthorne MacDonald in the late 1950s. SSTV involves the transmission of a 128 line picture which is transmitted over a period of approximately 8 seconds. This extended frame time, coupled with the modest number of scanning lines, results in a picture format that is compatible with voice bandwidth signals and thus can be transmitted on the high frequency bands using normal SSB phone equipment. At first glance one might assume that the 128 line picture with its limited resolution might be a problem, but most amateurs on seeing a photograph of an SSTV image are quite impressed by the quality of the pictures. The real problem arises when a convert sees his first SSTV demonstration. In order to view a picture that requires 8 seconds for transmission, a conventional monitor must employ a cathode ray tube with a long persistence phosphor, usually a P7 CRT. The long persistence component of this phosphor is not very bright and the pictures can only be viewed effectively under subdued light, hardly the conditions that exist for most demonstrations. The phosphor is quite bright where the screen is actually being scanned, but fades rather rapidly, resulting in a pronounced "window shade" effect as the picture is scanned from top to bottom. Another disturbing feature is that the phosphor is yellow, resulting in black and yellow images rather than the familiar black and white of monochrome TV.

Slow scan experimenters have long recognized that a conventional TV set represents a very effective display system if there were some means available to convert the slow scan image into a conventional TV picture. This conversion process is known as *scan conversion.* In theory, scan conversion requires some means of storing the incoming SSTV picture and then repeatedly reading out the stored video information at scanning rates compatible with conventional television display. The two most promising approaches to this problem to date have been *analog* scan conversion and *digital* scan conversion, and amateurs have pioneered in the development of each. The analog process involves the storage of the picture by means of a vidicon-like tube with a special silicon target. The picture is painted electronically on the target by scanning at the SSTV rates and, once it is impressed on the target of the tube, it is retained for a considerable period. The charge distribution resulting from the SSTV image is then scanned repeatedly at fast scan rates to produce a conventional TV video signal. The first SSTV analog scan converter was produced by W9NTP and displayed at Dayton several years ago. W2DD and a number of other amateurs successfully experimented with modifications of commercial analog scan converters with some success, and Robot Research of San Diego eventually introduced their Model 300 analog scan converter. This was an effective unit that could not only

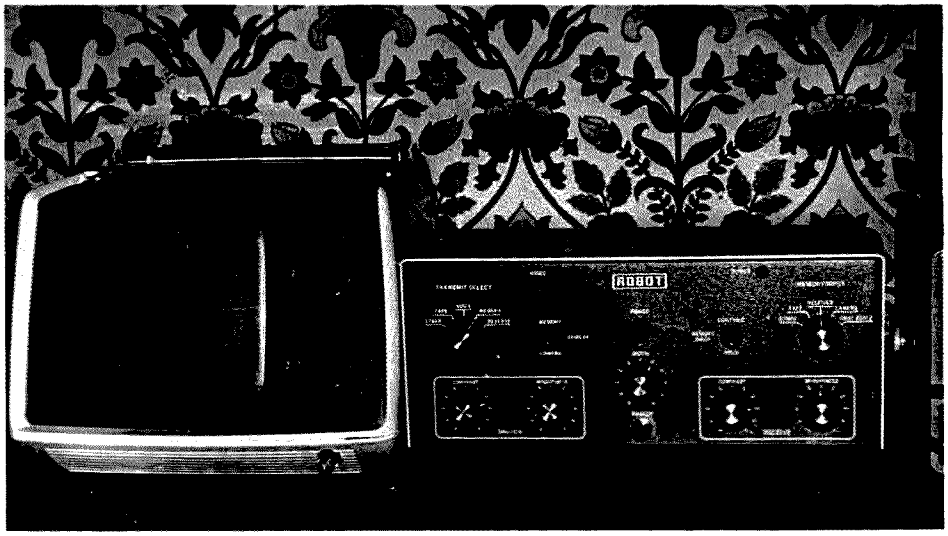

Fig. 1. The Robot Model 400 digital scan converter and the Sony TV-770 which has been modified to serve as a video monitor. A set of this size is ideal for viewing at the distances encountered in most installations. The 400 is very compact and generates essentially no heat, allowing it to be placed anywhere that is convenient.

provide fast scan display of an SSTV picture, but it was also capable of storing a single frame from a fast scan closed circuit TV (CCTV) camera that could then be transmitted in the SSTV format. There were several major restraints to both amateur and commercial efforts in the analog area. The first was cost, due almost entirely to the expense of the special storage tube. Secondly, because such converters are analog devices, the scan converters had a great many interacting level controls that took some practice to use effectively. Finally, the image storage in the tube is not perfect, and the image begins to fade after 10-20 minutes of display. Although the retention factor is not important in some applications, it does limit the device.

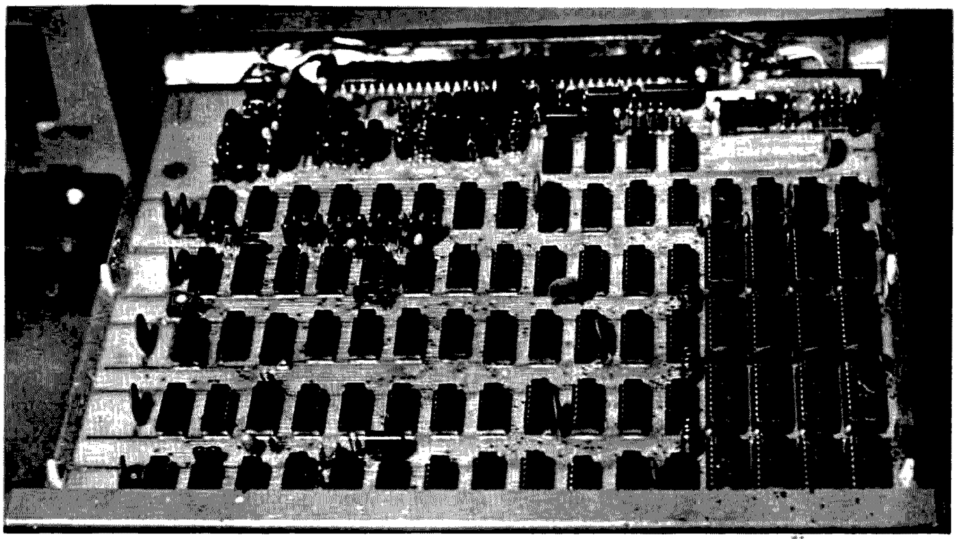

Fig. 2. Internal view of the Model 400 with the top cover removed. Virtually all of the active circuitry is confined to the single large plug-in circuit board. The 16 large ICs in the lower right are the 4K RAM chips that comprise the main memory. All of those other little packages are required to address the memory, perform A/D and D/A conversions, and process both SSTV and fast scan video. Cabinet space below the circuit board is devoted to power supply components. Controls are mounted on the front panel with I/O jacks on the rear panel. The controls and jacks have few discrete components associated with them, and those which are present are used mostly for rf bypassing, resulting in excellent resistance to RFI. Note that sockets are employed for all ICs, easing any problems with servicing and making it relatively easy to experiment with the unit.

The other alternative — digital scan conversion — appeared to offer the greatest long-term promise, but development was impeded by the sheer complexity of the circuitry required. One of the major problems was the sheer size of the digital memory. A 128 line SSTV picture consists of 128 x 128 picture elements or *pixels* — a grand total of 16,384. The solid state memory (in the form of shift registers or later RAM) would have to have a capacity of at least 16,384 bits to store an SSTV picture without loss of resolution. Digital storage, however, is in the form of low or high data bits so that even a 16K bit memory could only store a picture of either white or black pixels with no intermediate gray scale values! Storing gray scale values requires still more memory. Too few gray scale shades and the picture will have a crude paint by numbers appearance known as *video contouring.* Video contouring is essentially unnoticeable on a standard TV display if 32 gray shades are employed, but the memory requirements are excessive. 16 gray scale shades (requiring four bits of memory for coding for each pixel) appears to be the best compromise between memory size and picture fidelity. The memory must therefore consist of 16,384 x 4 bits — a total of 65,536 bits. If the memory is in the form of 1024 bit shift registers, as it is in most current amateur designs, a total of 64 shift register chips are required for the main memory alone. To this must be added the SSTV signal processing circuits, analog to digital conversion (A/D) to convert the analog video to a digital format, slow scan clocks, clocks to circulate the main memory, fast scan clocks and sync circuits, the D/A converters to convert the digital video back to analog form, and finally a series of input and output line buffers (more memory) to clock the video in and out of the main memory. Needless to say, a digital scan converter is a complex project. Beginning just a few years ago, the design and building efforts of WØLMD, W9NTP, and WB9LVI produced working scan converters that were displayed at the annual Dayton extravaganza. Anyone who viewed the clear, non-fading, black and white images displayed by these units could not help but realize that digital scan conversion of SSTV pictures was the wave of the future. Other amateurs worked up PC board layouts for such projects, the LVI unit was described in *QST*[1] and, despite the complexity of undertaking such projects, the home brew SSTV exhibit at Dayton last spring consisted almost entirely of digital scan conversion units. What was needed to bring such technology from the experimenters to the average ham shack was the introduction of comparable commercial equipment. Robot Research, true to its position as a pioneer in the area of commercial SSTV equipment, has done just that with the recent introduction of their Model 400 digital scan converter. One of the early model 400s was obtained to perform an evaluation of the unit's potential, and what follows is the result of that evaluation.

The Model 400, in conjunction with a closed circuit TV monitor or, in some cases, a modified TV set, and a standard CCTV camera, will perform virtually all of the operations required for working two-way slow scan TV. On the display side, it will take an SSTV signal from *any* source — the receiver, tape recorder, SSTV camera, flying spot scanner, or keyboard — and display the picture on a TV monitor. With the flick of a switch you can have each new picture replace the previous one, bit by bit as it comes in, or you can freeze the picture in memory and view it as long as power is applied to the scan converter. Recordings of incoming SSTV pictures can be made directly from the source or from the digital information stored in the memory. A very handy feature of the 400 is its ability to provide "instant replay" of pictures received

over the air. If a received picture is held in memory, you can transmit from the memory and thus show the station at the other end what a representative frame looked like at your end. This is particularly useful in critiquing pictures as it is possible to show the other operator that contrast, lighting, composition, or some other factor requires improvement.

The 400 also functions in generating SSTV pictures from a fast scan CCTV camera or other video source. A single frame of fast scan video can be "snatched" and stored in the 400's memory and read out in the SSTV format for transmission and/or recording. Frame snatch can be initiated manually at any time desired or it can occur automatically at the beginning of each SSTV frame. Since a single fast scan frame, occurring over a time interval of 1/60 of a second, is all that is required, motion no longer distorts the image and the subject need not remain motionless during the SSTV frame interval. The 400 permits real time viewing of the fast scan video in its digitized form so that there is no doubt as to how the picture will look when snatched. Levels are set up in the 400 so that the picture as viewed on the monitor is exactly how it will appear at the other end. All frames obtained using the snatch function have a four step gray scale inserted in the last couple of lines in the frame. This is an extremely useful feature as it provides you with a constant contrast reference when setting up the picture as well as providing the operator at the other end with an unambiguous reference against which to judge tuning, his contrast and brightness adjustments, and your video "swing."

The 400 also incorporates a precision 4 step digital gray scale to assist in setting the brightness and contrast on received pictures and providing a comparison scale for setting up the same values in pictures to be transmitted. In short, it would seem that the 400 can do just about anything. Let's look briefly at the physical and electrical characteristics of the unit and then see how this performance potential is actually realized in practice.

Physical Description

The 400 arrives beautifully packed and is unlikely to suffer damage in shipment. It weighs 12 pounds and is packaged in a rugged two-piece aluminum cabinet measuring 12.5 inches wide, 6 inches high, and 11.75 inches deep. The unit is finished in the two-tone gray that is characteristic of the Robot equipment line. A front panel view of the 400 is shown in Fig. 1. All of the active circuitry (including the 16 4K RAM chips for the main memory, 77 other ICs, 19 transistors, and an array of discrete components) is contained on a single magnificent circuit board (Fig. 2). The rest of the cabinet simply serves to hold the power supply, front panel controls, the I/O jacks on the rear apron, and a few components associated with the controls. The main circuit board is a work of art and all of the components and wiring are of the highest quality.

The front panel control layout is well engineered with a largely functional grouping of controls. Power is controlled by a single central toggle switch with an LED indicator. The unit can be ordered to operate on 115 or 230 V ac at 50 or 60 Hz. Line voltage and frequency must be specified when ordering since there is some change in clocking and associated circuits when operated at 60 Hz as opposed to 50 Hz. Input to the main memory for display is selected by a front panel rotary switch (MEMORY INPUT). Options include GRAY SCALE, CAMERA (fast scan CCTV), RECEIVER, TAPE, and OTHER (SSTV sources such as cameras, flying spot scanners, keyboards, or alternate receivers or recorders). A MEMORY INPUT toggle switch permits continuous display of new pictures or freezing the existing picture in memory. BRIGHTNESS and CONTRAST controls are provided to adjust these values for SSTV display. Another control (WIDTH) adjusts the internal oscillator to accommodate pictures from 60 Hz and 50 Hz sources.

The remaining controls function on the transmit side of the SSTV operations. A TRANSMIT SELECT rotary switch controls the signals routed to the transmitter and tape recorder. These options include VOICE (station microphone audio in transmit and unprocessed audio from the receiver when recording), MEMORY (the contents of the main memory), REVERSE (a black to white reversal of the image in the memory which is handy for special effects), TAPE (pictures previously recorded on tape), and OTHER (other SSTV sources which can be transmitted or recorded without going through the 400s digital memory). A DISPLAY toggle switch permits real time viewing of the digitized output of the fast scan camera or viewing of the memory contents. A SNATCH push-button permits manual updating of the fast scan camera image in memory. The fast scan snatch function has its own front panel CONTRAST and BRIGHTNESS controls so that good video swing can be obtained from cameras whose fast scan output may be of marginal quality.

The rear panel has the ac cord and circuit breaker plus the multitude of jacks required for interconnecting the 400 with the other equipment. Two of the jacks are BNCs (input from the CCTV camera and output to the video monitor) and Robot supplies a 5 foot length of coax with BNCs on each end for connection between the 400 and the monitor. Two jacks are 3 conductor phone jacks, one of which is for the station microphone and the other for a cable between the 400 and the audio input to the transmitter. Robot supplies a cable for the latter and you simply have to equip your microphone with a 3 conductor ¼" plug. Normal microphone PTT functions are looped through the 400. The microphone provides the audio to the transmitter in the VOICE position of the TRANSMIT SELECT switch while other positions select video sources as described previously. A front panel LED indicator comes on when video has been selected and a gain control on the rear apron lets you set the video output from the 400 to a level compatible with your transmitter audio input, eliminating the need to alter the transmitter audio gain. This gain control only functions when the 400 is generating the SSTV signal from its memory. Outside sources such as tape or other SSTV cameras must have their levels adjusted at the source. All of the other jacks on the rear apron are standard phono jacks for the receiver output, input from other sources, and input and output from the tape recorders). Robot supplies a cable for connection to the receiver and all other interconnections can be made with suitable shielded hi-fi cables.

Circuit Description

There is no way that a few well-chosen words or paragraphs are going to do justice to a complex circuit such as the 400 or any other scan converter for that matter. All I will attempt here is to hit some of the high points in describing the operation of the unit. The heart of the 400 is its digital memory. The memory is composed of 16 UPD411D random access memory (RAM) chips, each with a capacity of 4092 bits

* The Robot 400 Converter can be connected to the antenna terminal of a home TV set by means of the Robot RF Adapter Kit option for $25.

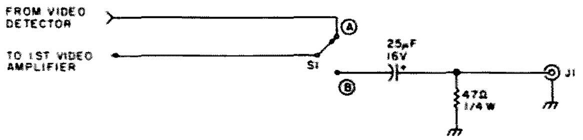

Fig. 3. Modification of a small solid state TV set for use as a video monitor. The set must be transformer operated with a grounded chassis to avoid a shock hazard and possible damage to the 400. J1 is a BNC jack and S1 is an SPDT toggle switch. Position A is for normal TV viewing, while in B the set functions as a video monitor. Similar conversions can be implemented in a variety of sets. The one I use is a Sony TV-770. In the 770, the line from the detector to the first video amp is a small piece of gray coax with a brown stripe. The coax is disconnected from the video board and soldered to the switch contacts (A). A small piece of subminiature coax is routed from the common switch lug back to the disconnect point on the video board. In converting the 770 or any other set, you should obtain a schematic or, better yet, a Sams Photo-facts booklet for the set prior to surgery. All of the SSTV pictures for this article were taken using the TV-770 and it does an excellent job.

(4K). These are dynamic memories and hence require a refresh cycle to retain their stored data. The 400 circuitry is set up so that the refresh cycling is provided in conjunction with the fast scan read operation which is going on continuously as long as power is applied to the 400.

Processing of SSTV signals is fairly conventional with op amps employed as limiters and active filters to provide the video waveform and sync signals to appropriate Schmitt triggers interfacing the SSTV sync signals to system logic levels. Incoming SSTV clocking is derived from a free running oscillator whose frequency is set by the WIDTH control on the front panel. The oscillator is triggered by the horizontal sync pulses derived from the incoming SSTV signal, thus locking the clock to the incoming video format. The A/D converter is composed of a series of 711 voltage comparators. The use of 1% resistors in the A/D circuits assures a precise A/D conversion. Initial A/D conversion is to gray code with onboard conversion from gray code to binary.

Fast scan clocking and sync and all internal slow scan clocking from memory is referenced to an onboard crystal oscillator assuring rock stable clocking at all points in the system. The RAM memory is multiplexed in the 400 to achieve the speed required for fast scan display. The D/A conversion is accomplished with a 7486 and a series of 1% weighting resistors with several discrete transistors providing the interface to the external video monitor.

When snatching video from a fast scan source, the fast scan sync pulses from the source lock up an oscillator which serves as the reference for clocking the fast scan frame into memory. Readout from memory in the slow scan format is achieved with a custom VCO chip factory set for the 1200 Hz sync and 1500 and 2300 Hz black and white levels. Active devices are used throughout the 400 for digital and analog switching functions, thus vastly simplifying the interconnections between the board and the 400 controls and I/O ports.

The 400 manual provides a complete schematic and quite a detailed circuit description, and your ability to understand the inner workings of the beast should largely be limited only by your effort in studying the manual. Should you want to do a little digital design work yourself, the 400 is a marvelous store of interesting design approaches.

Performance

Hooking up the 400 to perform all of its tricks will require a video monitor and a standard CCTV camera. Suitable video monitors can be purchased from Robot or CCTV outlets and you can expect to pay between $250 and $300 for a suitable monitor going this route. Excellent monitors can often be obtained at very good prices from computer stores and at the larger hamfests. It is also possible to modify a standard TV set for use as a monitor but *you must not use a set with a hot chassis.* Such a set can be dangerous to your health and, what is worse, will almost certainly damage the 400. The set shown in Fig. 1 is a Sony TV-770 converted to video monitor service as shown in Fig. 3. A small screen monitor is a must and you should not consider a screen size larger than 9" unless you plan to use it strictly for large group demonstrations. Screen sizes between 5 and 8" are ideal for normal viewing distances and the TV-770 is just about ideal and costs about $140 maximum. If you absolutely must use a set with a *hot* chassis, then you should go the rf route, converting the 400 video output to an rf signal for viewing on an unused VHF channel. Robot markets a board ($25) for this purpose. The rf route is the only safe approach to using a hot chassis set since the manufacturers have taken great pains to isolate the antenna terminals from the dc circuitry. Personally, I would only resort to rf display for occasional use in large demonstrations where it is feasible to use any large screen set that might be available.

CCTV cameras can also be purchased from Robot, CCTV outlets, or at the larger hamfests. As noted later, almost any camera with standard video (not rf) output can be used. Bargains in used cameras can usually be obtained from CCTV outlets, security operations, or community TV companies.

An experienced slow scanner can have the 400 displaying pictures within ten minutes after the package arrives at the door, but I would suggest that you spend some time with the instruction manual as it has an excellent description of the function of the various controls and should answer all of your questions about interconnection with your own equipment. In terms of all of its functions, the unit I received worked right out of the box, but I did notice an apparent problem with a lack of sensitivity at the SSTV inputs (receiver, tape, and SSTV sources). This was particularly noticeable when the level from external SSTV sources was reduced for proper transmitter operation, for at the proper output levels, the 400 would not lock up reliably. The specifications indicated that the SSTV inputs should limit with a signal level of 20 mV, but a quick check showed that this was not the case. A call to Robot revealed that this had been a problem with some of their first production units and that current production models had some resistor changes that eliminated the problem. Substitution of the new values immediately brought my unit up to specs and it is unlikely to be a problem with any 400s other than the first sets that left the factory.

The 400 was very easy to set up for proper video display and has performed flawlessly. Noise immunity is the equal of the best home brew circuits I have used, and the unit does an excellent job even under current band conditions. The major feature I felt was lacking was a tuning indicator to assure proper carrier insertion when tuning the HF sideband gear. If the pictures you are receiving have normal contrast, tuning

Fig. 4. A collection of miscellaneous SSTV pictures logged on 20 meters and displayed on the Robot 400. Only a simple dipole was used for the antenna system and, despite the current state of the band, the 400 delivered excellent pictures. Picture quality in terms of sharpness and contrast is limited only by the care with which pictures are set up at the transmitting end. If you are willing to alter the receive BRIGHTNESS and CONTRAST controls from their proper settings, even pictures of poor quality can be improved considerably. I tend not to alter these controls once they are properly set, as I want to be constantly in a position to realistically evaluate picture quality, and the replay (from the 400 memory) of a station's pictures can do wonders in getting the operator at the other end to set the pictures up more carefully!

is quite easy — you simply tune for maximum contrast and you will be right on the money. Unfortunately, there are still too many operators who are grinding out pictures that are low in contrast, and these can result in errors in tuning as you attempt to optimize video display. An LED tuning indicator can easily be added to the 400 (see the *73 SSTV Handbook* for circuit possibilities) if you desire. The lack of a tuning indicator does not really detract from the 400's performance — I just like the convenience they provide. A number of representative pictures are included to show you what can be expected under normal band conditions.

Tape display is extremely reliable even with cassette recorders. Despite Robot's caution to use recorders with good wow and flutter specifications, a number of 10 year old tapes — recorded on a battery operated reel-to-reel recorder — actually displayed quite nicely. Given the over-the-air performance, one might expect that display of local SSTV sources would present no problems, and this is definitely the case. A variety of SSTV cameras, flying spot scanners, and an SSTV keyboard were tried with excellent results being obtained in all cases.

Experienced slow scanners may be curious to know how the 400 shapes up in the contouring department since it does not employ line averaging or psuedo-random noise techniques. The key here is the use of a small screen monitor. With the proper monitor display, contouring has little or no subjective impact when the pictures have a normal contrast range. Contouring will always be visible with 16 gray scale shades if you take the trouble to look for it, but none of the people who have seen pictures on my 400 have even mentioned the effect. Contouring is more easily noticed if there are extensive areas of the picture with little or no detail, such as the background of an ID sign that is not evenly lighted, or in pictures with too little contrast. In the latter case, you are attempting to display a picture using too few gray scale steps and the effect is that of using a system with fewer gray shades.

One operational convenience of the 400 that I did not anticipate was the case in making demonstration tapes. I usually record pictures off the air using a cassette tape deck. Such tapes typically have many frames marred by QRM and intervals of conversation. When such a tape is reviewed, you can freeze a particularly good frame in the memory, remove the tape from the machine, and substitute your demo cassette. You can then record two or three frames from the 400 memory, replace the tape again, and begin looking for other good frames. A single small cassette can thus contain the best pictures from a large number of tapes, result-

ing in an excellent record of your contacts as well as a good tape to play at radio clubs or hamfests to generate a little interest in SSTV. Many tape decks do not incorporate automatic level control, and these are often tedious to use since you have to ride the gain control to keep a reasonably constant signal level when recording pictures off the air. This problem can be eliminated if the transmit select switch is placed in the memory position during recording. You are thus recording from the 400 memory and the signal will have a constant amplitude regardless of the input variations in the incoming SSTV signal. The only disadvantage of this technique is that you do not preserve the audio commentary. If the voice signal is desirable, you can simply switch the transmit select to voice when pictures are not coming in, but you will have to ride the gain!

The 400 does an equally good job in terms of all of its transmit functions as well. In common with past Robot equipment, the 400 handles the interconnection of the tape recorder and other SSTV signal sources to the transmitter with the ability to select either voice or a video source. Where it really shines, however, is in frame grabbing from fast scan sources such as a CCTV camera. With the display switch in the camera position, you view the fast scan picture in real time, but in its digitized form. The brightness and contrast controls for the snatch function let you compensate quite nicely for poorer than average subjects or flat camera output. The signal you see is precisely what will be stored in memory, so setup is no problem. With the memory input toggle switch in the continuous position, a new fast scan frame is snatched at the start of each SSTV frame. In the hold position, frame snatch is manually controlled with a front panel pushbutton. This is particularly nice if the camera is in an inconvenient position as you can face the camera, leer, and press the button, and then return to scratching or whatever else you do when the camera is not "live." A variety of cameras were used with the 400, ranging from some excellent new cameras with built-in viewfinders to an old Dage and several ancient home brew cameras. If you take the trouble to bring the broadcast video out of a TV set, you can also frame grab from that source. Broadcast video is excellent for test setups and demonstrations since it invariably has excellent resolution and contrast, but it is questionable whether you should transmit it on the air. I have seen quite a bit of snatched broadcast material on the air in the last few weeks, but it is worth noting that technically the practice is illegal since it involves the relay of material from the broadcast service via the amateur service. In any case, the material from soaps or afternoon game shows hardly raises the quality of 20 meter operations! The 400 will also frame grab nicely from a video tape recorder if you are lucky enough to have one of those goodies to play with. The frame grab capability of the 400 is simply so convenient that I will gradually be phasing much of my slide pickup and special effects cameras from SSTV to fast scan format, probably with a common sync source so that all can be tied in effectively with my fast scan operations on 440 MHz. The 400 has some interesting possibilities here since fast scan video from 440 can be frame grabbed and relayed via SSTV on 2 meters to stations that are outside of the normal ATV range in our area.

Summary

The components, workmanship, and performance of the 400 are simply first rate, and it is my own personal opinion that it represents the finest piece of commercial SSTV equipment on the market today. You can build a somewhat more versatile scan converter than the 400 and you would probably be able to do it for somewhat less than the $695 price tag of the Robot gear. Such an effort, however, would be a major project – probably one of the most complex projects that amateurs can undertake these days – and a careful evaluation would be required to determine if the small margin in performance that you might obtain would be worth the effort. The 400 is an excellent package at a good price for the value received. Its performance is such that I have no plans to put together a conventional scan converter for SSTV. I am in the process of adding additional memory and video circuits to accommodate real time color display, but any attempt to duplicate the features of the 400 itself is simply not worth the effort unless you enjoy building for its own sake.

Once you have used a digital scan converter, you will simply not be satisfied with a conventional monitor. Digital scan conversion is going to be responsible for another burst of growth in SSTV and a great deal of that potential growth will be chalked up courtesy of Robot and their 400. The unit is well-engineered and can be expected to perform well in the hands of a neophyte or an experienced operator. By all means seek one out for a demonstration – it will be worth the effort. ■

References

[1] Steber, George R., 1975, "SSTV to Fast Scan Converter." *QST*: Part I in March issue, Part II in May issue. This article is must reading for anyone interested in digital scan conversion. It not only describes an excellent scan converter (using 1024 bit shift registers), but it also has excellent sections on the theory of scan conversion and some approaches to image processing.

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Bounceless TT Decoder

-- a single chip does it!

Do you remember the first time you went to the doctor and your mother told you that it wasn't going to hurt? Well, that trick only worked once, didn't it? I had much the same feeling the first time I tried to interface some TTL logic to the outputs of 567 decoders. Nobody told me that those nice decoders take several milliseconds to stabilize and, as we all know, TTL will count each and every little glitch just as if it were the real thing.

So, how do you debounce seven 567s without building some kind of one-shot or flip-flop for each one? Easy, especially if you have a Motorola CMOS data book. Look in it for an MC14490 and you will discover that it is a hex contact debouncer. How about that — 6 debouncers in one chip! Fantastic. How does it work? The same — fantastic!

Fig. 1 is the schematic of a circuit I built for our repeater. The 567s go directly into TTL gates to generate 12 data lines, 0-9, * and #. The gates faithfully transmit all the glitches supplied by the decoders. Reviewing the operation of the 14490s (Figs. 2 and 3) shows that basically all it does is wait until the signal on its input has been stable for four clock periods before the output will change to be the same as an input. Another handy feature is that by putting a single capacitor between two pins, a clock oscillator is formed. This same oscillator can be used to clock several chips. Interfacing the inputs of an MC14490 to a switch or TTL output is easy because pull-up resistors are included right on the chip. This means unused inputs can be left open, unlike normal CMOS inputs. But that is not all. Each output of a 14490 is capable of driving one TTL load. In our system, we decided that a 20 ms delay was desirable as it would eliminate all glitches from the 567s and tend to eliminate false noise decoding. The 0.01 capacitor results in an oscillator frequency of approximately 200 Hz, which gives four clock pulses every 20 ms.

The MC14050s are included to give enough current to drive the subsequent TTL logic used to decode various numbers and sequences we don't want dialed by our autopatch.

So, armed with MC14490s, no one should get stung by 567s, switches, or anything else that generates similar TTL-eating glitches. ■

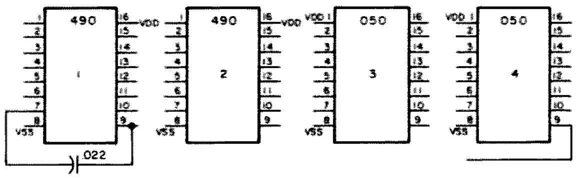

Fig. 1. Debouncer.

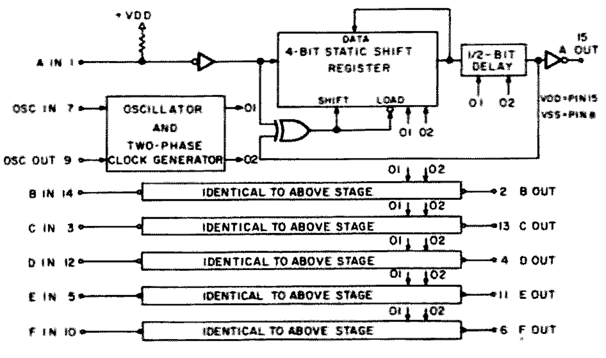

Fig. 2. Block diagram.

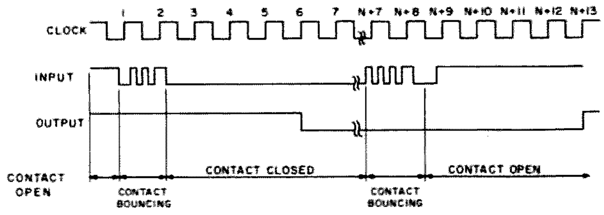

Fig. 3. Timing diagram.

Hams Profit From CB

-- how to set up a service center

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Okay, most of the communicating community agrees – if somewhat grudgingly – that Citizens Band has a place in the scheme of things and even serves its user quite well at times. What most non-CB users and new CB users don't know is that there is a definite shortage of qualified CB technicians – and the shortage gets more acute each day. This is not to say that there aren't a lot of would-be CB repairmen. There are. The shortage is of *licensed* qualified technicians.

Under current FCC Rules and Regulations, only the holders of First or Second Class Radiotelephone operator's licenses can make repairs which can affect the legal operation of CB transceivers. That license isn't all that easy to get, either.

While there is no code test required for commercial phone tickets, there is a very stiff testing procedure. In order to qualify for a Third Class license – little more than a glorified Restricted Operator's Permit – elements I and II must be passed with a score of 70 or better. That is duck soup. These two elements are only to check the applicant's familiarity with basic FCC rules and proper operating procedures. Unfortunately, a Third Class license does not entitle the holder to do anything other than *operate* certain classes of radios – which are not germane to this article.

In order to qualify for a Second Class license, element III must be passed in addition to elements I and II. This is where it gets binding.

Element III is 2 to 4 hours of the hardest multiple choice questions that you can imagine. The closest parallel to it in amateur service is the Extra Class exam. The applicant who goes to the nearest FCC office had damn well better be prepared for element III or he is going to find himself winning only a Third (not much of a consolation prize) and facing a 60 day wait before he gets to try again.

If, however, he feels confident and really well prepared, he can add another buck and take element IV as well. The test applicant who passes elements I through IV, inclusive, gets to have his name typed on a beautiful, suitable-for-framing, First Class Radiotelephone operator's license (Fig. 1). Actually, element III is the hard one. Element IV only checks the applicant a little more closely in areas mostly pertaining to commercial broadcast stations.

For a couple more dollars, the passing applicant gets a wallet-sized verification card which attests to his having passed the necessary tests.

If you only want to work on non-commerical transmitters – CB, marine, land mobile, etc. – or smaller broadcast stations, a Second Class license is all that is required. However, there is a certain satisfaction in being "First Class" even if you never intend to exercise the additional privileges. And it just might happen that one of the local radio stations needs a part-time chief engineer. For an extra dollar, there is nothing to lose by trying for it.

If an amateur is pretty well up on his theory – General Class or higher – learning the extra knowledge required to pass the commercial tests will be a simple matter. The only additional materials that a commercial aspirant will need to borrow or buy are study guides or outlines for elements I through IV. Many local libraries have such volumes – which are published by TAB, Sams, Hayden, and others – on the shelves to lend. If your library doesn't have one or the one it has is several years old, either check in a larger bookstore or newsstand or watch for ads in electronics publications such as *73*.

The study guides that you used for brushing up on theory before taking the General test and the *ARRL Radio Amateur's Handbook* are excellent for taking a different approach on a point which gives you trouble. For more than one electronics hobbyist, that First or Second Class ticket has been the passport into a whole new career. If the holder of a commercial license has any ability at all to troubleshoot and repair electronic equipment, he can always make a living at it. Maybe he will have to move from where he is, and maybe he won't always do just what he wants at the pay he feels that he deserves, but he will always eat.

Attitude is Important

Just because a person has a crisp new First or Second ticket on his wall doesn't mean that those "chicken banders" are going to beat a path to his door. He is going to have to let them know that he is interested in seeing that their equipment is working properly and that, as an amateur, he doesn't look down on them. As is the case in amateur radio, operators of CB equipment have many different vocations and often are very, very good in their particular fields. A case in point is a recently overheard

QSO on 40 meters where the ham was remarking that the friend in the shack with him had a trenching machine and was digging the footings for the tower and guy anchors for the tower which the ham was in the process of building. That is the kind of friend to have. Dig?

As CBers learn of a new repair service in the area, word travels quickly. The bad word travels fastest. The good word travels farthest.

In almost every town, there is at least one CB dealer selling CB gear without having any real service department. A polite call on him to ask for his business and assure him that you are not interested in competing with him may be the beginning of a profitable relationship. The current rash of discounting takes a lot of profit out of the selling part of the business, anyway — you can make more on an installation than he does on the sale.

Taking all of your business from various dealers has at least one real advantage. If you deal strictly with dealers, you spend little time just talking to retain customers. On the other hand, the dealers may not provide you with as much business as you would like to have.

If the latter is the case, you should spend a few bucks taking out ads in CB club papers or local newspapers. If you plan your ads carefully and schedule them often enough to keep your service in the eyes of those you wish to serve, a few dollars will do a lot of good.

One fringe benefit of dealing directly with your customers rather than through dealers is the additional exposure that you can give amateur radio. (It's also a good way to move that older gear that you wish to replace with more sophisticated equipment.) Each year thousands of CBers will decide to get further into radio. What better way to spark this interest than offering to give demonstrations — you can even schedule a group to watch — some slow weekend?

A positive, non-condescending attitude will go a long way towards making friends and regular customers among local CBers.

Equipping Your Shop

If you intend to do any large amount of CB repairs, you will need to have some kind of shop. The shop can be your shack, if space and the XYL permit. However, a garage or small outbuilding is much better.

If you have a shop isolated as much as possible from the house, you have a more peaceful atmosphere in which to work; your customers won't be as likely to disturb your family or vice versa. If space at home doesn't permit a shop or zoning restrictions preclude it, you have at least two alternatives.

In most areas, there are small shop spaces for rent for 50 to 100 dollars per month. The drawback is that the locations are usually less than choice. If you are not geared for walk-in trade and keep erratic hours, this can be an advantage, especially if dealers provide the bulk of your business.

Another possibility is that one of your dealers may have a small back room that he will let you use. This is a little sticky, though, if you are doing work for more than one dealer. In any event, these are just ideas. If you have a friend who wants to work with you, he may have another alternative.

If you are really an active experimenter, you may already have much of the test equipment that you will need for CB service. Even if you have to start from scratch, you can do it for less than you might think. A lot depends on your resourcefulness. A successful dealer really hungry for service just might be willing to help you acquire what you need.

What do you really need for CB service?

Actually, $5000 will just about make it — plus parts inventory. However, let's assume that you *don't* have $5000 to invest in service equipment at this stage of the game.

Frequency Measuring Equipment

After the small tools and diddlesticks, soldering irons and wrenches, screwdrivers and drills, the first item to acquire is some device for measuring frequency. A Cushman or H-P or Lampkin would be nice, but none of these is a necessity. Among others, Heath makes several counters which work just fine for CB.

An older heterodyne frequency meter can also be used. All that is required is that transmitters tested meet or exceed FCC requirements. At CB frequencies, the tolerance is plus or minus 50 parts per million. However, only a poor technician or one faced with an unusual situation would ever pass a piece of CB equipment which was barely within the law. Most modern CB transceivers are selective enough now that a station anywhere close to the legal limit would sound distorted and range would suffer.

Signal Generator

Unfortunately, many small shops try to cut corners with signal generating equipment. When this is the case, the technician spends much longer than he should tuning a receiver. Rock-solid signal generating equipment capable of attenuation to below one

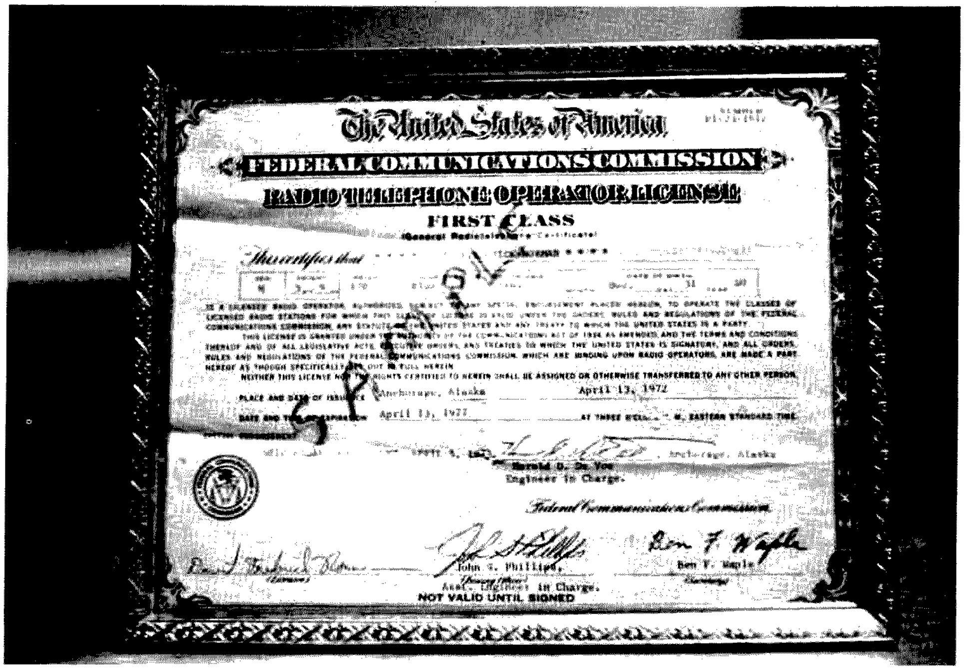

Fig. 1. An FCC First or Second Class Radiotelephone license is well worth the trouble it takes to get it.

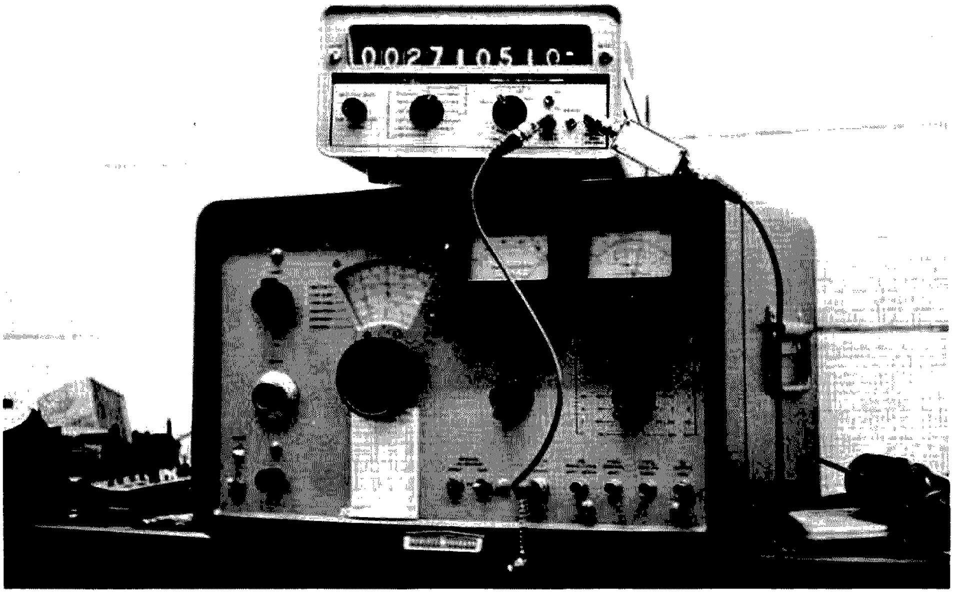

Fig. 2. Stable signal generating and frequency measuring equipment is essential for profitable CB service. Many hams already have such equipment sitting idle on their bench.

microvolt with adjustable amplitude modulation is hard to come by on a budget (Fig. 2).

In order to do the job with less equipment, you may have to constantly check the frequency output against your shop counter or frequency meter. This takes time and, if overlooked, can mean that the whole procedure must be redone. One technician solved the problem with an old CB transceiver.

This particular unit had good oscillators, but the power stages had been fried by reversing the power polarity and overfusing. The buffer stage was still good in the transmitter and the audio driver still worked.

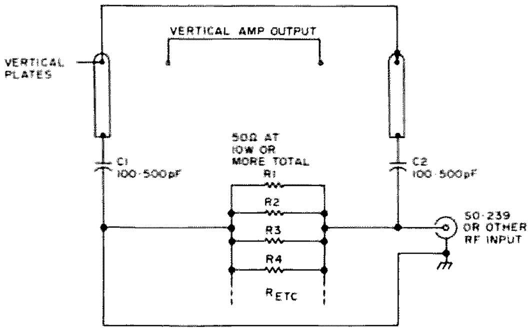

Fig. 3. A simple modification will permit practically any scope to directly handle 27 MHz transmitter output. A visual indication of modulated rf output can tell a technician not only how much modulation is present, but also how much distortion is present as well. On some scopes, it may be necessary to build the termination/coupling network so that it may be removed from the circuit when not in use. Care should be taken to see that the vertical amplifiers are not fed excessive levels of rf; average CB units will have 13-15 volts rms of rf across 50 Ohm load. Resistors should be carbon — not wirewound — paralleled as necessary for 50-52 Ohms total with a power rating of at least 10 Watts. Values of C1 and C2 should be adjusted for adequate deflection with minimum loading or swr on input.

He stripped out all of the damaged circuitry and coupled the buffer output to the antenna terminal. He then jiggered around with the driver in the audio section until he got feedback on it. This tone was adjusted, by varying the amount of feedback capacitance, and coupled through a pot to the buffer stage in the transmitter. The push-to-talk switch was replaced with a toggle switch, and he had a reasonably useful crystal generator with variable modulation. There were only two drawbacks.

Some of the crystals were off-frequency several hundred Hertz and the rf spray from the unit was terrific. Our hero merely disconnected the offending crystals and installed the unit in another chassis. When the seams were sealed with aluminum tape, spray was reduced to a tolerable level. A homemade attenuator between the original chassis and the outer chassis allowed him to reduce the output to close to one microvolt.

As units vary considerably, and this particular one is reposing in a junk pile somewhere, no specifics are offered for such modification. The item was mentioned strictly for its inspirational value. If you don't think that the idea is worth toying with, though, just try to price a commercial piece of equipment designed to do the same thing.

Scope

There is probably more controversy regarding the use of a scope than there is about all of the other test equipment combined. Some technicians use a scope for practically every test that they make, and constantly monitor the performance of one thing or the other with it. Other technicians seldom use a scope except for audio work. Most of us take the middle road and use the scope anytime that we need to compare audio or rf voltages and need the frequency discrimination provided by the scope's adjustable sweep rate.

Most inexpensive scopes share two disadvantages. They are grossly insensitive at high frequencies, and input impedance is so low that many small-signal circuits are swamped by the probe. At high frequencies, low capacitance probes usually lower overall vertical gain even more than do regular probes.

Obviously, one solution would be to get a 30 MHz scope. Unfortunately, the price of such exotic tools is quite high, even when they are surplus. Another solution is to buy a scope with as high a frequency response as the budget will stand and use it wherever possible.

For CB work, the wisest choice is probably to opt for an inexpensive 5 MHz scope and add blocking caps and a dummy load to the vertical deflection plates for viewing of modulation patterns. See

Fig. 3.

Electronic Voltmeters and Multimeters

Each CB shop needs at least one high impedance electronic voltmeter and at least one small, tough VOM for the abuse which such instruments always get. The old H-P 410B with the UHF rf probe is always a good choice for the budget bench. Not only are these instruments accurate, but they are also fairly cheap now.

With the whole world racing to become metric and digital, there are still some old ways that are better. Maybe the digital meters *are* handier for most purposes, but it is hard to beat an analog meter when it is being used to monitor a tuning response. Perhaps someone would prefer to dip a final with a digital meter, but most people prefer the smoother swing of a needle. The point is simply that brand new digital equipment is not indispensable.

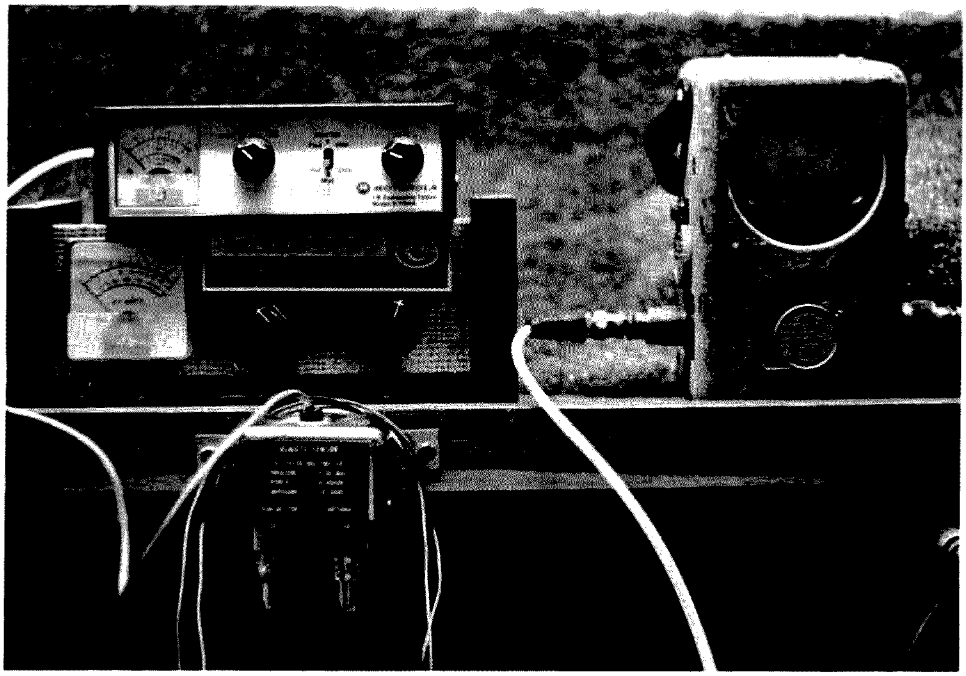

Fig. 4. FCC Rules require that CB rf output not exceed 4 Watts. These instruments measure reflected power or swr, as well as forward power.

Swr Meters and Wattmeters

A well-equipped ham shack has some means of measuring rf output power and either vswr or reflected power (Fig. 4). Legal CB transceivers, however, operate at very low power levels compared to most amateur equipment. This being the case, you may have to purchase special test instruments for CB service. If there is a Bird in the house, all that is necessary is an element for high accuracy at CB frequencies. If not, one of the multi-purpose CB transceiver testers on the market will do just fine.

The scope dummy load mentioned earlier can be calibrated against a known reference to handle bench checks, and a separate swr meter will handle the tests into operating antennas. The swr meters are not expensive and usually are quite reliable.

Bench Power Supply

Most of the transceivers which you will service are mobile 12 V dc units which draw about 1 to 2 Amperes at 13.8 V dc. A regulated and metered bench supply is absolutely essential for profitable CB service. In lieu of a neatly packaged bench supply, a battery with a well-filtered charger and a voltmeter/ammeter readout in the bench panel (Fig. 5) works very well. If you like to build and design, add switches to control charging, a circuit breaker to protect the meter and equipment being serviced, and as many status lights as desired.

A good bench safety feature is a panic button which will shut down all ac line power at once. If the ac switch — which can be an inexpensive wall panel circuit breaker — and the dc switch are mounted close together, you can kill everything instantly when you get smoke — as you surely will sooner or later.

Antennas, Library, Jumpers, and Misc.

This last category is sort of a catchall. But watch it. The shop antennas, technical library, and various cables for connecting this to that can entail a considerable investment. However, to attempt to service CB equipment without them is to turn what could be a good part-time business into an expensive hobby.

If you intend to offer installations — and you should as part of the service — you can expect to lay out more bucks for tools. Don't try to cut corners with your hand tool budget. There is nothing in this world more frustrating than having a

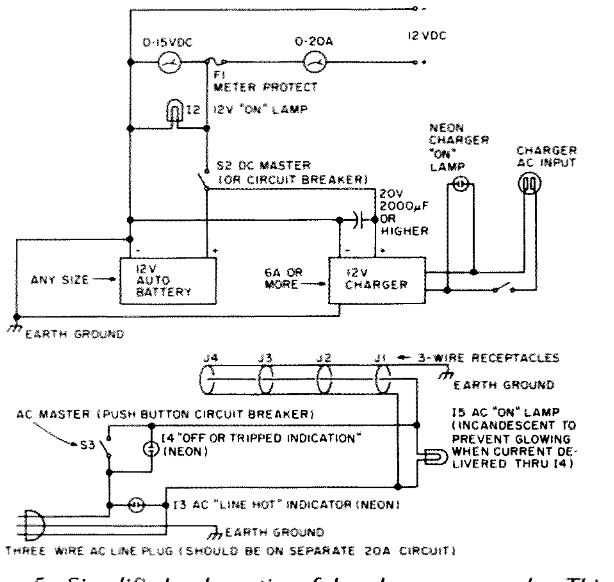

Fig. 5. Simplified schematic of bench power supply. This battery supply provides plenty of stable, well-filtered dc power. While few CB units use more than 2 Amperes at 13.8 V dc, the ambitious technician may soon find himself expanding into other fields. I4 may be omitted if it is desired to remove all leakage.

cheap tool break right in the middle of a job. If the customer is looking on, it's even worse — it's unprofessional as hell.

Parts Inventory

Most CB units are combinations of very common parts — resistors, caps, diodes, transistors, etc. — and extremely rare parts — channel selector switches, crystals (sometimes impossible to get even on new units), and special chassis parts. In most cases, the manufacturers can supply you with the parts unique to their respective units — for a price and after a time. In other cases, the time and expense involved may make the job economically unfeasible.

There is no pat solution to the parts problem. You may find that it is worthwhile for you to accumulate a few junkers of assorted brands. Some parts may be available from a "manufacturer" who markets a unit nearly identical to the one on your bench but under another name. This is where your most important tool comes into play — your brain.

No matter how limited your budget or cramped your quarters, you always have room to keep your brain. This handy item can often take the place of a whole shelf of test equipment. Remember that most problems can be diagnosed without taking the unit out of its case — if you only know what symptoms to look for and what they mean when you have them. This same tool can pull your fat out of the fire when you remember that the unit on the bench is just like the one that you have in the junk pile except for the label on the front.

One way to take care of this tool and even improve its performance is to keep a notebook on every job that you do. After a few months, the data begins to add up to increased profits. ■

Patch Up Your 101

- - simple mod for the HW-101

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I had a dream for several years to own the Heath SB-100 — then the SB-101 — then the 102, but I never could quite get: a) the XYL to buy the deal; and/or b) the green stuff together to swing the deal! Finally, I realized that second best was "on-the-air best," so I laid out for the HW-101. I already had the phone patch and electronic keyer by Heath. In the dream days of the SB series, I had even bought the assembly manual for the SB-102, so I had quite a familiar start with the new project.

Anxious to have the phone patch, I was surprised to find no mention of it in my first "charge" through the assembly manual for the 101! I checked the index and every part of the manual, carefully studied it even — no mention at all. Hmmm!

Then I went back to the SB-102 manual, and careful study revealed that it would be quite a simple matter to add the patch to the HW-101. And, the place already existed for the parts needed when I checked the Modulator Circuit Board in my kit. The holes are drilled and the board appears to be the same one used in the SB-102 unit.

All that's needed is a ½ Watt, 22 kΩ resistor, 2 feet of RG 174/U coax and the spare jack on the back of the HW-101 chassis. If you are putting a new kit together as I was, provide for it at this time. If not, just remove the covers and get down to where the action is.

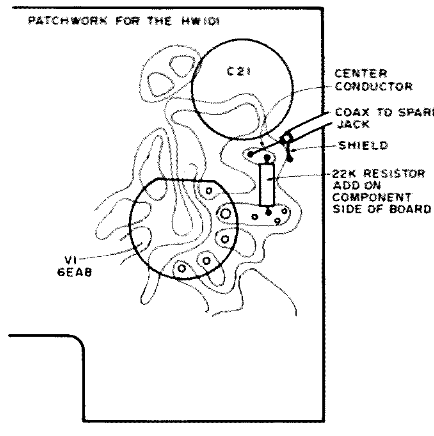

Fig. 1. Modulator circuit board (foil side).

Fig. 1 shows the corner of the modulator circuit board right around V1, foil side up. This is also available to you kit builders on page 188 of your manual, and is the upper right-hand corner of the illustration. The 22 kΩ resistor goes in the position indicated. Then the coax is put in as shown: the center conductor to the same island as the resistor and the braid to the outside or ground portion of the board. Holes are already there for the components.

Next, dress the coax back to the spare jack on the rear of the chassis. There you solder the center conductor of the coax to the center lug on the jack, and solder the shield to the ground lug. Be sure that you make a neat job of the coax as it runs back through the chassis; tie it off or thread it so that it will stay in place. Incidentally, there was enough spare coax in my kit to make up the piece for this purpose. If not, a 2-foot piece of RG 174/U will do the job.

Now all you need do is plug in your phone patch and you're ready to go. Since most of the components are the same as for the SB-102, you have actually made your kit more valuable, if you have done it neatly.

Happy patchwork! ■

The History of Ham Radio

-- part IV

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During 1921, for sending their signals, amateurs were still thinking in terms of spark transmitters. The vacuum tube, as a simple three-element detector, was being advertised prominently and illustrated profusely in all the wireless literature. Not until the VT-1, 201, 202 and other tubes came along could much conversion from spark transmitters take place. It was well into the 1921-1922 period that this happened with the realization that wavelengths below 200 meters were of considerably more advantage for DX and better tuning characteristics than at 200 meters and above.

While in the Signal Corps Officer's Training Camp in College Park MD in 1918, I saw and operated the first three-tube transmitter. It was similar in appearance to the first three-tube DeForest set which was extensively advertised in radio periodicals in 1921. It came equipped with Western Electric VT-1 tubes.

Construction articles appeared monthly in the 1920 and 1921 magazines. These were simple circuit diagrams showing application. The Fessenden, Marconi, the Telefüncen, the Colpitts and many others were displayed. The radio amateur was doing a lot of experimenting in adapting this new device to all sorts of circuit layouts toward improving reception and transmission of signals.

Amateurs and commercial interests devised all sorts of receiving circuit combinations under such names as the *neutrodyne*, the *amplidyne*, the *Roberts*, the *Cockaday*, etc. One must remember that radio broadcasting had its real beginning in earnest right after World War I, and the general public became all agog over this new mysterious phenomenon entering their homes. Hearing strange voices and music out of nowhere . . . through earphones . . . without wires . . . It was unbelievable!

From now on the ham was no longer alone with his dots and dashes in his little cubicle, carrying on his own brand of mysterious private conversation.

Serious consideration was being given by the amateurs to the possibility of making improvements in signal reception by adding several stages of tube amplification to the detector. The single crystal detector and the old coherer could now be permanently replaced and abandoned. Those weak and often inaudible signals could now be picked out with ease and at a greater distance. And so, with the discovery of the regenerative circuit by Major Armstrong, the vacuum tube *started to oscillate* and gave signals a thousand fold boost in strength.

Peoria Radio Sales Co., 1923-1924.

The vacuum tubes were not quite ready for transmission purposes. Their lack of ruggedness, their size, their cost and their scarcity held back adaptation by the amateur fraternity of tubes for strong CW signal generators. After the war, and even into 1922, amateurs who had served Uncle Sam were still operating their spark transmitters.

Many of us were familiar with either the Army Signal Corps or the Navy gear. They all looked and operated alike. In the beginning of wireless adaptation to the armed services, very little innovation could be expected for field combat purposes. The quenched gap transmitter stood out as a most reliable unit. To the ham this was proven equipment. True, it operated in many instances from a 500 cycle source of

power, but it was regarded as a dependable unit to cover fairly long distances and was used by commercial companies in the field. It was semiportable when loaded on a horse, a mule, or two-wheeled cart.

The returning amateur was trained in the use of such transmitting equipment and took a fancy to the unit. He was very familiar with its performance, knew how to operate it, and had practical knowledge of its capabilities and application. During his period of service he was always thinking in terms of adapting it to his own use if and when he got back home. The one and only drawback was the 500 cycle power input. Replacing the quenched gap in the circuit proved a minor drawback.

When we examine the spark gap circuit used in all stations as illustrated and described in the literature of the early 1920s, it can be said that it was really quite simple and direct, and not difficult to understand in operation and performance.

The "spark-gap-ham" preferred to build his own condenser. He would use glass plates, mostly 8" x 10" in size, obtained from a photographer who was ready to discard them. (Exposures were made on glass plates "in them olden days.") These were covered, both sides, with tin or aluminum foil or other thin metal sheets. Tobacco pouches were often sources of foil. Enough plates were coated so that the assembled condenser gave a value of .01-.012 uF. To make sure that the unit could withstand potential surges as high as 25,000 volts, four of these sections were connected in series-parallel, making the capacitance still the correct value, approximately 0.01 uF. The whole thing was immersed in oil. Not to do so caused corona discharges around the edges. Being well soaked made them stand up much better under the high potentials. Even then they punctured unexpectedly!

The high potential was quite dangerous around the place. It was important that the condenser box be surrounded by a protective wall and openly marked: DANGER — HIGH VOLTAGE — KEEP YOUR DISTANCE!

The discharge gap in the circuit is in series with the primary spiral inductance, usually made of flat-wound brass or copper ribbon. This was known as the oscillation transformer. Every time the key in the low voltage primary circuit was closed, the charged condenser let loose for the shortest fraction of a second, in rapid fire, and discharged across the spark gap. On discharge, the energy surged around the helical coil, and, in turn, the secondary coil inductively coupled to the primary received a burst of electromagnetic energy. This in turn sent a damped wave signal out into the ether by way of the antenna configuration. A hot wire ammeter in series with the antenna to ground connection indicated the amount of current being emmitted. A fuse block in the main power line provided protection against overloads.

Although the circuit

looked quite simple, we amateurs had other problems to contend with in meeting the 200 meter (or less) wavelength requirements. The condenser design value had to stay within the above stated uF limits. I will not attempt to delve into the mathematical equations to prove the point. Remember that we had a wrong concept of wavelength versus distance in those days.

Some amateurs were in a position to obtain 500 cycle power generators. Many signals could be heard on the air using such units. The signal coming from a 500 cycle source had a distinct tone quality. It was music to many an ear.

By way of interest, here is a statement which appeared in *Radio Amateur News* in 1920:

> "Surely the US government is not imposing upon the American amateur when he limits the operating wavelength of your transmitter to 200 meters. Contrast this law to that of Canada where the limit is placed at *50 meters*. As a Canadian amateur recently remarked, with this short wave we may consider ourselves fortunate indeed to cover the extraordinary distance of one mile. As for democratic England, the would-be amateur is simply out of luck, for no license or permission is at present even obtainable under any condition. From the foregoing, we may therefore deduce the timely moral: *Keep your transmitter on the lawful side of 200 meters*."

The amateurs up to now had really not discovered the potentially great advantage of the shorter wavelengths.

The rotary gap caused havoc on many occasions, since the studs had a tendency to become pitted after a short time of operation unless constructed of stuff that withstood the constant arcing in an open oxygen atmosphere. Of considerable help was an enclosed gap, sufficiently airtight to exclude oxygen to the extent possible.

Much experimenting with the number of studs on the rotor and the speed of the motor improved the efficiency of the system. An 1800 rpm synchronous motor and a wheel with twelve well-designed studs, made of material that could withstand pitting, usually provided the right kind of pitch and whine to satisfy the critical ham in his quest to excel on the air.

By the characteristic frequency over the air, most ham stations were recognized without the usual QTH report. "I know the sound of his spark" was a common remark among hams.

After a station had its mechanical problems fairly well under control, the problem of decrement of the signal emitted received considerable attention. Specifications from the bureau in Washington decreed that the decrement could not, or should not, be higher than 0.2 when the energy was transferred to the antenna. Otherwise the signal emitted would be unduly broad with accompanying increased interference due to high damping.

What was this decrement all about? The subject was discussed at great lengths. It took front and center attention and was good for an argument anywhere, anytime. Decrement and how to meet its requirements waxed hot and furious from many podiums at conventions. Today you never hear the subject mentioned any more.

Decrement, logarithmic decrement: Nobody knew very much about the subject, even though the Department of Commerce issued their well known Bureau of Standards book entitled *Radio Instruments and Measurements #74*, on March 23, 1918. This gave technicians and engineers an in-depth documentation on the subject. Mr. B. West ex-8KEZ discussed spark dischargers at the St. Louis convention in 1920. In the course of his presentation, he was interrupted repeatedly by well-meaning listeners in the audience, as they confused the issue by introducing the "damping factor" and then wondering what was meant by *napierian*. The confusion usually brought down the house, and the heated discussion ended in a draw. Not even well-meaning intellectual cowhands from the western ranches knew what to make of these arguments and decided to leave well enough alone when they got back to their radio shacks.

So decrement, damping factor, impulse excitation, and increment — all these factors — were eventually solved the usual "over-the-ether-waves-reporting" way — experimentally — trial and error methods prevailing. It was understood that a low resistance (the lower the better) in the secondary discharge circuit gave a low decrement and allowed the energy to oscillate freely with consequent low heat loss. We seldom worried about impulse excitation any more.

Our problems were put away for a while until the next convention came along. This was to be the First National American Radio Relay League super meeting at the Edgewater Beach Hotel in Chicago, to be reviewed in the next chapter.

We go back to our midnight operating hours when all is quiet and serene about the house. The ham does not want disturbances to interfere with his concentration on distant code from some far-off place. Besides, when the key is closed, the spark noise could disturb the neighbors, and any intruders into the privacy of the shack would be overcome by the ozone that often permeated the atmosphere. QRX till we meet later on when fully recovered in fresh air environment. ■

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Dipole Designer Program

- - calculates coils and length

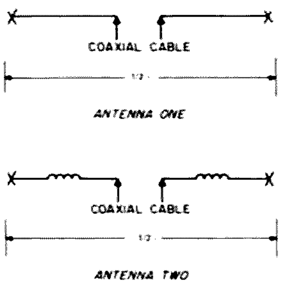

Fig. 1. Dipole Antenna Considerations.

The resonant half wavelength dipole can be shortened considerably using a pair of loading coils to provide lumped inductance between the center feed point and the ends of the antenna (Fig. 1). Both of these configurations can be resonant at the same frequency.

What's the tradeoff? The reduced physical length costs you bandwidth at any swr level of your choice. If you're using less than a couple hundred feet of RG-8 or RG-11 and your lot is as small as mine, then that's an attractive exchange.

The Dipole Designer program is written to help you juggle the variables involved. It can be broken down into 3 areas.

Program Description

The first area is the calcu-

Program listing for Loaded Dipole Design program. Written in Digital Group Maxi-BASIC Version 1. (Program plus BASIC requires approximately 17K.)

```
2 FOR K = 1 TO 16: #" ":NEXT K
4 #"LOADED DIPOLE DESIGN"
6 #"<---------------L--------
  ----->"
8 #"X-----<>-------------<>
  -----X"
10 FOR K = 1 TO 4
12 #"                 ↑↑":NEXT K
14 #"<>= LOADING COIL"
16 #"X-TO-X DISTANCE = OVERALL ANTENNA"
18 #"LENGTH."
20 #"THE DIPOLE IS FED IN THE CENTER"
22 #"& THE FEEDLINE TO LOADING COIL"
24 #"DISTANCE IS A VARIABLE YOU WILL"
26 #"INPUT ":FOR K = 1 TO 9000:NEXT K
28 FOR K = 1 TO 16: #" ": NEXT K
30 #"            DATA INPUT"
32 #"            -----------"
34 INPUT "PLEASE ENTER THE TARGET
  RESONANT FREQ. IN MHZ",F
36 IF F<=0 THEN 34
38 IF F>31 THEN #"THIS PROGRAM IS ONLY
  VALID TO APPROXIMATELY 30 MHZ"
40 IF F>31 THEN 34
42 FOR K = 1 TO 16: #" ":NEXT K
44 #"ONE HALF WAVELENGTH DIPOLE AT"
46 #F;" MHz"
48 #"HAS AN OVERALL LENGTH OF"
50 #468/F;" FEET": FOR K = 1 TO 2000:NEXT:
  FOR K = 1 TO 16: #" ":NEXT K
52 INPUT "WHAT IS THE DISTANCE IN FEET
      FROM THE CENTER OF THE DIPOLE
  TO EACH LOADING COIL?", B
54 IF B<=0 THEN 52: IF B>230/F THEN 52
56 INPUT "WHAT GAGE WIRE ARE YOU USING?",
  G1
58 IF G1<2 THEN 56
60 IF INT (G1/2)=(G1)/2 THEN G=G1 ELSE G=G1+1
62 IF G>32 THEN 56
64 GOSUB 138
66 INPUT "WHAT IS THE OVERALL ANT.
  LENGTH IN FEET?",L
68 IF L<=0 THEN 66
70 IF L>465/F THEN #"TOO LONG, YOU WILL NEED
  CAPACITIVE LOADING"
72 IF L>465/F THEN 66
74 IF L<2*B THEN #"COILS ARE OUTSIDE
  OF ANTENNA TRY AGAIN!!"
76 IF L<2*B THEN 66
78 GOSUB 112
80 #"THE REQUIRED LOAD INDUCTANCE"
82 #"IS ="; C0;"MICROHENRYS."
84 INPUT "JUMP TO COIL DESIGN?
  (Y OR N)",A$
86 IF A$ = "Y" THEN GOSUB 176
88 FOR K = 1 TO 1000:NEXT K
90 #"WANT?"
92 #"1 – COIL DESIGN"
94 #2 – STOP": #:3 – EXAMINE EFFECT ON
  VARIABLE CHANGES":"4 – RESTART"
96 INPUT K
98 IF K = 1 THEN A$ = "Y"
100 IF K = 1 THEN 86
102 IF K = 2 THEN 110
104 IF K = 3 THEN GOSUB 226
```

```
106 IF K = 3 THEN 90
108 IF K = 4 THEN 30
110 END
112 C1 = 1.E6/(69*9.8696*F*F)
114 C2 = LOG((24/D)*(234/F-B))-1
116 S = (1-(F*B)/234)
118 S2 = S*S
120 C3 = S2-1
122 C4 = (234/F)-B
124 C5 = LOG((24*(L/2-B))/D)-1
126 T = (F*L/2-F*B)/234
128 T2 = T*T
130 C6 = T2-1
132 C7 = (L/2)-6
134 C0 = C1*((C2*C3/C4)-(C5*C6/C7))
136 RETURN
138 IF G = 2 THEN D = .258
140 IF G = 4 THEN D = .204
142 IF G = 6 THEN D = .162
144 IF G = 8 THEN D = .129
146 IF G = 10 THEN D = .102
148 IF G = 12 THEN D = .081
150 IF G = 14 THEN D = .064
152 IF G = 16 THEN D = .051
154 IF G = 18 THEN D = .040
156 IF G = 20 THEN D = .032
158 IF G = 22 THEN D = .025
160 IF G = 24 THEN D = .020
162 IF G = 26 THEN D = .016
164 IF G = 28 THEN D = .013
166 IF G = 30 THEN D = .010
168 IF G = 32 THEN D = .008
170 RETURN
172 GOSUB 176
174 GOTO 226
176 #"THE VALUE OF INDUCTANCE CURR-"
178 #"ENTLY IN MEMORY IS:"
180 #C0: #"DO YOU WANT TO USE THIS"
182 #"VALUE IN DESIGNING A COIL?"
184 INPUT "ENTRY Y OR N", A$
186 IF A$ = "Y" THEN 190
188 INPUT "PLEASE ENTER THE NEW VALUE IN
    MICROHENRYS", C0
190 IF C0 = 0 THEN 176
192 INPUT "WHAT IS THE DIAMETER OF THE COIL
    IN INCHES?",R
194 IF R = 0 THEN 192
196 R = ABS (R/2)
198 INPUT "ENTER THE NUMBER OF TURNS PER INCH
    OF COIL LENGTH",T
200 T = ABS(T)
202 IF T = 0 THEN 198
204 #"----------------------------"
206 #"COIL DIAMETER = ";2*R;"INCHES"
208 #"COIL WOUND AT";T;"TURNS/INCH"
210 L(1) = ((10*C0)+SQRT((100*C0*C0)-(4*R*R*T*T
    *(-9)*R*C0)))/(2*R*R*T*T)
212 L(2) = ((10*C0)-SQRT((100*C0*C0)-(4*R*R*T*T
    *(-9)*R*C0)))/(2*R*R*T*T)
214 IF L(1) > L(2) THEN L(3) = L(1)
216 IF L(2) > L(1) THEN L(3) = L(2)
218 #"COIL LENGTH = "; L(3); "INCHES"
220 #"TOTAL TURNS = "; T*L(3)
221 #"INDUCTANCE = "; C0;"MICROHENRYS: #"---
    --------------------------"
222 FOR K = 1 TO 5000:NEXT K
224 RETURN
226 #"TO EXAMINE THE EFFECT ON COIL"
228 #"INDUCTANCE OF CHANGING A"
230 #"VARIABLE, ENTER AN APPROPRIATE"
232 #"NUMBER"
234 #"1-FEEDPOINT TO COIL DISTANCE"
236 #"2-OVERALL LENGTH"
238 #"3-WIRE SIZE"
240 #"4-RETURN FOR NEW DESIGN"
242 #"5-RETURN TO COIL DESIGN"
244 INPUT " #",V
246 IF V = 1 THEN 258
248 IF V = 2 THEN 298
250 IF V = 3 THEN 336
252 IF V = 4 THEN 30
254 IF V = 5 THEN 172
256 GOTO 226
258 #"LOAD CHANGE WITH FEEDPOINT"
260 #"TO LOADING COIL DISTANCE"
262 #"CHANGE"
264 FOR K = 1 TO 1000:NEXT K
266 #"OVERALL LENGTH = ";L;"FT"
268 #"RESONANT FREQ. = ";F;"MHZ"
270 #"WIRE SIZE = ";G;"GAGE"
272 #"---------------------------"
274 FOR K = 1 TO 1000:NEXT K
276 #"CENTER TO COIL    INDUCTANCE"
278 #"DIST.(FT)             MICROHENRYS"
280 Q = B
282 FOR B = (.05*L) TO (.45*L) STEP (.05*L)
284 #B;
286 GOSUB 112
288 #TAB(16);C0
290 NEXT B
292 B = Q
294 INPUT "READY TO CONTINUE?",A$
296 GOTO 226
298 #"LOAD CHANGE WITH CHANGE IN"
300 #"OVERALL ANTENNA LENGTH:"
302 FOR K = 1 TO 1000:NEXT K
304 #"CENTER TO COIL DISTANCE = ";B;"FT."
306 #"RESONANT FREQ.= ";F;"MHZ"
308 #"WIRE SIZE = ";G;"GAGE"
310 FOR K = 1 TO 2000:NEXT K
312 Q = L
314 #"----------------------------"
316 #"TOTAL LENGTH      INDUCTIVE LOAD"
318 #"FEET                  MICROHENRYS"
320 FOR L = (2.4*B) TO (465/F) STEP (((230/F)
    -(2.4*B))/4)
322 #L;
324 GOSUB 112
326 #TAB(16);C0
328 NEXT L
330 L = Q
332 FOR K = 1 TO 3000:NEXT K
334 GOTO 294
336 #"CHANGE IN LOAD WITH CHANGE"
338 #"IN ANTENNA WIRE SIZE"
340 FOR K – 1 TO 1000:NEXT K
342 #"RESONANT FREQUENCY = ";F;"MHZ"
344 #"LENGTH = ";L;"FT"
346 #"CENTER TO COIL DIST. = ";B;"FT"
348 FOR K = 1 TO 2000:NEXT K
350 #"----------------------------"
352 #"WIRE SIZE         INDUCTANCE LOAD"
354 #"(GAGE)            MICROHENRYS"
356 P = G
358 FOR G = 6 TO 28 STEP 2
360 #" ";G;
362 GOSUB 138
364 GOSUB 112
366 #TAB(16);C0
368 NEXT G
370 G = P
372 GOTO 294
```

lation of the size of the inductive loading coil you will need to insert in each leg of the antenna. The computer asks you to input:

a) the desired resonant frequency in MHz;

b) the distance in feet from the center of the antenna to where you want to place the loading coils;

c) the size of wire you are going to use in constructing the antenna. This information is entered as wire gauge size. Buried in the program is a wire gauge to wire diameter conversion lookup table;

d) the overall length from end to end that your new antenna will have to be in order to fit in the space you have available.

The computer will then promptly display the inductance in microhenrys required to meet the above design variables.

```
RUN
LOADED DIPOLE DESIGN
<-----------------L------------->
X-----<>-------     -------<>-----X
                ↑↑
                ↑↑
<>= LOADING COIL
X TO X DISTANCE = OVERALL ANTENNA
LENGTH.
THE DIPOLE IS FED IN THE CENTER
& THE FEEDLINE TO LOADING COIL
DISTANCE IS A VARIABLE YOU WILL
INPUT

              DATA INPUT
              ----------
PLEASE ENTER THE TARGET RESONANT
FREQ. IN MHZ -
7.123
ONE HALF WAVELENGTH DIPOLE AT
7.123 MHZ
HAS AS OVERALL LENGTH OF
65.702 FEET
WHAT IS THE DISTANCE IN FEET
FROM THE CENTER OF THE DIPOLE TO
EACH LOADING COIL?
5
WHAT GAGE WIRE ARE YOU USING?
18
WHAT IS THE OVERALL ANTENNA LENGTH
IN FEET?
37.5
THE REQUIRED LOAD INDUCTANCE
IS = 11.54 MICROHENRYS.
JUMP TO COIL DESIGN? (Y OR N)
Y
THE VALUE OF INDUCTANCE CURR-
ENTLY IN MEMORY IS:
11.64
DO YOU WANT TO USE THIS
VALUE IN DESIGNING A COIL?
ENTER Y OR N
Y
WHAT IS THE DIAMETER OF THE COIL
IN INCHES?
2
ENTER THE NUMBER OF TURNS PER
INCH OF COIL LENGTH
8
-------------------------
COIL DIAMETER = 2 INCHES
COIL WOUND AT 8 TURNS/INCH
COIL LENGTH = 2.46 INCHES
TOTAL TURNS = 19.69
INDUCTANCE = 11.54 MICROHENRYS
-------------------------
WANT?
1 - COIL DESIGN
2 - STOP
3 - EXAMINE EFFECT OF VARIABLE CHANGES
4 - RESTART
?
3
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 - FEEDPOINT TO COIL DISTANCE
2 - OVERALL LENGTH
3 - WIRE SIZE
4 - RETURN FOR NEW DESIGN
5 - RETURN TO COIL DESIGN
1
LOAD CHANGE WITH FEEDPOINT
TO LOADING COIL DISTANCE CHANGE
OVERALL LENGTH = 37.5 FT.
RESONANT FREQ. = 7.123 MHZ
WIRE SIZE = 18 GAGE
-------------------------
CENTER TO COIL         INDUCTANCE
DIST. (FT.)            MICROHENRYS
  1.875                  9.606
  3.750                 10.655
  5.625                 12.050
  7.500                 13.970
  9.375                 16.734
 11.250                 20.973
 13.125                 28.128
 15.000                 42.333
 16.875                 82.605
READY TO CONTINUE?
Y
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 - FEEDPOINT TO COIL DISTANCE
2 - OVERALL LENGTH
3 - WIRE SIZE
4 - RETURN FOR NEW DESIGN
5 - RETURN TO COIL DESIGN
#2
LOAD CHANGE WITH CHANGE IN
OVERALL ANTENNA LENGTH.
CENTER TO COIL DISTANCE = 5 FT.
RESONANT FREQ. = 7.123 MHZ
WIRE SIZE - 18 GAGE
-------------------------
TOTAL LENGTH           INDUCTANCE LOAD
FEET                   MICROHENRYS
  12.                   155.760
  17.072                 52.082
  22.145                 31.047
  27.217                 21.399
  32.300                 15.619
  37.362                 11.630
  42.435                  8.620
  47.507                  6.205
  52.580                  4.178
  57.652                  2.412
  62.724                  0.851
READY TO CONTINUE?
Y
TO EXAMINE THE EFFECT ON COIL
INDUCTANCE OF CHANGING A
VARIABLE, ENTER AN APPROPRIATE
NUMBER:
1 - FEEDPOINT TO COIL DISTANCE
2 - OVERALL LENGTH
3 - WIRE SIZE
4 - RETURN FOR NEW DESIGN
5 - RETURN TO COIL DESIGN
#3
CHANGE IN LOAD WITH A CHANGE
IN ANTENNA WIRE SIZE.
RESONANT FREQ. = 7.123 MHZ
LENGTH = 37.5 FT.
CENTER TO COIL DISTANCE = 5 FT.
-------------------------
WIRE SIZE              INDUCTIVE LOAD
(GAGE)                 MICROHENRYS
  6                      9.489
  8                      9.822
 10                     10.166
 12                     10.504
 14                     10.849
 16                     11.182
 18                     11.538
 20                     11.865
 22                     12.226
 24                     12.553
 26                     12.880
 28                     13.185
READY TO CONTINUE?
```

Sample run of Loaded Dipole Design program.

At this point you're probably wondering where you stashed that coil design slide rule. Look no further, because that's section two of the program.

First you're given a choice of starting with the value of inductance just calculated or a new value. In either case it's in microhenrys. The program then asks you to input:

a) coil diameter in inches, and

b) the number of turns per inch you plan to wind the coil at.

Using this data the computer will return both the overall coil length and the total number of turns required to obtain the design inductance.

Curious about what effect the wire size really has? How about changes in overall length? Or what happens when you move those coils away from the center of the antenna toward the ends? The third section of the program takes care of these variables.

Using the Program

Just select the appropriate option after the list is displayed and a table will be generated showing the change in inductive load (in microhenrys) with one of the design parameters changed over a wide range.

The first option is an analysis of what happens when feedpoint to loading coil distance is changed. The inductance of the loading coil required to produce resonance is listed in one column of the table and the center to load distance in a second column. The number of feet the coil is from the feedline starts at 5% of the overall antenna length you previously inputted and goes to 45% of the overall length in 5% increments. Does the inductance of the coil increase or decrease as it moves away from the feedpoint?

Choose the second option, and your computer will generate a table of load inductance in one column

and overall dipole length in the other column. The center to coil distance you originally specified is used. The overall antenna length starts at 2.4 times the center to coil distance and goes to almost one half wavelength. Sure enough, the inductance approaches zero as the overall length approaches half wavelength.

How about the wire size? Why is it even taken into consideration? Well, choose option three and look at a comparison of required inductive load to wire size with wire size going from 6 gauge to 28 gauge in steps of 2. Interesting.

A few comments about the program. It runs in about 4.6K of BASIC, not counting the memory consumed by the BASIC interpreter. I have it running on an 18K Z-80 Digital Group System. If memory capacity is a problem, the program can be chopped into 3 major areas described and portions deleted as required.

You could also delete the wire gauge to wire radius conversion section and enter wire radius in inches, to save a couple hundred words.

There are no remarks. However, I think the liberal use of print commands makes the program fairly easy to follow.

Formatted print commands were deliberately avoided to save confusion in applying this program with different systems. The language is Digital Group Software Systems Maxi-BASIC Version 1.

How about adding a section for inverted vee configurations? Extracting the loading for verticals and whips should be relatively easy, too. ■

References

1. *Reference Data for Radio Engineers,* 5th Edition, 4th Printing, 1972, Copyright H.W. Sams, 1968, pages G-1, G-3.
2. *QST*, September, 1974, page 209.

Software Control

-- for High Quality Video Display

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In the March, 1977, issue of *73* I described a video display which is seen to be a part of memory by the computer. This article is to present a software driver for that display.

The operation of the display is essentially that of a window to a portion of the computer's memory. The computer can read or write randomly to any portion of the display memory just as it can with its normal memory. In fact, programs may even be executed from the display memory. When the processor is not accessing the display memory, the display circuitry takes over and uses that memory to generate a video signal. As a result, display functions such as line feeding or erasing are software processes.

The program provides these basic functions:

1. Carriage return;

```
Video Display Driver    MAC80 Version 2(30)-2 running on  5-May-77 17:52:42      Page 1
File DSKA0:VIDEO.M80[4,40] created  5-May-77 17:50:00

                              TITLE   Video Display Driver

                        ;     This routine is a general purpose display driver.  A character  is
                        ;supplied  in  the  accumulator and this routine is invoked causing that
                        ;character to be transferred to the display memory.  If  that  character
                        ;is  a  control  character,  then a special action may take place such a
                        ;clearing the screen or changing the location of the cursor.
                        ;
                        ;     The following calling format is used:
                        ;
                        ;       LXI     H,BLOCK  ;Get the argument block
                        ;       CALL    VIDEO    ;Invoke the display processor
                        ;       always return here
                        ;
                        ;BLOCK: DB      n        ;Beginning line of display block
                        ;       DB      m        ;Ending line of display block
                        ;       DW      addr     ;Address of next character (updated by VIDEO)
                        ;
                        ;     A "display block" is a group of lines on the screen that are acted
                        ;upon together.  If the block is scrolled, for example, only those lines
                        ;between the starting and finishing lines are scrolled.  The "cursor" is
                        ;the  location  of  the  next  character  on  the screen.  The cursor is
                        ;represented on the screen by inverting  the  video  at  that  location.
                        ;Most  characters  are displayed at the current cursor location and that
                        ;location is advanced one position after  each  call  unless  a  special
                        ;character changes the cursor address.
                        ;
                        ;     The following special control characters are recognized:
                        ;CR     carriage return Move the cursor (next character position) to the
                        ;                       beginning of the current line.
                        ;LF     line feed       Move the cursor down one line.  If there are  no
                        ;                       more  lines  in  the block, then the rest of the
                        ;                       block  is  scrolled  upwards  and  the   cursor
                        ;                       position is unchanged.
                        ;BKSP   backspace       Move the cursor backwards one character.  If the
                        ;                       cursor  is  already  at the leftmost position on
                        ;                       the screen, then no action is taken.
                        ;TAB    tab             Move the cursor forward to the  next  tab  stop.
                        ;                       If  the  cursor  is  already  at  the  rightmost
                        ;                       position on the screen, then no action is taken.
                        ;                       Tabstops are  implicitly  set  every  8  columns
                        ;                       beginning at column 9.
                        ;FF     form feed       Clear the entire block and position  the  cursor
                        ;                       to  the  first  character  position of the first
                        ;                       line of the block.
                        ;CTRL-X control X       Clear the current line and move  the  cursor  to
                        ;                       the first position of the line.
                        ;BELL   bell            Temporarily invert  all  of  the  video  on  the
                        ;                       screen.   The  cursor  position  is  unaffected.
                        ;                       This is an attention getting function.
                        ;DEL    delete          Do nothing.  This character is sometimes used as
                        ;                       a filler character, therefore it is ignored.
                              PAGE
                        ;Define all characters of interest.
            000015            .CHCRT=^O15             ;Carriage return
            000012            .CHLFD=^O12             ;Line feed
            000007            .CHBEL=^O7              ;Bell
            000010            .CHBKS=^O10             ;Backspace
            000011            .CHTAB=^O11             ;Tab
            000030            .CHCNX=^O30             ;Control X
            000014            .CHFFD=^O14             ;Form feed
            000177            .CHDEL=^O177            ;Delete (rubout)

                        ;Define dimension of display (assume 64 characters per line)
            174000            TOP=^HF800              ;Starting address of display memory
            000040            DISLIN=32               ;Number of lines on display
            100000            PAUSE=^H8000            ;Number of wait loops for bell
```

```
000000  365                 VIDEO:  PUSH    PSW         ;Save registers
000001  305                         PUSH    B
000002  325                         PUSH    D
000003  106                         MOV     B,M         ;Get parameters, starting line
000004  043                         INX     H
000005  116                         MOV     C,M         ;Stopping line
000006  043                         INX     H
000007  136                         MOV     E,M         ;Low cursor address
000010  043                         INX     H
000011  126                         MOV     D,M         ;High cursor addrwss
000012  345                         PUSH    H           ;Save H and L as well
000013  376 015                     CPI     .CHCRT      ;Is this a carriage return?
000015  312 110 000                 JZ      XCRT        ;If so, do a carriage return
000020  376 012                     CPI     .CHLFD      ;Is this a line feed?
000022  312 211 000                 JZ      XLFD        ;If so, do a line feed
000025  376 007                     CPI     .CHBEL      ;Is this a bell?
000027  312 333 000                 JZ      XBEL        ;If so, invert the entire screen
000032  376 010                     CPI     .CHBKS      ;Is this a backspace?
000034  312 147 000                 JZ      XBKS        ;If so, do a backspace
000037  376 030                     CPI     .CHCNX      ;Is this a control X?
000041  312 164 000                 JZ      XCNX        ;If so, do a control X
000044  376 011                     CPI     .CHTAB      ;Is this a tab?
000046  312 122 000                 JZ      XTAB        ;If so, do a tab
000051  376 014                     CPI     .CHFFD      ;Is this a form feed?
000053  312 305 000                 JZ      XFFD        ;If so, do a form feed
000056  376 177                     CPI     .CHDEL      ;Is this a delete?
000060  312 076 000                 JZ      CURSRI      ;If so, go do nothing
                                    PAGE
                    ;Here for non-special characters.
000063  022                         STAX    D           ;Put the character in display memory
000064  023                         INX     D           ;Point to next character
000065  173                         MOV     A,E         ;Get the low address bits
000066  346 077                     ANI     ^H3F        ;Check for the start of a new line
000070  312 205 000                 JZ      LF1         ;If so, do an automatic line feed
000073  315 024 001         CURSOR: CALL    INVCHR      ;Invert this character
000076  341                 CURSRI: POP     H           ;Restore HL
000077  162                         MOV     M,D         ;Update caller's cursor address
000100  053                         DCX     H
000101  163                         MOV     M,E
000102  053                         DCX     H
000103  053                         DCX     H           ;Point HL back where it was
000104  321                         POP     D           ;Restore other registers
000105  301                         POP     B
000106  361                         POP     PSW
000107  311                         RET                 ;Return to caller

                    ;Here for a carriage return.
000110  315 024 001         XCRT:   CALL    INVCHR      ;Invert this character back to ordinary
000113  173                         MOV     A,E         ;Get the address
000114  346 300                     ANI     ^HC0        ;Make it point to beginning of line
000116  137                         MOV     E,A         ;Put it back in E
000117  303 073 000                 JMP     CURSOR      ;Go do cursor

                    ;Here for a horizontal tab DECsystem-10 style.
000122  315 024 001         XTAB:   CALL    INVCHR      ;Turn off inversion
000125  173                         MOV     A,E         ;Get low address
000126  346 370                     ANI     -7          ;Zero bottom 3 bits
000130  137                         MOV     E,A         ;Put back into E
000131  041 010 000                 LXI     H,8         ;Add 8 to cursor address
000134  031                         DAD     D
000135  353                         XCHG
```

Continued

2. Line feed;
3. Backspace;
4. Horizontal tab;
5. Form feed (erases the display);
6. Clear line;
7. Bell (an inaudible bell, no less);
8. Cursor;
9. Do nothing. (Most terminals accept a filler character which does nothing.)

Calling parameters to the program are used to define the beginning and end lines of the display block to be used and to specify the current cursor address. On return from the display routine all registers and status flags are restored, and the cursor address in the parameter list will have been updated.

Most normal applications of the display use all 32 lines and therefore would specify lines 0 and 31 in the parameter list. But, referring to page 82 of the March, 1977, *73*, you will see an example where I have several display blocks in use simultaneously.

```
000136  173                     MOV     A,E             ;Get low address
000137  346 077                 ANI     ^H3F            ;Check for new line
000141  312 205 000             JZ      LF1             ;If so, do a line feed
000144  303 073 000             JMP     CURSOR          ;Otherwise do a cursor

                ;Here for backspace.
000147  315 024 001     XBKS:   CALL    INVCHR          ;Uninvert this character
000152  173                     MOV     A,E             ;Get low address
000153  346 077                 ANI     ^H3F            ;At beginning of line?
000155  312 073 000             JZ      CURSOR          ;If so, don't backspace
000160  033                     DCX     D               ;Otherwise back up one
000161  303 073 000             JMP     CURSOR          ;Move cursor
                                PAGE
                ;Here for a control X.
000164  016 077         XCNX:   MVI     C,63            ;Get 63 in C
000166  173                     MOV     A,E             ;Get low address
000167  366 077                 ORI     ^H3F            ;Adjust to end of line
000171  137                     MOV     E,A             ;Restore address
000172  076 040                 MVI     A," "           ;Get a blank
000174  022             CXLOOP: STAX    D               ;Write blank to display
000175  015                     DCR     C               ;Decrease count
000176  372 073 000             JM      CURSOR          ;If minus, go move cursor
000201  033                     DCX     D               ;Move pointer back
000202  303 174 000             JMP     CXLOOP          ;And go blank it out

                 Here to do a line feed.
000205  033             LF1:    DCX     D               ;Entry for auto line feed
000206  303 214 000             JMP     XLFD1           ;Do not invert
000211  315 024 001     XLFD:   CALL    INVCHR          ;Uninvert present character
000214  041 000 010     XLFD1:  LXI     H,-TOP          ;Get negative of screen start
000217  031                     DAD     D               ;Add cursor address to get count
000220  175                     MOV     A,L             ;Get low count
000221  007                     RLC                     ;Get high two bits into low two bits
000222  007                     RLC
000223  346 003                 ANI     3               ;Zero the other bits
000225  157                     MOV     L,A             ;Save this number
000226  174                     MOV     A,H             ;Get high count
000227  007                     RLC                     ;Multiply by four
000230  007                     RLC
000231  205                     ADD     L               ;Add to get line number
000232  271                     CMP     C               ;Compare to end of line
000233  332 271 000             JC      LF2             ;If less, go point to next line
000236  315 007 001             CALL    LINES           ;Go get address for scroll
000241  353                     XCHG                    ;Put address into DE
000242  041 100 000             LXI     H,64            ;Get 64
000245  031                     DAD     D               ;Add it to start address
000246  006 100         SETLP:  MVI     B,64            ;Get characters per line
000250  176             LFLOOP: MOV     A,M             ;Load character
000251  022                     STAX    D               ;Store it one line up
000252  043                     INX     H               ;Increment pointers
000253  023                     INX     D
000254  005                     DCR     B               ;Decrease count
000255  302 250 000             JNZ     LFLOOP          ;Loop for this line
000260  015                     DCR     C               ;Decrement line count
000261  302 246 000             JNZ     SETLP           ;Loop for all lines
000264  353                     XCHG                    ;Get end address of last line in DE
000265  033                     DCX     D               ;Adjust by one
000266  303 164 000             JMP     XCNX            ;Go erase last line
                                PAGE
                ;Here for line feed that does not require scroll.
000271  041 100 000     LF2:    LXI     H,64            ;Get 64
000274  031                     DAD     D               ;Add to cursor address
000275  124                     MOV     D,H             ;Put back high address
000276  175                     MOV     A,L             ;Get low address
000277  346 300                 ANI     ^HC0            ;Adjust to point to line beginning
000301  137                     MOV     E,A             ;Put back in low address
000302  303 073 000             JMP     CURSOR          ;Go do cursor

                 Here to erase entire screen.
000305  315 007 001     XFFD:   CALL    LINES           ;Get starting address and line count
000310  345                     PUSH    H               ;Save start address
000311  006 040                 MVI     B," "           ;Get a blank
000313  026 100         STLOOP: MVI     D,64            ;Get characters per line
000315  160             ERLOOP: MOV     M,B             ;Erase this character
000316  043                     INX     H               ;Point next
000317  025                     DCR     D               ;Decrement count
000320  302 315 000             JNZ     ERLOOP          ;Loop for all characters in line
000323  015                     DCR     C               ;Decrement line count
000324  362 313 000             JP      STLOOP          ;Loop for all lines
000327  321                     POP     D               ;Retrieve start address in DE
000330  303 073 000             JMP     CURSOR          ;Go make cursor

                ;Here to do a bell.  Invert the entire screen.
000333  325             XBEL:   PUSH    D               ;Save cursor address
000334  315 361 000             CALL    INVDIS          ;Invert display
000337  041 000 200             LXI     H,PAUSE         ;Get pause time
000342  055             WAIT:   DCR     L               ;Loop PAUSE times
000343  302 342 000             JNZ     WAIT
000346  045                     DCR     H
000347  302 342 000             JNZ     WAIT
000352  315 361 000             CALL    INVDIS          ;Invert the display again
000355  321                     POP     D               ;Restore cursor address
000356  303 076 000             JMP     CURSR1          ;Go do cursor

                ;Here to invert the entire display.
000361  041 000 370     INVDIS: LXI     H,TOP           ;Get start address
000364  026 200                 MVI     D,^H80          ;Get a high order bit
000366  016 040                 MVI     C,DISLIN        ;Get lines
000370  006 100         INVLP2: MVI     B,64            ;Get characters per line
000372  176             INVLP1: MOV     A,M             ;Get a character
000373  252                     XRA     D               ;Invert it fast
000374  167                     MOV     M,A             ;Put the character
000375  043                     INX     H               ;Point next
000376  005                     DCR     B               ;Decrement characters per line
000377  302 372 000             JNZ     INVLP1          ;Loop for this line
000402  015                     DCR     C               ;Decrement lines per screen
000403  302 370 000             JNZ     INVLP2          ;Loop for all lines
000406  311                     RET                     ;Return
                                PAGE
                ;Here to calculate start address in HL and total number of
                ;lines in C for any display block.
000407  041 000 370     LINES:  LXI     H,TOP           ;Get start address
000412  021 100 000             LXI     D,64            ;Get double byte 64
000415  005             LINELP: DCR     B               ;Decrement start line count
000416  370                     RM                      ;If minus, then all done
000417  015                     DCR     C               ;Decrement stop line count
000420  031                     DAD     D               ;Add 64 to start address
000421  303 015 001             JMP     LINELP          ;Loop for all lines

                ;Here to invert the video and vice versa.
000424  032             INVCHR: LDAX    D               ;Get character from screen
000425  356 200                 XRI     ^H80            ;Complement high bit
000427  022                     STAX    D               ;Put the character back on the screen
000430  311                     RET                     ;Return from wence we came
000431                          END

[M80NED No errors detected]
[M80PBK Program break is 000431]

[M80CPT CPU time used 0:00:03]
```

(The picture on page 83 is labeled as split screen but it is not. It is merely an assembler listing.) In the example on page 82 I have the screen split into four blocks, two each of one line and two larger blocks. The program which is receiving the RTTY calls the display routine using lines 2-11 in its parameter list. Likewise, the transmitter routine calls the display driver using lines 15-31. The two one-line areas are from special function routines which call the display driver with the beginning and end lines defined to be the same.

The cursor function is provided by using the inversion capability of the display. Any character may be displayed as white on black or black on white as described in the March article. The software presented here uses that feature for the cursor and to implement the inaudible bell (invert the entire screen for about a half of a second.)

The cursor address is part of the calling program's parameter list since it is possible (as illustrated above) to have more than one cursor. Use of the display is facilitated by having any routine which uses the display driver to initialize its corresponding display block. This is accomplished by calling the display routine with a form feed (octal 14) in the accumulator. This will erase the specified portion of the display and will initialize the cursor address in the calling routine's parameter block to point to the upper left character of the display block.

The program listing is reasonably well documented so you should be able to follow the program flow without too much trouble.

I do want to mention that in the schematic on page 78 of the March *73* the line labeled "011" (center-left in the schematic) should be labeled C7. Also, the text on the same page says that part of the row counter is a 7490. It is really a 7493 as the schematic indicates.

I wish to express thanks to Victor Kean WA1LKU who took a program listing from my model 19 Teletype, complete with comments in freehand scrawl, and retyped the source and comments on a local DEC-System 10 to produce a readable listing. ■

QSL Tips

-- how to bat 1.000

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This month we interview Sir Henry Peter Fox, the world's greatest authority on QSL cards. Sir Henry works as a gun bearer on the Dark Continent, keeping the natives restless. He used to teach marksmanship until one of his students, Albert Scaramanga (known to his CB buddies as the Triple Nipple), tried to shoot a member of the British Secret Service. Ruddy awful business! After that, Sir Henry turned to QSL collecting. When we approached he was explaining to one student how to tell from looking at the edge of a QSL where the tree from which it came grew and the time of year it was cut down. In response to another question he named every ham in the world from memory, how many countries he had confirmed, and exactly how many cards he had outstanding and at which bureaus. I asked Sir Henry how to get a lot of QSL cards. He replied, "Get a CB and wait until 1980." I explained that we were interested in ham QSLs. "Oh," he said, "order from Brownie by the thousand." I tried again. "No. Already filled out." "Ah, why didn't you say so? Rob a QSL Bureau."

Sir Henry downed a Bud and continued, "There are two ways to get QSL cards after you work a station. You can send your card directly to the station you worked, or you can send it through the bureaus." I asked why go through all the intermediary bureau stages. His answer was strikingly clear. "Money." He explained that, to send a card directly, you have to fill in the data, look up the DX station's name and address in the callbook, and type it on a 9½" envelope. Then you type your own name and address on a 6½" envelope. If you can get it, put sufficient air postage in the stamps of the DX country on the small envelope. Otherwise, put several International Reply Coupons in the large envelope. Also put in the large envelope your QSL card, properly filled in, and the small envelope. Then put sufficient U.S. stamps on the large envelope and mail it promptly. Odds are such a mailing will cost about two dollars in IRCs and stamps for just one card.

I told him it seemed very expensive. He opened another ice cold Bud and went on. "It is. But it's fast. You have to decide for yourself whether the speed is worth it. Usually, if you have a small station and only work DX occasionally, you may as well get your souvenir fast and direct. But if you work 'em three a minute, your costs will go out of sight. Now, the bureau system will do the job slower, but for a fraction of a penny per card! Start by filling in all your cards, just the data section, don't address them. Then put them in alphabetical order by prefix. Put the cards in a box with a dollar and a copy of a current *QST* mailing label and address it to Outgoing QSL Bureau, ARRL, 225 Main St., Newington CT 06111.

"ARRL sorts the cards and mails a bundle off to each foreign bureau every week. Then it takes 30-90 days for the surface mail to travel from ARRL to the foreign bureau. Then figure 30-90 days for the foreign bureau to sort it and get it to the foreign ham you worked. The ham will probably take about 30 days to actually fill in his card for you and send it back to the foreign bureau. The foreign bureau may take another month to six months to get it on a boat; the big foreign bureaus such as DL, G, YU, F, ON, etc., will usually get a card out within a month. Then figure another 30-90 days on the high seas before the card gets back to the U.S. Then it goes to a U.S. bureau. The fellows in the bureaus, by the way, are the real unsung heroes of DXing. They do a super job of sorting. Every DXer in the call area keeps a 5" x 7" manila envelope, self addressed and with 13¢ postage stuck on and another 13¢ stamp clipped on, on file. The bureau man with your letter puts all the cards addressed to you in your envelope. When the weight of the envelope approaches the maximum postage limit, the bureau mails it off full of cards you earned the year before!"

"Will they really do the same job?" I asked. He fondled the beautiful woman sunbathing at his side and said, "Look at two guys in the Sterling Park club. WA4HPF has 260 countries confirmed and spent about $200 in IRCs. K4VT has 260 countries confirmed and never spent a dime. Of course, K4VT has been around a lot longer."

I asked Sir Henry how many countries he had. "Eleven," he replied proudly. I told him it seemed a small number compared with N4KW's 300+ countries, and asked if N4KW was a better operator. "You asked how many countries I had," he answered. "I *own* eleven countries. I have QSLs from every country, naturally."

I questioned Sir Henry about the practice of putting a dollar bill in with a directly sent QSL to encourage the DX to send his card in return. "Yes," he said, "some of the less experienced fellows do that. The sharp boys know how to do it right. You open an irrevocable letter of credit with a bank in the DX station's country. When the DX station sends off the card the bank releases a draft to the DX operator."

The sun was starting to set. Its orange light reflected off Sir Henry's station, especially the shiny black Collins HF-80s. Outside I could see W6AM patiently waiting to ask Sir Henry Peter Fox how to work DX and get QSLs. I shook Sir Henry's hand warmly, wished him well, and took out the ropes and pitons for the long trip down. ■

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CB to 10

-- part III: converting the TRC-47

With the slowdown in the CB boom and the recent expansion to 40 channels, the CB equipment manufacturers have been caught off guard with thousands of 23 channel radios in warehouses. These are being dumped on the market at very low prices. I've seen advertisements as low as $39.95 for a 23 channel AM rig. A very good one can be had for well under $100.00.

Most of these radios are very easily converted to ten meters at a cost of under forty dollars.

First, for those of you not familiar with the way these crystal synthesized rigs operate, a few basics, then I will go into specific details of the conversion of a Radio Shack TRC-47, a very common AM & SSB rig.

There are two basic 23 channel synthesizer schemes, the 14 crystal and the 12 crystal. First the 14 crystal type, the more common.

The 14 crystal radios usually have a single conversion receiver with an i-f of 455 kHz. The crystals are in three groups which I will call group A, group Bt, and Br. In my example, I will use the following crystal frequencies: group A – 16.465, 16.515, 16.565, 16.615, 16.665, 16.715; group Bt – 10.500, 10.510, 10.520, 10.540; group Br – 10.955, 10.965, 10.975, 10.995.

In operation, one crystal from group A is used, and one from group Bt on transmit and one from Br on receive. For example, on channel 1 (26.965 MHz) on transmit, 16.465 and 10.500 are mixed to get the operating frequency, and on receive 16.465 and 10.955 are mixed to get 27.420 MHz, which conveniently just happens to be 455 kHz above the operating frequency of 26.965. So if we add 1.735 MHz to each crystal in group A, we can get frequencies in the range of 28.700 to 28.990 MHz, with channel 9 working out to 28.800, the AM calling frequency. How about that?

So, with a 14 crystal AM rig, all that has to be done to put it on ten is to change six crystals and retune some coils. With minimal test equipment, a VTVM, signal generator (that old VFO), a wattmeter or swr bridge, and a dummy load, the whole job can be done in under one hour.

The most difficult part of the job is figuring out what crystals to order. Table 1 is a chart of the common heterodyne scheme and channel frequencies. Notice the 10-10-20-10 kHz spacing of the channels.

Note the channel marked ** is indicated by the dot on the dial between 22 and 23 and on some radios can be had by just installing a jumper or clipping one. Some other radios would require major mechanical modifications to the channel switch to get it.

When you decide what frequencies on ten meters you want, on the 10-10-20-10 spacing pattern, just subtract 26.965 from the lowest one and add this result to the frequency of each crystal in group A, order the new crystals from your favorite purveyor of quartz, wait for the post office, wait for the post office some more, and, when they come, get out the old trusty soldering iron and swizzle sticks, and soon you'll be on ten.

Now, for the 12 crystal rigs. These are cheaper to convert, as only 2 have to be changed. The receivers in these are usually better because they are dual conversion. The heterodyning scheme here is similar to the 14 crystal type but there are only 6 group A and 4 group B crystals, and 2 i-f crystals. Table 2 is an example from a Sanyo TA-923 which I still use on 11 meters.

In this type of radio, one crystal from group A and one from group B are used for both transmit and receive and are mixed to form a product in the 38 MHz range which is run through a bandpass filter at this frequency.

An example for channel 09 (27.065 MHz): Grp A = 23.390; Grp B = 14.950; A + B = 38.340 MHz.

On transmit this 38.34 MHz is mixed with 11.275 to get the operating frequency of 27.065, run through a bandpass filter at 27 MHz, amplified, and modulated. On receive, the 38.34 is injected into the first mixer to get the Rx first i-f at 11.275, which is then mixed with the 11.730 to get the second i-f of 455 kHz. Simple, isn't it? All that has to be done here is to lower the 11 MHz crystals by the amount you want to go up in operating frequency. For example, to make channel 09 come out on 28.800 lower them by 1.735 MHz making the Tx i-f = 9.540 MHz and the Rx i-f crystal = 9.995 MHz, retune the appropriate coils, and you're on the air on ten.

Now, down to the real nitty-gritty of one that I have had on the air on SSB for several months now, in use both at home and in the car. The one I picked is a Radio Shack TRC-47, about the same size as an Icom IC-22. It has a very good crystal filter centered at 11.2735 MHz which gives about 50 dB unwanted sideband suppression. The TRC-48 uses the same filter and oscillator PC board, so conversion data for it is identical to the TRC-47. The TRC-48 is slightly larger and fancier (it has an "S" meter, PA, and switchable noise blanker) and more expensive. They are both rated at 4 Watts rf output on AM and 12 Watts PEP on SSB. I am getting 10 Watts PEP out of mine on 28.600

Grp A/Grp Bt	10.500	10.510	10.520	10.540
16.465	26.965-01	26.975-02	26.985-03	27.005-04
16.515	27.015-05	27.025-06	27.035-07	27.055-08
16.565	27.065-09	27.075-10	27.085-11	27.105-12
16.615	27.115-13	27.125-14	27.135-15	27.155-16
16.665	27.165-17	27.175-18	27.185-19	27.205-20
16.715	27.215-21	27.225-22	27.235-**	27.255-23

Table 1.

MHz. That's only 10 dB down from the typical SSB exciter which has at best 100 Watts output, most of them more like 70 or 80 on ten meters. So what if I'm 1 or 2 "S" units down; it makes up for all the mobile noise from my own and other cars on the road. If I can hear them in the car, I can work them.

Now, how to do it to it.

Step 1: Getting the radio — new or used?

If you have a bit of test equipment you can probably get a better deal on a used radio, but check it out first! Check rf output on AM. If below 2.5 W or above 5.5 W when operated on 13.5 V dc or the ac line if a base station, forget it and go on to the next one. On SSB the output should indicate 8-16 Watts when you whistle into the mike. Check out the receiver on an antenna. Find a few strong local signals and make sure they disappear when switching to the next channel on either side. They should be way down when switching sidebands if SSB.

Next, take the covers off and have a good look inside for modifications. If you see any, put the covers back on and forget it, unless it is quite obvious that the mods will not affect operation of the radio in the manner in which it was designed to operate. As far as dust, dirt, and smudges go, they can easily be cleaned up, so don't let that bother you. Look for ads in the newspaper or in the local weekly *Buy and Sell*. Bargain over price as most sellers are not firm on asking price, and, after all, it's a buyer's market now for 23 channel radios, especially for SSB. Make a call to the local police to make sure it's not hot. For a new radio, shop around at a few stores. Again, it's a buyers market, and even at the chain stores you can get quite a good deal. So make an offer; they might just take it.

Step 2: Figuring it out

If at all possible, get the service manual! This will tell you all you ever wanted to know, but were afraid to ask. For the Radio Shack radios, it can be ordered from the store (they're everywhere just like MacDonald's) if they don't have an extra one in stock. It's well worth the two bucks. Most radios have a schematic diagram in the owner's manual, and some even have one glued inside the top cover. This may be all you need, but the service manual gives complete alignment information and a description of circuit operation which can help a lot.

Group A:	23.290	23.340	23.390	23.440	23.490	23.540
Group B:	14.950	14.960	14.970	14.990		
Tx i-f:	11.275					
Rx i-f:	11.730					

Table 2.

Step 3: Plotting and Scheming — just what has to be done?

Which crystals to change? Determine the type of synthesizer and do the arithmetic. If you have trouble, write me enclosing a copy of the schematic and existing crystal frequencies and one SASE, and I will be glad to help you. Next, order the new crystals and wait, and wait.

What about tuning on SSB? All the SSB rigs have a clarifier control which will move the receiver + or - about 1 kHz. On many of the rigs it also moves the transmitter the same amount. Don't worry if it doesn't move the Tx; it's easy to fix it so it will. What about moving more than 1 kHz? If you can't figure it out, ask one of the unscrupulous CB servicemen who advertize in the personal column of the local newspaper how to put in a slider. This will give you about a 20 kHz spread on each channel. Follow all signal paths on the schematic so you can figure out which circuits will need retuning.

Step 4: The Mod Squad Attacks

For the TRC-47 (and -48), which uses sort of a cross between the 12 and 14 crystal synthesizers, the existing crystals are shown in Table 3.

In this scheme, one crystal from group A is always used, one from group Bu for AM and USB, and one from group B1 for LSB only. The 11.275 is used for AM Tx and for USB. The 11.272 is used for LSB, and the 11.730 for AM Rx only.

Change the group A crystals to: 24.865, 24.915, 24.965, 25.015, 25.065, and 25.115 MHz. The clarifier control is a fairly large variable capacitor of two sections, with a fixed capacitor in parallel with each section. Clip these two fixed capacitors out of the circuit. This now gives you more range on the clarifier, about -1 to +4 kHz. Seeing as how nobody uses LSB on ten meters, remove the two resistors (1 K) which bias the diodes for switching the BFO crystals and short the diode for the USB BFO crystal (11.275). By doing this, when you move the mode switch to LSB the radio stays on USB, but you get a downward frequency shift of about 3 kHz. You now have two 5 kHz wide bands with a 2 kHz overlap for each of the 23 channels. Now retune the bandpass filters at 38 and 27 MHz to 39.6 and 28.6 MHz, peak the receiver front end, peak the transmitter driver and final coils. Do not adjust any of the pots in the transmitter unless you have access to and can use a spectrum analyzer, as this will affect drive level and bias and will affect intermodulation distortion just as much if not more than it will affect power output. The extra one or two dB you can get, just isn't worth the trouble.

Step 5: The Smoke Test

Get in contact with a local ham who can work ten meters, and arrange a sked to make sure that it is working on the frequency you think it is, and while he is transmitting on a known frequency, make sure you can tune him in where you think he should be. Then and only then, try out the transmitter to see if he can hear you. Also have him tune up and down the band to make sure you are only transmitting in one place and the radio has reasonably good audio quality. If you want to use an external speaker on it, be careful how far you advance the audio gain, as these rigs have much more audio than you will probably ever need on receive, as the Rx audio output is also the AM modulator. It will give you up to 5 Watts of audio, enough to wake the silent keys. They usually have resistors in series with the internal speaker to prevent the voice coil from smoking at an early age.

Step 6: Operating it, CQ CQ 10 CQ 10 CQ 10-10, etc.

Generally accepted calling frequencies are 28.600 USB and 28.800 AM, and activity seems to be centered about these, but it's best to check with a local who is active on ten to make sure first. There may be a local net or club using some other frequency

Group A:	23.330	23.380	23.430	23.480	23.530	23.580
Group Bu:	14.910	14.920	14.930	14.950		
Group B1:	14.907	14.917	14.927	14.947		
BFO u:	11.275	**BFO 1:** 11.272	**Rx 2nd mixer for AM only 11.730**			

Table 3.

that you may want. On many of these radios the squelch control works very well, so it's easy to monitor a specific frequency for calls, and have things quiet when there is no signal present, just like two meter FM. Local coverage, both mobile and fixed, seems to be about the same as two meter simplex operation, but more fun when it opens up, which is getting to be more often now that the sunspot cycle is on the upswing again.

Some Notes on Antennae for Ten.

For mobile operation I use one of the four foot long top loaded fiberglass whips with 12 turns removed from the top of the coil. This makes it resonate nicely at about 28.6 MHz. It's only about 1.5 dB down from a full quarter wave, and it's a lot easier to fit into the garage.

At home I use a Radio Shack 5/8 wave ground plane for 11m with the capacity hat removed, but everything else exactly as it comes out of the box and assembled following the directions. Removing the top hat (3 wires) makes it resonate at about 28.5 MHz with an swr of less than 1.4:1, not bad for an antenna which takes only about 15 minutes to assemble and erect.

What About Crystals?

They can be had from any of the manufacturers advertising in the magazine elsewhere, or you just may have some in your junk box. Canadians can order from Lesmith Ltd., PO Box 703, Oakville, Ont., at a price of six dollars per crystal. Delivery of crystals should take 4-6 weeks.

Best of luck, and hope to hear you on ten. If you have any trouble be sure and drop me a line, and I will try to help you out. ■

CB to 10

-- part IV: Johnson 123A mod

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As any fool can plainly see, the transceiver shown in Fig. 1 is a very common, midpriced CB unit. Right? Wrong. This particular E. F. Johnson Messenger 123A started out that way, but a few simple modifications have turned it into a 23 channel, crystal controlled 10 meter amateur rig.

When we were finished with the modification and tuning, we ran a performance check on this unit. Radio frequency output exceeded 3.5 Watts and receiver sensitivity was on the order of 0.5 microvolts for 10 dB signal plus noise/noise. That ain't bad. With the coming increase in sunspot activity, conversions such as this should be good for some very interesting low power DX.

The idea was sparked by the realization that many underpriced CB units were made available when the CB manufacturers began dumping 23 channel units to make room for the 40 channel models. An amateur with only basic skills should be able to buy and convert a 23 channel CB unit to 10 meters for less than $80 – of course, if the unit chosen for conversion is more exotic and costs more to begin with, the total price can be much higher.

Our primary reason for choosing the 123A over other models was simple . . . we had an extra one gathering dust on the shelf. We could have used practically any unit on the market, and so can

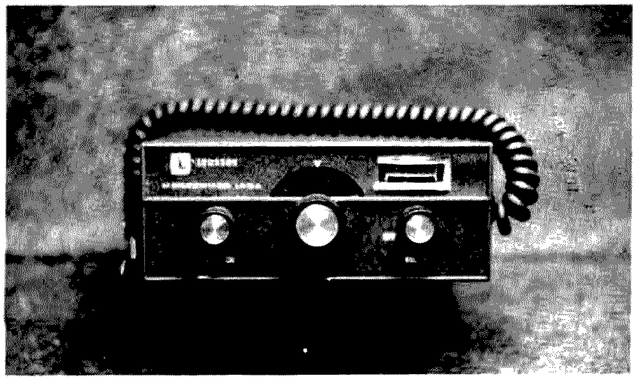

Fig. 1. No, it's not another CB. It's a hot little 10 meter conversion.

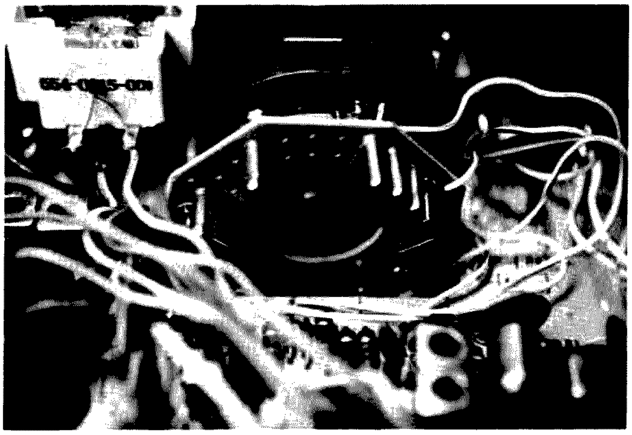

Fig. 2. The crystal bank PCB should be removed for easy access to the crystals.

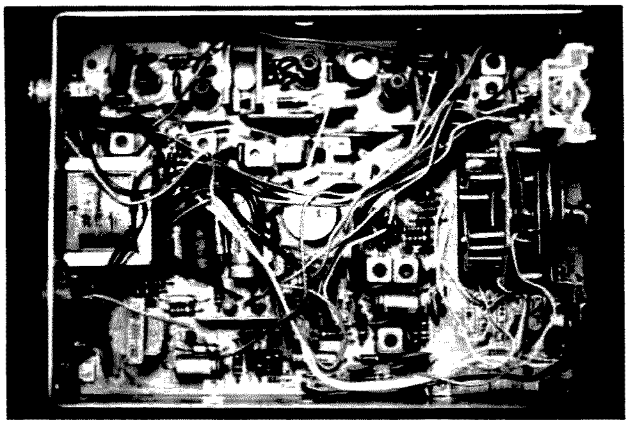

Fig. 3. Interior shot of the 123A showing the transmitter strip at the top.

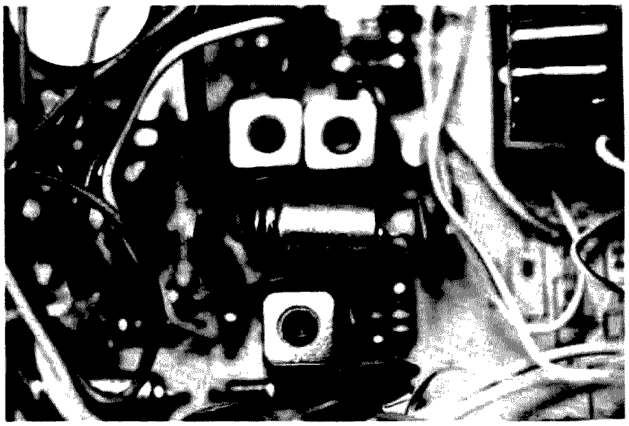

Fig. 4. Detail of the oscillator synthesizer mixer tuning adjustments and test points.

you. However, let's go through this particular conversion step-by-step, since most conversions will differ only in minor details. If you follow what we did here, you should have no trouble with other makes or models.

The 123A is a single-conversion synthesized unit using a channel frequency minus 455 kHz input to the receiver mixer. This is accomplished by mixing the output from a high frequency oscillator with that of a low frequency oscillator and using the difference frequency.

For example, when the unit is tuned to CB channel 1 (26.965 MHz), the high frequency oscillator operates at 32.700 MHz. The low frequency oscillator on channel 1 operates at 6.190 MHz. The difference frequency is 26.510 MHz, which is 0.455 MHz below the channel frequency.

When the unit is switched to the transmit mode – still on channel 1 – the high frequency oscillator continues to operate at 32.700 MHz, but the low frequency oscillator has a 5.735 MHz crystal switched into the circuit and the 6.190 MHz crystal is switched out. This new difference frequency – 26.965 MHz (same as the channel frequency) – is simultaneously switched to the transmitter strip, and the receiver is muted.

While the 123A is a 23 channel unit and only uses 14 crystals in all, each crystal must control several channels. If you start at the lower end of the band (channel 1) and change channels all the way to the top (channel 23), you will find that the high frequency crystals are switched after four consecutive channels and the low frequency crystals are switched for each channel and repeat every fourth channel. Table 1 should make that clearer.

We decided that since we had to start somewhere, a frequency jump of exactly 2 MHz would simplify matters, so that is what we used. It would have been as good from an operating standpoint to shift the low frequency crystals, but for economy we decided that it made much more sense to change only six crystals rather than eight. (Another reason to use the higher oscillator for changes is that low frequency oscillators are sometimes pretty narrow banded. We didn't want to have to change any tuning components if we didn't have to do so.)

By referring to Table 1, you can see that to raise receiver and transmitter frequencies 2 MHz, you simply raise the high frequency oscillator 2 MHz. The new difference frequencies (28.965, etc.) fall into the 10 meter phone band.

We ordered the new crystals and put the unit back on the shelf until they arrived. When they finally got in after several weeks, we took the unit out of the case and began the conversion.

Removing the crystal bank – it surrounds the channel selector switch – in the 123A is a relatively simple matter of taking off the front panel knobs, the four screws which secure the front panel to the chassis, and the two tiny bolts which fasten the crystal bank to the channel selector switch. In Fig. 2 you can see one of the nuts which holds the crystal bank located at the left center of the picture.

When the fiber PCB which holds the crystals is loose, it is a simple matter to remove the high frequency oscillator crystals and replace them with the new crystals. Use a good clean iron for the job in order to minimize damage to the PCB.

When all of the new crystals are soldered in place and the leads trimmed, reassemble the whole mess and you are ready to start tuning.

Tuning can be very simple if you have the right equipment. If you don't, we would suggest that you borrow it. In this case the right equipment is a diddlestick and an rf VTVM.

Look at Fig. 3. Slightly to the right and below center you can see two tiny transformers. Below them you will see one more. The lower transformer sitting all by itself is T7. Transformer T7 tunes the output of the high frequency oscillator.

Fig. 4 is an expanded view of T7 and its associated components. Just to the right of T8 and T9 is transistor Q14, the synthesizer mixer. The output from the high frequency oscillator is coupled through T7 to the emitter of Q14. With the unit in the receive mode, connect the rf probe to the emitter of Q14 and tune T7 for maximum. The reading should be somewhere between 0.5 and 1.0 volts rms of rf. After you have tuned T7 for maximum, switch through all of the channels. If you are measuring the right output, after every four channels the reading will momentarily dip as you switch in another crystal. When you turn the channel selector to the blank space between channels 22 and 23, the reading should go to zilch In this unit, as in many others, the channel selector switch has a cutout to prevent operation in this position. (It used to be called channel 22a, 27.235 MHz, which was illegal under the old CB rules.)

After you are satisfied that the oscillator is working properly, move the rf probe to the diodes to the left of the filter capacitor directly above T7. The cathodes of these two diodes are connected, and this is your next test point. Tune T8 and T9 for maximum at this point. You may have to go back and touch up T7 as you load it by tuning T8 and T9.

If you get something between 0.3 and 0.5 volts rf at this test point, it is downhill all the way from here. If not, go back and start over again at T7.

In Fig. 3 you can see two small transformers above the channel selector. These are T10 and T11. To tune them, connect the rf probe to the collector of rf pre-driver Q15 (in Fig. 3 Q15 is obscured by the mike cord, but it is the first transistor in the transmitter strip and is close to T10/T1). When the probe is connected, connect a dummy load to the rf output of the unit and key the mike. The rf output measured on the collector of Q15 should be several volts. If you have it, move the probe to the next transistor in the transmitter strip and tune each stage for maximum before going on to the next. By this time, you should have a Watt or two of rf at the transmitter's output, and you can complete tuning with a wattmeter if you have one – and you either do or have a friend who does.

Before you do any receiver tuning, complete the transmitter tuning. When you are finished, you should have 3.0 Watts or more at 13.6 volts dc input. Transformers T10/T11 may need to be stagger-tuned to optimize output on all channels. All other transmitter tuning should be done at or near the center of the band (channel 12 or 13). After you have maximum output, whistle into the mike. The wattmeter will probably kick down. If you have tuned to maximum, you may be showing as much as 5.0 Watts of output. The 123A will usually not modulate that much power fully and transmitter tuning should be touched up a little.

Between the rf final amplifier and the output connection you can see two tuning coils. After the unit has been tuned to maximum, insert a diddlestick into the coil nearest the final amplifier. Using short whistles, turn the slug clockwise into the coil until the wattmeter begins to kick up slightly on the peaks. Then go to the last tuning coil and retune it for maximum output. Do this back and forth until you have the maximum output which will allow the wattmeter to show a slight kick upwards on peaks. If this point happens to be in excess of 5 Watts, fine. If it is less – and it probably will be – that's okay too. In any event, that point is where the unit should operate for cleanest, best modulated output.

Now you are ready to tune the receiver section. Assuming that the unit was working properly on CB frequencies, you have only two minor adjustments to make.

Look at Fig. 3 again. Directly below and parallel to the transmitter strip is the receiver rf and i-f strip. Don't disturb any adjustments except those of the two cans closest to the rear of the chassis. The can sitting by itself near the modulation transformer is T1, the receiver rf input tuning. The next can in the line is the mixer input tuning, T2. There are two easy ways of tuning these two cans.

If you have a stable signal source and can be certain that it is on frequency, set it for 29.085 MHz (new channel 11-10m), couple it to the transceiver and tune for maximum output or S-meter reading.

The other way is to connect the unit to an antenna which exhibits a low vswr on 10 meters and tune for maximum noise. Normal precautions against tuning to an image frequency should be observed. As a general rule, if you tune to the first peak that you come to from the original positions, you will be right on the money the first time. Measure the output frequencies with a counter, check it out with a friend across town, and you are on the air. Total time involved? A couple of hours.

In our prototype unit, we noticed only one unusual item. On channel 4-10m (you have to call them something), we have a relatively strong received signal present even when the antenna is not connected. Since we have 22 other channels to use, we decided to forget it and not go looking for spurs. The same problem may or may not show up on your conversion.

As mentioned before, we chose this unit simply because we had it. If you have another make or model, your conversion may be a little harder. If the crystals are of the plug-in type, the conversion may be easier. When you begin to tune the unit, take it one step at the time. Few if any CB units will operate at a new frequency without careful retuning.

The 2 MHz jump seems to be a good idea to us. Channelization means that mobile operation is simple and fiddle-proof. As a suggestion, it seems to us that channel 1-10m (29.965 MHz) would be a good calling channel. If everyone who makes a +2 MHz conversion monitors this channel as the band opens this summer and fall, there should be a good chance of making contacts. If everyone jumps around all over the band, the chances go way down. Be seeing you on 10. ■

CHANNEL	HF CRYSTAL	RECEIVE LF CRYSTAL	RECEIVE OUTPUT	TRANSMIT LF CRYSTAL	TRANSMIT OUTPUT
1	32.700	6.190	26.510	5.735	26.965
2	32.700	6.180	26.520	5.725	26.975
3	32.700	6.170	26.530	5.715	26.985
4	32.700	6.150	26.550	5.695	27.005
5	32.750	6.190	26.560	5.735	27.015
6	32.750	6.180	26.570	5.725	27.025
7	32.750	6.170	26.580	5.715	27.035
8	32.750	6.150	26.600	5.695	27.055
9	32.800	6.190	26.610	5.735	27.065
10	32.800	6.180	26.620	5.725	27.075
11	32.800	6.170	26.630	5.715	27.085
12	32.800	6.150	26.650	5.695	27.105
13	32.850	6.190	26.660	5.735	27.115
14	32.850	6.180	26.670	5.725	27.125
15	32.850	6.170	26.680	5.715	27.135
16	32.850	6.150	26.700	5.695	27.155
17	32.900	6.190	26.710	5.735	27.165
18	32.900	6.180	26.720	5.725	27.175
19	32.900	6.170	26.730	5.715	27.185
20	32.900	6.150	26.750	5.695	27.205
21	32.950	6.190	26.760	5.735	27.215
22	32.950	6.180	26.770	5.725	27.225
23	32.950	6.150	26.800	5.695	27.255

Table 1. Synthesizer scheme. If 2 MHz is added to each frequency in the HF Crystal column, the Receive output and Transmitter output also increase by 2 MHz. NOTE: All frequencies in MHz.

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CB to 10

-- part V:

converting the Hy-Gain 670B

As a result of the recent dump of 23 channel Citizens Band radios on the market in anticipation of a big push for the new 40 channel units, there are many 23 channel units at real bargain prices. I paid $40.00 for the one I purchased, a Hy-Gain 670B (Hy-range I). The radio that I bought lends itself very handily to conversion to the 10 meter ham band. The Hy-range I is a 23 channel, synthesized, 4 Watt output, AM radio. If you choose another type radio make sure you get one that uses crystals, not phase locked loop. The newer types with the synthesizer lend themselves to conversion better than the older types that use one crystal for transmit and one for receive. With the newer units you get a lot more useable channels for a lot less cost.

Looking at the schematic that came with the radio, I located the bandswitch and the oscillator crystals were next to it. The Hy-Gain schematic has a chart that shows the crystals required to synthesize the unit. What you want to do is to change the smallest number of crystals possible due to the cost factor. I decided to use the 4 crystals in the 14 MHz oscillator section and leave the 23 MHz section alone as it contains 6 crystals. It may be possible to change only the offset oscillator crystals, in this case, 11.275 and 11.730 MHz. I did not try this as I believed that the coils in the front end of the receiver and in the transmitter would probably tune the proper range without modification. This proved correct. The i-f section may or may not tune. I'll leave that to someone else to try together with the chance of blowing the price of a couple of crystals.

The crystal needed for the Hy-Gain is determined as follows: Channel 1 is to be 29.000 MHz. The 23 MHz oscillator frequency is subtracted from 29.000 MHz. Then the offset oscillator frequency of 11.730 MHz is added to that figure giving the required frequency, in this case 17.440 MHz.

With one crystal then, I set my radio up on 6 channels which came out this way:

Channel 1 . . . 29.000 MHz
Channel 5 . . . 29.050 MHz
Channel 9 . . . 29.100 MHz
Channel 13 . . . 29.150 MHz
Channel 18 . . . 29.210 MHz
Channel 22 . . . 29.260 MHz

I felt that 6 channels were enough to start off with. The other channels will no longer transmit after the coils have been retuned, thus any possibility of transmission of unwanted frequencies will be avoided in case the channel selector happens to get off on a channel that is not set up on 10 meters.

In order to make it simple to keep track of what frequencies are combining to form the desired frequencies, I made up a chart giving all of the frequencies involved.

When you order a crystal, be sure and give all the in-

Channel	11 Meters	10 Meters	23 MHz	Old 14 MHz	New 17 MHz
1	26.965	29.000	23.290	14.950	17.440
2	26.975	29.010	23.290	14.960	17.450
3	26.985	29.020	23.290	14.970	17.460
4	27.005	29.040	23.290	14.990	17.480
5	27.015	29.050	23.340	14.950	17.440
6	27.025	29.060	23.340	14.960	17.450
7	27.035	29.070	23.340	14.970	17.460
8	27.055	29.090	23.340	14.990	17.480
9	27.065	29.100	23.390	14.950	17.440
10	27.075	29.110	23.390	14.960	17.450
11	27.085	29.120	23.390	14.970	17.460
12	27.105	29.140	23.390	14.990	17.480
13	27.115	29.150	23.440	14.950	17.440
14	27.125	29.160	23.440	14.960	17.450
15	27.135	29.170	23.440	14.970	17.460
16	27.155	29.190	23.440	14.990	17.480
17	27.165	29.200	23.490	14.950	17.440
18	27.175	29.210	23.490	14.960	17.450
19	27.185	29.220	23.490	14.970	17.460
20	27.205	29.240	23.490	14.990	17.480
21	27.215	29.250	23.540	14.950	17.440
22	27.225	29.260	23.540	14.960	17.450
23	27.255	29.290	23.640	14.990	17.480

Fig. 1.

formation on your radio along with the frequency wanted. The Hy-Gain takes a 4342743 CS 26C 47 pF (International Crystal Co.).

Conversion

After taking the covers off, locate the 14 MHz oscillator section. This is the 4 crystals grouped together with their designation printed on the chassis. Locate X7 (14.950 MHz) and unsolder. Replace it with the 17.440 MHz crystal. Tune L2 and L3 down two full turns. Also tune L4 and L5 down two full turns. By now you should be seeing some output on a wattmeter or use the meter on the front of the radio. Tune the pre-drivers, driver and rf power amplifier for maximum output, in my case I easily got 6 Watts. It is important to tune L2 and L3, L4 and L5 in or down in the coil so that the synthesizer will end up with the sum (40.730 MHz) rather than the difference as I did at first.

For the receiver section, the coils to be tuned down two turns are L10 and L11. L12, L13, and L14 go only about one turn down. Using an external signal source on 29.000 MHz, apply a signal until the S-meter gives an indication, then peak the coils for maximum. The final sensitivity was as good as the manufacturer's specifications on the 27 MHz band.

The possibilities are numerous that these converted units can be put to. Inexpensive walkie-talkies can be converted. How about hidden transmitter hunts? CB antennas can be easily converted by reducing the length a couple of inches. The radio only draws about 100 mils when in a squelched condition, so it could be left on in order to catch band openings or local calls. So how about it fellows? Let's use all that space on 10 meters! Will be monitoring Channel 1 . . . (29.000 MHz) . . . see you on 10! ■

Harry J. Miller
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Sarasota FL 33580

World's Smallest Continuity Tester

-- it's almost minute

Using a rubber-type two-pronged plug, the few components that make up this tester are mounted inside the plug. The hole in the end of the plug through which the cord enters is used for the NE-2 neon bulb.

Two small holes opposite each other are made near the base of the plug for the probe wires to extend, and the two 100k, ½ Watt resistors within the plug cavity, being in series with the probe cords, prevent shock. A piece of 5/8 inch i.d. aluminum tubing ½ inch long, placed over the bulb end of the plug, with a 5/8 inch o.d. clear plastic lens pressed into the tube, protects the bulb and enhances the appearance of the miniscule tester. Make the probe wires long enough to suit your needs. ■

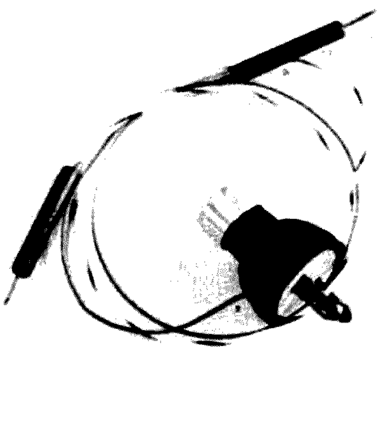


Fig. 1.

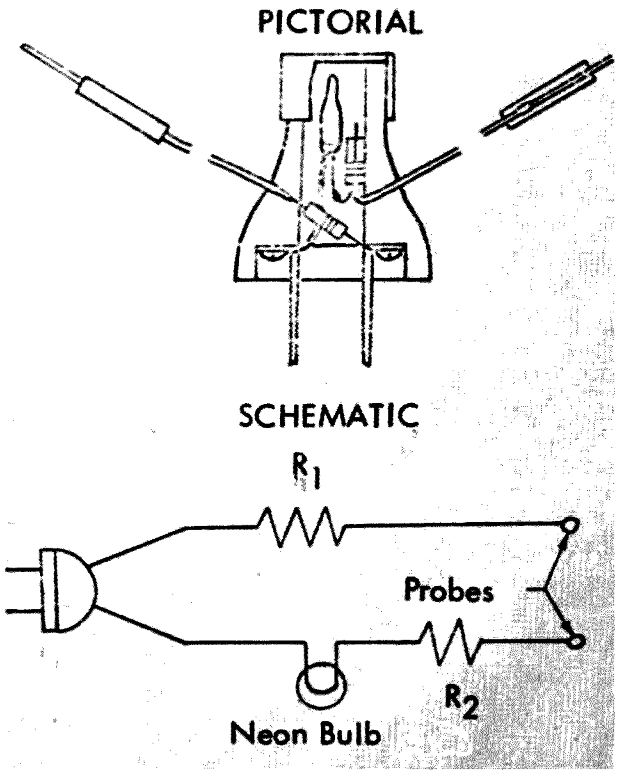


Fig. 2.

New Products

from page 38

VHF ENGINEERING PROFILE

Most hams into VHF experimenting are familiar with VHF Engineering products. The ubiquitous "RX" and "TX" receiver/transmitter strips have probably been responsible for getting more amateurs on VHF FM than any other series of products. VHF Engineering is an amateur success story.

The company was founded in a basement by Robert Brown W2EDN early in 1972. Brown's philosophy was based upon mass buying of components: Why not provide an inexpensive kit whose parts individually purchased would otherwise be overly expensive? The idea worked, and the small company soon expanded. To date, over 10,000 TX transmitter kits have been sold. An original product line of three devices has expanded to over 130.

VHF Engineering is now located on Water Street in Binghamton NY, the former site of McIntosh Labs, a manufacturer of quality high-fidelity gear. Most of VHF's business is amateur-related (about 70%), although the company also has military and civil contracts. Brown and Marv Druskoff K2VIV have designed most of the company's products. All of the pre-built VHF products are hand soldered and tested, as the company is not involved in high volume production. The company is actually a subsidiary of Brownian Electronics Corp., which is owned by Brown and William Kupfrian. They are presently projecting sales of over $1 million in the near future.

A look at VHF's product line will provide an insight into Brownian's success. The popular receiver and transmitter strips are multi-purpose devices that are the basis for many other products. The TX and RX strips are available for all VHF bands, and are also used in the company's handheld transceivers and repeaters. Those repeaters are another story! VHF Engineering can provide complete repeater installations or any part of one, based upon customer requirements. Each module is available as a kit or pre-assembled, allowing complete flexibility in designing individual stations. The experience gained in repeater design has been valuable, as Brownian plans upon entering the two-way commercial marketplace in the future.

The product line also contains a wide range of power supplies and VHF/UHF power amplifiers, along with the most recent addition, a digital frequency synthesizer. The "building-block" concept allows the ham to select whatever components fit his operating environment, all the way from power supply to final amplifier. VHF's latest line of power amplifiers is the Blue Line series, which are designed for high power UHF applications. Of course, the amplifier can be driven by a VHF Engineering TX strip! VHF also provides a complete line of accessories such as crystal decks, tone encoders, and cables.

Many hams would probably not be on the VHF bands had it not been for Brown's basement operation. The company is constantly expanding, and only time will tell what new devices from Binghamton will arise to excite today's VHF/UHF amateur.

John Molnar WA3ETD
Executive Editor

NEW WIRE DISPENSER ALSO CUTS AND STRIPS

The new WD series wire dispenser features unique cutting and stripping capability. Wire is drawn out of dispenser to the required length. Then, a built-in plunger cuts the length free from the roll, while a gentle pull through the stripping blade removes the insulation without nicking the wire. Repeating procedure removes insulation from second end. Although designed particularly for wire-wrapping, the inexpensive dispenser is ideal for many applications. The dispenser includes a 50 ft. (15m) roll of AWG 30 (0.25mm), top industrial quality, Kynar™-insulated, OFHC silver-plated solid copper wire. Insulation is offered in blue, white, yellow or red. Available from your local electronics distributor or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

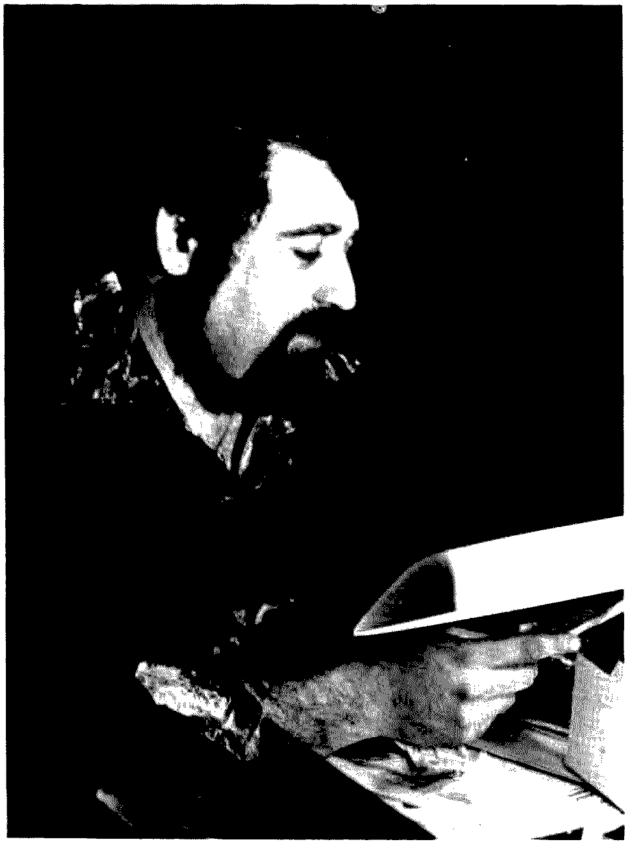
NEW CATALOG COVERS LIGHT EMITTING DIODE (LED) DISPLAYS

National Semiconductor has prepared a full-color short form catalog detailing its complete line of optoelectronic products. The catalog contains photographs, outline drawings, and specifications of National's red, yellow, and green light emitting diode (LED) lamps, large area (0.3", 0.5" and 0.7" high) multi-digit numeric displays, small calculator-type numeric arrays, and watch display die. *National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara CA 95051.*

NEW CONTINENTAL SPECIALTIES CATALOG

Continental Specialties Corporation, manufacturers of breadboarding and test equipment for the professional and hobbyist, announces the release of their new 1977 catalog. This 16-page catalog features the complete line of Continental Specialties QT sockets, proto-clips, protoboards, logic probes, logic monitors and design mates, and introduces the new Experimentor sockets.

Catalogs are available from — *Continental Specialties Corporation, 44 Kendall Street, PO Box 1942, New Haven CT 06509.*



Marv Druskoff K2VIV.

Bob Brown W2EDN.

James Eagleson WB6JNN
280 Manfre Rd.
Watsonville CA 95076

Open New Frontiers!

-- VHF sideband

I heard some "lowbanders" (HF types) chatting away the other day about some "crazy VHFer in Santa Cruz" (not me, by the way) who claimed to work Los Angeles, Fresno, and the like . . . even some mobiles out to about 150 miles on *two meters*!

The other fellow said, "Ah, sure. It's them repeaters, you know."

"Nope," replied the first. "This guy was using one of those little three Watt rice box rigs on *sideband direct* . . . not on any repeater, so he *says*!"

"Oh," replied number two. "Well, everyone knows those VHF SSB types are liars!"

Where's the Fun Gone?

I'm not so old and I haven't been in ham radio for much more than a dozen years, but it seems that some of the fun has gone out of the hobby for many people. Maybe it's because of the loss of so much of the "new blood" to CB, leaving us devoid of the enthusiasm generated by newcomers to the hobby. Maybe it's because of the rich man's war that has made 20 and 40 meter beams and kilowatts *required* equipment nowadays rather than luxuries. Maybe it's because unless you really dig CW (which can be operated with a minimum of cash outlay) or really like to stand in line on the local repeater for 25 minutes in order to get your *very own* three minutes (down to one minute on some machines around here), then you're either going to have to lay out a few kilobucks for gear or buy some ancient metal monster that's *already* been used for a boat anchor. The latter is not any more likely to make "brownie points" with the wife than the former!

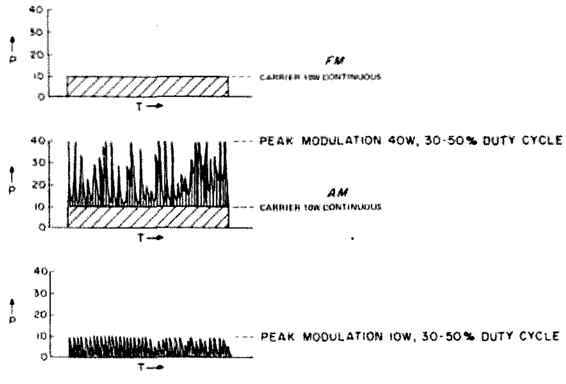


Fig. 1. Average power.

Frankly, when I got back on two meters after a few years' absence due to higher education, I wasn't enthralled by what I heard. True, to each his own, but I couldn't quite relate to tone bursts and 25 minute waiting lines on the local repeaters. I also balked at the four page lists of "dos" and "don'ts" that were being handed out by some repeater groups. Of course, the $20 initiation fee and $10 yearly assessment was a bit beyond my meager student income, too. So I stuck to the small but still active group of AMers left on the band.

Unfortunately, when I moved from the Bay Area to Santa Cruz, the 3000 foot mountains put a real dent in my signal. Though I could hear the boys across the hills on my receiver/converter combination, they had trouble picking me out of the noise on their Communicators and the like. If only those two meter AM rigs modulated like CB sets, had noise limiters, and good sensitivity!

At the time, two meter SSB was a once-a-week, Tuesday night net thing with about 15 active stations. However, I found a two meter single sideband transceiver (so it said on the label) made by Belcom so I put the thing on the air and made some noise! Having worked all the then-active SF Bay Area stations and finding the rig a nice package, I took it up to the SRI VHF/UHF Society meeting to a show-and-tell session and showed it off. Bruce Clark K6JYO scanned it with interest and shot off for home shortly after the meeting so that he could work me mobile all the way home to Santa Cruz . . . some 45 miles through those 3000 foot mountains. After this successful test, Bruce got KLM interested in the unit and the rest is history!

Why Single Sideband?

This isn't a question that's asked on the HF bands much any more, where sideband's advantages in a crowded band and for DX are obvious. On VHF there are fewer people who have been exposed to its advantages.

Single sideband has the same advantages on VHF that it has on the HF bands. It requires low average power drain for a given effective power, extends PA life and reduces heat sink requirements due to lower *average* power dissipation, reduces multipath and phase distortion, increases potential sensitivity by reducing required bandwidth, allows break-in operation, and provides excellent weak signal recovery.

These last two features have been responsible for the increase in medium range "DX" contacts on two meters in recent years. With increased activity, weak signals are often heard between syllables during a local QSO (something not possible with FM), and though the signal may not be copyable, with SSB *something* can be heard

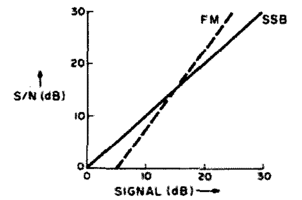


Fig. 2. Weak signal effectiveness. FM s/n is better than SSB above *10 dB s/n, but SSB is superior on weak signals below 10 dB s/n. This makes SSB better able to find and copy weak DX stations.*

and beams be brought around to peak up the station – or the old VHF wait-for-the peak game can begin.

Sideband Working Distance

In everyday terms, sideband extends the radio horizon 50% to 100%. In hilly terrain where multipath is a problem, sideband's advantage over FM can be even greater than 100%!

Here in hilly California, repeaters have a typical working range of 50-150 miles radius. Ten Watt sideband stations typically run equal range *and better* with higher powered stations (50-150 W), getting frequent contacts out to three or four hundred miles.

It is not uncommon, for example, for Santa Clara Valley stations running 10-20 W to work into Los Angeles on a good night. Well located, high powered stations like Mike Stahl of KLM or Jay Shaffer W6BWB can work LA and San Diego almost any time of day or night!

Special Modes

In addition to regular point-to-point communication, there *is* one repeater on two meters (though sidebanders prefer the term "translator") that is used quite extensively throughout the United States. It has a beautiful location about 1000 *miles* above sea level and has a working radius of some *2500 miles*! Oscar VI and more recently Oscar VII provide a fascinating means of SSB and CW contacts for anyone with a Technician class license or higher.

From the East Coast, Britain and Western Europe can be worked via Oscar. Canada and Mexico, Central and parts of South America can be worked throughout the U.S. Japan and the Pacific are available to West Coast hams.

Getting Started

There are several approaches to VHF SSB. The easiest for the HF operator with a rig having a low power transverter output is to buy the transverter made for his rig.

Those who prefer not to tie up their HF rig when they get on VHF SSB may prefer one of the separate transceivers available.

Those who already operate two meter FM may want to trade up to one of the AM/FM/SSB/CW multimode rigs now available.

The following listing gives a brief overview of what's available, including some general remarks about the strengths and weaknesses of each rig.

THE KLM ECHO II

The KLM Echo II was the first two meter transceiver available (discounting the Gonset Sidewinder from several years back). It is totally solid state and runs off 11-15 V dc (no built-in ac supply). It is conveniently mobile, measuring only 2.5 x 8.5 x 10 inches, and has squelch (the only unit that does on SSB), an effective noise blanker, and excellent stability (crystal control with a VXO and RIT).

Specifications

Sensitivity: under .18 uV typical*;
Selectivity: 2.1 kHz @ 6 dB, 4.2 kHz @ 50 dB typical*;
Af Output: 3 W into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP typical @ -22 dB 3rd order distortion*;
Spurious: -55 dB typical*;
Harmonics: -60 dB typical*;
Af Response: 150-2250 Hz typical*;
Features: S/RFO meter, Crystalplexed synthesizer with VXO (±6 kHz) and RIT (±2.5 kHz receive only), squelch, noise blanker, ALC, vswr protection, semi break-in CW, bandswitch (up to 5 bands, 230 kHz each with 145-145.23 and 145.77-146 included), ext. key for linear, ext. spkr. jack, upper and lower sideband mod kit (for Oscar VII downlink), and accessory FET preamp (improves AGC action and gives .08 uV/12 dB SINAD or better);
Price: $390.

***Values marked with an asterisk are units that I have tested or had dealings with. Sensitivity = 12 dB SINAD. Tx IMD *referenced* to *each* tone. Spurs and harmonics references to PEP output.**

Pluses and Minuses

On the plus side, the Echo II is easy to service, has plenty of room available for modifications, and costs less than the multi-mode rigs. The only other SSB-only rig is only 3 W PEP and isn't easily modified for lower sideband for Oscar reception. The VXO allows good frequency control and resettability, so that finding frequencies for skeds is easy. Given two Echo IIs, if each moves up 30 kHz (three channels) they will end up within 100 Hz of each other. This is great for mobile where QSYing can be safely done by merely counting one channel for each 10 kHz *without looking* at the dial.

The major drawback with the receiver is the lack of AGC below 1 uV. This is quite bothersome when working strong locals with weak DX. The KLM preamp helps with this, as do other mods.

The transmitter is frequently accused of being "muffled" or "bassy." This can be helped by tuning the BFO frequency until a 400 Hz tone in the mike input drops to ½ W from a starting level of 2 W (6 dB). Of course, this drops the CW output quite a bit as well. Another approach is to find a mike with a natural roll-off below 1 kHz. (Note: A D-104 *doesn't* work unless its high output is transformer-coupled to the 500 Ohm Echo II input.)

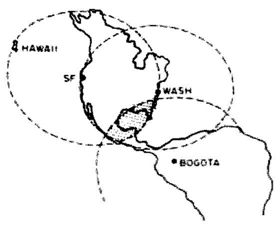


Fig. 3. Oscar working radios. Overlapping areas can work each other.

THE ICOM IC-202

The Icom IC-202 is SSB only. It is a "walkie-talkie" similiar in size to the TR-22 FM rig. About 2.5 x 6.5 x 7.5 inches, it has a built-in whip antenna in addition to its normal output jack. The unit covers 200 kHz with a VXO multiplied up from 14 MHz and calibrated in 5 kHz increments. There are positions for four crystals, with 144.0 and 144.2 MHz standard. Why Icom doesn't make 145 MHz one of the standard crystals, I have no idea, considering that it would about *double* their potential customers by adding the Technicians.

The receiver works quite well with a MOSFET/JFET front end which gives 70 dB intermod and crossmod rejection. AGC is reasonable . . . about 15 dB change from .3 uV to 1000 uV input change. Provision is made for an external VFO, although none is presently available.

Specifications

Sensitivity: under .125uV typical*;
Selectivity: 2.4 kHz/4.8 kHz (6 dB/60 dB), 70 dB ultimate;
Af Output: 1.0 Watt @ 10 THD into 4 Ohms*;
Rf Output: 3.2 W PEP typical @ -30 dB 3rd order distortion*;
Spurious: -60 dB or better (most below 70 dB*);
Harmonics: -60 dB or better;

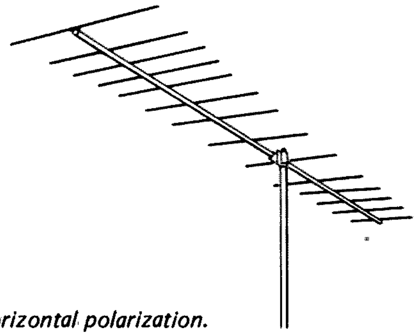


Fig. 4. Horizontal polarization.

Af Response: 500-2900 Hz typical*;
Features: S/RFO meter, 200 kHz VXO calibrated in 5 kHz steps, noise blanker, ALC, RIT with center off detent, CW/SSB switch, bandswitch (four bands, 144.0, 144.2 included), external speaker jack, VFO input jack, built-in battery compartment (uses nine "C" cells), carrying strap, pilot light/panel light on/off switch (to conserve power on batteries), built-in whip antenna;
Price: $280.

The **Good**, the Bad, and ...

The IC-202 comes with a very good, large size schematic in spite of the 202's small size. It is extremely portable and fun to take on trips or mountaintopping. Numerous 202s have shown up on the air in the Monterey Bay Area and San Francisco Bay Area while their owners were on vacation or on business in the area. It also is a natural for emergency and public service operation. The unit's range varies depending on terrain and location, but normally has good signals over 5-10 miles with marginal results as far as 25-30 miles. Mountaintoppers can expect 100 miles easy with the built-in whip — and more with a beam.

The 202's receiver is remarkably free from spurious, crossmod, and intermodulation problems. Under some conditions, the noise blanker will cause cross modulation by very strong in-band stations. Most of the time it does not, though. Its sensitivity is about what is needed for a 3 Watt rig, but can be improved. I suggest using a preamp of the FET type (*not* MOSFET), with about 10-15 dB gain mounted in the power amplifier box if one is added later. The J-310 or U-310 (Siliconix) are popular on the West Coast for this.

All 202s have a slight drift problem, especially if cheaper US crystals are used in the VXO. Some retuning in any ten minute period is often required, but it is by no means as bad as what we used to put up with on 2m AM several years back. Checks in the lab show about 500 Hz drift over a temperature range of -30 to +50 degrees Centigrade. Normal variations can then be expected to be 100-200 Hz at room temperature. (By the way, if your shack has the kind of temperature range we used in the lab, I suggest you install a heater in the place!)

The 1 Watt audio output is adequate for most applications. However, in noisier vehicles like my VW bus, the af output is marginal. A well placed external speaker would probably help.

The size of the IC-202 is both a blessing and a curse. Of course, it makes it very convenient for mobile operation, but it also makes it difficult to service or modify. This is why I suggest putting any preamps in the power amplifier instead of trying to put it inside. It also makes it difficult (probably impractical) to put lower sideband into the 202.

THE KENWOOD TV-502

The first transverter that became apparent on the market in the recent sideband boom was the Kenwood TV-502. It covers 144-146 in two bands, with the 144-145.7 range included normally (converting from 28.0-29.7 MHz). The transmitting section seems to be very clean sounding and puts out around 8 W PEP. The receiving converter lacks gain and noise figure, so that its sensitivity is only around .5 uV; an additional preamp is almost always necessary. There *is* room to build the preamp inside the unit. The 502 matches the Kenwood HF line, of course. Price class ... $260.00.

YAESU

Yaesu also makes a transverter for their equipment, but none has shown up in this area as yet. Little information (specs, price, etc.) is given in the ads by Yaesu, but performance equivalent to the Kenwood seems likely, with a price to match. It seems that there is little effort on Yaesu's part to promote this unit, as they don't tell enough about it to get anyone interested in it!

THE EUROPA B

A different approach can be seen in the Europa B transverter ads. Through small ads by a small company, I can learn that the unit uses 5894s in the final with about 80 W PEP output, interfaces with the Yaesu line with no external power required, is 9 x 4-3/4 x 4-1/2 inches, has MOSFETs in the converter section, and requires about 100 mW of drive. It costs $299 ($279 without tubes).

THE KLM MULTI-2000

An early comer to two meter SSB was the ITC Multi-2000. Unfortunately, the small size of the importing company did not result in good enough quality control, and numbers of these multimode, synthesized rigs got out to the field with out-of-band spurs only 25-35 dB down! The FAA got upset, since these were falling on aviation frequencies, and the FCC "respectfully requested" some changes. Well, KLM was the change that came about. They bought out ITC's franchise for the Multi (made by FDK of Japan) and bought an HP Spectrum Analyzer so that *each unit* could be checked before going out. They also sent a test unit to the FCC, which gave it a clean bill of health. So now the Multi-2000 is one of the four multimode rigs on the market.

Specifications
Sensitivity: .1 uV typical (less if peaked for 1 MHz of the band)*;
Selectivity: 2.4 kHz;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: around 10 W PEP;
Spurious: -55 to -60 dB or better;
Harmonics: -60 dB or better;
Af Response: 300-2700 Hz;
Features: S/RFO meter, digital synthesizer with 10 kHz steps across the entire 2m band, VXO (±10 kHz), RIT (±5 kHz), noise blanker, ALC, CW/AM/FM/SSB, upper and lower SSB, ext. key for linear, ext. spkr. jack, wideband and narrowband FM, 600 kHz up or down or simplex, three crystal channels, FM squelch, FM 1 W or 10 W position, rf gain control, ac and dc power supplies built in.

Strengths and Weaknesses

Unlike the other multimode rigs, the Multi-2000 features a PLL synthesized 10 kHz step frequency control, which makes frequency setting for FM (and SSB, for that matter) very easy. Each click is ten kHz, making mobile operation safer by not requiring the operator to tune by a meter or VFO, etc. Of course, there are times when the VFO is better, as when operating SSB. However, the VXO and RIT allow good flexibility here, too.

The Multi's AGC has had some problems according to some users. It's not as bad as

the Echo II, but perhaps not quite as good as the FT-221 or TS-700. I get an impression from off-the-air comments that the difference is slight, however.

As previously mentioned, the early Multi's had out-of-band spurious problems with a vengeance. This has been cured by KLM's quality control.

Some feel that the Multi-2000's transmit audio is not quite as good as the other multimode units. While I agree that it usually does not sound as "hi-fi," I think that I have heard about as many FT-221s and TS-700s with bad audio as Multi's. A *good* 221 or 700 sounds very good, but a bad one sounds really bad.

THE KLM MULTI-2700

Another entry in the multimode market is the KLM Multi-2700. This rig has a stiff $800 price tag, but it has some unique features, too. These include a VFO *or* PLL 10 kHz per step synthesizer, converter built in to receive the 10m Oscar downlink with reception tracking the two meter transmitter, VOX, LED readout, and user programmable FM repeater splits in addition to the normal ±600 kHz splits.

Specifications
Sensitivity: .1 uV;
Selectivity: 2.4 kHz;
Af Output: 2 W into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP (10 W or 1 W FM);
Spurious: -60 dB or better;
Harmonics: -60 dB or better;
Af Response: 400-2800 Hz;
Features: S/RFO meter, PLL 10 kHz step synthesizer *or* VFO, VXO, RIT, CW/FM/SSB, upper and lower SSB, noise blanker, ALC, ext. key for linear, ext. spkr. jack, FM squelch, built-in ac and dc supply (incl. 220 V European standard with 115 V ac and 14 V dc), space for 50 MHz or 432 MHz converters, LED readout, tracking converter for Oscar 10m downlink (but cannot receive while transmitting), 600 kHz up/down split or user programmed, built-in VOX.

As this unit is barely introduced as I write this, little is known of its performance. Listening to this unit, I noted that it is clean, but not "hi-fi." The Oscar feature is nice. One drawback is that the 10m downlink can't be monitored while transmitting, since the unit is a transceiver having a common i-f. The RIT can be used to approximate the Doppler shift, but this is imprecise, to put it mildly! It is still quite usable in this mode, even if not as convenient as a separate receiver.

THE YAESU FT-221

As soon as it hit the market, the FT-221 was a success. By preceding the TS-700 by a few weeks and by being more readily available in stock early in the game, the 221 has enjoyed a great deal more popularity in *this* area than the TS-700. One frequently mentioned reason is the modularized construction the rig sports. Cosmetic-wise, the two are essentially similar, but the 221 has its circuits on vertically-mounted cards, providing good isolation and ease of replacement. The theory goes that service is easier, too. If you happen to have a substitute board, I suppose this is true, but unless you have extender boards (not supplied), service of a "live" circuit is out of the question! So, it's six-of-one-and-half-a-dozen-of-the-other.

Specifications
Sensitivity: .2 uV or less on SSB;
Selectivity: 2.4 kHz/4.1 kHz 6/60 dB;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: 12 W PEP nominal (14-16 W typical, 18 W on FM);
Spurious: -60 dB;
Harmonics: -60 dB;
Af Response: 300-2700 Hz;
Features: S/RFO/FM tuning meter, phase locked VFO covering all of two meters in 500 kHz bands, 1 kHz readout, AM (2 W), FM, CW, SSB, upper and lower SSB, noise blanker, ALC, ext. spkr. jack, FM squelch, ac and dc power supplies, tx/rx or rx only clarifier.

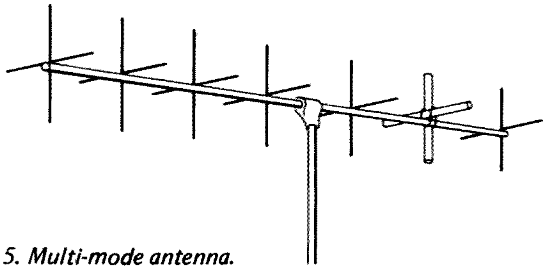


Fig. 5. Multi-mode antenna.

Bouquets and Brickbats

The only real problem that has been noted on the FT-221 is that the gain setting for FM and SSB on the mike gain control is not the same. With normal FM mike gains, SSB tends to overdo it a bit, causing distortion. Since this level is front panel controlled, no problem should exist once proper levels are established for the two modes.

Even with proper settings, some FT-221s have bassy and mushy audio. Most units are very clean and good sounding, but *some* have this problem.

Some 221s have lacked sensitivity. Most are good, but *some* seem to get through Yaesu's quality control department.

On the plus side, most 221 owners are quite happy with the units on both SSB and FM. Good ones sound *very good*.

THE KENWOOD TS-700A

Kenwood's TS-700A is similar in function and performance to the FT-221. It also features full coverage of two meters in 500 kHz segments (VFO) and has AM/FM/SSB/CW. Styling is also similar. One notable difference is that the 700 has final load and drive controls, making its operation less "hands-off" than the Multi-2000 or FT-221. I'm told by users that these controls are very broad, requiring little adjustment over a given band segment, however.

Specifications
Sensitivity: .1 uV/12 dB SINAD;
Selectivity: 2.4 kHz/4.8 kHz @ 6/60 dB;
Af Output: 2 Watts into 4 Ohms @ 10% THD;
Rf Output: 10 W PEP, 3 W AM;
Spurious: -60 dB;
Harmonics: -60 dB;
Af Response: 400-2600 Hz (published);
Features: S/RFO meter, FM tuning meter, PLL VFO in 500 kHz bands across 144-148 MHz, 1 kHz readout, AM/FM/SSB/CW, upper and lower SSB, noise blanker, ALC, ext. spkr. jack, FM squelch, built-in ac/dc power supply tx/rx or rx only clarifier;
Price: Around $700.

Ups and Downs

Most sound very good on the air, with a resonant "broadcast quality" tone. The tone is not necessarily "natural," however, and under weak signal conditions *some* voices do not "punch through" too well. Adjustment could be made by microphone choice or BFO frequency shift, if desired.

Most comments of TS-700 owners parallel those of FT-221 owners. The AGC in both cases is reasonable, but not as good as might be desired for working DX and locals simultaneously. A preamp could be useful, especially if a linear is added to the system (j-310, or equivalent).

Which Way To Go?

As you can see, the options for two meter side-

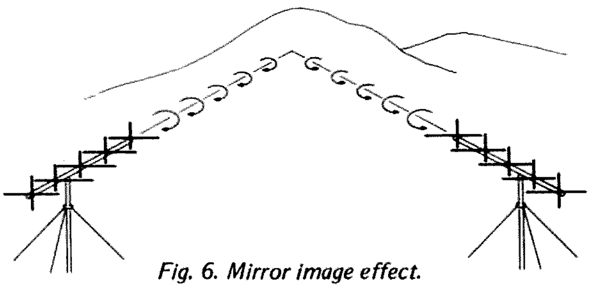


Fig. 6. Mirror image effect.

band have rapidly expanded in the past two years. Since KLM broke the waters with the Echo II, sideband has been growing very rapidly, with several manufacturers jumping on the bandwagon. Your final choice should be based on your operating habits and taste. But don't let your *current* operating habits have too much influence, as you may decide to *change them* once you've been on sideband for a while!

Of course, the best thing is to compare units side by side. Unfortunately, not all stores stock all units, and their open hours are often not during peak operating hours. So you may have to socialize a bit and find someone who has the unit(s) you are interested in and give him a visit. This is a good bet, anyway, since he can give you an idea of the idiosyncrasies of the rig, along with its good points. He can also give you pointers on other aspects of setting up a VHF SSB station.

As far as one method of getting on over another ... transceiver or transverter, etc. ... it depends on your budget and needs. If you don't mind tying up the HF rig while operating VHF SSB, a transverter is an inexpensive way to get on. Consider, however, that unless your HF rig has a noise blanker, the transverter method suffers 6-20 dB degradation in performance on reception when ignition or other noise exists. It can also be annoying!

If you have FM and just want to add SSB with little additional outlay, the IC-202 or Echo II would look good. This also allows simultaneous monitoring of SSB and FM (which could be a plus in emergencies).

Full coverage and all modes are the attractive features of the 2000, 2700, 221, and 700 multi-mode rigs. Trading up to these rigs buys not only SSB but full frequency FM coverage as well!

Other Things

Of course, a beam antenna, horizontally polarized, is likely to be something you'll want to add. Vertical beams or ground planes and the like are good for repeater use, but the cross polarization is going to cost you 10-30 dB when you try to work SSB stations (all of which are horizontal except for newcomers). There's good reason behind horizontal. This polarization has less sensitivity to noise than vertical, and seems to have better consistency over long-haul paths. In 1963, several Santa Cruz VHFers experimented with WB6IZF in King City ... a path of about 100 miles. WA6YOG used an antenna rotatable in polarity from full vertical to full horizontal, as did IZF. Over a period of several months, horizontal showed better signal levels and less fading than vertical, and horizontal gave up to 6 dB improvement in noise rejection on the AM signals. Cross polarization showed 10-30 dB of loss, as would be expected.

As for what antenna to buy, your budget may be the limiting factor. Here in the West we are partial to the KLM line of antennas. Perhaps it's because Mike and Mel of KLM are quite active on 2m SSB out here, but it is also because their broadband, rugged antennas work exceptionally well. Many of the top moonbounce stations are using the KLM 12 or 14 element beams in their arrays, simply because they are made of heavy gauge aluminum. Since they cover the entire two meter band with low vswr and high gain, they are easy to stack without worrying about detuning one antenna with another close by.

On the other hand, the antennas made by CushCraft and Hy-Gain are also good, though made with lighter aluminum and narrower bandwidth (standard yagi) design. Their prices are very attractive compared to KLM's, being roughly one-half to two-thirds as much. *At resonance*, they can perform as well as the KLM units, but bandwidth will only be about one megacycle for 5 elements and around 500 kHz for long yagis. Stacking can be problematical beyond two antennas, as well.

One interesting consideration for owners of multi-mode rigs is the circularly polarized antennas that use only one feedline. These allow SSB and FM operation without switching antennas for vertical and horizontal polarization. KLM, CushCraft, and Hy-Gain all make them. KLM's cover all of two meters, but cannot have the polarity switched from left- to right-hand polarization. The others are normally cut with the vertical elements favoring 146-148 MHz and the horizontal elements favoring 144-146.

There is one caution to be noted here, though, and that is that two stations using circularly polarized antennas over a reflected path (bounced off a mountain, etc.) will end up cross polarized because of the "mirror image" effect. If one station is able to reverse his polarization (e.g., right-hand to left-hand), this problem can be eliminated. There is no such provision on the KLM antenna (KLM 16-C). The others show how it can be done, and since the elements are cut for opposite ends of the band, true CP doesn't really exist (it's more elliptical than circular).

Another caution is that CP causes a 3 dB drop in signal strength over the equivalent linearly polarized antenna, since half of the power goes to the vertical antenna and half to the horizontal. If working a horizontal station, he only receives the horizontal radiation. The same is true for vertical. Of course, when working another CP station, the 3 dB is *not* lost, and considering that 10-30 dB is lost by being *cross polarized* when using a vertical beam working a horizontally polarized station, the 3 dB loss is a good compromise!

So again, it boils down to your needs and choices. Five elements for SSB should be a minimum. Twelve or fourteen is typical. For Oscar satellite use, three or four elements, vertically polarized, tiled up from the horizon by about 30-40 degrees, work very well. Twenty-five to fifty foot antenna height is average, but higher antennas can give a decided advantage for stations shadowed by mountains close by. Figure about 6 dB every time you *double* the antenna height.

Be careful of cheap, CB-type coax. This stuff (sold by Radio Shack and others) has only partial shielding (recognizable by the loose weave of the shield) and is *not* good for two meters! It is lossy and may cause vswr problems.

Use a good grade Belden or Times Wire, RG-58 or RG-59, for runs up to 35-45 feet, total. Up to 100 foot runs, RG-8 or RG-11 is good. Above 100 feet, RG-17, though quite expensive, really pays off. Make sure the coax you use is the right impedance for your system. (58 and 8 are 50 Ohms, 59 and 11 are 75 Ohms.)

If you buy a cheaper antenna, make sure to trim it so that it is tuned for your

operating frequency. If you do this, you'll get optimum results and you'll have saved some money. If you don't, you may not be as happy as you would have been if you did.

Worrywarts of America

If that three minute timer's got you fretting about getting cut off in mid-sentence and you don't mind someone making nasty remarks under your five minute monologue (which you can do on sideband and everyone but the guy with the mike button pushed will hear it), get on board two meter sideband! We may sound like a bunch of higher class CBers on those occasions when our mood is less than sober (we like to have fun), but I dare say that most of our joking around would go right over the heads of the eleven meter crowd. You'll get *few* comments about your operating procedures on SSB (unless you're one of those who likes to run 15 kHz wide FM on the sideband frequencies . . . we *do* get unblessed by *some* things!). Not only that, but occasional "drop in" DX makes the band quite interesting. And when the marginal fringe (say, 150-250 miles) starts coming in like it was local, extended rag chews with stations you normally say "hello"/goodbye" to make for a community spirit.

Who knows? Someday *I* may even join an FM repeater group, but for now I'm enjoying myself too much on the lower end of two meters! Hope to meet *you* there someday! ■

Fig. 7. Cheap coax: bad on left, good on right.

Digital Synthesizer

-- revitalize old xmtr strips

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Have you ever wanted to either use that nice Motorola or GE tube type strip transmitter you have around because of the 25 to 30 Watt power it's nice to have for a base station, or noticed how cheap they are around the hamfests if you don't own one? This article is especially for you. It allows you to run that one or two frequency base rig, but on any frequency from 144 to 148 MHz (and higher for you MARS-CAP folks), every frequency, that is, in 10 kHz steps, or in 1 kHz and less steps, if you want to add more parts.

Not that this unit can't be used with the transistor type rigs – it can! If the transmitter requires 6, 12, or 18 MHz crystals, read on.

Some basic parameters were desired for the unit for use around the ham shack here. They were:

1. The unit should be "program" type in common switch combination, not tons of diode matrixes, rotary switches, etc. The ideal would be a decimal type thumbwheel switch having BCD outputs.

2. It should not require "coding," that is, the number you dial in should be identical to the frequency desired. No tables or charts.

3. It should use only cheap and easily available ICs, preferably TTL digital. This is my own hard core feeling of digital over PLL, analog, etc.

4. For my own requirement, it should be remote capable using only a single rf type cable to the transmitter strip. Multi-wire cables are both a problem and also can be quite costly for a 30 to 40 foot run like I have. When the EME rack went into the basement ham shack, the FM 3 band base rack had to go – upstairs to the back porch.

5. Comparison of desired and running frequencies must be done before modulation to avoid after lockup hunting.

6. Frequency derivation should have both the other bands in mind, the use of the Motorola "strip" transmitters because of their easy availability and maintenance (it is commercial grade gear), and

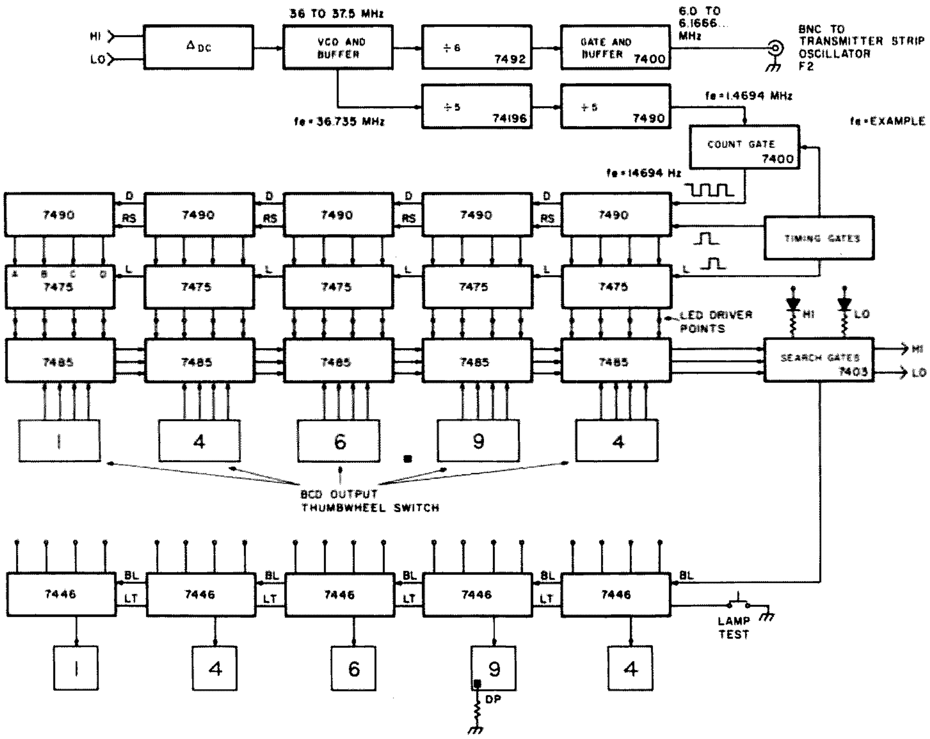

Fig. 1. Block diagram.

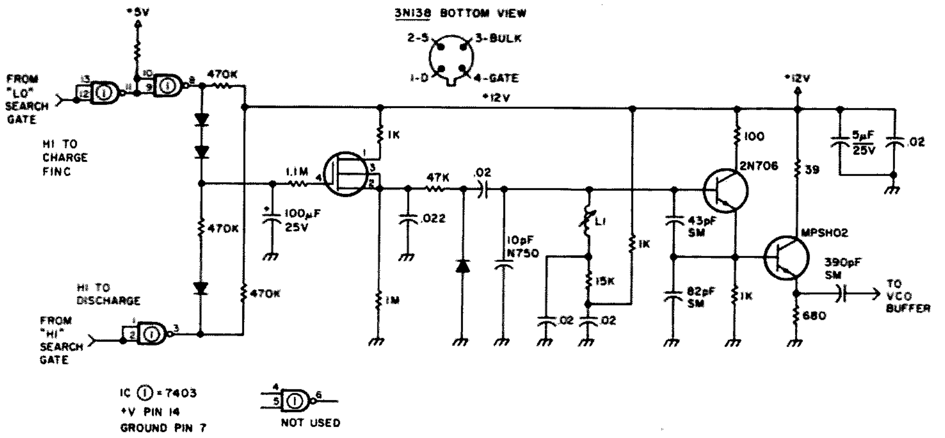

Fig. 2. VCO and "memory." L1=5½T #20 enam. ¼" form.

low cost now, and to do all this be of a divide nature (TTL) rather than multiplication type (discrete tuned circuits, bandwidth, etc.). The last requirement was going to be hard enough to do just getting the bandwidth out of the commercial strips – or so I thought.

I believe you will find it very beneficial to your success if you do things in a specific order on this project. If you already have the Motorola strip transmitter and a schematic and tune-up information on it, you are a long way along. If you have not already put it on some frequency on 2m, I suggest you do so and be sure it is all running right before you add this frequency unit. In fact, I would suggest you choose your favorite frequency and crystal up for it and leave it as F1. Then add an F2 deck modified to an amplifier as shown, so you have a backup if something fails, and a constant other normal oscillator source to compare to during the tune-up of the new unit. This way you can shift back and forth between the two sources to assure all is well during hookup.

The new unit works because it was designed very much for and around the unit it was intended to drive – the Motorola strip. Therefore, a word of introduction to that unit, and my apologies if I can't guarantee its perfect operation right off the bat with other units. The GE tube transmitter should be a very good substitute; however, I don't have one to try it on.

The strip used was a 30 W, single 2E26 final, 1 to 3 frequency model of the PA8664 chassis type. It requires an oscillator of 6.0 to 6.166– MHz for the output frequency to fall within the 144 to 148 MHz band. It should be noted and remembered these strip units are not broadband, and the 144 to 148 MHz figures are given for the new frequency unit's normal range. The transmitter should be peaked or stagger-tuned over the range you really intend to use (i.e., the 146 to 147 MHz range for me).

It should be pointed out that this is a digital VFO (VCO? – DVFO?) unit of sorts, and as such can be used with any number of tube type transmitters – FM or not!

One of the reasons this unit works is the very scheme that Motorola uses to get from the 6 MHz oscillator region to the 2m output (high band 150 to 174 MHz in their case). The multiplication scheme on these transmitters is oscillator times 24, but it happens as oscillator, doubler, tripler, doubler, doubler, to output. This is an important fact that is causing problems working out a similar scheme for the 6m and 450 MHz gear in the same cabinet. When you follow through the scheme I used, you will no doubt see what I mean.

The frequency unit runs a VCO oscillator in the 36 to 37.5 MHz range that is controlled the same as our "digital HFO" used on the EME BC-348s. Any VCO is dc controlled and our dc source is an FET-capacitor combination that has two separate and discrete electronic charge and discharge switches. Possibly the best part of using a dc controlled VCO is the fact that digital scanning, AFC, etc., can be added to these VCOs at a later date if desired. We don't want all this in the base FM station, but you will be able to see how it can be done as I manage to get the "Junque" series on BC-348s completed and turned in to *73 Magazine*. In fact, you will see a lot of the same circuitry used on a more than one item basis around here. This allows "modules" to be built, and repetitive results to be obtained time and time again.

Assuming the 36 MHz VCO works for the moment, let's carry that on out to the point it can run a transmitter. The VCO is quite capable, given the proper range, to run any 6m, 2m, or 450 MHz Motorola strip station. The dial in frequency comparison is where the hitch creeps in, so let's show how the VCO works on all first. The 2m transmitter, which I have mine running for, starts at the 36 MHz VCO and goes to a TTL gate and buffer to square up the VCO output for further TTL processing. From the buffer, in the transmitter chain direction, it goes to a divide by 6 TTL IC (7492) and has an output of 6.0 to 6.166– MHz. It is best to do the divide by 6 as a divide by 3, then divide by 2, for a symmetrical square wave output. The transmitter is usually narrow enough, and the feedline to transmitter

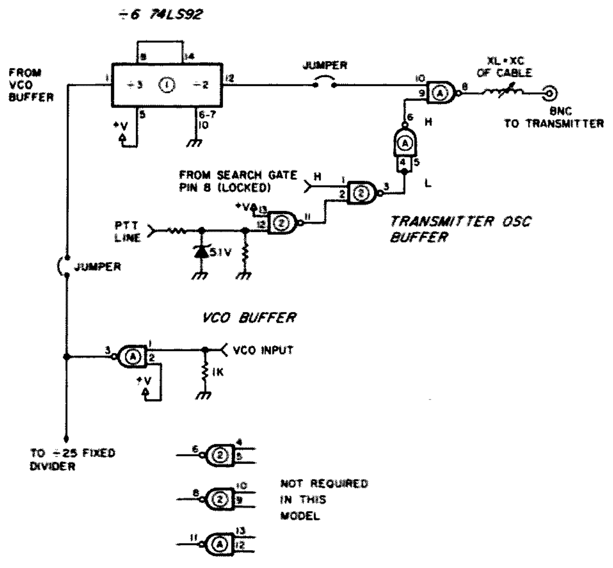

Fig. 3. Buffers and oscillator divider. IC1 – 7492; ICA – 74S00; IC2 – 7400.

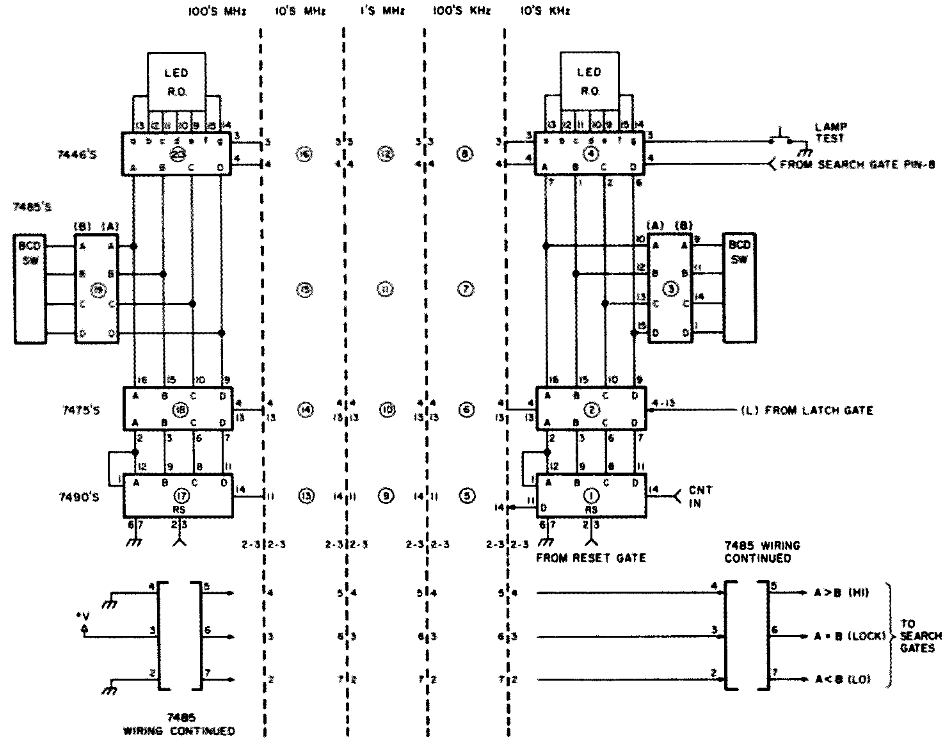

Fig. 4. Counter/comparator.

good enough, to remove the undesired harmonics of a square wave, but I did not want to chance that on a pulse type asymmetrical waveform you get from a divide by 2, then divide by 3. This is entirely unimportant for waveforms feeding more TTL, as only the high to low transition is important. The output 6 MHz signal goes through a buffer and gate for those who may find it necessary to shut off the oscillator output to the coaxial feedline to the transmitter (one feedline to more than one transmitter – choose frequency according to transmitter and transmitter by what PTT line is keyed).

The other direction the signal goes from the VCO buffer is to a divide by 25 in the form of a divide by 5, followed by another divide by 5. This is desired because the VCO runs at ¼ of the transmitter frequency, and dividing it by another 25 gives a total division by 100 and the same numbers as the output frequency only at 1/100 the frequency. This all allows a digital comparison to be made between this new 1/100 frequency and the BCD frequency select switches. Please note: The fact that this divided frequency and the switches match will show a "lock" condition and will run a transmitter by supplying it the proper oscillator frequency, but does *not* assure in any way that you are on frequency at the output any more than plugging in the right crystal does. All stages in the transmitter must still be properly tuned to proper multiplication frequency. The "lock" indication provides only the indication the VCO has moved to the correct new frequency and it is outputting to the transmitter. Gates are provided to allow no output while searching or out of lock and, of course, the provision of no output until keyed is included.

Bearing in mind that by keying oscillator output on and off, or to different transmitters, or holding it off during search, you will not be keying the oscillator VCO on and off, you can see that chirp and run-up is no problem. The oscillator is always running, and when it reaches proper frequency and the "lock" or transmitter ready indication shows, it merely means the oscillator output is gated on and frequency is being fed to the strip oscillator now converted to an amplifier. Some who read through the notes on this article shrieked at oscillator chirp and Class C stages running without drive in the transmitter, etc. For your, and their, piece of mind, this paragraph was added.

We are now down to the count and compare lines, and it is here the sneaky part enters. By feeding a 1.4 MHz region signal to what really is a frequency counter with a comparator added, a number that is 1/100 the output is counted. Since only the most significant 5 digits are important, that is all we count, by using a gate time of .01 second instead of 1 second. If a 1 second gate were used, the counter would overflow, too much time would be required to set up and keep comparing the VCO to keep it on frequency, and this scheme just plain becomes less feasible.

Let's take an example to show what goes on. 146.94 MHz is a common frequency, so let's follow it through. Since the VCO runs at the ¼ frequency, this means 146.94 MHz divided by 4 or 36.735 MHz. Divide this by 6 (to get the oscillator range frequency) and you have 6.1225 MHz. Multiply this by 24 in the transmitter and you have the 146.94 MHz output. Returning to the VCO frequency of 36.735 MHz and dividing by the fixed divide by 25 ICs, we have 1.469400 MHz to feed the counter. If you use a .01 second gate, then the counter will count and load .01 times 1.469400 MHz, or 14694 Hz. If the switches are set up for 14694, then, and only then, will the lock indication come on showing the delta dc module is not being turned on to charge or discharge, a fixed dc is being applied to the VCO, and a steady frequency is leaving the VCO that when divided by 6 is giving the right 6 MHz region oscillator signal. The nice part of all this versus frequency multipliers is that TTL division is quite fixed by the device when wired correctly. A divide by 6 is a divide by 6, etc.

You may have noted that the range of the VCO is all that limits how far you go on excursions with the VCO counter/comparator portion. Further, there is no need for fancy VHF PLLs, or dividers, or multiple PLL-mixers, etc. This alone made it worth trying for me. The very idea of an analog circuit where a digital one will work has a bad taste for me. I guess it is the fact it is so much easier to build, troubleshoot, maintain, etc., digital circuits, since everything is either on or off!

Now I mentioned earlier the idea was to run this whole thing as a digital master oscillator for all 3 bands (and later ideas of 1296 MHz FM!), but there came a few snags I am still working on. Let's take

6m first. The band of interest is 52.5 to 54 MHz and the Motorola strips require a 3 MHz region crystal and a times 16 multiplication. This band *can* be done as follows, and can even be added in as on mine, but bear in mind as with any versatile scheme, you will be capable of out of band operation, so be careful and pay attention to what you are setting up if you try it!

To get the same scheme to work on 6m, we let the same general region function for the VCO, but the VCO frequencies of interest are from 39.375 MHz to 40.5 MHz. These are then divided by 3 to get 13.125 to 13.5 MHz. These 13 MHz region frequencies are at ¼ of the transmitter output, the same as some frequency of the chain was for 2m. Therefore, dividing from this point gets you another 1/100 frequency if you use the same fixed divide by 25 pair used on 2m.

Again, let's use a common example, 52.525 MHz. Divide by 4 to get a VCO divided point of 13.131250 MHz, times 3 is a VCO of 39.393750 MHz. So, you divide the VCO by 3 to get the split point. In one direction you divide by 4 again to get the transmitter oscillator of 3.2828125 MHz. Toward the switch deck you do a fixed divide by 25 to get 525250 Hz. Since only one digit (the last) is insignificant here, we have to use a .1 second gate and settle for the slower lockup and less frequent comparison and updating of the VCO. Remember, this is still 5 updates a second, so you aren't going to drift very far with any VCO stability at all. The same switch deck is used to "dial in" the 52.525 MHz frequency as 052525. Since the gate is .1 second, it allows .1 times 525250 or 52525 Hz to pass into the counter, be compared, and match the dial in frequency.

Now the hard one! For 450 MHz, an 18 MHz region oscillator is required. This is easy enough by dividing our 36 MHz VCO by 2, so let's follow on through the range and a particular frequency. The range required (to cover it all) is from 420 MHz divided by 24 times 2 equals 35 MHz (not bad) to 450 MHz divided by 24 times 2 equals 37.5 MHz (again, okay). You do a divide by 2 to get the frequencies required by the transmitter from the VCO. Now to get a way to find the 1/100 frequency. To get down to the VCO frequency in the case of 2m, and to a lesser frequency in the case of 6m, only a division by 4 was required, allowing a further division by 25 for the 1/100 frequency for the switch deck. This gets tricky on the 450 MHz band, as any division that gets us to the VCO or less has an oddball divisor to get the 1/100 count. Further, suppose we run a divide by 10 approach to run the VCO from 42 to 45 MHz? Now an oddball divisor is required to get the 18 MHz required by the transmitter! We did not try to get any other crystal range, etc., for fear of not ending up right in the modulation department, but it is being looked into (i.e., a 6 MHz oscillator for all 3 bands, or even just 2m and 450 MHz).

This one will have to wait for now, unless you are willing to figure out the few places you run on 450 MHz and what those frequencies are when divided by 3 (or the 2m region equivalents). Example: If you take the 449.1 MHz simplex frequency, you get a 149.70 MHz "dial in." This is a VCO frequency of 37.425 MHz. This is well within the VCO range. A simple VCO to divide by 2 to a gate-buffer will supply the required oscillator frequency. A high band/UHF bandswitch would have to be added to control the destination and division from the VCO, and a small chart somewhere on the front panel to show the more commonly used UHF frequencies in 140 MHz equiva-

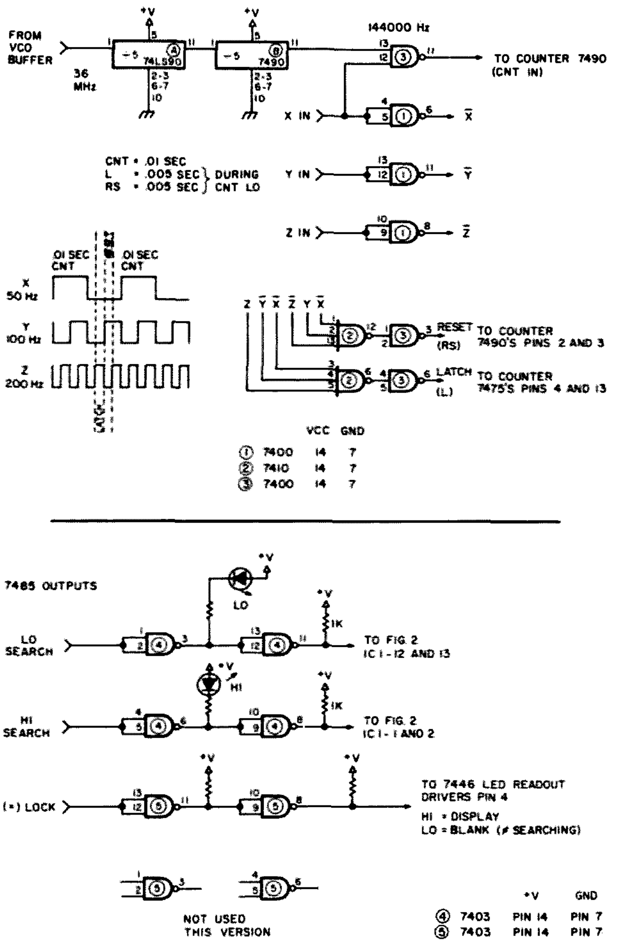

Fig. 5. Timing search.

lents. It would be wise to add in a panel lamp to show the band status anyway. The hundreds MHz A line can easily be used for this on the 6m band, as the low on the A line can be inverted and used to enable the 6m oscillator-gate-buffer, and the A line high can run the equivalent gate directly on 2m. You can even use the C line (4) if the switch scheme can be figured out for the 450 MHz use.

I believe this describes the how to, and a wire by wire shouldn't be required. Enough counter articles have come out to explain the 7490-7475 counter part, the 7490 timebase (we run one master for a lot of things in the station – clock, etc. – to save duplication and money), and the time gating arrangement. Only the 2m version is shown to avoid confusion, but as the 450 MHz version is worked out or as interest demands, maybe a future article will include the other 2 bands – I have left provisions!

SASE for help. The "Junque" BC-348 articles will resume. Happy TTL, and I hope you are learning as you build. It can be a lot of fun, and if you don't think the electronic industry doesn't think digital is the way to go – look again! ■

Note: **The modifications required to change over the oscillator tube in the FM strip will vary with the model, type, and whether Motorola or GE, etc. All that was required on mine is as follows:**

1. Remove C105 (150 pF)

2. Replace C101 (50 pF) with .02

3. Remove C102 (10 pF)

4. Install 220 Ohm resistor in parallel with R103 (47k)

5. Install BNC or like connector near crystal socket on new F2 deck, and wire center pin to grid of 6AK6 added as second (F2) oscillator (now an amp).

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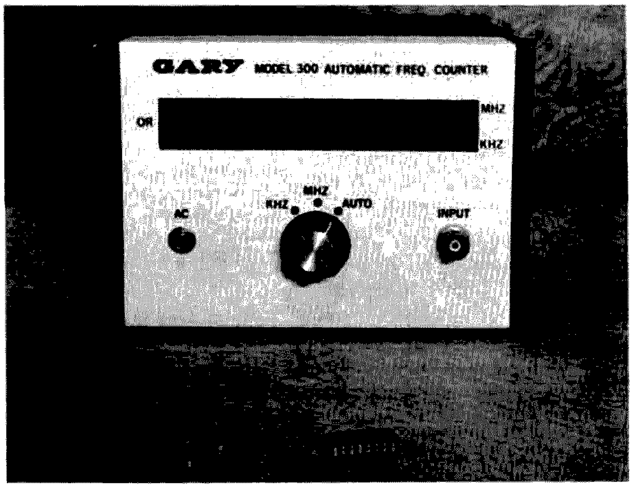
Selecting A Frequency Counter

-- pitfalls to avoid

Thanks to microcircuits, there has been a major revolution in test equipment within the last few years. The prices of devices such as digital voltmeters, triggered sweep oscilloscopes, and others have dropped dramatically, a neat trick considering inflation! But more important, this excellent, low cost gear is getting into the hands of servicers and electronics enthusiasts where good equipment is both useful and necessary to cope with today's advanced products. The frequency counter has also benefitted from microcircuits and price cuts, but only recently has it begun to "take off" with electronic hobbyists and service people. I think that this may be due to the past high prices, and a misunderstanding of what a frequency counter can do. But these things are going to change as more people are discovering what a counter can do for them!

I am going to show you some of the things to look for when you shop for a counter, and some of the not-too-obvious pitfalls to avoid. There's a lot more than specs to consider, too — all counters have special features that may be obvious or not in the advertising literature. In short, I am going to try to make your selection a better one by showing the more important *general* features and explaining them, so you'll know what to look for. As for myself, I work for a company that makes counters, and I have to use them nearly every day. So I am in a very good position to help you!



Some of you skeptics are probably thinking, "Why do I need a counter?" A good question, indeed. Have you ever designed/built an oscillator and couldn't find the frequency? Then spent hours pruning the circuit to the proper frequency? A counter would tell you where you are at a glance. Or have you ever aligned a filter or trap or i-f stage and found that the center frequency was a city block off? A counter would help you keep tabs on the calibration of your signal generator and get a better alignment in the bargain! Have you ever had trouble accessing the local 2 meter repeater? A counter can tune up that tone generator in a jiffy. Ditto the transmitter with a VHF counter. Or, perhaps you are a CBer and people complain that you "bleed" on several channels. This could be caused by a sick transmitter with a bad crystal(s). A qualified technician can easily check this out with a good counter. Anybody still skeptical? Remember that you can do far more with a counter if you put your imagination to work!

A Wee Bit of History

You might be interested in how frequency counters evolved. The first method of frequency measurement evolved around the turn of the century when it was necessary to measure the frequency of radio transmitters. The gadget was called a *wavemeter* and it consisted of a paralleled coil, variable capacitor, and spark gap (later replaced with a meter or light bulb). The capacitor had a calibrated dial, and it was adjusted until a spark appeared at the gap. The frequency was either read off the dial or extrapolated from a coil/capacitor chart if the dial read pFs. By the '30s, another form of frequency measurement came into vogue: the *frequency meter*. This unit had a built-in frequency standard and the unknown was mixed with it; the meter was adjusted until the signals "zero beated" in the headphones that were part of the unit. Old-timers will no doubt recall the

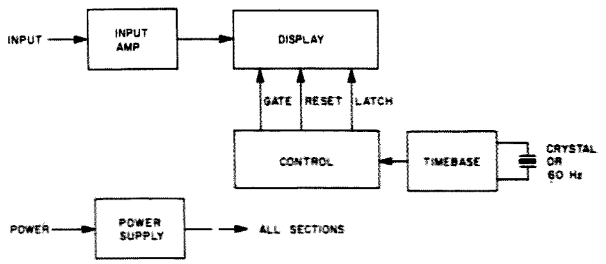


Fig. 1. Block diagram of a basic counter. The circuitry of modern counters is in ICs — mostly 20 to 30 packages of TTL.

BC-221 and LM frequency meters of WW II vintage with this mention — they were very famous! Digital electronics was the next development, and a digital frequency counter appeared in the early '50s. The first ones had 40-plus tubes, had neon lamps arranged in 0-9 columns for a readout, and were called EPUTs (Events Per Unit Time meters). The top frequency of those early counters was only a few MHz at most, although VHF range extenders appeared quickly. The early manufacturers were Berkley Scientific and Hewlett-Packard. The next step was in the '60s when ICs became available. Counters became smaller and much cheaper, too. Many companies are still using these warmed-over circuit designs today, despite advances such as CMOS. Recently, one semiconductor company has introduced a "2 chip" counter, where all of the major parts of a 6 digit counter are on 2 LSI chips! Needless to say, the future has much to hold!

A Look at Basic Specs

You have probably looked over enough of the ads by now to realize that selecting the right counter takes some thought and an understanding of counter fundamentals. Without these things, you could end up with a 3 digit "toy" and have to align a generator that is 10 times more accurate, or a unit that is so versatile it does everything but makes the morning coffee (extra cost option), to check a phono oscillator. So, needless to say, the way to start is to sit down and analyze *your own needs.* Ask yourself such questions as, "What am I going to use a counter for?" and "What do I expect to be doing with my counter within a few years?" These questions will help you decide the *primary* features that you must have in the counter you select.

For example, suppose you are an experimenter and you like to work with audio circuits and TTL logic. This suggests that you should start looking for a counter with a 20 MHz maximum range, because that is probably the highest frequency you are working with (frequency limit of standard TTL). Accuracy probably isn't critical to you and you might be able to settle for a unit that is 0.03% accurate.

Or perhaps you are a professional servicer and you are getting into CB repair. Your requirements are more strict. Since CB is 27.255 MHz maximum, you need one of the popular 30 MHz counters. Also, you need a counter that is 0.001% or "10 parts per million" (abbreviated 10 ppm) accurate to satisfy FCC requirements.

Consider the future, too. If the experimenter upgrades to, say, CB, he'll need a faster counter. But there are devices such as *prescalers* to extend the range of counters at low cost. So, when the day arrives, he might only have to add a low cost black box to his counter.

On the other hand, if the servicer upgrades to commercial radio repair, he may have to replace the counter. Why? The frequency tolerance of commercial gear is often 0.0005% and that requires a counter of 0.00001% or 1 ppm. That spec is 10 times better than the old unit's! These are a few thoughts to keep in mind when you start your search for the right counter. Try to anticipate the future!

Let's list the primary specs of a frequency counter and then discuss them. *Note:* They are not necessarily listed in order of importance.

1. Accuracy
2. Input sensitivity
3. Minimum and maximum frequency range
4. Display
5. Power supply
6. Special features or options

Accuracy

The accuracy of a frequency counter is determined by a quartz crystal or sometimes the ac power line (60 Hz). Fig. 1 shows a block diagram of a simple frequency counter. As you can see, the crystal/60 Hz is divided in frequency to operate the rest of the counter; this entire section is called the *timebase.* The timebase (or TB, for short) is the heart of the counter and its accuracy determines the accuracy of the counter. Price is also a function of the quality of this section. You'll find counters that use the 60 Hz line as a frequency element that sell for up to $150, and you'll see units that have crystals in *ovens* (temperature stable enclosures) that sell for $6000 or more. The difference in accuracy is incredible: The 60 Hz TB counter will average 0.034% accuracy, the average accuracy of the 60 Hz coming out of the wall, to 0.0001% and better for the crystal oven unit! This is clearly one area where money talks. Typical counters run 0.005%

Inside a Modern Counter

The frequency counter is still undergoing some changes, as this photo of the Gary Model 302 Pocket Counter shows. You are looking at a 20 MHz, 4 digit unit that can be expanded to show up to 6 digits of readout. Power consumption is under 0.63 Watt, as compared to the 5 to 7 Watts required by a comparable TTL unit. The secret of this unit is hybrid construction of CMOS and TTL logic. The heart of this unit consists of 3 CMOS/LSI chips. The DCU section which many hobbyists would build with 12 or more chips is contained in one special CMOS IC. The timebase section has two more CMOS ICs, replacing at least 6 TTL chips. The front end or Schmitt trigger deserves special attention because the input amplifier is the hardest part to design in a counter. This one has an FET amplifier and a biased NAND gate that serves as a Schmitt trigger. Sensitivity is excellent — 50 mV at 20 MHz with this arrangement. As you can see, counters have changed quite a bit, and they will continue to do so as more people continue to show so much interest in them.

(50 ppm) to 0.001% (10 ppm). They use 4 MHz or 10 MHz crystals without ovens for low cost. These crystals are usually custom ground and the TB is carefully adjusted to get this degree of accuracy.

When you shop for a counter, try to get a counter with as much accuracy as you can to suit your needs. Remember you need at least a 10 ppm timebase for CB repair work, if that is your interest. The 60 Hz units are not for serious electronics work; 0.034% accuracy is terrible in the counter world. Anyhow, the few units available with these may be off the market by the time you read this!

Input Sensitivity

Another sign of a counter's quality is the sensitivity it has to measure the frequency under question. Fig. 1 shows an *input amplifier*, the section that has to do with the input sensitivity, and Fig. 2 shows a block diagram. The job of the input amplifier is simple: It amplifies the input signal and converts the signal to a corresponding set of pulses that is necessary to drive the counter's digital circuitry. The heart of the unit is the *Schmitt trigger*; it converts the incoming signal, which may be any kind of a waveform, into the necessary digital square wave. Generally, when you read input sensitivity specs, you must assume that the sensitivity refers to the minimum signal required at the maximum rated frequencies of the counter to get a steady reading. In other words, the specs are worst case. Generally, the sensitivity of most counters is not flat over frequency, hence the min-signal-at-max-frequency bit. Fig. 3 shows the sensitivity plot of the Gary Model 301 Counter, a 32 MHz unit. As you can see, the input sensitivity is not flat! But in this case, a non-flat sensitivity curve can work to your advantage: The high gain at audio frequencies allows use of devices such as microphones and magnetic pickups for organ tune-ups and tachometers. The lower gain at 32 MHz reduces the chance of overload by radio transmitters, too.

Typical input sensitivity is on the order of 10 mV to 120 mV for most counters. It is desirable to get a counter with slightly more than enough sensitivity to do the job; in most labs, 100 mV worst-case does fine.

You will also find a maximum input voltage spec on some units. This refers to the maximum voltage you can apply to the counter without damage. This is always the *peak* ac signal plus any dc that may be present in the signal. For example, suppose you are measuring the signal of a homemade oscillator directly at the collector of the output transistor. You have, say, 9 volts dc at this point, plus, say, a 6 V peak-to-peak signal: You are applying 9 V dc + 3 V peak or 12 volt worst case to your counter! Fig. 4. illustrates this. This spec isn't really important to you unless you work around high voltage tube circuits and moderate to high power transmitters. In this case, there are counters built with range switches (usually calibrated x1, x10, x100, etc.) for use around high voltages. Typical maximum voltages are 20 to 100 volts for counters without range switches and 500 volts for the ones with them. These voltages are rated at a counter's maximum rated frequency, where the maximum input voltage must be reduced to prevent damage to the input amplifier. At low frequencies, such as 60 Hz, most counters will handle 120 V ac without problem.

Min/Max Frequency Range

This is probably the most advertised feature of frequency counters. Everywhere you look you are bombarded with ads screaming, "30 MHz Counter," "80 MHz Counter," "Or How About A 250 MHz Counter . . ." and so on. Yet top frequency isn't all that important. A 30 MHz counter measures a 27 MHz signal as readily as an 80 MHz unit or even a 250 MHz unit or above. Yet, the price difference between these models can be at least several hundred dollars. All you are getting for the extra money of a faster counter is a unit with more capability. And that's fine if you sometimes need a counter to measure VHF signals; otherwise you can save money if you stick to a lower cost, lower frequency counter that will read the maximum frequency you expect to be working with. Remember, too, that low cost prescalers are available that divide the input signal by 10, so you can have your cake and eat it too! (Gary McClellan and Company now offers two counters with built-in prescalers. – Ed.)

An often ignored spec is the minimum frequency a counter will display. This depends upon the timebase and the sensitivity of the input amplifier. In order to get any accuracy from a counter when measuring slow signals, at least 10 Hz must be displayed on the standard MHz range switch set to *kHz* (actually 1 second gate time). Why? All counters have a built-in ± 1 count inaccuracy due to the circuitry. That's 10% of 10 Hz – in other words, your 10 Hz is 10% accurate! Also, TB errors show up in these digits, and can worsen or even improve accuracy at this point. The input amplifier sensitivity may drop at this point, too, making it hard to pick up low frequency signals. It's safe to say that the low frequency limit of most counters is 50 Hz for good accuracy (5x the minimum frequency is good test equipment practice) even though the counter will read lower frequencies. If you do a great deal of measuring at low frequencies, you should consider a counter with a 10 second gate time, or a unit with a frequency multiplier, notably the Heath IB-1103. They will give you a display such as 60.1 Hz (10 sec TB) or 60.030 Hz (IB-1103).

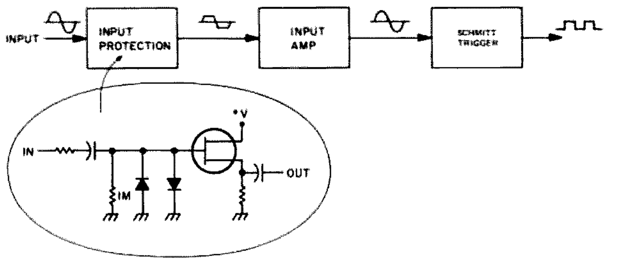


Fig. 2. Expanded drawing of input amplifier and a rough schematic of a typical input circuit.

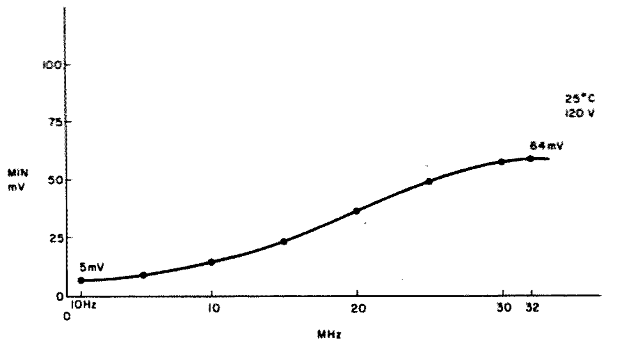


Fig. 3. Input sensitivity of a commercial counter. This plot shows the minimum voltage required to get a stable reading on the counter.

Display

The display on a counter can have a powerful bearing on whether you buy a certain model or pass it up. Important things here are the appearance of the digits and the number of them. LED type displays currently reign supreme in counters, so this is mostly what you'll see. Nixie tubes are seen in some older ac-only counters, but their use is dying out. Liquid crystals show promise for the future, because they don't require the high current of LEDs and the high voltage of Nixies. When you shop, look for the largest and brightest display you can get, but do not let the appearance of the display bias your thinking: Accuracy and sensitivity are far more important in determining your choice.

The number of digits should be considered, also. As a rule of thumb, five to six digits are about the optimum number. Fewer (such as the three digits found on an inexpensive kit) require complicated range switching or more knob turning for you. And more digits can be confusing to read. Ever see 146.96 MHz read out on a large counter as 146960001 Hz? It's very confusing at times. Also, large digit counters consume larger amounts of power; consider that if you are buying an ac/battery model!

Power Supply

Some counters offer you different ways to power themselves, often at no extra cost. The most common power source is 120 volts, 60 Hz. You'll find many units that can be wired for 240 volts ac, but you may have to check the operator's manual to find this out. There are also counters that have 120 V plus 12 V dc connections. You can often plug them into a cigarette lighter for working on mobile electronics. A few battery operated counters are becoming available, but at present none have the full features of the other models.

Special Features/Options

A whole plethora of special features are available on counters. Switching ranges from a simple kHz/MHz switch to a full blown range switch of 0.01 ms to 10 sec. Inputs range from simple jacks to complicated attenuators and trigger level controls. Input impedances may be different, too. You'll find the standard 1 meg plus 10 to 50 pF input and a straight 50 Ohm input (for VHF) on some units. Some of the more expensive units have timers/stopwatches and time interval measuring features built in. And the list could go on. Base your selection on what features you really need and not what looks nice. It makes no sense to buy a \$300 counter/timer, then use the timer once and spend the rest of the time measuring frequency!

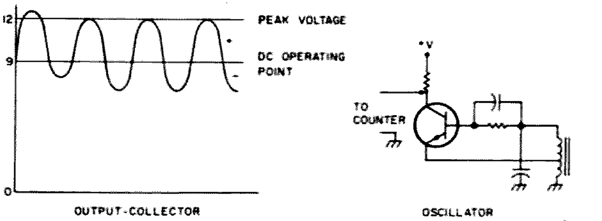


Fig. 4. Calculation of peak or worst case voltage that could appear across a counter input. Note sample circuit.

Most options can be quite useful. Some popular options include frequency range extenders, high stability TBs, power cords, etc. Also, don't overlook good probes and cables. A x10 scope probe is often used with the standard 1 meg input counter and will increase the maximum input voltage 10 times, preventing overload in most cases, and making connection to the equipment under test much easier. Needless to say, this is a very handy option and one that you should consider! If you feel that you must go for options, try to anticipate future needs. Sending a counter back to the manufacturer for modifications at a future date is usually much more expensive than ordering everything at the same time.

Some Pitfalls

Let's wrap this discussion of counters up by briefly mentioning some pitfalls that can trap you. In the past sections, I have mentioned problem areas and pointed out ways to avoid them. But here are some of the other areas to watch. Accuracy specs are sometimes hard to find on a counter data sheet, and when you do find them, they may not be complete! Although the data sheet may say "Accuracy: 10 ppm," nothing is said about the temperature or supply voltage, all of which affect the accuracy slightly. If accuracy is important to you and you are in this situation, it may pay to contact the manufacturer. Input amplifiers also have questionable areas. The input circuit of counters without attenuators should have an overvoltage protection network, usually diodes. Check. If the counter doesn't have one, avoid it or you'll be doing a lot of repair work on the counter! Finish up your evaluation by looking over the counter for any other features that you think will cause trouble.

If possible, try to get a "hands on" demonstration of the unit you select. Make sure that everything works to your satisfaction, and that the counter lives up to your expectations. With the information I have given you, the selection should be easier, as you should be aware of the *basic* things to look for in a counter. Good hunting! ■

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Lancaster PA 17601

Build A Multiplying Prescaler

-- adds value to any counter

For several years I've been fascinated by tone signalling like subaudible squelch, touchtone,* tone burst and sequential tone paging systems. If I had been rich or lazy, I probably would have bought commercial modules for my experimentation, but since I am neither, I've been trying to build my own. One large advantage in buying any electronic device is that one needs a minimum of test equipment to get it working. However, if you "roll your own," the more sophisticated the performance you want, the more sophisticated your test equipment must be. Like most home experimenters, I have an oscilloscope and VOM and have managed to acquire an audio oscillator, power supply and ac millivoltmeter at relatively low cost at local hamfests. The one piece of gear I've been badly lacking is a frequency counter. Fortunately, there have been numerous construction articles for them in the last ten years in the ham and hobbyist magazines. The one I built is similar to the K2OAW counter.[1,2,3] This is entirely adequate for most uses an amateur has, but I wanted better performance at audio frequencies. This article describes the frequency scaler I came up with and details the design process I went through in achieving the final circuit. If you are interested only in the final product, please feel free to skim the article for details. But if you'd like to "look over my shoulder" to watch the design evolution, perhaps you can benefit from my experiences in your own ham projects.

Project Goals

What I wanted was a circuit to use with a counter to enable me to measure audio frequencies of 20 Hz or higher to within 0.1 Hz or so. For example, a widely used subaudible squelch tone is 114.8 Hz. I wanted to be able to measure this frequency and know that it was 114.8 Hz and not 114.7 or 114.9. The basic unmodified K2OAW counter will not do this. Its maximum resolution is 1 Hz. This is so because in the Hz mode it counts the number of cycles that occur in one second (see Fig. 1). Therefore, it would read 114 or 115 Hz because only that many cycles occurred. Being digital in nature, it cannot resolve fractions of cycles. (Because of the rounding off error of the gate there is a ± 1 count uncertainty. Unless otherwise specified, this will

*AT&T trademark.

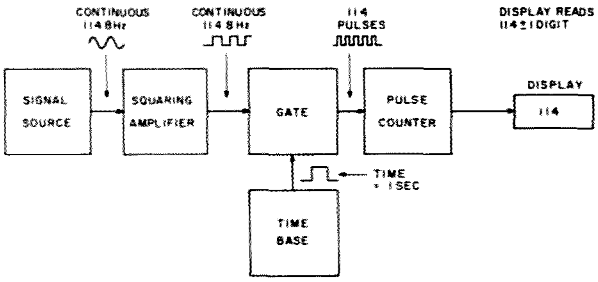


Fig. 1. K2OAW counter in Hz mode. Gate opens for 1 second, allowing 114 pulses to be registered in pulse counter and displayed.

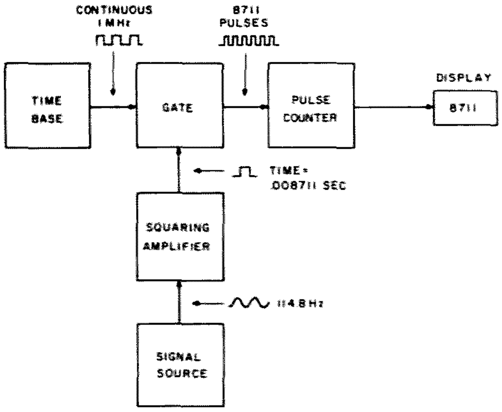


Fig. 2. High resolution can be obtained by measuring the input signal's period rather than its frequency.

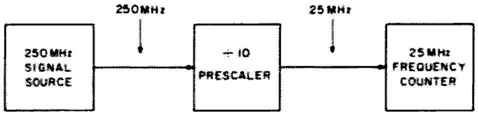


Fig. 3. Using a (dividing) prescaler to extend the high frequency capability of a simple counter.

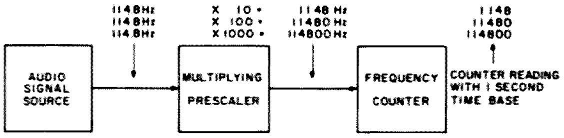


Fig. 4. Using a multiplying prescaler to improve measurement resolution at low frequencies.

be assumed for the rest of this article.)

The simplest method of gaining added resolution is to allow the gate of the counter to remain open longer so that it will pass more pulses. To get 0.1 Hz resolution means that the gate would have to allow 1148 pulses to go through; thus the gate time would be 10 seconds rather than 1 second. This approach works and has been used in frequency counters for years. But 10 seconds is a long time to wait for a reading. In fact, in the K2OAW counter, the update would take 20 seconds because of the nature of the gate circuitry. When you're setting an oscillator or filter on frequency, a 20 second wait between adjustments seems like an eternity. Needless to say, this simple method was not what I wanted.

Another way of quickly getting good resolution is to sort of turn the counter around. Instead of allowing the timebase to open the gate and pass the incoming signal to the counter section to be counted, it is possible to open the gate in response to the incoming signal and then pass pulses from the timebase to the counter section. Fig. 2 shows this setup. Here the input to the gate is a 1 MHz square wave from the counter's timebase. The input signal opens the gate, allowing the 1 MHz signal to pass to the counter section. At 114.8 Hz, the gate opens for 1/114.8 = 0.008711 seconds, allowing 8711 pulses from the timebase to be counted and displayed. This setup measures the *period* of the signal source in microseconds. To get frequency, you have to take the reciprocal of the period. So, 1/.008711 = 114.79738, according to my pocket calculator. Rounding off to the nearest tenth of a Hertz, we get 114.8 Hz. The period method, as presented, gives the required resolution, and gives fast reading updates, but it doesn't give a readout directly in frequency. Numerous commercially available frequency counters measure period. It can be handy to measure time, but it's awkward for frequency measurements.

Some frequency counters, like the Heathkit SM109 and the HP 5360 get around this problem by adding a "brain" to the basic counter. They are called "computing counters" and include logic circuits between their counter and display sections. The logic circuits take the reciprocal of the period and display a frequency readout directly. Anyone so inclined could interface a microprocessor or cheap calculator chip to perform the inversion. One brave soul has done just that.[4] His combined frequency counter, calculator, etc., is an elegant way to build a computing counter. But I already had a frequency counter and didn't need a little computer, too.

The scheme I finally decided on is analogous to the method used to extend the high frequency range of an inexpensive frequency counter. This scheme is known as prescaling. K2OAW used the prescaling technique to enable his 25 MHz counter to read up to 250 MHz. The method is shown in block diagram form in Fig. 3. The frequency counter won't operate by itself much above 25 MHz, because the ICs used operate too slowly. The prescaler, however, uses a special divider IC which will operate up to 250 MHz and produce an output at 1/10 of the input frequency. Thus, for 250 MHz input, the output is at 25 MHz, which the basic counter can handle. The price paid for this frequency range extension is in measurement resolution. If the input to the prescaler is 200,000,001 Hz, its output would be 20,000,000.1 Hz. With one Hertz gating, the 1/10 Hz digit would be lost, so the best resolution of this counting method would be 10 Hz at 200 MHz.

What does this loss of resolution at VHF have to do with added resolution at 20 Hz? That's simple. To gain low frequency resolution, we use a prescaler that multiplies the input frequency instead of dividing it. Fig. 4 illustrates the use of a multiplying prescaler. If the prescaler multiplies the input frequency by 10, the last digit of the output frequency corresponds to 1/10 Hz of the input frequency. Similarly, a x100 multiplier has an output corresponding to 1/100 Hz in the last digit. If the frequency counter uses a one second gate, then, a x10 multiplier gives 1/10 Hz resolution, x100 gives 1/100 Hz, and x1000 allows you to see 1/1000 Hz as the last digit of the input frequency. No sacrifice in counting speed is incurred, and the only arithmetic involved is remembering where the decimal point has to be placed in the counter's display. I wish I had thought of this method first so that I could patent it, but I'm years behind the test equipment industry. Systron-Donner and others for several years have manufactured frequency counters that use the same principle.

Now then, how do we multiply the input frequency by the right factor? Well, one way involves the use of a phase locked loop (PLL). Fig. 5 shows the block diagram of such a multiplying loop. The input signal is compared in phase with a signal from the divider shown, to produce an error output voltage. This voltage, in turn, is filtered and applied to a voltage-controlled oscillator (VCO). This voltage tends to retune the oscillator so that the output of the phase comparator is minimized. The net effect is to keep the frequencies of the two phase comparator inputs identical, but with a slight phase difference. The output of the VCO, however, is at 10 (or 100 or 1000) times the input frequency, and its frequency is locked to the input frequency. Thus, if the input is 114.8 Hz and a ÷10 divider is used, the VCO output is 1148 Hz, which is exactly the desired result. The above is an exceedingly oversimplified description of PLL operation, but it should

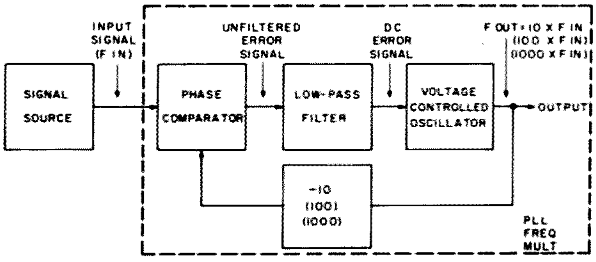
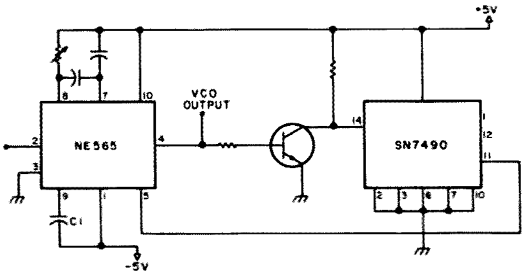


Fig. 5. Phase locked loop frequency multiplier.

Fig. 6(a). First circuit attempt of PLL frequency multiplier.



be adequate to demonstrate the multiplication principle. By the way, digital frequency synthesizers use the same basic principles with variable dividers to lock VHF signals onto lower frequency crystal oscillators.

Well, so much for the design concept. The thinking outlined above took lots of spare time over a six month period. After all that mental effort, I wanted to heat up my soldering iron and build something! The first attempt is shown in Fig. 6(a). The circuit was "borrowed" from a Signetics data sheet for the NE565 PLL chip. Component values have been intentionally omitted so that you won't be tempted to build it. Theoretical operation is the same as for Fig. 5. The input signal is applied to one input of the phase comparator via pin 2 of the NE565. The VCO in the 565 runs at 10 times the input signal frequency. The VCO output is divided by 10 by the 7490 and applied to the second phase comparator input via pin 5. The phase comparator output *should* try to lock the VCO at ten times the input frequency. It didn't. I tried different devices, readjusted component values, varied supply voltages, rewired the circuit several times, and nearly fried the 565 with too much input signal. But the #@*!! thing would not lock! At least it wouldn't lock at 10 x F_{in}. It liked 20x and 30x instead.

I had noticed, though, that it would lock at the input frequency if the divider was removed and pin 4 of the 565 was jumpered to pin 5. Similarly, locking was possible at F_{in} x2 with a ÷2 divider, F_{in} x4 with a ÷4 divider and F_{in} x8 with a ÷8 divider. This was a clue that something was wrong with the ÷10 section. The output waveform was perfect except for one thing: It wasn't symmetrical. It had a 20% duty cycle, since the output pin was high during only the last two input cycles out of ten. Very quickly I set up the 7490 for a symmetrical output as shown in Fig. 6(b). Finally, I could get the VCO to lock at ten times the input frequency. Further reading on phase comparators revealed that the doubly-balanced multiplier used in the NE565 likes to see signals with a 50% duty cycle. If it strays far from 50%, screwy things happen just like I had noticed.

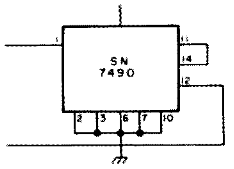
Now that I had a working breadboard circuit, I wanted to see how well it would work. I tried to get it to multiply various frequencies in the audio range. One serious drawback very quickly appeared, though. The capture range was too small. That is, the circuit wouldn't lock onto a signal very far from its free-running frequency. For example, if it free-ran at 600 Hz, it would only lock from 450 Hz to 750 Hz or so. That meant that the multiplier would have to be coarsely tuned to the operating frequency each time it was used. Also, I was restricted to a 10:1 tuning range. The manufacturer recommends that R1 be between 2k and 20k Ohms. To cover the audio spectrum from 20 Hz to 20 kHz would require switching in 3 different values of C1 in addition to a "diddle" pot for fine tuning. This seemed awfully awkward. What I really wanted was a minimum of controls.

Just about the time I reached the impasse, though, I had a need to use some phase locked loop techniques at work. I had all sorts of practical knowledge from my lunchtime and evening work with the multiplier, so I dug out the textbooks, application notes and IC data books for some theory. After too much math and sore eyes from reading, I found that using a PLL with a doubly-balanced modulator phase detector wouldn't do the job. It's fine for relatively narrowband PLLs and works well with noisy signals, but had too many drawbacks to be practical for my multiplier. Something like the Motorola MC4044 seemed much more practical.

The 4044 is really a phase frequency detector. It consists of interconnected logic gates and flip-flops which give it an interesting characteristic. For signals close in phase on its inputs, it gives an output proportional to the phase difference between the two signals. But if the signals are not close in phase, it outputs a steady dc level. The second characteristic makes the 4044-type phase comparator far different from the doubly-balanced mixer. The 4044, in contrast to the 565-type comparator, is very useful for a wideband phase locked loop. Incidentally, it's also useful for narrowband PLLs, too. Many commercial frequency synthesizers use this IC.

The 4044, though, was of no use to me in my project at work. It simply consumed too much power. The system that I wanted to put the PLL in used all CMOS (Complementary Metal Oxide Semiconductor) integrated circuits, running at less than 5 V and consuming microamps of

Fig. 6(b). Correct connections for symmetrical ÷10.



current. The 4044 needs 5 volts at 40 mA! Further research of the data books revealed the RCA CD4046. This was just the IC I needed, both for my work and home projects.

The 4046 is a CMOS IC which contains two phase comparators and a VCO. See Fig. 7. Phase comparator I is an exclusive OR gate which behaves like the doubly-balanced mixer phase detector. Phase comparator II, however, is what RCA calls an "edge-controlled digital memory network." Forget the long name. It's basically the same phase frequency comparator that the MC4044 uses. Phase comparator II is intended for use in wideband PLLs. The 4046 is almost like the NE-565 in low power form. And it's more versatile.

Now that I had a practical and theoretical background in PLLs, it took only a few hours to come up with the bare bones of the working multiplier as shown in Fig. 8. For a first attempt, I set the VCO just below 60 Hz and connected the VCO output (pin 4) directly to the phase detector (pin 3). Sure enough, when I applied a 60 Hz signal to pin 14 (the input), the VCO locked on and read exactly 60 Hz. Excitedly, I connected a CD4017 to divide by 10 and hooked it between pins 3 and 4 of the CD4046. Next, I replaced C1 with a new capacitor one tenth its original value. With no input signal, the VCO now read about 500 Hz. When the 60 Hz source was reconnected, the VCO read precisely 600 Hz! At long last, the multiplier was a reality.

Next, I calculated resistor and capacitor values per the RCA CMOS data book to

tune the VCO over the range of 20 kHz to 200 kHz. For these values, the multiplier is useful over the usual audio range of 20 Hz to 20 kHz. For 20 Hz to 200 Hz, the VCO runs at 1000 times F_{in} and the required divider (Fig. 5) is a ÷1000. For 200 Hz to 2 kHz, the multiplication is 100 with a divider of 100. Finally, the 2 kHz to 20 kHz range is multiplied 10 times using a ÷10 between the VCO and phase comparator. Keeping the VCO tuning range constant and changing dividers is the most practical method of using the multiplier over the audio range. Little is sacrificed in having a smaller multiplication factor for the higher audio frequencies, though, since my method provides a constant resolution percentagewise over the whole range.

The original breadboard was wired up on an AP Superstrip.TM These strips are rather expensive (about $18), but are extremely useful for anyone who likes to experiment because you can try out a new circuit almost as fast as you can draw its schematic. Since the circuit was easy to change, I tried all three multiplication ratios just to be sure. This only meant changing a few wires, and I wanted to be sure that all was working on the breadboard. I wanted no surprises in the final version.

Now that the breadboarding was successful, I decided to build the circuit in final form and put it in a cabinet. I didn't want to bother with a PC board, since I was building only one, so I used the wire-wrapping technique. I used wire-wrap IC sockets (10¢ each at a hamfest) and 0.1 inch vectorboard. Wire-wrapping was accomplished with a $2.50 tool made by Cambion (their part number 45-1816-01-00-16). This tool, incidentally, is widely available at electronics parts houses. It's great for small wrapping jobs and costs less than $3.00, as opposed to $50 or more for motorized wrappers. At the same time that I hooked up the multiplier, I added an input amplifier which will be described later.

When I fired up the wrapped wire version, all sorts of strange things happened. First, the VCO kept locking up at the high end of its range without any input signal. This shouldn't be, because the phase comparator should have zero output with no input. And when I applied an input signal, the loop would try to lock, and then wander all over the place in seemingly random fashion. I was really perplexed because the breadboard had worked so well. My scope showed that there were pulses at the phase comparator output even with the input of the linear amplifier grounded! But when the input to the PLL IC was grounded, the pulses disappeared. Obviously, there was junk coming out of the linear amplifier, but I couldn't see it on my oscilloscope. I took the circuit into work the next day, to have a look at it with a decent scope. Sure enough, there were very narrow spikes being fed to the PLL IC even when the linear amplifier's input was bypassed to ground. I found that if the PLL IC was disconnected (pulled from its socket), the pulses went away. Now the light came on. The VCO signals from the PLL IC were being coupled to the linear amplifier by stray wiring capacitance. With the Superstrip, this coupling didn't occur, but wire-wrapping gives much more possibility of this stray coupling to exist. The linear amplifier was constructed from CMOS, so its high impedance inputs were very susceptible to capacitive coupling.

CMOS is extremely *insensitive* to noise when used in digital circuits, because the outputs are full "on" transistors at either ground or Vcc. However, the output impedances are much higher when

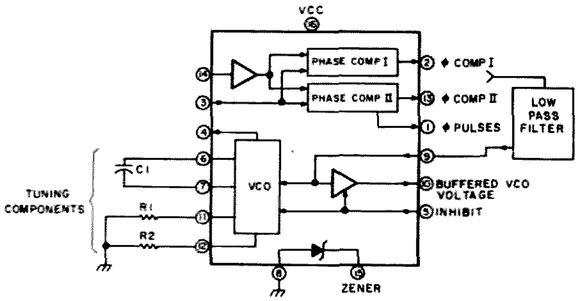


Fig. 7. RCA CD4046 phase locked loop IC.

the devices are biased in between to work as linear amplifiers.

To eliminate the problem of coupling, I built the input amplifier using point-to-point wiring on a piece of perfboard, leaving the PLL IC and dividers connected in wrapped wire fashion. The circuit behaved much better, although there was still a trace of VCO instability. This was cured by connecting the VCO tuning components R1, R2, and Cl to the IC with short-direct point-to-point wiring, and dressing the pulse-carrying wires away from these components. Apparently there had been the same strays noted earlier being induced into the VCO. Finally, everything worked well using point-to-point wiring for the linear amplifier and PLL IC, and wire-wrapping for the digital dividers.

When I got tired of the boards lying loose on the bench with wires dangling all over the place, I put it in a cabinet, a 2 x 4 x 6 shadow-box from Lafayette. Since then, two additional models have been built, and a half dozen or so sets of ICs substituted. All of them worked okay, except that one of the PLL ICs required a slight readjustment of the VCO range pot.

The Final Circuit

Several minor revisions occurred in the process of building the three packaged versions mentioned. Fig. 9 is the schematic diagram now that the design is "frozen."

The input circuit is detailed in Fig. 9(a). IC1 is a CD4001AE CMOS integrated circuit designed for logic circuits. In this application, it is an ideal amplifier and squaring circuit. The first gate, the "A" section, is biased as a linear amplifier by the 1.5 megohm feedback resistor. Input signals to it are ac coupled by two capacitors, and a sensitive control potentiometer sets the input level. The 47 pF feedback capacitor rolls off the amplifier's high frequency response to lessen sensitivity to stray pickup and high frequency transients. Gates B, C and D shape the input signal from a sine wave into a steep-sided square wave of about 5 volts p-p.

The phase locked loop section is shown in Fig. 9(b). IC2, the CD4046, is the actual PLL, while IC3, 4 and 5 are digital dividers. R1, R2 and C1 are the VCO tuning components. R1 sets the high

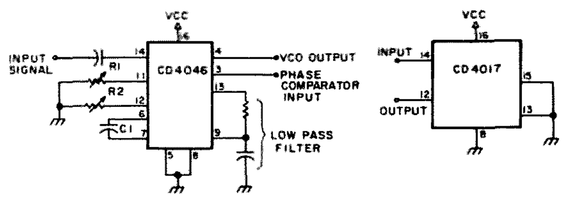


Fig. 8. Breadboard circuit for the successful PLL frequency multiplier.

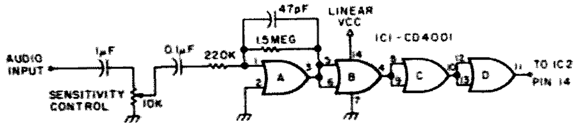


Fig. 9(a). Input amplifier and wave shaping.

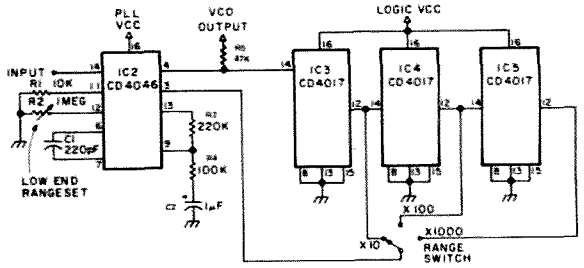


Fig. 9(b). PLL and logic for multiplier.

frequency end and R2 is used to set the low frequency end. Dc from the phase comparator output at pin 3 is filtered by R3, R4, and C2, and is fed to the VCO control terminal, pin 9. The VCO output at pin 4 is fed to the output connector through R5, which prevents loading of the VCO by the external frequency counter.

The output level is 5 volts peak-to-peak into an open circuit. IC3, 4 and 5 are each ÷10 circuits. Since the VCO tuning range is 20 kHz to 200 kHz, the output of IC3 feeds a 2 kHz to 20 kHz signal back to the phase comparator (pin 3) when S1 is in the x10 position. In this configuration, a signal in the range of 2 kHz to 20 kHz fed through the input amplifier is multiplied 10 times at the output terminal. Similarly, having S1 in the x100 position results in 100 times multiplication for inputs of 200 Hz to 2 kHz. And the x1000 position multiplies 20 Hz to 200 Hz signals by 1000.

Dc power is provided by the power supply of Fig. 9(c). A 9 V transistor radio battery is the prime source. This voltage is reduced to a regulated 5 volts by Q1, Q2, D1, and associated resistors. This is a pretty good regulator, by the way, for currents up to 20 mA or so. It stays in regulation until battery voltage drops to about 6.5 V, and is usable at inputs up to 20 volts. Decoupling is provided by the two 47 Ohm resistors, the 0.1 uF capacitors and the 5 uF capacitor, preventing interaction between the ICs through the Vcc lines. You may wonder why I used a discrete regulator rather than one of the new three terminal IC devices. Well, that's easy: a) I had the parts; and b) the IC versions don't work well at low current. Since the total circuit current drain is about 5 mA, I built my own regulator. The regulator circuit is copied from a design used in some industrial control equipment, so I claim no originality.

Construction

This is one project that does have critical parts layout. As I mentioned earlier, CMOS in logic circuits is noise immune, but CMOS in linear circuits is noise susceptible. The input amplifier and the IC2 wiring must be cleaner than the rest of the circuit. Point-to-point wiring on 0.1 in. x 0.1 in. vectorboard is fine, so long as the leads are kept short and direct. If you're ambitious, a PC board would be excellent. In any case, keep the wires with steep-sided pulses from the logic dividers away from the small-signal wiring of the input stages. Wiring of the divider stages and power supply regulator doesn't require any special precautions. In addition, it's a good idea to wire the audio input and VCO output lines with shielded cable to minimize any unwanted coupling. For guidance purposes, Fig. 10 shows the layout of the most recent point-to-point wired version. If you're ambitious and want a really neat construction job, a PC board version would be ideal – but so far I've been too lazy to build this multiplier that way. Incidentally, a metal cabinet is preferred as an enclosure to provide shielding, particularly if you plan to use the device around a transmitter.

Parts

In choosing parts for this project, I relied heavily on my junkbox. Admittedly, mine is probably better stocked with modern components than those of many other hams I know, but this is true only because I'm a hard core scrounger. I'll give you a few ideas about what components to use, but feel free to try those you have. If you substitute intelligently, your parts will work as well as mine.

The only really critical capacitor is the 220 pF capacitor used for VCO tuning. An ordinary disc ceramic will probably drift too much, even with the usual room temperature changes, causing the VCO lock range to vary from day to day. You should use a dipped mica or polystyrene capacitor for best results. The 1 uF input coupling capacitor should have paper or mylar dielectric and be rated at 100 V or so, since often you don't know what dc voltage you'll put on it making frequency measurements. The other capacitors of 1 uF or larger rating can be any electrolytic or tantalum types rated at 6 volts or more. All remaining capacitors can be disc ceramic types with 12 volt or higher voltage ratings. The CA4001 (IC1) and CD4046 (IC2) were purchased from James Electronics (a *73* advertiser) at reasonable cost. IC3, IC4 and IC5 are also available from James, but I took a cheaper route. The local Radio Shack store has been selling IC divider assortments for $1.98 (cat. no. 276-1607). They claim to be 100% functional devices, although I found a reject rate of about 20%. At any rate, several packs of them contained one good 7490 (a TTL device not used here), and several CD4017 and CD4018 devices each. For less than $4.00 (excluding tax), I got enough ICs to build two multipliers. Please note that the schematic in Fig. 9 shows the wiring for the 4017 dividers; if you have 4018 units refer to the RCA *CMOS Databook* for the correct wiring. If you are brave, try the Radio Shack assortment. If not, the devices are available from James and others at low cost. I recommend using sockets for all of the ICs. They often cost as much as the ICs themselves, but they make initial checkout and future troubleshooting much easier. The input potentiometer is a sensitivity adjustment; thus a panel-mounted control is most convenient. The VCO range pot, R2, can be a single turn PC mount device because its setting is not touchy. The remaining resistors can be ¼ or ½ Watt 10% carbon composition. The schematic shows a 1N5231 for the power supply zener diode. You can use any other ¼ Watt to 1 Watt device. The two transistors used in the regulator are not special. I've built this regulator in dozens of projects, and any NPN small signal silicon device such as 2N5172, 2N2222, 2N3394, 2N3904, or 2N4401 has worked equally well at this voltage and current level.

Checkout and Adjustment

When I designed the multiplier, I tried to make it as easy to build and use as possible. Ditto for adjustment. When you have it all assembled correctly, connect power, turn it on, and check

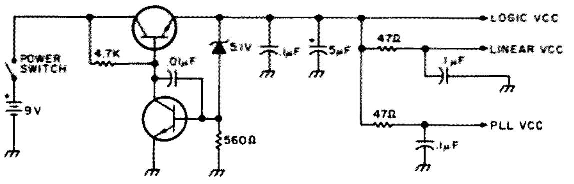


Fig. 9(c). Power supply regulator.

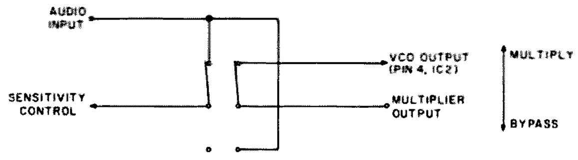


Fig. 9(d). Bypass switch wiring.

the power supply voltage at pin 14 of IC1 and pin 16 of IC2, 3, 4, and 5. When ail is well, it should be between 5 and 6 volts. If not, disconnect power and check your wiring. Should you have any remaining problems, the simplest troubleshooting method is to remove the ICs one at a time while checking the Vcc line. Incorrect regulated voltage with all of the ICs disconnected means a gross wiring error or bad components in the regulator.

When all is well powerwise, connect a frequency counter to the VCO output. Temporarily short circuit pin 9 of IC2 to ground. With pin 9 at ground, the VCO free runs at the low end of its range. You should be able to adjust the VCO frequency as read on the counter, with R2. Set the low end frequency at about 15 or 16 kHz. Now connect pin 9 to Vcc. This puts the VCO at its upper end, which should be 200 kHz or higher. If it is not between 220 and 280 kHz, change the value of Cl slightly — more capacitance for lower frequency and vice versa. After either adjustment, check both ends of the VCO range to make sure there is some overlap (low end less than 20 kHz and upper end above 200 kHz). In my prototypes, any CD4046 I've tried will fall easily within the above limits.

Now you can make an operational check. First use a 60 Hz source, such as the output of a filament transformer. *Do not* use the ac line directly. The multiplier won't be damaged by ac up to 20 V rms or so, but you can be severely fried playing with the ac line. First, connect the frequency counter to the ac source directly to verify the presence of 60 Hz ac. Then connect the counter to the multiplier output and the ac source to the multiplier input. Set the multiplier range switch to the x1000 position. By adjusting the input level control, you should be able to get the multiplier to lock on, causing your counter to read 60000. The input level control is not at all critical above some minimum setting. Once you've gotten this far, it's probably best to get hold of a signal generator and check the multiplier over its whole range of 20 Hz to 20 kHz. Should you have difficulty getting the device to function properly, a good oscilloscope is invaluable, and the aid of a friend familiar with digital circuits is recommended.

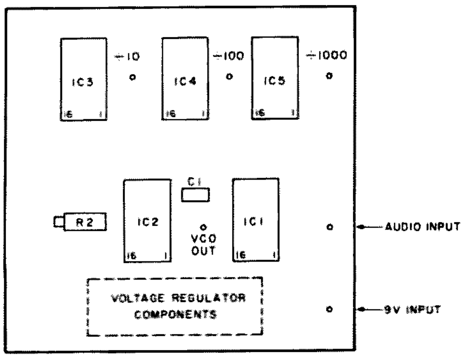


Fig. 10. Frequency multiplier parts layout.

Usage

A prescaling multiplier is a valuable addition to an ordinary frequency counter for fast, precise measurement of audio frequencies. Fig. 11 is a typical test setup for measuring the frequency of an audio oscillator. To set the multiplification factor of the prescaler, you must first know the approximate frequency of the signal being measured. To measure this quickly, set the prescaler's INPUT switch to the BYPASS position, so that the signal will go directly to the frequency counter. Taking note of the frequency, set the RANGE switch to the appropriate position. (For signals from 20 Hz to 200 Hz, use the x1000 range, for 200 Hz to 2 kHz use x100, and for 2 kHz to 20 kHz use the x10 setting.) You'll remember that there is some overlap in the ranges from the VCO tuning adjustment mentioned earlier. Now set the INPUT switch to the MULTIPLY position, turn the unit on and turn the SENSITIVITY control clockwise. If the signal is greater than 50 mV or so, the prescaler should lock on in several seconds and the frequency counter will read the oscillator frequency scaled up according to the multiplier setting. Thus, with an input signal of 50 Hz and the RANGE switch set for x1000, the VCO output is 50,000 Hz. With the frequency counter's timebase at 1 second, it will read 50000. Set at .1 second we get 5000, for .01 second 500, and finally, for .001 second the display reads 50. So by setting the counter timebase, you can tradeoff measurement resolution for faster updates. This makes setting the oscillator frequency much easier.

Final Comments

This has been a multipurpose article. Its overall purpose has been to present the circuit for a unique piece of test equipment. But, in addition, I've thrown in some theory and a bit of the background on how the device was conceived and implemented. Hopefully, it will prove valuable to brainy types who could come up with a similar gadget given enough time, and also maybe it will give some incentive to the average home builder who hasn't successfully gotten through the design of any modern circuitry. Whatever your background, I hope the article has been interesting and informative. At any rate, the frequency multiplier is easy to build and an extremely useful addition to any frequency counter. ■

References

1, 2, 3. Peter A. Stark K2OAW, "A Modern VHF Frequency Counter," *73 Magazine*, May, July, and September, 1972.

4. Robert Johnson, "The Calculating Counter," *73 Magazine*, September, 1975, p. 22.

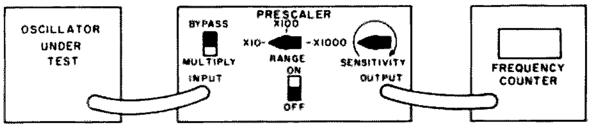


Fig. 11. Test setup for high resolution frequency measurement.

Phone Patch Tips

-- a lost art?

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Here are a few tips for you home brewers who have tried to build phone patches from scratch parts which for one reason or another never quite turned out right. I've built quite a few, and these are some tips I think you will find helpful.

The first problem is to connect the speaker to the phone for the person on the other end to hear. Then we have to connect the phone line to the transmitter. This can be done in a number of ways. One of the simplest is shown in Fig. 1. It is fairly common to find such a transformer on the surplus market, and it makes a quick and easy phone patch. I have one with a 500 Ohm, a 50 Ohm and a 50,000 Ohm winding. It works quite well, but it does have its drawbacks.

In the very simple patch the audio from the speaker is always connected to the phone line, so you must mute the speaker completely when you are transmitting. Any hiss in the receiver output will be transmitted along with the voice of the person on the other end of the patch. Also, when you are in the receive mode the receiver output is crammed back into the transmitter. This means that it will be impossible to operate VOX. In fact, some transceivers may share audio sections with transmit and receive, and this loud signal into the mike jack may crossover into the receiver section. A simple solution is to get a DPDT switch and use it to key the transmitter and mute the mike as in Fig. 2.

If you would like to avoid the hassle of having the switch or perhaps would like to be able to operate VOX, you want to go to a hybrid phone patch. There are several different types of hybrid phone patches. The hybrid patch usually uses one or two transformers (coils) which are connected in such a way that the signal from the receiver is coupled to the phone line but is cancelled by an opposite signal in the lead that goes to the microphone. Attenuation in a good hybrid is typically around 40 dB, or about one one-hundredth of the receiver output gets to the transmitter.

In the one coil hybrid in Fig. 3 the flux set up by the speaker winding in the transformer core produces a voltage across the secondary windings and across the phone line. Notice the capacitor. This keeps the dc from the phone line from flowing through the transformer windings and saturating the core. If this happens the transformer will behave unpredictably and most certainly will not give you a good null between speaker and mike. Now if we look carefully at the mike winding we see that when current enters the speaker winding (with the dot) it leaves through the mike winding with the dot making the ends of both windings positive. The voltage across the mike winding bucks the voltage across the speaker winding, so the speaker audio will be cancelled in the mike output. However, when a signal comes in from the telephone it sets up a flux in the transformer core which seems to set up the same situation for cancellation as the previous situation. Actually it does not. The secret is in the 430 Ohm resistor and the fact that the signal is coming from the phone line rather than the speaker. In this case the current from the speaker is flowing through the 430 Ohm resistor in the opposite direction. And so instead of bucking each other they add, and the signal gets through.

Fig. 4 shows a typical two coil hybrid. It achieves its nulling effect by using the two cross connected number 1 windings. The 2.15 uF capacitor and the 900 Ohm resistor are typical values for nominal telephone line impedance. To get the best match you could put a capacitance meter across the line and find the exact capacitance of your line and then use a variable resistor to find the best null between speaker and mike. One important thing to remember when adjusting the null or "balance" is that you should place a call to a friend when you do so. Your telephone line impedance looks different after you complete a call. The phasing on the number 3 windings are different for each installation depending on how many phase inversions take place in the audio sections of your rig. Flipping one of the leads over might help you get that extra couple of dB isolation if your patch doesn't quite work as well as you would like on VOX. But for the most part the phasing is unimportant. Otherwise T1 and T2 are identical hybrid type transformers. The capacitors "C" are both identical non-electrolytics about 1.0 to 2.0 uF.

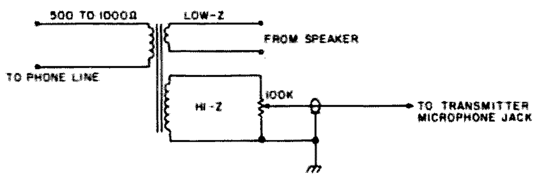

Fig. 1. Single transformer as a simple patch.

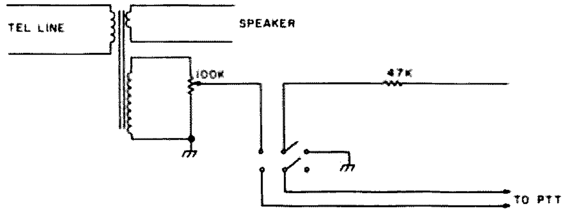

Fig. 2.

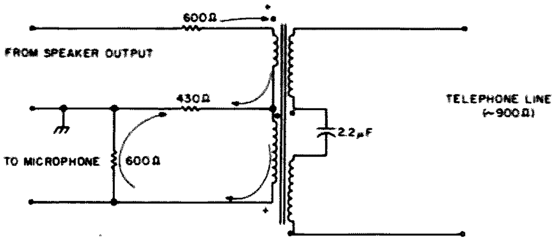

Fig. 3. One coil hybrid.

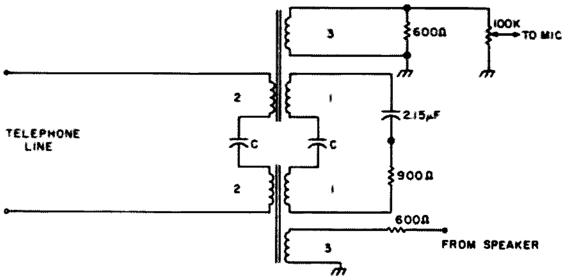

Fig. 4. Two coil hybrid.

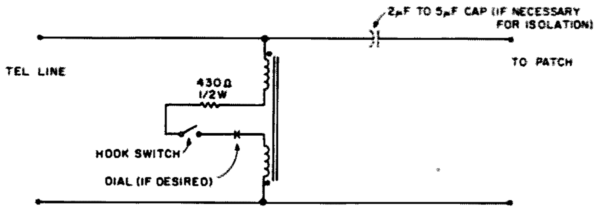

Fig. 5. Retard coil.

Again, it is very important to keep dc off the windings. But it is also necessary to provide a path for dc to keep the phone company equipment from seeing an off-hook condition and hanging up the phone. This can be done by simply keeping your phone off the hook, but any noise in the shack seems to come over much louder than the person on the other end of the picture. You could just slap a 500 Ohm resistor across the line, but that loads the patch. You have to crank up the gain, and you unbalance your hybrid if you are using one.

The phone companies have a real slick and simple solution for this problem. They call it a retard coil. All it amounts to is a 1:1 transformer with its windings set up to buck each other. Fig. 5 shows how a 1:1 transformer would be wired to act as a retard coil. By placing a switch in the center of the two windings you can go on or off hook as you desire. Place a dial in series with the switch and you can dial right from your patch. I have one set up like this, and it really works well. The resistor limits the current you draw from the line to a safe value. If your old homemade patch relies on current flowing through the patch transformer to hold it off hook put a 2 to 5 uF capacitor in series with your patch and try a retard coil to hold it. I'm sure you will find an improvement in frequency response. I used a cheap little 500 Ohm to 500 Ohm transistor transformer and it works fine.

Once you can hang up your phone during the patch you need some means to monitor the conversation so you can throw the switch or retune the receiver if necessary. Earphones work fine but you have to be careful about loading the line. Put a 0.1 uF capacitor (or larger) in series with a 2.2k resistor to your phones. Stereo headphones work quite well. Just connect the right and left channel in series by just using the two tips on the jack. No connection to the common or ground side is necessary. This works quite well and affords the people on the patch a little more privacy, or so it seems. (See Fig. 6.)

Store bought phone patches have nice meters on them to monitor audio levels. Regular VU meters are a little on the expensive side but they give a good indication. However, I chose to use one of the cheaper level meters you see advertised in ads in this magazine for $1.50 or $2.00. I ordered a couple from Poly Paks and found that they are about 140 uA full scale with 100 uA being about "0 VU." Plenty sensitive but they are dc meters. I used a diode bridge to rectify the audio. I used four germanium diodes and made it myself. Be sure you have germanium diodes. Their lower forward voltage drop (0.2 V instead of 0.6 V for silicon) makes them preferable for rectifying low voltages. Fig. 7 shows the finished meter circuit. The resistor R is a fixed resistor that is chosen experimentally to give the desired meter deflection. Again I urge you to keep it on the large side. If 3.3k and 3.9k both look pretty good choose 3.9k. This is best chosen by calling someone and having them tell you when the signal from the patch sounds like a comfortable listening level. Then change resistors until the meter peaks around two-thirds of the way up the meter face. You may want to put a switch in series with the meter circuit, so it will not peg out when you are dialing or when your phone rings.

Which brings up another interesting idea. If you are hard of hearing or have a high noise level in your shack and have the bell on the telephone in your shack turned down you can see your telephone ring by hooking a neon light across the line. The ac ringer voltage will light the light when the bell rings. Don't forget to put a current limiting resistor in series with the light. It can be a small light or a larger one that can be seen for quite a distance. (See Fig. 8.)

It's always a good idea to keep rf out of your patch and the phone lines. Fig. 9 shows a brute force type line filter. The ground shown should be a good earth ground. If you get rf into your meter try a 0.01 uF ceramic type capacitor across the terminals.

Following these tips and with good construction practices you should be able to come up with a very good phone patch that you can be proud of. Just remember to keep dc currents from flowing through your patch transformer. If nothing else put a 2 to 5 uF capacitor in series with the winding. Try the retard coil gimmick and phones, and see if the people you patch together don't like it much better. ■

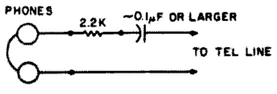

Fig. 6. Headphone monitor for tel line.

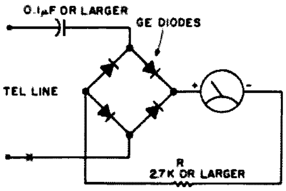

Fig. 7. Meter circuit.

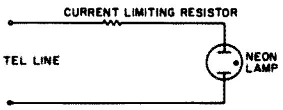

Fig. 8. Visual ringer.

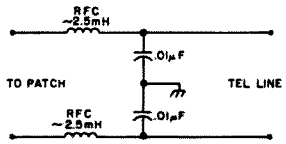

Fig. 9. Rf filter.

Impedance Matching

-- simplify a complex process

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In designing an antenna system or matching network, a radio amateur many times finds the need to measure the actual complex impedance of a transmission line, antenna, or network at the rf operating frequency. This can be done simply and accurately by using a directional wattmeter and various lossless mismatches constructed from capacitors, without the expense of measuring equipment such as network analyzers and RX bridges costing upward from several thousand dollars.

Materials Needed

– A directional wattmeter having the capability to measure forward and reflected power at the operating frequency. An accurate vswr meter may also be used.

– Transmitter or exciter capable of transmitting a CW signal at the operating frequency with enough magnitude to properly operate the power meter or vswr bridge. (The output impedance of the exciter should be equal to the characteristic impedance of the transmission line being used; in most cases, 50 Ω for amateur applications.)

– A dummy load of proper resistive impedance and power dissipation characteristics to terminate the output of the exciter, having a vswr of not more than 1.2:1 (not more than approximately 1% reflected power). The closer the load is to a 1.0:1 match, the more accurate the impedance measurements will be.

– Capacitors, silver mica, not less than 500 WV dc (see text).

– Coaxial cable for connection of the exciter to the input of the wattmeter or vswr meter, having a characteristic impedance of that of the exciter (usually 50 Ω for amateur applications).

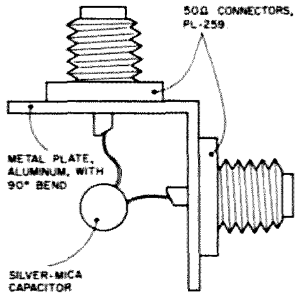


Fig. 1. Construction of capacitive mismatches for impedance measurements.

Construction of the Capacitive Mismatches

The capacitors used should provide an imaginary impedance of approximately -j0.5 to -j3.0 at the operating frequency. This means that the range of reactance of the capacitors used can be from $0.5Z_0$ to $3.0Z_0$.

In a 50 Ω system,

$0.5Z_0$	$3.0Z_0$
= 0.5(50 Ω)	= 3.0(50 Ω)
= 25 Ω	= 150 Ω

So, the capacitive reactance can range from 25 Ω to 150 Ω at the rf operating frequency for a 50 Ω system (see Table 1).

Calibration Procedure

1. Construct measurement circuit as shown in Fig. 2. Select two capacitors that fall in the proper capacity range for the frequency at which the impedance measurement is to be made.

2. Measure and record the vswr of the load with each capacitor in the circuit. If the wattmeter used does not have an swr scale, refer to Fig. 3.

3. Draw a constant vswr circle on the Smith chart for each of the vswr measurements taken with the capacitors in the circuit.

4. Find the point along the resistance circle, R=1, where intersection with each of the constant vswr circles occurs.

5. Record the value of each of the reactive components at the points of intersection, (-jX). These values are the reactive values of the capacitive mismatches that are to be used in measuring complex complex impedances at the rf frequency at which the calibration was made.

Impedance Measurement

1. Construct measurement circuit as shown in Fig. 4. Measure and record vswr of the load.

2. Construct measurement circuit as shown in Fig. 5. Measure and record the vswr of the load in series with each of the capacitive mismatches.

3. Plot and label the vswr circles of the measurement of the load vswr and the vswr of the load plus each of the series mismatches.

4. Find the resistance circle on which △jX (the change in jX) between the load vswr circle and the load-plus-mismatch vswr circles is equal to that of the value recorded for each value of -jX recorded in the calibration measurement.

5. Follow the resistance circle to the point where it intersects the vswr circle of the load only. This point of intersection is the value of the complex impedance of the load, R + jX.

Example

The frequency at which

Amateur Band	-j0.5	-j3.0
80m	1700 pF	280 pF
40m	890 pF	150 pF
20m	450 pF	75 pF
15m	300 pF	50 pF
10m	220 pF	37 pF

Table 1.

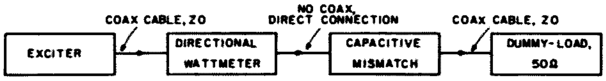


Fig. 2. Measurement circuit for calibration of the capacitive mismatches at the rf operating frequency.

$$\text{swr} = \frac{1 + p}{1 - p}$$

$$p = \log 10^{-1} \left(\frac{10 \log 10 \left(\frac{P_{forward}}{P_{reflected}} \right)}{-20} \right)$$

Fig. 3. Conversion of forward and reflected power to vswr.

Fig. 4.

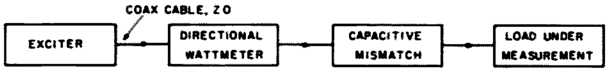


Fig. 5.

the impedance measurement is to be made is 14.250 MHz.

The value of the capacitors in the two capacitive mismatches, ZX_1 and ZX_2, equals:

Capacitor, ZX_1 = 400 pF
Capacitor, ZX_2 = 120 pF

Calibration (50 Ω system)

1. Measurement circuit in Fig. 2 was constructed. Two capacitors were selected for use in the capacitive mismatches, corresponding to the limits specified in Table 1.

2. The vswr of the dummy load plus each of the capacitive mismatches was measured and recorded.

vswr, ZX_1 + load = 1.8:1
vswr, ZX_2 + load = 5.2:1

3. Constant vswr circles were drawn for each measurement. See Smith chart A.

4. The points of intersection with the R=1 resistance circle were found and labeled, points A and B.

5. The value of each of the reactive components of ZX_1 and ZX_2 were recorded from points A and B of the Smith chart.

ZX_1 = -j0.62
ZX_2 = j1.85

Impedance Measurement

1. The measurement circuit in Fig. 4 was constructed. The vswr of the load was measured and recorded.

vswr, load = 2.5:1

2. The measurement circuit in Fig. 5 was constructed. The vswr of the load plus each of the capacitive mismatches was measured and recorded.

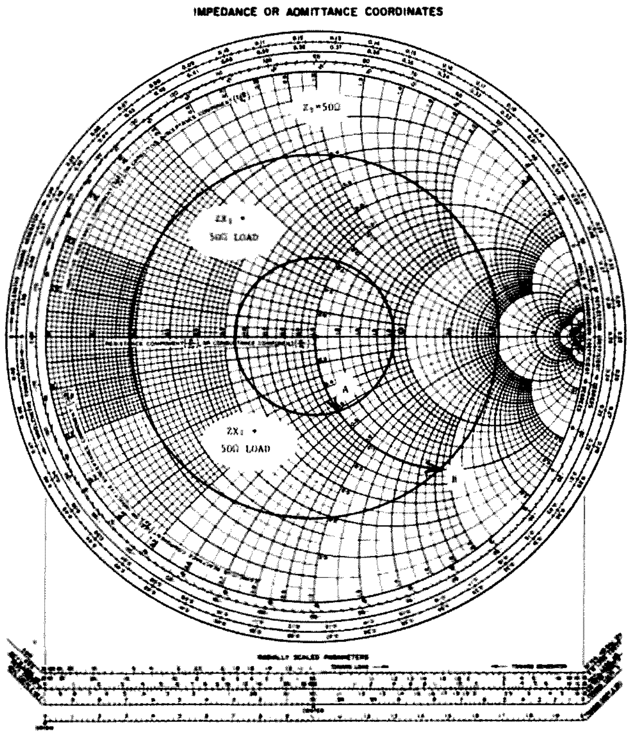
vswr, load plus ZX_1 = 1.78:1

vswr, load plus ZX_2 = 5.2:1

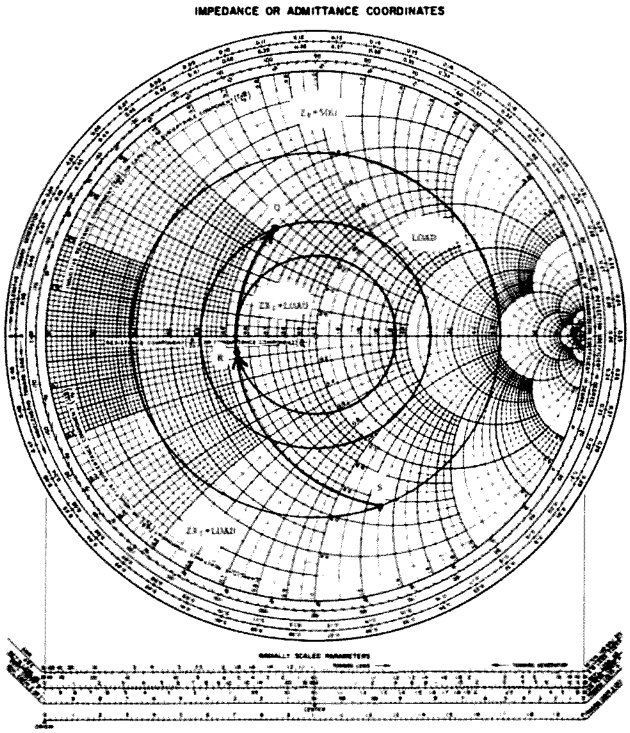
3. Constant vswr circles were plotted for the measurement of the load vswr and the vswr of the load plus each of the series mismatches. See Smith chart B.

4. The resistance circle on which $\triangle$jX between the load vswr circle and the load-plus-mismatch vswr circles is equal to that of the recorded value of -jX found in the calibration measurement located on Smith chart B. $\triangle$jX between points Q and R = (-j0.62) = 0.62. $\triangle$jX between points R and S = (-j1.85) = 1.85.

5. The $0.55Z_0$ resistance circle is drawn from point S to point Q, as indicated by the arrow. Point Q lies on the vswr circle of the load only, so point Q is equal to the value of the complex impedance of the load, R + jX. So, the load impedance = 0.55 + j0.55. ■



Smith Chart A.



Smith Chart B.

Looking West

from page 33

people like Ernie for the time spent updating us, and sincerely hope that this kind of information flow will continue.

As you are aware, part of the trip from here on was spent both SWLing CB and QSOing a "Ham Trucker" into Santa Barbara (on both CB and via two meters). It was not long after that, while listening on .28/.88, that the voice of Larry WA6OBT was heard on the Sulphur Mountain, Ventura County Repeater (WR6AOX). That meant that home was but an hour away. I hope that you enjoyed this trip along with us; maybe soon we can do it again. I can tell you that I will have some updated information this fall, since I intend to accept Ernie's invite and will definitely be at the Santa Maria Convention in October. I've heard that the barbecue is something to behold . . .

"73 AND 55"

"WA6ITF clear WR6BAX – 73 and 55, everyone." Something like that is being heard a lot out here these days on both HF and on our VHF repeaters. In fact, 55s are coming from as far to the west as Korea, according to Lenore Jensen W6NAZ. The Los Angeles Council of Radio Clubs, acting in cooperation with the California Highway Patrol, has hit upon a way in which amateurs can actively participate in a program designed to conserve two of this nation's most important natural resources: fuel and people.

When CHP Officer Dean Hirst came to my place of employment not long ago to speak on the subject of the Highway Patrol's renewed effort to motivate voluntary compliance with the national speed limit of 55 mph, and brought forth incontrovertible proof that the ten mile per hour reduction in the speed limit (from its previous 65 mph) had substantially lowered the number of fatal accidents in this state, it occurred to me that amateur radio might just be the proper vehicle to help spread the word. After all, the life saved might be yours, mine, or that of one of our loved ones.

A subsequent conversation with Officer Hirst led to an introduction to Southern California ARRL P.R.A. Lenore Jensen and to a meeting with the Los Angeles Council of Radio Clubs. Out of the final step has come a pledge that amateur radio operators will do all they can to adhere to the 55 mph limit and to help spread the word of the dual savings by ending QSOs with "73 and 55," thus signifying the individual pledge of voluntary compliance.

Whether you believe that there is a real energy crisis or are one of the skeptics is not important. The fact that the lower speed limit saves lives has been proven, and that in itself is more than enough reason for my own compliance with it.

How about you? Want to help make this a national movement within amateur radio? It's easy: just watch your speedometer and spread the word by using "73 and 55!"

Officer Dean Hirst of the California Highway Patrol and Mary Ed Killitz WA6EJP of the San Fernando Valley Amateur Radio Club.

Social Events

SWIFT CURRENT SASKATCHEWAN JULY 2

There will be a hamfest held at Swift Current, Saskatchewan on July 2, 1977. For more info contact H. Bassendowske VE5PZ, 1433 Taylor Drive, Swift Current, Saskatchewan.

MILTON ONTARIO JULY 8-10

The Ontario Hamfest '77 will be held on July 8, 9 and 10, 1977, at the Milton Fairgrounds in Milton, Ontario. Program includes numerous commercial displays, giant flea market (no space charge), auction late Saturday afternoon, CW bingo, prizes and ham displays. Registration $4.50 adults; $3.00 children; children under 3 no charge. Registration after June 15 will be $5.00 for adults. All activities will be held inside in the event of rain. Talk-in station on 146.520 MHz simplex. For more information write Burlington Amateur Radio Club, PO 836, Burlington, Ont. L7R 3Y6.

OAK CREEK WI JULY 9

The South Milwaukee Amateur Radio Club Swapfest '77 will be held Saturday, July 9, 1977 at Shepard Park (American Legion Post #434), 9327 South Shepard Avenue, Oak Creek, Wisconsin. Activities begin at 7 am and will run until about 5 pm. Parking, picnic area, hot and cold sandwiches and liquid refreshments will be available on grounds. Overnite camping is available. Admission is $1 and includes a "Happy Hour" with free beverages. Prizes will be awarded. Talk-in on 146.94 MHz FM. More details (inc. map) from: South Milwaukee Amateur Radio Club Inc., S. F. Schreiter W9AKF, Sec., 104 Brookdale Drive, South Milwaukee WI 53172.

CUMMINGTON MA JULY 9-10

The Northern Berkshire Amateur Radio Club Hamfest will be held July 9th and 10th at the Cummington Fairgrounds, Cummington MA. Free overnight camping, tech talks, demos., and dealers. Flea market $1. Admission $3 with XYL $5, advanced $2 and $4. For information write Hildy Sheerin WA1ZNE, 79 Greylock Ter., Pittsfield MA 01201.

CHARLESTON SC JULY 9-10

The Charles Towne Hamfest, Charleston, South Carolina, will be held on July 9 and 10, 1977. Saturday, July 9th, the Charles Towne Hospitality Room will be at the Heart of Charleston Motor Inn starting at 7:30 pm. Sunday, July 10th, the flea market and swapfest will be at the Gaillard Municipal Auditorium starting at 8 am. Complete details by writing to: Charles Towne Hamfest Committee, Box 4555, Charleston Heights SC 29405.

INDIANAPOLIS IN JULY 10

The Sixth Annual Indianapolis Hamfest will be held on Sunday, July 10, 1977 at the Marion County Fairgrounds. There will be hourly prize drawings, a main prize drawing, a large indoor flea market, and a large outdoor flea market, forums, etc. Over 100 campsites are available. Forty with full hook-ups. Gate admission: $2. For more information write Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

BROOKLYN NY JULY 10

The Kings County Repeater Association of Brooklyn, New York, will hold its annual outdoor flea market (if rain – indoors) on Sunday, July 10, 1977, at 9 am to 4 pm. Located at 17 Eastern Parkway (at Grand Army Plaza), Brooklyn, New York. Sellers $6 per table, $3 half table, buyers $1. Refreshments available. Talk-in on 147.43, 146.43 and 52 direct. For further information contact WA2UMY (212) 941-8780.

SARATOGA UT JULY 16

The Utah Amateur Radio Club will hold its annual Utah hamfest and steak fry on July 16th at Saratoga resort. Bill of fare includes swap tables, CW contest, home brew contest, Oscar demo, women's activities, steak fry and many more ham games. Registration is $2 for UARC members, $5 for non-members and $1 for children under twelve. Registration includes choice steak, discount on rides, hot dog for kids, drawings and all other activities. Events begin at 9 am and run until after dark. Talk-in on repeater 16/76. For more information contact John Dehnei, c/o Utah Amateur Radio Club, 1547 Redondo, Salt Lake City UT 84105.

CORUNNA MI JULY 16-17

The Shiawassee Amateur Radio Association (SARA) is hosting the Buzzards Roost, Michigan Emergency, and Wolverine Nets picnic and SARA's 3rd Annual FREE Swap and Shop, Saturday and Sunday, July 16 and 17 at McCurdy Park in Corunna, Michigan just east of Owosso. Swap and Shop tables and trunk sale spaces available at $2.00 for 1 day and $3.00 for 2 days. Talk-in with W8QQO on 3930 kHz, 146.52 MHz, 147.63/03 repeater, 449.3/442.1 MHz repeater. For a flier with a map and further information write: SARA, W8QQO,

Continued on page 197

Raymond S. Isenson WB6HJQ
4168 Glenview Drive
Santa Maria CA 93454

Digital Clock Fail-Safe

-- so you won't miss the train

Honey, what time is 88:88:88?" "Oh, oh! You pulled the plug. Find out what time it is and I'll reset the clock." "Sorry I'm late, Boss. There must have been a power failure during the night and my electronic digital clock was talking garbage this morning." "Every time I close the transmitter key, that fool clock jumps two hours!" Situations sound familiar? Sure do, but this doesn't have to be. The fact is that of the three basic types of clocks, electrical, mechanical, or electronic, the latter is the one most easily made fail-safe. The trick is to get a little extra filtering in the normal ac to dc power supply and to provide a standby source of dc voltage and a 60 Hz (50 Hz) signal to keep the clock counting during a power outage.

For a clock built around the CT7001 or similar chip, there's no problem. Beef up the filtering a bit, add a backup battery supply with some diode switching, and let the built-in oscillator provide the counting signal. The ac/dc power supply shown in Fig. 1 should do the job nicely. For almost any other chip, however, an off chip oscillator has to be provided as well as the battery backup.

One way to generate the reference signal for the counting circuit is to use a precision crystal oscillator coupled with a suitable frequency dividing circuit. There are several ads in this magazine for just such circuits, prebuilt or in kit form. But if your clock is normally operated from the ac mains, the crystal oscillator is only the more expensive, not the best, approach to keeping reasonably accurate time. In the long run, the 60 Hz (50 Hz) signal provided by the power company should average out to a much more accurate count than will even a well-compensated crystal oscillator. It is possible to synchronize the crystal oscillator to the power company line frequency. However, this generally is not done in the known available kits and, even if it were, it would be an unnecessarily expensive solution.

An alternative technical approach is shown in Fig. 1. It is considerably less expensive than the crystal oscillator/divider circuit and is inherently as accurate as the power company's line frequency whenever ac power is available. As long as the power company keeps furnishing the ac voltage, this oscillator will remain synchronized to the line frequency.

The circuit consists of an ac and backup battery power supply, some switching diodes to automatically engage the battery only when the ac voltage fails, and a phase-shift oscillator that will either synchronize with the line frequency or, during power outage, will provide a reasonably accurate signal to keep the clock counting. The "tickler" coming from the secondary of the power transformer to the base of Q1 serves to lock the oscillator to line frequency, working best when the resonant or free-running oscillator frequency is slightly low, even if ever so slightly. Only during a power outage will the resonant frequency of the oscillator determine clock accuracy.

Will the fact that the free-running oscillator is slightly slow cause much of a problem during power outage? Not really. Let's assume that it runs at 59.9 Hz and also that we have a reasonably long power outage, say four hours. The 0.1 Hz error translates to a 0.167% error, the clock losing 24 seconds during the power outage.

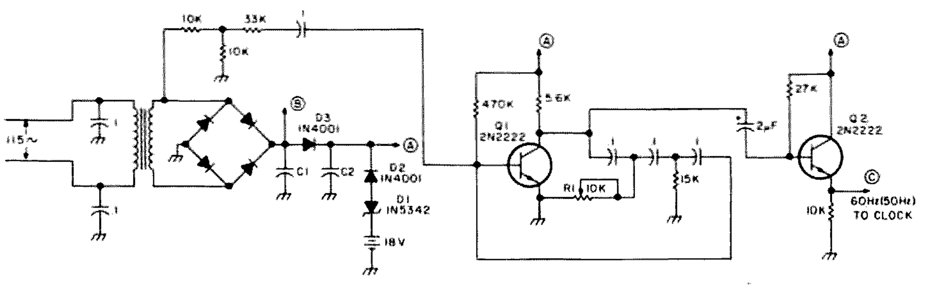


Fig. 1. Fail-safe power supply and clock count generator. Notes: 1. C1 = C2 = 200 to 300 uF, 25 volt; 2. D1, D2 — see text; 3. Adjust R1 for 50 or 60 Hz; 4. Point B to LED supply (see Fig. 2); 5. Resistors ¼ or ½ Watt, as available.

That shouldn't be upsetting in most cases.

Emitter follower, Q2, isolates the oscillator from the clock chip load and provides the necessary current sink. It, like Q1, is shown as a 2N2222. Actually, almost any small silicon NPN transistor will do either job. This looks like a great place to use some of those house-numbered transistors salvaged from a surplus board!

In the typical digital clock circuit, a signal is taken from the secondary of the power transformer, through a current limiting resistor (about 100k Ohms), to one of the clock IC's pins. A signal diode generally goes from that pin to the positive voltage supply. These components should not be removed. Simply cut the existing foil lead near the transformer secondary and solder a lead from the 60 Hz (50 Hz) output of the oscillator to the end of the current limiting resistor that formerly went to the transformer.

Providing a battery backup for the dc voltage to the clock chip may be a little more difficult on a previously assembled board than is coupling in of the timing signal. The actual complexity will vary from board to board, and all that can be said is, "It isn't really tough!" For new construction, whether using a "store bought" PC board or a "home brewed" one, it's probably best to use a separate board for the power supply and phase shift oscillator. If rebuilding an existing clock, it may be best to carefully salvage the power supply associated components from the old board and reuse them on a separate board. By the way, don't forget to remove the clock IC from the board while doing any soldering or unsoldering. It could save you the cost of a new chip!

Fig. 1 shows an 18 volt battery power supply made up of two 9 volt transistor radio batteries in series. The voltage is dropped 6.8 volts across a 1N5342 zener diode and another 0.6 or 0.7 volts through a 1N4001 before coupling to the ac power supply output (point A on Fig. 1). With the exception of the 1N4001 (or equivalent) diode that provides a switching function, nothing in the combination is critical. It is important only to have the battery-supplied voltage slightly below the normal ac-supplied voltage so as to prevent battery drain during normal operation.

Measure the dc voltage at the filter capacitor in your existing circuit. This will tend to fluctuate as the number of LED elements activated in the display changes. The highest value observed is the one of interest. From that value, subtract about 0.7 volts to account for the drop that will occur across diode D3. The battery voltage to be furnished to point A should be below the resultant figure and above the minimum operating voltage specified by the clock IC manufacturer. Within that range, any combination of batteries and voltage dropping diodes is satisfactory.

For example, the highest measured voltage at point A in the prototype was 12.5 volts. The clock chip specification called for an 11 volt minimum. Thus, any value between 11 and 12.5 volts would be satisfactory. The battery supply could have been made up of a 9 volt cell in series with two 1.5 volt cells with the zener eliminated. The actual circuit used was chosen because the zener was available and for ease in packaging the battery pack. Custom your package to fit your needs. Don't forget, however, that new cell terminal voltage for the 9 volt cell is about 9.4 volts and, for the 1.5 volt cell is 1.55 volts. If you cut your design too close, inadvertent drain of the battery supply during ac operation is possible.

The fail-safe circuit is designed so that, in principle, the LEDs will not display during battery operation. This is done deliberately to minimize battery drain. In some cases, however, the digits may be faintly displayed. This could occur with the circuit configuration shown in Fig. 2 if the LEDs are particularly efficient. The enabling current is base current flowing through the base of the NPN to the clock IC.

If your digital clock has an alarm clock feature and there happens to be a power outage at the instant the alarm should sound, the fail-safe circuit may or may not cause the alarm to function. It depends upon the design of the alarm feature. If there's an on- or off-chip oscillator, with or without an additional amplifier, driving a small speaker, the alarm buzzer can be made to function even though the time is not being displayed. It's necessary only to insure that power for the alarm circuit is tapped from point A and not from the LED supply bus. Obviously, if the clock functions to enable a radio-alarm, there won't be power available to play the radio, so... This does raise a good point, however. Should you have a radio-alarm, most likely the clock chip is driving a transistor which, in turn, pulls in a relay at the preset time. The relay can be a power hog. In order to protect the batteries, Vcc for the transistor that drives the relay should come from the LED supply bus.

The power supply of Fig. 1 has two filter capacitors, one on each side of diode D3. Capacitor C2 serves to further smooth the ac-supplied voltage against voltage transients. If the batteries are reasonably fresh, this capacitor isn't really necessary. It's most important as the batteries begin to age or are out of the circuit. It, like the zener diode, was a designer choice.

Calibration of the phase shift oscillator is most easily accomplished with the aid of an oscilloscope or frequency counter. With the latter, simply set the frequency to 59.9 Hz (49.9 Hz). For the scope, connect the vertical probe to the oscillator output, and the horizontal probe to the line frequency terminal on the scope or a similar 50 or 60 Hz source. Adjust R1 until a single ellipse (Lissajous pattern) appears. Then back off ever so slightly so that the pattern appears to be slowly rotating in a clockwise direction about an axis in the plane of the scope.

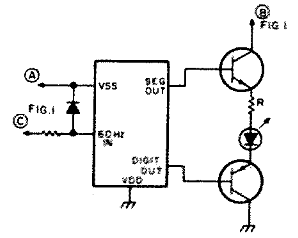


Fig. 2. Isolated LED supply and count in.

An alternative technique for calibration is with the sweep second hand of a watch or clock. Rig a temporary switch to enable and disable the ac line to the digital clock. Set the clock, turn power off for a period of 90 seconds, and switch power back on. Adjust R1 until the digital clock advances 90 seconds during the ac power off period. If, after a period of several days, the clock has gained time, tweak R1 to a slightly higher resistance. If the clock is four digit only, switch ac power off just as the minute digit changes. Delay 120 seconds and turn power back on. Adjust R1 so that, at first, the clock is running slow; the minute digit has not quite advanced again when power is reapplied. Gradually adjust R1 to decrease the error.

As the transformer used in the prototype was of the printed circuit board type, a simple PC board was used for the power supply and oscillator. It could otherwise just as well have been assembled on perfboard, vectorboard, or any other of the commonly used assembly techniques.

This simple fail-safe circuit works. Try it, you'll like it! ■

Craig Anderton
PO Box 381
Clayton CA 94517

Interest In Mail Order?

-- an insight into facts and myths

No, this isn't an article about setting up a mail-order business; rather, the subject is how you, as a consumer, can get the most benefit from mail order. As partner in an ad agency, I've had the opportunity to talk with several mail-order companies, and see how they work . . . from announcing a product to shipping out orders. You should know about some of the things I've learned in the process, as this information will help you get the satisfaction you deserve out of mail-order businesses. First of all, let's dispel two myths about the mail-order business:

Myth #1: Mail Order is Unreliable. This used to be true, especially in the days of patent medicines and sure cures for gout. Now, however, the competition is tough enough that no business can afford shady operation or unsatisfied customers. Additionally, new federal regulations – plus the severity of postal fraud charges – keep a watchful eye over mail order in general; and finally, magazines stop carrying advertising of those companies that inspire complaints to the magazine. A deadbeat company reflects negatively on the magazine that carries the advertising and makes life difficult for the legitimate operators.

How often do you get taken? Over the past eight years I've ordered something from just about every parts company that popped its head up over the horizon. The only problem I had was with a certain company that advertised surplus Switchcraft jacks and ended up sending me Japanese imports (worth far less than the jacks I ordered), and 6 months after I had sent my order, to boot! They cemented my unkind feelings by refusing to answer my letters. Six months later, no magazine was carrying their advertising, which confirmed my opinion was shared by others.

This is not to say you won't have problems; mail-order business employees have bad days, too, and dumb days, and sometimes they misplace an order or give you the wrong part. But these mistakes are forgivable; after all, we all make them.

Myth #2: Mail Order Can Sell Cheap Because There Is No Overhead. True, there is no store. But there are employees, ad budgets, rents on warehouse space, office space, city taxes, state taxes, bookkeeping, repair services, bank charges, insurance, social security payments . . . and the list goes on. But the important point for you to remember is that all of these have to be paid out of the customer's order. We'll see why this is important as we go along, since your actions can make a company operate more efficiently, and help keep costs down for you and other customers.

Ordering

First, order from *current* ads and catalogs. Prices fluctuate; some items are constantly going up, some are constantly going down (seen any $350 8080s lately?) Also, terms of sale sometimes change as a company changes, and there is no set policy on shipping, which varies from company to company. Sending in an order with not enough or too much money slows things down and increases expenses, and guess who ends up paying for it? So it may seem like a small thing, but courtesy dictates that you not send in for a special advertised in April two weeks before Christmas. If you want to find out whether an item is in stock, or if you want to check price, a phone call (remember the new 1 minute rates) or a post card if you're patient will do the job. And, of course, you can always circle the reader service cards in this and other magazines to keep abreast of the latest catalogs.

However, there will be times when you need more information about a product before making an informed buying decision. Again, write or phone the company, but take a few thoughts into account. Keep your questions as specific and to the point as possible; if you waste the time of the people at the company, they will not be able to do what they're paid to do – tend to the orders of paying customers. In fact, if the question you ask is specialized ("I have an antique Atwater Kent and would like to know if your part #45A3 is equivalent to their part #6543"), it is a nice gesture to include a self-addressed, stamped envelope, with your question written out, and a space for the answer. Then the company gets your request, scrawls an answer, and it's back in the mail the same day. Otherwise, the secretary has to be pulled off writing invoices to handle your request, then postage has to be affixed, the address double-checked, and so on. Remember that your requests are being paid for by the customers, so be considerate.

Now you know what to order. Next comes . . .

The Order Blank

First, make sure your

name and address are on the order! It really gets a company bothered to have an order for $76 worth of parts and no idea of where to send them, or who ordered them in the first place. In a case like that, the only hope is that the customer will write in and ask what happened to the order. Having your address on the check is not good enough, because most companies, when the mail comes in, verify that the amount of the check jibes with the order . . . at which point the check is immediately rushed to the bank to begin the clearing process, while the order moves on to the packing department. It is almost impossible for a large company to go back through a week's worth of checks to weed out one address. For similar reasons, if you have correspondence or questions that don't pertain to the order, put them on a separate piece of paper. That way your question will go to the technical service people, the order will get packed, and the check will get safely put in the bank.

Next, use the order blank the company provides; if that's not available, then type or print up your own, making sure you include 1) the name and/or stock number of the item desired; 2) the quantity you want; 3) a brief description of the item; 4) the subtotal for this item. If applicable, you might put acceptable substitutes on the line below. After you've listed all your items and prices, add the subtotals together and you're in business. If you need to add extra money, for insurance, handling charges, state tax, or whatever, list what it is, clearly. Don't just add on $2 and expect the company to know what you're doing it for. Is it tax? Or maybe you're ordering two catalogs. Be specific! When a packer is faced with dozens, maybe hundreds, of little pieces of paper in a day, each one of which must be perfectly packed – anything you can do to help speed things up is greatly appreciated. And that includes neat handwriting, too.

One way to make a company happy is to reference an ad if you're buying from an ad. Now I know people don't like to do this – sort of the "why should I help them, they're taking my money" attitude – but this is poor strategy, and here's why. Advertising is the *only* way a mail-order company can promote itself; there are no walk-in sales. And, advertising is not cheap. The money a company pays for ads has to come out of the profits generated by selling goods. A company with a good, effective, simple advertising program can sell for less and make more money if they know where their ads are doing the most good. This in turn keeps costs down for you. Money wasted on advertising that no one orders from only raises the prices of items you want.

The Postage Problem

In the semi-good old days, postage was cheap and the living was easy. Not so any more. The cost of postage, particularly for something heavy like a power supply, can turn a profitable product into a money sucker . . . which gets passed on to you. So, more and more companies are requesting postage or just tack on a straight percentage to cover postage and handling. This brings up a pet peeve of mine: the credit slip. Luckily, these do seem to be dying a slow death, and, unless the amount is very small, most companies will write a refund check if you include too much money for postage. If you get a credit slip, you can always request a check and send back the slip. Xerox your letter and credit slip, though, just in case there are any problems.

More and more companies are relying on UPS to ship their packages. This generally gives better service than the PO, but remember that UPS goes to your house and needs a street address. They cannot deliver to a post office box, unless, of course, you happen to live in one (cramped quarters, but cheap rent). If you do not include a street address, there will be delays: First UPS has to check with the post office to see if you have a local street address; then they send out a notice that informs you that you need to call UPS and complete arrangements for the delivery of the package. Save time and hassle – include your street address and PO box if you have one (for the mailing list).

There is an easy way to find out exact postage charges. Let's say you're ordering a 10 pound widget from a company in Florida, and you live in Ohio, and the widget is being sent via UPS. Just call up your local UPS and ask them how much it would cost to send a 10 pound widget to Florida from Ohio. It costs the same whether a package goes from point A to point B, or from point B to point A.

Minimum Orders

Here is what appears to be a classic example of screwing the little guy, or at least that's what I always thought. But look at it from the company's point of view, and from yours . . . it only takes a little more time to pack a $200 order than a $2 order. Let's say it takes 30 minutes total to process a single order. This comes out to at least $1.50 worth of labor at today's wages. So in the case of the $200 order, there's enough profit to pay for the cost of the processing. But with a $2 order, the company may actually lose money. A company that loses money has to make up the difference somewhere, and that difference comes out of the pockets of customers. To help defray this, most companies tack on a service charge for orders under a certain amount. It's a drag, I know; there have been many times I wanted to buy a single IC, only to find out it would be cheaper to buy ten. But you can't really blame the companies, at least not until people are willing to pack orders for free. Meeting minimum orders keeps the cost down for everybody.

Complaints

Eventually you may have to complain about something. But before you do, simmer down for a second and look at the situation objectively. People are only human, and mistakes do occur. Before you assume that a company is out to do you in, give them the benefit of the doubt. Letters do get lost or misplaced; water can spill on an order and make the ink run to the point of illegibility; handwriting can be undecipherable; in short, Murphy's Law is no stranger to the mail-order biz. Or maybe the product that was scheduled to be shipped January 1 is missing two ICs, which were promised by the supplier to arrive in November and finally show up in March. Be sympathetic. The object of a complaint is not to vent your spleen, or to take your aggressions out on some poor clerk, but to get a problem resolved. Don't accuse someone of dishonesty when their only crime may be ignorance or carelessness. It happens to all of us. First time, state your problem clearly and unemotionally; ask for their explanation. But – and this is an important but – although the odds are against it, you may be dealing with a thief. If you make a complaint, make at least two copies of your correspondence in case you need to complain again to the company or the authorities. If you don't get any action after two or three weeks (which should be enough time for the company to answer you), your next letter should be a little less courteous. Mention the date of the previous correspondence, and

show them you've been patient. My father taught me an almost foolproof way of getting answers from people who don't answer the first letter: Take a carbon copy (this is why you make two copies), and write across it, in the biggest letters possible, DON'T YOU ANSWER YOUR MAIL? It gets results.

But if it doesn't . . . the company has two strikes against it. Now comes your "last straw" letter. Document your previous attempts (". . . there was no reply to my letter of October 2 or November 15 . . . ") and get mad; you've earned it. Send a carbon to the magazine handling their ads, the Better Business Bureau, and possibly someone at consumer affairs in their state government. By the way, you can almost always get a street address for a business from a magazine that carries their advertising; they can't hide behind a PO box anymore. Don't forget the action line of local papers, too; although they may not be able to help in your specific case, they can refer you to the proper authorities.

Postal fraud is a very serious federal offense, and if you can't get satisfaction after all this pressure, it's time to get the government into the act. No doubt some young, hungry bureaucrat would love to sink his or her teeth into a nice fraud conviction. Just make sure you're right before you get heavy.

Repairs

From time to time you'll get a kit or a finished product that either doesn't work or doesn't come up to spec. The problem may be at your end or the company's; you won't know for sure until they've looked at it. So don't assume the design is lousy, or that the company is putting out a piece of garbage: You could have a cold solder joint, or the company's supplier may have slipped them a bad component, or anything. When dealing with a repair, first check the unit over thoroughly yourself, preferably on two different days and with a friend who also is familiar with electronics. Sometimes unfamiliarity with a unit prevents getting good results; how can you set up a unit to do something when you aren't quite sure what it's supposed to do? I run into this problem sometimes with the musical modifiers I design; people don't know what it's supposed to sound like, so if there's a bum IC and a distorted sound, they might assume the distortion is part of the effect. Sometimes a phone call to the tech person at the company is all that's needed; sometimes a letter, carefully describing the problem, can save you having to return the unit. So, always write the company before returning something. This isn't just to find out if others have had the same problem – sometimes a company will move and your package can end up in post office limbo; sometimes a company has a separate repair facility, and you could save time by sending your problem child directly to the repair facility. Also, a prior notification alerts the company to watch for your unit.

No company gets rich on repairs; one company I know has yet to charge for any repairs it has done, even those which were the customer's fault. They do enough business, and have a low enough rate of returns, that they can afford to do this. But not all companies can be that generous, especially when asked to repair a problem they didn't cause (bad wiring or soldering, for example). In many of these cases, if the builder, upon receiving the kit, had simply looked at it, recognized it as being beyond his ability, and returned it unbuilt, he could have gotten a full refund. But to botch a kit and then expect the poor company to make good – for free – is too much, and people can expect to pay for their mistakes. This isn't real good for their pride, maybe, but I have seen some genius computer programmers do lousy soldering jobs. If you're new to kits, start with something simple, then move on to the heavy stuff. Until then, buy your units assembled if you have doubts about your abilities. In many cases, the manufactured units also have more extensive warranties.

When you return the kit, pack it well. You don't want things to go from bad to worse in transit. Also, get a self-stick label and put your name and address on the piece of equipment itself (you won't regret it). Include in the package a thorough description of the problem, along with copies of any pertinent letters (don't say "this is a kludge"; be specific). You can save a repair technician lots of time by relating your experiences with the unit. In your letter, you might also mention that if repair costs are more than a certain amount (whatever you are willing to spend and feel is reasonable), to please notify you by post card. This way, if there is some really bad problem, you won't get any surprises. If it's any consolation, the companies I have seen are conscientious about repairs. Just as word of mouth is the best advertising, a non-working product is the worst. Plus, a company can gain respect by handling repairs in a prompt and intelligent fashion.

Summing Up

So far we've talked about all the things that can go wrong, and the nightmares that a mail-order operator or customer may confront. Lest you get the wrong idea, just as the majority of companies are ethical, so are the customers. Most are courteous, patient, decent people who trust the companies and have that trust confirmed by a company that acts likewise. Businesses are truly grateful for their customers, and frequently recognize the names of repeat customers. The point is that even the biggest companies are run by people; you're not dealing with nameless automatons at the other end. So you should know that your patronage is valued, and enjoyed, and they want to keep you as a customer. In this respect, you owe them one favor. If a company does something that leaves you feeling let down – whether it's a part that doesn't meet spec, a delivery commitment that isn't kept, or a kit that doesn't seem to work right – let the company know. Don't just write it off; you may be writing off something whose only problem is a hairline short on a circuit board. If it is a problem at the company's end (like a design flaw that only shows up under certain conditions), they *need* to know about it. Otherwise, they can send out hundreds of the things before someone says something and the error gets corrected. Companies do extensive prototyping, but even then, you can't cover all circumstances of operation. So if you're disappointed, speak up! But remember, you're writing to someone with feelings. Don't just say something is a piece of garbage; be specific, constructive, and objective. You will be doing everybody a favor . . . it's feedback for the company, an elimination of the problem for future buyers, and you've made a contribution.

I hope that all the preceding will help you get the most out of mail-order companies. I buy almost all my parts that way. I've had some bummers, but none that the company wasn't willing to make good (usually with profuse apologies). Treat them like human beings, and you'll be treated likewise. Help them a little bit by following these tips, and you'll simultaneously keep the costs down for yourself and fellow mad scientists . . . and score quite a few bargains in the process. ■

Social Events

from page 167

1302 West Main St., Owosso MI 18867.

CHENEY WA
JULY 16-17

The Spokane Amateur Radio Council (SARC) will hold its third annual hamfest July 16 and 17, 1977 in the Pence Union Building at Eastern State College, Cheney, Washington, about 15 miles west of Spokane. Pre-registration is $9.50, the same as last year, which includes the banquet on campus and many prizes. Numerous seminars, flea market and activities for YLs, XYLs and MYLs. Make pre-reg checks payable to SARC and mail to Jim Johnson WA7BWO, Drawer "A", Cheney WA 99004.

ALLENTOWN PA
JULY 17

The Tri-Club Hamfest will be held July 17, 1977 from 8 am to 5 pm at the Allentown Police Academy Pistol Range in Scenic Lehigh Parkway South at Allentown PA. Admission is $1.00 to all including sellers. Children are free. Talk-in on .34-.94 and .52.

EAST MCKEESPORT PA
JULY 17

The Two Rivers Amateur Radio Club will hold its 13th Annual Hamfest on Sunday, July 17, 1977 at the Green Valley Fire Department fairgrounds off U.S. Route 30 near East McKeesport. With the expanded parking facilities and the addition of a large flea market area, this event has become one of the largest of its kind in Western Pennsylvania. For more info contact John Roberts WA3SOZ, Secretary, Two Rivers Amateur Radio Club, McKeesport PA 15132.

BOWLING GREEN OH
JULY 17

The Wood County ARC Ham-A-Rama is Sunday, July 17, 1977 from 8:00 am to 5:00 pm, at the County Fairgrounds in Bowling Green, Ohio (about 25 miles south of Toledo). Free parking and admission. Donation $1.50 advance, $2.00 at the door. Tables $2.00. Talk-in on 146.52. Refreshments available. For further info write WCARC, 7929 Rudolph Road, Rudolph, OH 43462.

EUGENE OR
JULY 23-24

The Annual Lane County Ham Fair will be held on July 23-24, 1977 at the Lane County Fairgrounds in Eugene, Oregon. Registration donation will be $2.00. CW contest – fox hunts on 2 meters – swap and shop – commercial displays – prizes – YL craft table. A Saturday banquet at $4 per plate with musical entertainment from 7 pm until midnight. Free parking for RVs with limited free hookups. Advance registration contact Earl E. Hemenway K7KVV, 2366 Madison St., Eugene OR 97405.

SLATER MO
JULY 24

Indian Foothills Amateur Radio Club will hold their Hamfest and Communication Show on July 24, 1977 in Slater, Missouri at the city park. Activities include flea market for OM, flea market for XYL, equipment you wish to display, old – new, prize for best home built, KØRWG and wife musical entertainment, kiddie pool, swimming pool, and tennis courts. Talk-in 94, 52, 28-88, 3963 kHz. For information and registration: R. D. Beilsmith WOKNF, Box 74, Slater MO 65349, phone: (816) 529-2173.

NEENAH WI
JULY 24

The 3-F's A.R.C. Northeast Wisconsin Swapfest will be held Sunday, July 24, 1977 in Neenah, Wisconsin, 0900-1500. This annual event features inside tables, food and refreshments, bar and easy access from U.S. Highway 41. (Take Wisconsin Highway 114 exit east, then take first left to the Neenah Labor Temple at 157 South Green Bay Road.) Dealers will be there, an auction at the end of the day has traditionally offered super deals, and there's a special $3 rate for families. Talk-in on .94/.94. Admission $1.50, tables $2. Send advance reservations to 3-F's, Box 1032, Neenah, Wisconsin 54956.

FLAGSTAFF AZ
JULY 29-31

The Ft. Tuthill Hamfest will be held July 29-31, 1977. Ft. Tuthill is the historical name given to the Coconino County Fairgrounds located on Rt. 89A south of Flagstaff AZ. Hamfest activities include a transmitter hunt on 2 meters, exhibits and demonstrations on many facets of amateur radio. Technical sessions, special contests, and many other interesting activities. Talk-in frequencies will be 146.22/82, 146.52, 3.910 MHz. For more information write Ft. Tuthill Hamfest, PO Box 11642, Phoenix AZ 85061.

OLIVER BC
JULY 30-31

The Okanagan International Hamfest will be held July 30 and 31, 1977 at Gallagher Lake, 8 miles north of Oliver, B.C. Family fun, contests, flea market, and gabfest. KOA campsites available. No inflation prices. Prizes galore. Talk-in 34/94. For more information contact Phil Wilkinson VE7ALV, Naramata, B.C.

FARMINGTON NM
JULY 30-31

The Totah Amateur Radio Club, Inc., will hold its club field day on July 30 and 31, 1977, at the Four Corners National Monument (New Mexico, Arizona, Utah and Colorado). Mode: SSB and CW, bands – 15, 20 and 40. Club station call K5WXI.

NORTH MANKATO MN
JULY 31

The Mankato Area Radio Club will hold its annual picnic, swapfest and auction on July 31, 1977, between 10 am and 4 pm at Spring Lake Park in North Mankato MN. Talk-in 3.93, 146.94 and 146.25/85 MHz. Liquid refreshments will be available; bring your own dinner. For further details write the Mankato Area Radio Club, Box 1961, North Mankato MN 56001 or call Allen Windhorn at (507) 931-1349.

MACS INN ID
AUG 5-7

The 45th Annual WIMU (Wyoming, Idaho, Montana and Utah) Hamfeast is scheduled to be held at Macs Inn, Idaho, just south of West Yellowstone about 25 miles. This is one of the Rocky Mountain Northwest's largest hamfeasts and we would like to invite you to attend, and at the same time enjoy a tour through Yellowstone National Park. Advance registration is $6 (before July 1st). $7 at the Hamfeast. Please send all pre-registrations to WIMU Hamfeast, PO Box 30756, Billings, Montana 59107, c/o Ronald Conley, General Chairman, WIMU Hamfeast.

NEWBURGH NY
AUG 6

The Mt. Beacon Amateur Radio Club will hold their 4th Annual Hamfest on Saturday, August 6th, 9 am to 5 pm, at Stewart Field, Newburgh NY, inside hangar. Flea market and auction. Talk-in on 37/97 and 16/76. Rain or shine. Plenty of free parking. Admission $1, Tailgating $1, under 12 free.

JACKSONVILLE FL
AUG 6-7

The Bold City Hamfest sponsored by the Jacksonville Range Association will be held at the Jacksonville Beach Auditorium August 6-7. Vacation at our Hamfest – Florida's Friendliest. Visit our special "Solar" and "QRPp" forums. Send request for information and tables to Hamfest Coordinator, Jacksonville Range Association, PO Box 10623, Jacksonville FL 32207. For motel reservations call Ramada Inn toll free (800) 228-2828.

OKLAHOMA CITY OK
AUG 6-7

The 1977 Oklahoma Ham-Holiday will be held August 6 and 7, 1977 at the Southgate Inn Best Western, 5245 South Interstate 35, Oklahoma City, (405) 672-5561. Pre-registration $3.00, at the door $4.00.

FORT WAYNE IN
AUG 7

The Orignal FM Hamfest will be held Sunday, August 7, 1977, rain or shine, at the Allen County Police Reserve Center, 3022 Easterday Road, Fort Wayne, Indiana. 5400 square feet of air conditioned exhibit area, hot food and refreshments and prizes. Sponsored by Fort Wayne Repeater Association, Inc. Advanced registration $1.50 – call in to WA9EAU on 146.16/146.76, WR9ADI 146.52 or 52.525 MHz. Tickets at door $2.00. Taped route information available on 146.91 MHz. For more information and advance tickets please write: Fort Wayne Repeater Association, Inc., PO Box 6022, Fort Wayne IN 46806.

ANGOLA IN
AUG 7

The Steuben County Radio Amateurs presents the 19th Annual F.M. Picnic and Hamfest to be held on Sunday, August 7, 1977, at the Steuben County 4-H Park, approximately 2 mi. west and 2 mi. north of Angola, Indiana. Hamfest includes picnic-style B.B.Q. chicken and refreshments, inside tables for exhibitors and vendors, overnight camping permitted in park for those desiring to arrive Saturday, movies Saturday night, as usual. Tickets $1.00 by donation, advance registration not necessary. Talk-in frequencies 52.525, 146.52, 223.5, 446.0.

CANTON OH
AUGUST 7

The Canton, Ohio, Hall of Fame Hamfest (an official ARRL hamfest) will be held at the Stark County Fairgrounds on Sunday, August 7, 1977. Hamfest includes ARRL, Amateur Electronic Supply, Ken-Mar Industries, Omar Electronics, flea market, YL activities including games and drawings. Admission $3 at gate, $2.50 advanced. Under 13 years of age free. For advanced reservations contact: Butch Lebold WA8SHP, Box 3, Sandyville OH 44671. Advanced deadline July 30, 1977. For directions and information call: W8ZX on 146.19/79 (WR8ADE) or W8AL on 146.52/52. Mobile check-in prize!

PITTSBURGH PA
AUG 7

The 40th Annual Hamfest of the South Hills Brass Pounders and Modulators will be held on August 7, 1977 from noon until dusk at St. Clair Beach, Upper St. Clair Township, 5 miles south of Mt. Lebanon, on Rte 19. Swap and shop, picnic space and swimming for the family. Mobile check-in on 29.0 and 146.52. Information and pre-registration at $1.50 per ticket ($2 at door) from Rich Eckenrode, 1410 Bellaire Pl., Pittsburgh PA 15226. Vendors must register.

LEVELLAND TX
AUG 7

The 12th annual West Texas Emergency Net Picnic and Swapfest will be held in the city park, Levelland, Texas on Sunday, August 7. Bring your own picnic basket. Registration begins at 8 am. Lunch at 12:30. Swapping all day. Tables are provided. This family event is jointly sponsored by the Hockley County Amateur Radio Club and the West Texas Emergency Net. Mobile talk-in frequency is on 2 meters only, on 28/88, the Levelland Repeater (WR5AFX). Prizes will be given this year and a $2 donation will

be appreciated, but is not required for registration.

WASHINGTON MO
AUG 7

The Zero-Beaters ARC will hold their annual Hamfest on Sunday, August 7, 1977 at Washington, Missouri city park. Free parking, bingo, and many prizes. No admission fee or fee for parking in the trader's row. For info or tickets contact Marvin Holdmeyer WBØVPF, or Zero-Beaters ARC WAØFYA, Box 24, Dutzow MO 63342.

AMARILLO TX
AUG 12-14

The Panhandle Amateur Radio Club of Amarillo, Texas, is sponsoring the 1977 Edition of the Golden Spread Hamfest at the Holiday Inn West, Amarillo, Texas, August 12, 13 and 14. A grand prize and pre-registration prize worth over $800 will be given away. Activities include six big tech and info sessions, commercial exhibitors, flea market, free bingo for all, two hospitality hours, live entertainment, special activities for the ladies, and demonstrations. Pre-registration $3, at the door $4. Write Golden Spread Hamfest, PO Box 10221, Amarillo, Texas 79106 for pre-registration packet.

POLSON MT
AUG 13

Western Montana amateurs will sponsor an annual Mini-Hamfest on Flathead Lake, near Polson, Montana, on August 13, 1977.

CHARLOTTE VT
AUG 13-14

Burlington A.R.C. International Field Day will be held on August 13 and 14, 1977, at Charlotte, Vermont. Flea market both days 7 am Saturday to 5 pm Sunday. $3.00 early bird registration. $3.50 at door — write P.O. Box 312, Burlington, Vermont. Talk-in .01-.61.

PLAIN CITY OH
AUG 14

Union County Amateur Radio Club proudly presents Hamfest 77 to be held on Sunday, August 14, 1977 at Plain City Fairground near Columbus OH on St. Rt. 42, 4 miles south of 33. Hamfest includes large flea market, indoor tables for dealers, food available, free parking, and free overnight camping. Admission $1.50 advance, $2.00 at gate. Talk-in on 146.16/76. Check in (for prize) on 146.52. For more information write: Union County Amateur Radio Club, 13613 U.S. 36, Marysville OH 43040.

FORT WASHINGTON PA
AUG 14

The Mt. Airy VHF Radio Club (the Packrats) is holding its annual family picnic in the Flourtown Area of the Fort Washington State Park on Sunday, August 14, 1977 (rain date August 21). Talk-in W3CCX/3 on 52.525, 146.52, and 222.98/224.58 MHz.

BRISTOL TN-VA
AUG 13-14

The Bristol Amateur Radio Club, Inc., will hold the Bristol Hamfest August 13-14 at the Beacon Drive-In Theatre on Blountville Hwy., 9 am to 5 pm, Saturday, 9 am to 3 pm Sunday. Tickets $1, flea market space $2. Talk-in on 01-61, 28-88 and 3980. Contact Bristol Amateur Radio Club, Paul E. Booher WA4KAS, 1221 Jonesboro Road, Bristol VA 24201.

DESOTA IL
AUG 22

The SARS Hamfest will be held on August 22, 1977, in Desoto, Illinois. Program includes prizes, food, auction. No charge for flea merchants. For more information write Nick Koeningstein, 2009 Gray Dr., Carbondale IL 62901.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	14	7	7	7	7A	14	14	14	14	14
AUSTRALIA	14	14	14B	7B	7	7	7	7	7	7B	14	14
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	14	14
ENGLAND	14	7	7	7	7	7	7A	14	14	14	14	14
HAWAII	14	14	7A	7	7	7	7	7	7A	14	14	14
INDIA	7	7	7B	7B	7B	7B	7B	14	14	14	14	14
JAPAN	14	14	7A	7	7	7	7	7	7	7A	7A	14
MEXICO	14	14	7	7	7	7	7	7	7A	14	14	14
PHILIPPINES	14	14	7	7B	7B	7B	7B	7	7	14B	14B	14
PUERTO RICO	14	7	7	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	7A	7
U.S.S.R.	7A	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	14	7	7	7	7	A	14	14	14	14
AUSTRALIA	14	14	14	14B	7	7	7	7	7	7B	14	14
CANAL ZONE	14	14	14	7	7	7	7A	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7	7A	7A	14	14
HAWAII	14	14	14	7	7	7	7	7	7A	14	14	14
INDIA	14	7A	7B	7B	7B	7B	7B	7B	7A	7A	14	14
JAPAN	14	14	14	7	7	7	7	7	7	7	7A	14
MEXICO	14	7	7	7	7	7	7	7	7	7A	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	14B	14B	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	14	14	7A	7
U.S.S.R.	7A	7	7	7	7	7	7	7A	7A	14	14	14

WESTERN UNITED STATES TO:

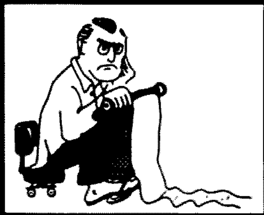
GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7A	7A
ARGENTINA	14	14	14	7A	7	7	7	7A	14	14	14	14
AUSTRALIA	14	14A	14A	14	7A	7	7	7	7	7B	14	14
CANAL ZONE	14	14	7A	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7A	7	7	7	7	7	7	7A	7A	14	14
HAWAII	14	14	14A	14	7A	7	7	7	7A	14	14	14
INDIA	14	14	14	7B	7B	7B	7	7	7A	14	14	14
JAPAN	14	14	14	14	7	7	7	7	7	7A	14	14
MEXICO	14	14	14	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7A	7	7	7	7	7	14B	14B	14
PUERTO RICO	14	14	7A	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7B	7B	14	14	14	7A	7
U.S.S.R.	7A	7A	7	7	7	7	7	7A	7A	14	14	14
EAST COAST	14	14	7A	7	7	7	7	14	14	14	14	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

1977			JULY			1977
SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 G
3 G	4 G	5 G	6 P	7 F	8 F	9 F
10 P	11 F	12 P	13 F	14 F	15 F	16 G
17 G	18 G	19 G	20 G	21 G	22 G	23 F
24/31 F/F	25 F	26 F	27 G	28 G	29 G	30 F

AUGUST 1977
$2.00

73 AMATEUR RADIO



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

ARE YOU MISSING SOME GOOD ARTICLES IN KILOBAUD? YES!

Our policy is to make sure that articles are not reprinted between *73* and *Kilobaud* . . . and this means that you are missing a lot of very important material if you are not getting *both* magazines.

The articles in *Kilobaud* cover a wide range of topics, centered on the new microprocessor chips . . . articles on wire-wrapping, how memory works, the new printers, handling ICs, surplus keyboards, video terminals, video generators, and a lot of stuff on the various microcomputers and programs for them . . . a whole lot.

Most of this material will be published just once, so you'll need your back issues of *Kilobaud* to use as a library for reference . . . on business programs, games, operating systems, interconnections of popular boards, etc.

You'd best send in your subscription now . . . before this new scene gets too far away from you. It's going to be big . . . and fun . . . and there is more opportunity here than in anything we've seen in the past.

Send in your subscription to *Kilobaud* and find out why it is the most popular small computer magazine out. It's just as packed with good articles as *73* . . . and you already have the background to understand them.

OPENINGS AT 73

The staff at *73* is at an all-time high . . . and still more are needed to pursue the expanding magazine, book, and computer aspects of the business. Help is needed in the form of a dyed-in-the-wool amateur with writing and editing experience, to help with the rapidly growing book department. Help is needed in drafting. We need someone to work at *73* and draft the schematics for the magazine. Computer programmers and technicians are needed to help with the development and production of business and educational programs for microcomputers.

Oddly enough, *Kilobaud Magazine* may surpass *73* in revenues within its first year of publication, and the sale of computer programs is expected to soon dwarf both magazines in sales.

Our first big exposition, COMPUTERMANIA™, will be held in Boston in late August, and is the first of many such expositions we'll be running. This show is budgeted at $350,000, so it is a big undertaking. Further shows are being planned for San Francisco and other cities, using the team which will be putting on COMPUTERMANIA. Not bad for a tiny group of people in New Hampshire who are having the time of their lives.

Nishi, Sherry, and Wayne in Los Angeles.

CODE LEARNING SYSTEMS STUDIED

A recently released study from the University of Southern Illinois showed the results of a series of code learning tests. The conclusions to be drawn from these tests were inescapable.

This was essentially a test of the *73* system of learning the code vs. the system used by most other code courses (such as those from the ARRL). The main difference is that the *73* system starts beginners out with the sound patterns of code sent at 13 words per minute, while the others start out with the individual characters sent at a very low speed and change the sound patterns as they speed up.

The result, as has been noted in *73* before, is that the *73* code tapes do not have the pronounced learning plateau to be surmounted that other tapes do. Thus the *73* tapes require substantially less time for mastering the code.

The faster learning with the *73* code tapes results in a much higher percentage of Novices being licensed, and far fewer dropouts in the Novice courses run by clubs. Clubs running Novice or Tech (or General, for that matter) programs should make note of this and use the *73* Morse code tapes.

I/O MAGAZINE

The first hobby computer magazine in Japan got started last November. The editor and publisher is a very active ham and computer fanatic by the name of Nishi. Where did the magazine's name come from? From the I/O section of *73* — which he's been reading for years.

Nishi came up to visit *73* HQ last winter — a most interesting and entertaining chap. It is a little unsettling to see what Nishi has done so far . . . and he's only 21 years old! He's been into computerized music for several years

Continued on page 16

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

For eleven years it was known as the Lockheed Burbank Hamfest, a nice little get-together sponsored by the Lockheed Amateur Radio Club/ Lockheed Employees' Recreation Club. I have always enjoyed it, as it gave me a chance to eyeball many of my peers without having to travel a few thousand miles to do so. Each year, though, I noted that it drew more and more attendees and a greater number of exhibitors — in general, it showed a definite growth pattern.

This year, renamed the "12th Annual Los Angeles Amateur Radio Convention" by its sponsors, the old Burbank Hamfest reached the status of a "great one" in your reporter's opinion. Along with Dayton and Atlanta, it truly fulfills the goal it has set for itself: to educate and entertain. Like Dayton and Atlanta, the L.A. convention features exhibits both of manufacturers and of the special interest variety, such as one depicting an early amateur station. Also like both Dayton and Atlanta (and unlike SAROC), there are ongoing symposia on just about any topic that you could dream of. At this convention, the sponsoring organization makes sure that everyone in attendance leaves with a feeling of satisfaction. Moreover, if someone happens to win a prize valued at more than $30, he need not be present to claim it. All prizes whose value exceeds that figure are shipped to the winner. That's a comforting thought when the grand prize happens to be an FT-101EI

You might get the idea that I enjoyed my visit to "beautiful downtown Burbank." It's really more than that. I know a lot of the people involved in putting on this annual show. I have had the opportunity to sit with them and speak with them, and I know full well the measure of total devotion that goes into making each year's Los Angeles Amateur Radio Convention a greater success than the last. It's a convention put on by hams for hams, and the level of pride is evident. Whether you are an avid DXer, an OSCAR enthusiast, or are interested in finding out about the latest equipment available to locate the turkey who's jamming your favorite repeater, you will find something of interest in Burbank. I predict that next year will be even better.

For information on next year's "13th Annual Los Angeles Amateur Radio Convention," write to the Lockheed Amateur Radio Club, 2814 Empire Avenue, Burbank CA 91504.

Who said 220 never has band openings! As I sat here writing this, I received a call via WR6AWQ from Warren Andreasen N6WA/WA6JMM, who related the following: The other evening, while taking advantage of the well-known Southern California "inversion," Warren was in QSO with Lon Albright W6SLF on 223.5 MHz. Lon happens to be located in San Diego, which makes for a 90 mile or so path (which in itself is not bad, especially since Warren's abode is in the center of the San Fernando Valley). Shortly after signing with Lon, Warren noted another conversation on 223.5. It was in Spanish, and each transmission ended with the telltale "crash" of some form of relay device (such as a repeater). Since he neither speaks nor understands the Spanish language, Warren could only make a supposition as to what he was hearing, based upon his beam heading and his working knowledge of 220 activity. His conclusion was that he was hearing the La Paz, Mexico, police department, which operates on 223.5 — and also happens to be about 1,000 miles away. If such was the case, then N6WA/WA6JMM probably holds the unofficial 220 MHz SWL DX record, thanks to a hand from Mother Nature.

Month after month I keep forgetting to do something, so before I forget again, here goes. Question: What's an FM-144DX? Answer: It's a mistaken nomenclature for what is really an FM-28, manufactured and distributed by Clegg Communications. The real question, still unanswered, is how I came to make the mistake in the first place. To date I do not know. My notebook from SAROC is chockfull of goodie information gathered, and includes the notation "New Clegg 2 meter radio — FM-144DX — refer pictures two and three roll B." However, after submitting the article for publication, I happened to call Ed Clegg to set up an interview appointment for an article soon to appear in this magazine, and he informed me that my model designation is not exactly the correct one. Even funnier, since the article had already appeared in print, he was receiving inquiries as to what an FM-144DX was. To compound matters, I mentioned the whole thing to Bill Orenstein KH6IAF (who happened to spend a lot of time playing with the radio at SAROC) and he confirmed again what Ed had already told me on the telephone.

Three weeks later, along with Larry Levy WA2INM, I was in Ed's office holding in my hand the very same radio that I had played with at SAROC — clearly it reads FM-28. How and where I ever came up with "FM-144DX," I will never know. I am going to "cop out" on this one and blame it on too much Las Vegas night life or something like that. However, those of you who already own one of these beauties know that I was correct on two points: It is a radio that does everything the advertisement promises, and it's available at a price most any ham can afford. It also happens to be backed by one of the finest and most reputable manufacturers in the amateur radio field today: Ed Clegg W3LOY. That in itself means a heck of a lot!

Many of you write to ask why I do not spend time discussing all the rulemaking proposals flowing forth from the FCC in Washington. It's simply a matter of publication lead time. What you are reading today was written at least sixty days ago, and any discussion of pending legislation written now would be a moot point by the time you read it. However, here is a brief synopsis of the points I covered in my official replies to a few of the dockets and RMs.

On repeater/remote deregulation, I felt as follows: (A) The Commission must realize that a specific difference exists between the concepts governing a repeater and those governing a remote base. While the hardware might be similar, the methods in which they function are totally dissimilar and the purpose and/or objective of each is different. (B) Remote bases must be considered as a separate entity, and regulations governing such operation must be separated from those governing repeaters — to give the remote owner the freedom necessary to experiment and thereby advance the state of the art. (C) While repeaters are an important entity, they are but one aspect of VHF/UHF operation. Therefore, I favor retention of repeater sub-bands on certain of our bands to protect non-relay format interests that share the spectrum from encroachment by relay format communication. However, on ten and six meters I favor total deletion of sub-bands, to stimulate activity in that spectrum and to relieve the overcrowded conditions on two and in

Burbank's not as big as Dayton, but it has a good flea market nonetheless.

Is it the 1920s? No— it's W6HS exhibiting an amateur station of that era at the 12th Annual Los Angeles Amateur Radio Convention.

places on 220 and 450. In regard to ten meters, I requested that the Commission act to give Technician class licensees radiotelephone privileges for that band (specifically, narrowband FM, again to help stimulate growth on ten and as a method of preventing encroachment by the "HF" – read that as unlicensed CB – crowd). Sub-bands do provide a significant value on two, 220, and 450, where both relay and non-relay communication share significant amounts of spectrum, and with slight expansion to both two and 450, I favor retention of sub-bands there. (D) I favor deletion of the need for specialized auxiliary link, control link, etc., licenses; I agree with the concept of one license with most privileges contained therein. However, I do favor retention of the specialized repeater license (along with its specific "WR" designation). Having the blanket right to erect and operate a repeater inherent in every amateur license could, and probably would, lead to a multitude of unsanctioned and uncoordinated repeaters, and would thereby lead to an overall degradation of the amateur service. (E) I requested that all deregulation along these lines be instituted on a specific time schedule over a period of two years, with the most pressing problem, that of remote base deregulation, taken care of immediately. (F) Amateurs could prove their ability to administer their own affairs through the formation of a National Voluntary Band Planning Council, made up of elected officials representing each area, mode, and special interest, which would develop lines of communication to the FCC for the purpose of providing feedback to the Commission as to how well deregulation is progressing. Such a council would, in effect, replace FCC regulation with voluntary self-regulation.

In a nutshell, that's a brief synopsis on repeater/remote deregulation. If this were 1969 or 1970, I probably would be looking at this a lot differently. However, this is 1977 – there are over 3,000 systems on the air and many places such as L.A. have plumb run out of room on two and 220. We now face a threat to our spectrum from those who flaunt the law and are slowly inching their way toward 10 meters. If we are to survive and prosper, we must "get it all together" – get off our individual ego trips and make deregulation work toward our own advantage on a collective basis.

It would be nice to say "take all the rules away today," but in reality any society without some form of governmental structure is sure to crumble. History more than proves this out. To many of us, amateur radio is more than just a hobby – it's a dedication in our daily lives. While some of the views I expressed in my reply comments on this matter may not be popular, I believe that they make sense in that they systematically lead to a transfer of power from governmental regulation to self-regulation, and provide some semblance of protection for the sanctity of our spectrum.

De WA3ETD

John Molnar WA3ETD
Executive Editor

CONTEST RESULTS

The results are official! The "*73* Call For Papers" competition ended on May 15 with many entries. You may recall that the intent of the writing contest was to discuss one of the many facets of ham radio in an article appealing to the beginning enthusiast. The articles submitted encompassed subjects ranging from contest operating to the conversion of old receivers. The winning article is by Richard R. Parry. His effort, "So You Want To Get Into RTTY," explains radioteletype in concise, easy to understand terms, and is loaded with pictures and diagrams. Richard's article will appear in the September issue of *73*, an issue devoted to RTTY. Look for it. Congratulations, Richard, and thank you for the other articles, authors! They will be considered for publication and processed normally.

Speaking of special issues – keep your eyes on *73* for the next few months. As you can see, the August issue features antennas and related subjects. Summer is the time to build antenna systems. Hopefully one of the feature articles will provide the stimulus to build the system you've been putting off "until next weekend." Once the antenna farm is complete, you will need some gear for the shack; why not try a new mode? More and more hams are getting into RTTY – give it a try! The September issue will feature RTTY, and some super articles are on tap. Everything from message generators to computer-controlled TUs will be covered. No one remotely interested in RTTY will want to miss this issue! November is OSCAR 8 (AOD) time; that means time for another *73* OSCAR special issue. Our last satellite special (July '75) was a sellout – don't miss this one! About your subscription – don't let it expire now, not with three blockbuster specials coming. Send in the renewal card, and make sure your friends do the same – if you lend one of the special issues, the chances of never seeing it again are good!

CB TO 10

The response to the continuing series of CB to amateur conversions has been fantastic. We presented several "band plans" in hopes that reader response would allow us to promote one of them. Check Ray Barnum's plan (June '77) and Wilder's (May '77) and let us know which you favor. Several additional conversions are on the press. Some readers have indicated a problem with information provided in Bob Wilder's article, concerning the Cobra conversion. It appears that a simple crystal switch will not effect the desired change. Refer to "Letters" for information by WB3CJI concerning the Cobra modification. Watch for additional CB to amateur band articles.

TIPS FOR AUTHORS

I have several suggestions to pass along to present and future *73* authors. Most of the submitted manuscripts look good; however, a few problems prevail. Please type your effort! After reading several dozen letters, product releases, articles, and reviews, a handwritten manuscript can be murder. Most are sent back for typing. Editor's eyesight aside, there are practical reasons for typing. Our typesetter must produce magazine type directly from your manuscript – why make her guess at the handwriting, especially in a technical article?

Photographs: Good pictures make a fine article better and increase the size of your check. Please do not send Polaroids or Instamatic shots. The photos you send are converted directly into magazine pictures (halftones); thus the original quality is important. We would like 5 x 7 black and white pictures if possible. Negatives are not required – keep 'em in your file.

Please write your name, address, and call on each manuscript page and photo. This allows us to keep track of your article.

TIPS FOR READERS

Several authors have complained about receiving large volumes of mail concerning their *73* article. This is fine and to be expected, but when requests for information come without an SASE, it's a bit much! Imagine receiving fifty questions about an article and having to provide fifty stamps and envelopes, as well as the time required to answer queries. The SASE is a required courtesy when corresponding with authors. Give them a break! The same applies when writing *73* for information. We are not really equipped to answer technical correspondence – that's what "Ham Help" is for; however, we do our best when possible. SASE is required!

NEW TRENDS – 10 GHZ BECOMES ACTIVE

My experiments with the Gunnplexers by Microwave Associates are continuing. The microwave front end requires a 30 MHz i-f and FM detector to function, as well as power and control voltage. Modulation is applied to the Gunn oscillator by coupling audio to a varactor diode which is an integral part of the transceiver. A number of schemes can be used for the 30 MHz i-f. My system consists of VHF Engineering receiver modules and a home brew 30 MHz to 10.7 MHz converter. The VHF modules are a natural for the application, as a complete receiver can be custom-tailored using the receiver strips. I will describe my system in detail in a month or two. If you have done any experimenting with microwaves or Gunnplexers, let me know. Many *73* readers are interested in UHF and microwave experimentation; if you're already into something, pass along your knowledge to the beginners!

Concerning UHF: I made a trek up Pack Monadnock Sunday, loaded with gear for 432-450. The rigs consisted of the Icom 30A FM transceiver, KLM Echo 70 SSB combo, and the VHF Engineering BLE 10/80 power amp. The UHF antenna was the KLM 27 element log, which allowed operation from 432 to 446. The DX results were a bit discouraging. I guess not many people sit around on Sunday afternoon monitoring 446.0 simplex, as only a few stations were worked. I did discover a large crop of repeaters up there, and activity was light. If anyone needs New Hampshire on UHF, drop me a line and we can set up a sked, either on 446.0 or 446.5 FM, or on SSB down below. I have the capability to stack another 27 elements, and should be able to work into New York if someone is on the other end. If you have not tried UHF, you're missing something – especially if the requirement for dependable line-of-sight communication or control is present. Authors take note – your UHF articles will be well received. Keep the beginner in mind when you start writing about UHF and microwaves! Have fun and keep us posted!

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Last month I described how letters, figures, and special machine functions are encoded for dc transmission. Recalling that all characters are represented as five pulses, this month we will investigate techniques for sending encoded information by radio.

A CW transmitter can be keyed directly by the TTY pulses. The result is called "ON-OFF" keyed RTTY. Fig. 1 illustrates this technique. Subsequent figures are also grouped here for comparison. ON-OFF keying was, in fact, the earliest method used to transmit TTY over the air. Advantages are related to simplicity in transmitting: Merely hook the TTY to the key jack! Receiving is also easy, and reception techniques for all modes discussed will be covered in a subsequent column. Disadvantages relate primarily to interference susceptibility and fading. A nearby CW signal can wipe out an ON-OFF TTY station, and fading can remove whole letters.

A better way to send TTY is by presenting a constant signal for the MARK state, and changing it in some way for representation of the TTY signal. Changes may be introduced in amplitude, frequency, or by a superimposed modulating waveform. Direct amplitude modulation with the TTY approximates ON-OFF keying, with all its attendant flaws. Some fancy forms will be discussed at the end of this column, but the two most used ham methods are FSK and AFSK.

In FSK, frequency shift keying, a carrier is shifted in frequency to correspond to MARK and SPACE. Fig. 2 diagrams this nicely. This system, as are all to follow, is a redundant system. That is, information is obtainable by looking at either MARK or SPACE, even in the absence of either one. (Remember that in ON-OFF keying, if you lose the SPACE, you have a steady MARK, and if you lose the MARK, you have nothing.) Transmission of FSK is accomplished by shifting the transmitter vfo in step with the TTY, and reception, by decoding either or both the MARK and SPACE. Done properly, this system is very immune from interference, and, since fading normally affects only one of the MARK or SPACE frequencies at a time, proper use of the built-in redundancy makes fading no problem either. The frequency shift involved may be anything from kilohertz to fractions of a Hertz, which might be more properly called "phase shift." In amateur circles, "standard" shifts are 850 Hz (wide, old) and 170 Hz (narrow, new).

Unfortunately, FSK presumes very stable transmitters and receivers. The level of shift is less than one kHz, and drift in the vfo of any significant degree would be intolerable. VHF transmitters, especially early ones, could not maintain this degree of stability. Use of an audio tone, shifted in frequency in a manner similar to FSK, became the standard on VHF links. Take a look at Fig. 3. This AFSK is more useful than it appears at first glance, and some of its uses will be covered in future columns.

Finally, as promised, some erotica — I mean, exotica! What if I send a pulse during each 22 ms "window" representing a TTY bit? By changing the pulse's amplitude or position within the window, I could encode MARK and SPACE with a decodable system. Fig. 4 shows what I mean. Such Pulse Amplitude Modulation (PAM) or Pulse Position Modulation (PPM) is not used much in the amateur service, but it is neat, huh?

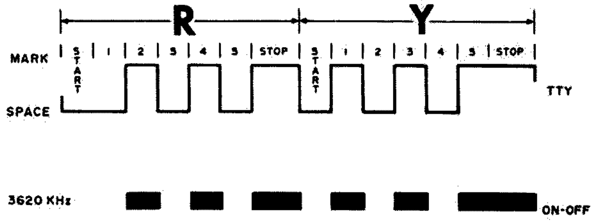


Fig. 1.

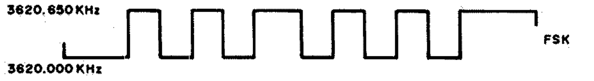


Fig. 2.

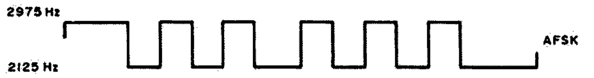


Fig. 3.

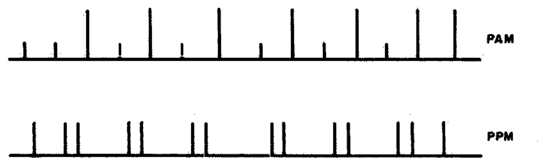


Fig. 4.

Next month we will discuss the hardware necessary to receive a RTTY signal. Details concerning the Model 15 printer will be provided, as that machine is widely available at reasonable prices. If you are interested in getting started in RTTY, it would not be a bad idea to shop around for a usable Model 15. The machines are available at flea markets, as well as through commercial sources. Details will be provided in future editions of the RTTY Loop.

NEW ENGLAND RTTY REPEATER

Best of luck with "RTTY Loop"! I hope it will be a success. You'll be hearing from me from time to time as I am an avid RTTYer. I'm also net control for a local 2 meter TTY net. We meet each Wednesday at 9 pm on 147.69/.09 (WR1ABN) at 60 speed, 850 Hz shift. We exchange pictures, and a couple of the boys have microprocessors which we play with on the air. Perhaps you could mention us in your column and help "spread the word."

Dick Peters WA1PWF
27 Lafayette Lane
Norfolk MA 02056

If your group is involved in a unique RTTY application, let 73 know. Keep your letter short. Each month, space allowing, we will publish as many letters as possible. — J.M.

Ham Help

To Whom It May Concern: HELP!!

I have been trying to get into SWLing for the past year now and have been frustrated at every turn. I have studied the equipment catalogs and such and the prices have taken me aback somewhat. I do not know what equipment can be had that will do a good job and keep within a self-imposed $300.00 budget. Yesterday I picked up your mag (the first one I had ever seen!) and found it helpful. Your article on receivers was outstanding! But alas, where might I find excellent used quality equipment at a good price?

My knowledge of antennas is kaput for the present. The space I have for an antenna is severely limited except for the possibility of a longwire type. I am not familiar with any other type I can use.

Sorry if I have sped a deluge of questions your way, but I'm a babe in the woods not wanting to be taken at every turn and wanting to learn more about this new-found hobby. I am currently limited to a GE 10-bander my wife bought me last year for my birthday and hence my interest was born!

Any and all help will be deeply appreciated.

Robert B. Goltare
4100 N. O'Henry Blvd.
Box 126, Oakwood Forest
Greensboro NC 27405

I am a freshman college student who is majoring in Electrical Engineering and is disenchanted with Citizens Band radio communications. I currently hold only a CB license, but I am independently studying on my own for the Technician license so that I can operate on 2 and 6 meters. I would like to meet, contact, or correspond with amateur radio operators or clubs in my area who can fill me in on local testing procedures, 6 and 2m radio communications (especially repeater operations). I would also like to know if there are any clubs or schools giving Morse code classes.

I also need a schematic for the Heathkit 6m transceiver (HW-29), the original which has only 4 tubes (6AU8, 6AN8, 12AX7, and 6AQ5), not the later type of the same model which has an additional suffix "A", as in HW-29A, which is the only schematic I was able to obtain from the Heathkit Co.

Raymond Tom
1646 West 87th St.
Chicago IL 60620

You sure have a fine magazine there, especially since it gives everyone an equal chance to voice an opinion whether you there at the plant agree or not.

Well, this letter is not meant to mound praise on your magazine, even though it is a very good one, but to ask you if you would please place in ham help that I am looking for alignment info and a schematic to photocopy for a Heathkit AR-3 and a Bendix FM transceiver converted to two meters, model no. MRT-6FB.

Your diversification will keep your magazine on my renewal list. Again, thanks for a very fine magazine.

Robert D. Houlihan WB9WPE
497 E. Second St.
Galesburg IL 61401

I need an instruction manual and schematic for a Gonset Communicator IV 6 meter AM xcvr, model #3342. Will buy or copy.

Bill Fletcher WB9UYE
Rt. 1, Box 190-B
La Crescent MN 55947

New Products

THE DENTRON MLA-2500 LINEAR AMPLIFIER

Dentron Radio represents the kind of American success story you often read about. It began just three years ago in a basement workshop, but Dentron today occupies a modern plant with over 60 employees. Dentron products are in use all over the world in applications just as varied as the languages of the customers. The company has made its name on tuners and antennas, not to mention the 160m transverter that Dennis Had K8KXK designed and built in his Ohio basement workshop three years ago.

The company has taken a different approach in developing its product line than most. They've gone from the transverter and matching antenna tuner to a complete line of antennas (fully assembled and ready for installation as they leave the factory), a complete line of tuners, to amplifiers, and, before year's end, to HF transceivers. There has been a refinement process along the way, and with each new product, Dentron has opened another door, another market.

With the introduction of the MLA-2500 amplifier, for example, the company found itself swamped by orders from (among others) the US military (SAC), foreign government and commercial interests, the medical research community (which uses the MLA to produce rf at continuously controlled levels for cancer treatment), the welding industry, researchers probing the separation of iron ore, HF satellite ground linking, and, of course, the amateurs for whom the amplifier was designed in the first place.

Demand for the MLA has far exceeded supply at Dentron dealers across the country, and it is expected that that situation will continue for some months to come. (By the time this issue reaches you, however, availability should be up.) But why do so many people want MLAs? Read on.

The MLA-2500 weighs just over 45 pounds (including full duty built-in power supply), measures only 5 inches high by 14 inches wide (about the same width as the popular Heath SB-200 1200 Watt amplifier) by 14 inches deep. The MLA is surprisingly small in size for an amplifier of its class (2000 Watts in the amateur service, 2000 plus Watts in commercial and military service), and runs as if the 8875 finals were somehow water-cooled, instead of by forced air. It is significant to note that at no time in more than two months of testing did the MLA ever reach more than a "warm" temperature; that is, the MLA actually ran cooler than any other piece of station equipment (exciter, receiver, scopes, and so on). Not even after an afternoon of SSTVing on 20m was the MLA observed to be abnormally warm, and the main comment from visitors to the shack (aside from finding the aesthetics of the amplifier very pleasing) was how surprised they were that the unit ran so coolly. As can be seen in the photograph, nearly all of the system's cooling action is directed towards the tubes and associated output stages, while the power supply, control, and relay boards must rely on circulated air, independent of the forced air system on the 8875s. A dual speed cooling system is used, with automatic override of the slow speed function when tube plate temperatures approach unsafe levels (over 200 degrees C). Even that automatic function can be overridden through a "continuous duty" feature, which locks up the cooling system at maximum. Dentron recommends use of the MLA in a tilted-up position, through the use of a hinged bail between the front feet. A 19 inch rack panel mounting kit is also available.

Another reason for the MLA-2500's quick acceptance and popularity is performance. It takes only 36 Watts of drive to produce a full kW input (or 65 Watts to yield 2 kW PEP for SSB operation) on 160 through 10m. Efficiency, according to checks with

The Dentron MLA-2500 160-10m linear amplifier. The MLA offers modular construction, with a two step forced air cooling system.

an outboard Bird monitor, is outstanding, with over 700 Watts out at 1 kW input, making for 70% efficiency. (Lab tests showed that the MLA's efficiency went up with increased power inputs; e.g., at 1336 Watts dc input, the MLA yielded 1000 Watts output, for an efficiency figure of 74%.) At 1 kW input, then, the MLA is running at less than half its capabilities, thus accounting for its remarkable tendency to run very quietly and coolly for hours, even days, on end. It would be fair to say that the MLA is well suited for contest operations, and our tests certainly prove that to be true.

The power supply is one of the MLA's unique features. Offered standard is a low profile 24½ pound transformer designed especially for the MLA. On rural mains, the MLA produced 2300 V worth of plate voltage. A rear panel cover allows access to line fuses and the transformer primary taps for switching between 234 and 117 V ac service, although 234 V ac 15 A service is recommended for this class of amplifier. An important note here is that the MLA produces extremely high voltages, and must be treated with care. Aside from a direct line for the 234 volt service, sufficient grounding is important, and no attempt should be made to defeat Dentron's circuit breaker system, which cuts all voltage to the unit if the covers are removed. The Operating Manual recommends waiting at least five minutes before getting into the unit for cleaning or adjustment, so that the electrolytic capacitors have fully discharged through their bleeder resistors. As with all the other circuitry in the MLA, the power supply is modularly constructed, allowing for easy removal of the associated boards for service.

Tuning the MLA is made easier because Dentron used twin 3 inch meters, one for output in Watts, the other a multimeter for measuring plate voltage, current, and grid current. Whether the MLA is "in" the line or not, the output meter functions, so it is easy to tune your exciter and antenna tuner for the specified drive and flip the amplifier into the line for final tuning. There is little doubt in tuning the MLA; it's an easy, quick process of tuning and loading up to the desired power input. One cannot forget, however, that the MLA is *designed* to be run far from its maximum limits, not unlike a finely tuned sports car capable of much more than the 55 mile per hour speed limit. Enough said?

To account for the easy tuning of the MLA, one only has to check out the tank circuitry. Dentron tried a number of different designs, including silver-plated copper tubing, but found a teflon covered conductor of 19 silver-plated wires worked the best. Dentron engineers discovered that their design allowed for closer windings, thus improving harmonic suppression, which is rated by the factory at better than 55 dB at full power on all bands. There is also the side benefit of extra protection from the use of teflon. Dentron says tests show that the system is especially good in high humidity or salty environments.

Shipped from the factory, the MLA comes in two cartons – one for the main unit, and a smaller package for the 8875 finals, the delay tube, and plug-in control relay. All four devices are easy to install after removing four top cover screws and the cover itself. If you carefully follow the instructions in the MLA Operating Manual, the 8875s will go in easily, but due to their short, narrow pins, it can get a bit tricky. Best idea is to follow the manual!

All adjustments, wattmeter, ALC, and power transformer taps, are accessible without removing the MLA's covers. All controls are factory aligned, and I did not find it necessary to readjust them. Operating the MLA, in fact, was about as troublefree as possible ... there really wasn't a glitch encountered during our test period.

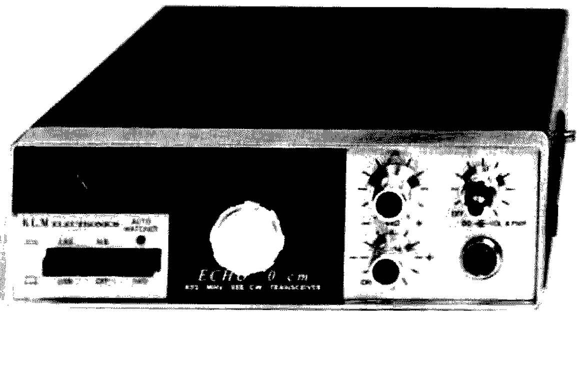
Operating the MLA is very satisfying. One of our editors put it this way: "Using the MLA-2500 in conjunction with my Heath HW-101 was one of the most pleasant experiences I have had in ham radio. It was nice being told over and over again that I had one of the best and strongest signals on the band, be it 40 meters or 15. This was all done with the use of only dipole antennas, so there was little that could be credited with the great signal strength reports except the amplifier. The MLA is also very easy to operate; in fact, it is so easy to use that at first I thought I must be forgetting something. I wasn't, however, because the signal was very definitely there."

My use of the MLA began with the last ARRL DX phone weekend, and its performance left me reeling. Using wire beams, slopers, and dipoles, I worked non-stop for the entire weekend without once turning off the MLA. Nearby stations running multi-element antennas checked with me several times to confirm I was running wire antennas, and one fellow actually came over to see for himself. (I attribute that mostly to the fact I'd been running substantially less power in the past.)

Power, especially when you're dealing with an amplifier like the MLA, can get away from you. I found myself running the amplifier for the sake of running it, instead of saving the power for when it was truly needed. After the excitement had worn off to some extent, I began to spend more time on CW, running 100 Watts or so on first calls, and then switching to the MLA for ego recovery purposes. It never missed!

On SSTV the MLA was a great improvement over the SB-200 mentioned earlier. Picture quality was reported much less susceptible to QSB and QRM, in direct comparison to the smaller amplifier. The interesting thing was that the MLA, running twice the power continuous duty, ran much, much cooler than the SB-200.

Considering what's ahead from the FCC, it appears the days of the super-amplifier may be numbered. Amplifiers like the MLA, which offer high power capability at a moderate



The KLM Echo 70cm transceiver.

price (and thus can be operated conservatively for longer component life), are coming into vogue. Pending FCC proposals may force future MLAs to cover only 160 through 15m, but the basic machine will remain the same. It is a highly efficient, very compact, full power linear amplifier that at $799.50 costs less per Watt than any amplifier manufactured anywhere. For a while, you may have a hard time finding an MLA-2500 at your local dealers . . . but on the basis of our experience, it's well worth the wait. *Dentron Radio Company, 2100 Enterprise Parkway, Twinsburg OH 44087.*

Warren Elly WA1GUD
Bennington NH

USER IMPRESSIONS OF KLM ECHO 70CM SSB UHF TRANSCEIVER

Are you ready for the Phase III OSCAR satellites? If you are an amateur satellite enthusiast, you probably know that the new series of birds will be the first to use an assigned amateur satellite band: 435 MHz. The first of the orbiting repeaters is due to be launched within nine months. The satellite will carry a two meter to 435 MHz transponder, which will require the Earth station to have UHF SSB receive capability. (Recall that the existing OSCAR 7 satellite *receives* on 432.) The only known commercial rig that offers 435 MHz SSB capability, as well as other functions, is the Echo 70cm, by KLM Electronics.

Many OSCAR 7 Mode B users are already familiar with the Echo 70. This ten Watt transceiver allows SSB and CW communication on the 432 and 435 MHz amateur bands. It has many features that should appeal to the UHF enthusiast. Let's take a quick look at the transceiver, starting with front panel controls. The predominant feature of the rig is a large, center-mounted knob calibrated from "01" to "47" in increments of two. These numbers correspond to 20 kHz increments in frequency, with an implied starting point at either 432.01 or 435.01 MHz. This allows a tuning range of 480 kHz in each band. Continuous coverage within each 20 kHz segment is provided by a normally centered vxo control. The vxo range on either side of zero is 10 kHz – thus the entire segment can be continuously tuned. Additionally, an RIT control is provided to clarify received SSB signals. The range of the RIT is about 2 kHz. Squelch and volume controls are mounted on the right side of the panel, with the power switch connected to the volume control.

Three push-button switches are mounted on the left side of the main tuning control, under a dual purpose meter. This meter is calibrated in S-units when receiving, and provides relative power output when the rig is on the air. One button selects upper/lower sideband. The second engages an impulse noise blanker when activated. The third switch allows any 20 kHz band segment to be continuously swept for the presence of signals. The "Auto Watcher" is most useful when the Echo 70 is being used for point-to-point Earth communications. It is only necessary to know which 20 kHz is going to be used – the scan will pinpoint the signal. The presence of the "Auto Watcher" scan is denoted by a small red lamp which is illuminated during the function.

The back panel also contains several controls. A slide switch selects the base frequency of 432 or 435 MHz. A second slide switch determines the mode of the transceiver – either SSB or CW. A final control selects the internal vfo, or allows an external device to be used. When in external mode, the panel lamp on the main tuning dial is extinguished. Jacks for key, vfo, relay, and speaker are also provided. Power for the Echo 70 is a nominal 12 V dc. KLM provides two power connectors and fuses for the rig, allowing one to be permanently connected in an auto. The antenna connector is a standard SO-238 UHF jack.

I have operated the Echo 70 on SSB, CW, through OSCAR, and on simplex. Unfortunately, there are not many stations in New England on 432 SSB, so a test had to be arranged. Receive and transmit audio quality is crisp and clear, and the vxo operates in a smooth, linear fashion as the signals are tuned. The receiver consists of a double conversion design, front-ended by a six cavity helical resonator and FET amplifier. Overload was no cause for concern, as I operated the Echo 70 in the presence of an 80 Watt signal at 446 MHz and a two meter transmitter without any problems. One unexpected bonus was obtained from the receiver. I was tuning a 2m SSB transmitter, and was able to copy the third harmonic on the Echo 70. I am sure that KLM did not design the transceiver to be used as a test instrument, but of course one must use what is available!

The transmitter section delivers better than 10 Watts into a 50 Ohm load, as measured on a Bird Model 43 wattmeter. This was sufficient to access OSCAR 7 using a home brew turnstile antenna system. The 10 Watt output is more than enough to drive an outboard amplifier for extended DX or OSCAR work.

The Echo 70 only draws five Amps under transmit, so an existing 12 V supply can probably be used to power the rig. The transceiver is a natural for OSCAR satellite work. It has the versatility to operate with existing and future birds, as the Phase III satellites will use the 435 MHz band. If you are interested in greeting the new OSCAR when it is launched, the Echo 70 is a natural! While you are waiting for the launch, look for me on OSCAR 7, Mode B. I would also be happy to arrange a QSO on 432 SSB or CW from our local test mountain.

At $495.95, the Echo 70cm is complete with microphone, internal speaker, two power cords, mobile mounting bracket, and spare lamps and fuse. *KLM Electronics, 17025 Laurel Rd., Morgan Hill CA 95037.*

John Molnar WA3ETD
Executive Editor

NEW FREQUENCY COUNTER/GENERATOR

A unique new frequency counter/generator has been announced by Lunar Electronics. The model DX-555P is a basic 30 MHz counter with 5 digit display and 7 digit readout (with front panel scaling). The 10 MHz timebase, which includes easy zero adjust to WWV, exceeds most accuracy requirements. The built-in prescaler extends the frequency count range to 300 MHz, and is activated by a rear panel switch.

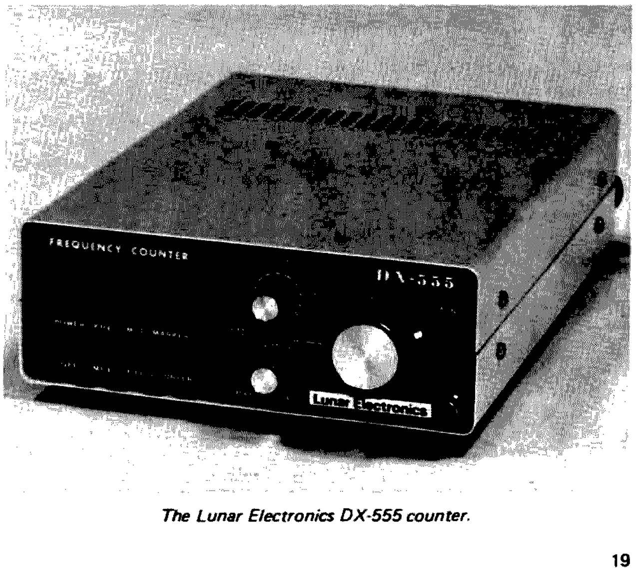
The unique part of the unit is the variable frequency marker oscillator, covering 440 kHz to 30 MHz in 3 bands. When the marker oscillator is activated by its front panel switch, its output is both available from a rear panel jack and displayed on the counter readout. The output of the marker oscillator, which also may be AM modulated with a 600 Hz tone, is of sufficient strength to align receivers down to the 455 kHz i-f and up through 30 MHz. The marker oscillator, which also includes a front panel fine tune adjust, serves as a highly accurate and economical frequency source in lieu of much more expensive frequency synthesizers.

Uses are innumerable, including the many varied counter applications through VHF and CB. The marker oscillator allows alignment of receivers in the HF spectrum, including their 455 kHz i-fs. The high harmonic output of the marker oscillator may also be used through the lower VHF range with careful attention to frequency, which will preclude aligning on the image. SWL users can easily set their receivers to the frequency listed for a foreign broadcast station without having to hunt across the receiver's usually inadequately accurate dial for the station of interest. Besides the SWLers, CBers, and bench technicians mentioned above, other users would include radio amateurs, experimenters, field technicians, and many others.

The model DX-555P counter/generator with prescaler lists at $239.95. The unit is also available without the prescaler at $189.95. Units may be obtained via dealers, or direct from Lunar Electronics. *Lunar Electronics, PO Box 82183, San Diego CA 92138.*

THREE NEW COUNTERS FROM YAESU

The introduction of a new line of three frequency counters, designated as YC-500, has been announced by Yaesu Electronics Corporation. The three models offered are the YC-500J (with an accuracy of 10 PPM), the



The Lunar Electronics DX-555 counter.

The Yaesu YC-500J frequency counter.

YC-500S (at 1 PPM), and the YC-500E (at 0.02 PPM). All three counters provide six display digits and cover the range of 10 Hz to 500 MHz. Two separate inputs are provided, one covering 10 Hz to 50 MHz, and the second, 50 MHz to 500 MHz.

A built-in ac or dc supply provides for complete portability. Advanced IC techniques are used in the circuit design, and a double-sided computer quality circuit board ensures stable and extremely accurate operation for many years.

The counters are now on display at all authorized Yaesu dealers throughout the United States. A copy of the operating manual may be purchased for $4.50 postpaid from *Yaesu Electronics Corporation, PO Box 498, 15954 Downey Avenue, Paramount CA 90723.*

NEW HUSTLER AMATEUR ANTENNA CATALOG

A brand new catalog describing the entire line of Hustler amateur HF, VHF, and UHF antennas has just been published by New-Tronics Corporation in Cleveland, Ohio. New-Tronics is the originator of the Hustler brand of amateur and CB antennas.

Hustler's new amateur antenna catalog contains more than 40 antennas and accessories. Featured products include the new no rip-off "Hustloff" trunk lip mount that does not require drilled holes. A turn of a knob removes or mounts the entire antenna assembly on the side or edge of a trunk lid, all without disconnecting the cable. The antenna assembly stores easily inside most trunks. Test data shows that the solid grounding of the "Hustloff" mount provides the user with consistent performance under any conditions – plus far greater range potential, compared to other available rob-proof mounts (including the magnetic and hinged flip-out variety).

Another featured item is the improved performance built into the base-loaded 5/8 wavelength BBLT and BBL series of two meter mobile antennas with 3.4 dB gain (compared to a 1/4 wave ground plane).

Other products include a fixed station four band vertical antenna (one setting for 10, 15, 20, and 40 meter coverage), a fixed station two meter vertical with 6 dB gain (compared to a 1/2 wave dipole), and a variety of mobile antennas for 2, 6, 10, 15, 20, 40, 75 and 80 meters, as well as 140 to 500 MHz operation.

A copy of Hustler's new amateur antenna catalog is available by writing to: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Cleveland OH 44142.*

NEW SMALL-SHANK ELECTRONIC TECHNICIAN DRILL

Wahl Clipper Corporation has introduced a compact electric drill that accommodates drills and burrs with a shank size up to .123 (1/8"). The ISO-TIP electronic technician drill is ideal for prototype development, circuit board revision and redesign, solder removal, lead hole cleaning, and a variety of other jobs. Its compact size (less than 5" minus drill bit) allows use of the drill in confined areas and within cabinetry. High impact plastic housing makes it lightweight, and an extra long 10' cord provides a wide working radius. An on/off switch provides both "intermittent-on" and "locked-on" positions for convenience.

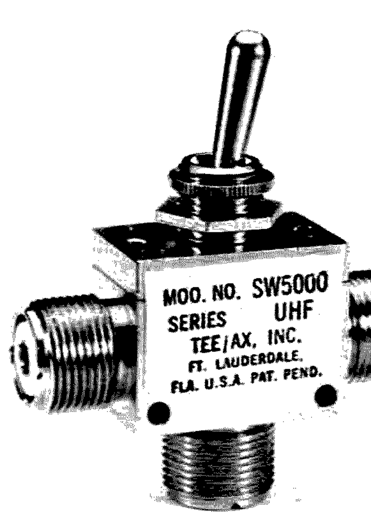
Operating at approximately 9,000 rpm, the drill is supplied with a collet chuck, 3 collets, and 2 drill bits (#56 and #71). The no. 6275 kit features a 110 V transformer power source, while the no. 6280 kits features a 12 V cigarette lighter plug assembly for on-the-spot drilling capability. Burrs, abrasive wheels, or discs can be added to expand the drill's versatility to carve, shape, form, or rout on wood, plastic, leather, and a variety of materials. *Wahl Clipper Corporation, 2902 Locust Street, Sterling IL 61081.*

The ISO-TIP electronic technician drill.

FIRST COAX TOGGLE SWITCH

TEE/AX, Inc. of Ft. Lauderdale, Florida, has announced (after nine years of development) the first complete line of coax switches with features not previously available in coax switching. The TEE/AX coaxial toggle switches are available in every series, from SPST to 6PDT. The erector set construction of the switches allows the user to stack a VHF, BNC, TNC, and SMC in one switch. By removing the top place or toggle, you can replace it with a variety of solenoids to allow using the TEE/AX as a relay. The coax switch is fully designed to survive in any environment (such as that in aircraft, where shock and vibration are a factor). The TEE/AX coaxial switches are 100% anti-shock proof.

TEE/AX, Inc., will also fabricate coaxing switching systems and custom coax switches to specific customer needs. Over 300 variations of switches and relays will be available. Technical specifications are available on the entire coax switch line. *TEE/AX, Inc., 5701 NW 31st Ave., Fort Lauderdale FL 33309.*



The TEE/AX coax toggle switch.

COMPUTERIZED MORSE CODE RECEPTION PACKAGE

Polaris Computer Systems has announced the development of a Morse code reception package for the S-100-based 8080 microcomputer. The package consists of a tone-to-dc converter module and complete software. The converter connects to the communications receiver via headphone jacks and to the computer via a parallel I/O port.

The converter contains a phase locked loop for tone decoding, and adjustable center frequency and bandwidth controls. Its design is highly immune to impulse noise. Provision for audio and visual synchronization of the incoming signal is provided.

The software adjusts for variations in transmission as each code element is received, allowing for manual or automatic transmission of CW at speeds ranging from 5 to 60 words per minute. Noise and dropout negating logic is included. The final output of received text is to an SIO port for display to a printer or CRT.

The package price in kit form for the converter, object program, and complete documentation is $95.00. An assembled and tested version lists at $145.00. Source tapes and complete turnkey packages are also available. On the low end, schematic of the converter, object dump, and documentation are available for $17.00. *Polaris Computer Systems, 3311 Richmond Avenue, Houston TX 77098.*

HEATH ANNOUNCES PERSONAL COMPUTERS

The latest entry into the hobby computer field is Heath, the popular manufacturer of electronic kits. The long-awaited computer product line consists of two processors, a video terminal, and an array of peripheral I/O devices.

Heath chose the widely available 8080 8-bit microprocessor as the basis for the H8 computer. The other computer, dubbed the H11, is based on the Digital Equipment Corporation (DEC) LSI-11 computer, which is a 16-bit minicomputer.

Targeted for release this summer, the H8 computer features an intelligent front panel with octal display and data entry capability. One-button program loading is provided by a resident monitor and built-in bootstrap program. Sixteen push-buttons are provided for data entry, and an LED display allows machine states and register contents to be displayed. A speaker is built into the H8 to allow special programming effects.

The H8 computer features a 1K ROM that contains the monitor program and bootstrap. The machine has a memory capacity of 65K bytes. The mainframe utilizes 50 pin connectors, of which 10 are available for memory and peripheral controllers. The built-in power supply can support the CPU, 32K of memory, and two I/O devices. The price for the basic H8 computer kit is $375.

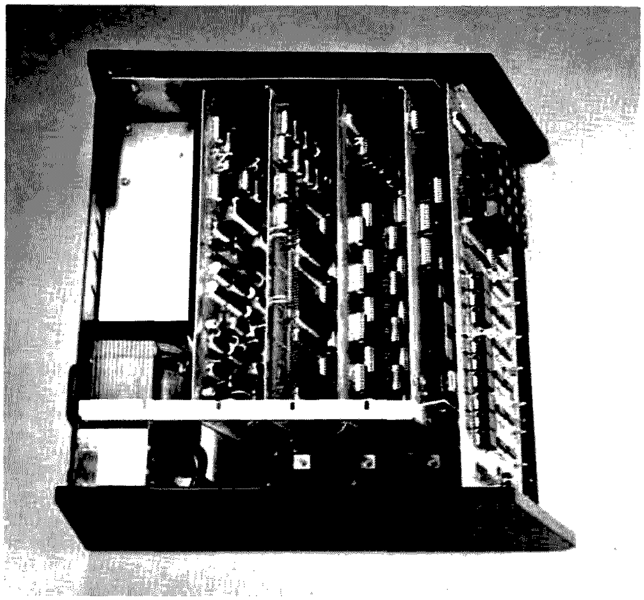
Heath has bridged the 8-bit gap with the H11 computer, to be shipped this fall. Based on DEC's powerful LSI-11 computer board, the H11 is a full 16-bit machine that features the DEC PDP-11 instruction set. The H11's CPU board is fully wired and tested. The LSI-11 board features 4K x 16 RAM, expandable to 20K. A switching power supply is standard, as is full circuit protection and a wired backplane. Interfaces initially consist of serial and parallel I/O modules. A 4K memory board is also available.

However, one of the most attractive features of the H11 is the software provided by Digital Equipment Corp. An assembler, editor, linker, and debug package is provided, as well as the BASIC and FOCAL languages. Owners of the H11 will also be able to use programs from the extensive DEC users group, DECUS.

A complete line of peripheral devices is available to support the H8 and H11 computers. A CRT display and paper tape reader/punch, designated the H9 and H10 respectively, will allow I/O capability. The following products will be available from Heath when H8 and H11 production commences:

H8	8080 Computer	$375
H8-1	4K Memory	140
H8-2	Parallel Interface	150
H8-3	4K Chip Set	95
H8-5	Serial/Cassette Interface	110
H9	Video Terminal	530
H10	Paper Tape Device	350
H11	LSI-11 Computer	1295
H11-1	4K memory	275
H11-2	Parallel Interface	95
H11-5	Serial Interface	95

The listed equipment is in kit form from *Heath Company, Benton Harbor MI 49022.*



Inside the H8: Heavy-duty power supply is visible, as well as the ten slot mother board.

Heathkit H11 Computer, based upon the DEC LSI-11.

The Heath 8-bit family: H9 Video Display, H8 Computer, and H10 Paper Tape Reader/Punch.

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

EUROPEAN DX CONTEST
CW
Starts: 0000 GMT, Saturday, Aug. 13
Ends: 2400 GMT, Sunday, Aug. 14
Phone
Starts: 0000 GMT, Saturday, Sept. 10
Ends: 2400 GMT, Sunday, Sept. 11
RTTY
Starts: 0000 GMT, Saturday, Nov. 12
Ends: 2400 GMT, Sunday, Nov. 13

Sponsored by the Deutscher ARC (DARC), this contest is open to all amateurs, who may use all amateur bands, 3.5 to 28 MHz. Classes include single op/all band and multi-op/single transmitter. Only 36 hours of operation out of the 48 hours are permitted for single op stations. The 12 hours of non-operation may be taken in not more than three periods anytime during the contest. Each station may be worked once per band. A contest QSO can only be established between a non-European and a European station, except in the RTTY section, where contacts between all continents and one's own continent are permitted.

EXCHANGE:

An exchange consists of the usual 5 or 6 digit serial number, RS(T) report, plus progressive QSO number starting with 001.

SCORING:

Each QSO counts 1 point. Each confirmed QTC (given or received) counts 1 point (see below). The multiplier for non-European stations is determined by the number of European countries worked on each band. Europeans will use the last ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, UA9Ø. The multiplier on 3.5 MHz will be multiplied by four, on 7 MHz by three, and on 14 to 28 MHz by two. The final score is the total QSO points plus QTC points multiplied by the sum total multipliers from all bands.

QTC TRAFFIC:

Additional point credit can be realized by making use of the QTC traffic feature. A QTC is a report of a confirmed QSO that has taken place earlier in the contest and later been sent back to a European station. It can only be sent from a non-European station to a European station. The general idea is that after a number of European stations have been worked, a list of these stations can be reported back during a QSO with another station. An additional one point credit can be claimed for each station reported. For RTTY section only, QTC traffic is allowed between all stations (sent and received), but not between stations in the same country. A QTC contains the time, call and QSO number of the station being reported. Example: 1300/DA1AA/134. This means that at 1300 GMT you worked DA1AA and received number 134. A QSO can be reported only once, and not back to the originating station. Only a maximum of 10 QTCs to a station is permitted. You may work the same station several times to complete this quota, but only the original contact, however, has a QSO point value. Keep a uniform list of QTCs sent. QTC3/7 indicates that this is the 3rd series of QTCs sent and that 7 QSOs are reported. Europeans may keep the list of received QTCs on a separate sheet, if they clearly indicate the station which sent the QTCs.

ENTRIES AND AWARDS:

Certificates to highest scorer in each class in each country, reasonable score provided. Continental leaders will be honored. Certificates also given to stations with at least half the score of the continental leader. Violation of the rules, unsportsmanlike conduct, or taking credit for excessive duplicate contacts will be deemed sufficient cause for disqualification. The decisions of the contest committee are final. It is suggested to use the log sheets of the DARC or equivalent. Send a large size SASE to get the desired number of log and summary sheets (40 QSOs or QTCs per sheet). Mailing deadlines are: CW Sept. 15th; Phone Oct. 15th; RTTY Dec. 1st. Entries should be addressed to: WAEDC – Committee, Post Box 262, D-895 Kaufbeuren, Germany. North American residents may send their entries to: Hartwin E. Weiss WA3KWD, 323 North Street, Millersburg PA 17061 USA. Minimal requirements for a certificate or trophy are 100 QSOs or 10,000 points. European country list is same as shown for EURD awards!

Special note – Please keep the following sections free of contest activity. CW: 3550-3800, 14075-14350, 21100-21450, 28100-29700. Phone: 3650-3750, 14300-14350, 21400-21450, 28700-29700.

CALENDAR

Aug 6-7	Illinois QSO Party
Aug 13-14	European DX Contest – CW
Aug 20-21	Worldwide SARTG RTTY Contest
Aug 20-21	SEANET Contest
Aug 20-22	New Jersey QSO Party
Aug 20-22	CAN-AM Championship Contest
Aug 27-28	Ohio Interstate QSO Party
Aug 27-28	Rep. of Trinidad and Tobago QSO Party
Aug 27-28	All Asian Contest – CW
Sept 3-5	Four Land QSO Party
Sept 10-11	Washington State QSO Party
Sapt 10-11	Pennsylvania QSO Party
Sept 10-11	ARRL VHF QSO Party
Sapt 10-11	European DX Contest – Phone
Sept 17-18	Scandinavian CW Contest
Sept 24-25	Delta QSO Party
Sapt 24-25	Scandinavian Phone Contest
Oct 1	Open CD Party – CW
Oct 1-2	VK/ZL/Oceania – Phone
Oct 8-9	VK/ZL/Oceania –CW
Oct 15-16	Open CD Party – Phone
Oct 15-17	Manitoba QSO Party
Oct 29-30	CQ WW DX Phone Contest
Nov 5-6	ARRL Sweepstakes – CW
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest – RTTY
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Nov 26-27	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

CAN-AM CHAMPIONSHIP CONTEST
Phone
Starts: 0200 GMT, Aug. 20
Ends: 2400 GMT, Aug. 20
CW
Starts: 0400 GMT, Aug. 21
Ends: 0200 GMT, Aug. 22

OBJECTIVE:

To increase the communication and friendship between the Canadian and American amateurs and to provide the means of measuring the performance of their operating skills and equipment.

BANDS:

All bands 1.8 through 28 MHz are permitted; general portion of the bands is recommended for use on phone and CW.

CATEGORY OF COMPETITION:

1. Single operator – stations operated by the station license holder.
2. Multi-operator, single transmitter – stations operated by one or more operators other than the licensee.
3. Club competition.

EXCHANGE:

Signal report, RS on phone and RST on CW, plus sequential QSO number starting with 001, plus multiplier area abbreviation, i.e., 59001CT or 599001ON. Multiplier area abbreviation is the usual two letter postal abbreviation for 50 US states, CN – Caribbean (KC4, KG4, KP4, KS4, KV4, KZ5), PC – Pacific (rest of US possessions). Canadians will use: NL – V01, V02; NB – VE1 New Brunswick; NS – Nova Scotia; PE – Prince Edward Isl.; SI – Sable and St. Paul Isl.; PQ – VE2; ON – VE3; MB – VE4; SK – VE5; AT – VE6; BC – VE7; NW – VE8 NWT; YU – Yukon.

MULTIPLIERS:

50 US states, 2 US possessions (Caribbean, Pacific); 10 Canandian provinces, 2 territories (NWT, Yukon), 1 Islands (Sable, St. Paul).

Total of 65 multipliers per band; maximum possible on all bands is 390.

POINTS:

1. Americans to Americans, Canadians to Canadians QSOs count for 2 points.
2. Americans to Canadians and vice versa QSOs count for 3 points.

The same station can be contacted once on each band and mode. Stations operating from outside of their own call area must sign slash and the area they are operating from, i.e., W6AM/7, W2PV/KH6, KP4AST/W2.

SCORING:

The final score is the result of the total QSO points from all bands, multiplied by the sum of the multipliers from all bands. Phone and CW sections of the contest are considered separate contests. However, combined scores of phone and CW will be used for overall competition. Combined scores will be calculated as a result of the addition of phone and CW scores.

AWARDS:

First place certificates will be awarded in each multiplier area on both modes in single operator category. Top five multi-operator stations will receive certificates. (Combined phone and CW scores will be considered.) Free one year subscription to *LONG SKIP* – The CANADX bulletin

– will be awarded to the top 5 stations overall in both categories.

TROPHIES AND PLAQUES:

1. Single operator, overall – Canadian champion, American champion.
2. Single operator, phone – Canadian champion, American champion.
3. Single operator, CW – Canadian champion, American champion.
4. Multi-operator champion.

Each station is eligible for one trophy only. In a case where one station would qualify for another trophy, the less significant trophy goes to the next eligible station.

CLUB COMPETITION:

A handsome plaque will be awarded to the club submitting the highest aggregate score of the phone and CW scores submitted by its members under the same rules as CQ WW contest.

LOG INSTRUCTIONS:

All times must be kept in GMT. Indicate multiplier the first time only on each band. Log must be checked for duplicate contacts, correct QSO points, and multipliers. Do not use separate logs for each band. Each entry must be accompanied by a summary sheet showing all scoring information, category of competition, operator's name and callsign, address of the station, and signed declaration. Entries with over 200 contacts must include check sheets for each band. Official logs, check sheets, and summary sheets are available from CANADX – a large SASE will bring you samples.

DISQUALIFICATION:

Violation of amateur radio regulations in the country of the contestant or the rules of the contest, unsportsmanlike conduct, or taking credit for excessive duplicate contacts or unverifiable QSOs or multipliers will be deemed sufficient cause for disqualification. (Incorrectly logged calls will be counted as unverifiable contacts.) Actions and decisions of the CANADX contest committee are official and final.

DEADLINE:

All entries must be postmarked no later than September 30, 1977, and mailed to: Canadian DX Assn. – CC, Box 717, Station Q, Toronto, Ont. M4T 2N7, Canada.

NEW JERSEY QSO PARTY

Contest Periods:
2000 GMT, Saturday, Aug. 20 to
0700 GMT, Sunday, Aug. 21;
1300 GMT, Sunday, Aug. 21 to
0200 GMT, Monday, Aug. 22

The Englewood ARA invites all amateurs worldwide to take part in this year's annual contest. Phone and CW are considered the same contest. A station may be contacted once on each band and mode; CW contacts may not be made in phone band segments. NJ stations may work other NJ stations. General call is "CQ NJ". NJ stations are requested to identify themselves by signing "DE NJ". Stations planning active participation in NJ are requested to advise the EARA by August 6th of their intentions, so that full coverage from all counties can be planned. Portable and mobile operation is encouraged.

FREQUENCIES:

1810, 3535, 3905. 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, 28600, 50-50.5, 144-146. Suggest phone activity on the even hours, 15 meters on the odd hours between 1500 and 2100 GMT, 160 meters at 0500 GMT.

EXCHANGE:

QSO number, RS(T), and QTH (NJ-county, others – ARRL section).

SCORING:

Non-NJ stations multiply number of completed QSOs times number of NJ counties worked (21 max.). NJ stations score 1 point per US/Canadian QSO, 3 points per DX QSO, and multiply total QSO points times number of ARRL sections (including NNJ and SNJ). KP4, KH6, KL7, KZ5, etc., count as 3 point DX contacts and as section multipliers.

ENTRIES AND AWARDS:

Certificates to first place NJ station in each county, and first place in each ARRL section and country. Second place certificates when four or more logs are received. Novice and Tech certificates also to be given. Logs must show date/time in GMT, band, emission, etc., and be received not later than Sept. 17th. The first contact for each claimed multiplier must be indicated and numbered, and a checklist of contacts and multipliers should be included. Multi-op stations should be noted and all calls listed. Logs and comments should be sent to: Englewood ARA, 303 Tenafly Road, Englewood NJ 07631.

REPUBLIC OF TRINIDAD AND TOBAGO QSO PARTY

Starts: 0000 GMT, Saturday, Aug. 27
Ends: 2400 GMT, Sunday, Aug. 28

This QSO party was organized by the Trinidad and Tobago ARSoc to commemorate the first anniversary of the Republic of Trinidad and Tobago. Use any band/mode, 10 through 160 meters, and OSCAR/SSB.

EXCHANGE:

Usual 5 and 6 digit exchange consisting of the RS(T) and serial number starting from 001.

AWARDS:

A certificate will be awarded to any station working 5 or more 9Y4 stations. Contacts may be on different bands, but must be in the same mode! A certificate with endorsement sticker and QSL cards confirming contacts will be awarded to stations working 9Y4 on five bands, all contacts in the same mode.

ENTRIES:

Logs should show date/time in GMT, stations worked, number sent/received. Logs only required for five station awards; QSLs required along with log for five band award. Include a remittance of $1.00 or IRC equivalent with logs if eligible for an award. Entries must be postmarked no later than Oct. 15th to: TTARS, PO Box 1167, Port of Spain, Trinidad, West Indies.

RESULTS

RESULTS OF THE 1977 DX YL TO NORTH AMERICAN YL CONTEST

DX Phone:		DX CW:	
DJØEK	714 points	I3MQ	143
DJ1TE	552.50	DJØEK	70
F5RC	488.75	DF2SL	9

NA Phone:		NA CW:	
W2GLB	1108 points	WA2DMK	11.25
VE3MRS	726	K6DLL	7.50
WA8EBS	432	W3CDQ	4
		W2HFR	4

Highest Combined Phone + CW:
DX = DKØEK, 784 pts.
NA = K6DLL, 337.5 pts.

RESULTS OF THE 1977 YL-OM CONTEST

YL Phone:		OM Phone:	
I3MWP	57,750 points	W4CHK	1,538
HB9ARC	26,934	W7ULC	805
FG7XL	25,125	WØGNX	648

YL CW:		OM CW:	
WA5VJW	17,010	W4CHK	1,463
K8ONV	13,484	W7ULC	1,295
K1NEI	10,710	VE3EMA	990

OHIO INTERSTATE QSO PARTY

Contest Periods:
1600 to 0200 GMT each day, Aug. 27 and 28

Co-sponsored by the Ohio Council of Amateur Radio Clubs and the Farout Amateur Radio Club of Kettering. This contest replaces the two contests originally planned by the two groups! Rules are as follows: Out of state stations work Ohio stations only; OH stations work any station. Each station may be worked once per band and mode. Multi-xmtr, multi-op stations are allowed, but are ineligible for awards. Repeater contacts are not allowed, except through OSCAR.

EXCHANGE:

Serial number, RS(T), and ARRL section or country – or OH county for OH stations.

SCORING:

Score 1 point per QSO. Add 50 points to final score for working Ohio State Fair Station NO8HIO. Multiply score by 1.5 for operating portable using temporary power and antennas in any OH county except Butler, Clark, Cuyahoga, Franklin, Hamilton, Lake, Lorain, Lucas, Mahoning, Montgomery, Portage, Richland, Stark, Summit, or Trumbull.

Note: The latest copy of the rules omitted the scoring multiplier, so I would assume that it would be the number of Ohio counties for non-Ohio stations and the number of ARRL sections for Ohio stations.

FREQUENCIES:

5 kHz up from lower edge of General class band.

ENTRIES/AWARDS:

Entries should include logs showing time, band, mode, and exchange info, summary sheet claiming score, and return mail address. Include an SASE for results. Logs must be postmarked by Sept. 15, and should be sent to: Joe WB8HWE, Box 7825, SR188, Circleville OH 43133. Trophies to highest OH and out of state. Certificates to top OH in each county and each ARRL section and DX score. Participation certificate to each entrant with 50 or more QSOs. Special certificate for working 3 or more Farout ARC members.

W8MBI

The Ohio Buckeye Belles will be operating their memorial station W8MBI (and individually) during the Ohio Interstate QSO Party, giving everyone an excellent opportunity to work Ohio YLs. The Buckeye Belles award a certificate to OH stations for 12 confirmed QSOs, to other US stations for 8 confirmed QSOs, and to DX stations for 4 confirmed QSOs. Send complete log data – name, call, date, time, band, mode, and Buckeye Belle numbers – to Certificate Custodian Marge K8ITF, 1608 Randeley Avenue, Dayton OH 45403. Please include 50¢ to help cover mailing costs.

EURD

Congratulations to Bruce Balla VE2QO, who was the first non-European station to obtain the RTTY Award EURD-3 from DARC. As of this writing, he is one of ten amateurs to receive this award – only three have made it to the top (EURD-1).

Dual Rhombic For VHF-UHF

-- work some DX!

Bill Parker W8DMR
2738 Floribunda Drive
Columbus OH 43209

What single antenna can provide 26 dB of gain over a half wave dipole and also

(a) exhibit relatively low wind resistance;
(b) operate over a bandwidth approaching twice the design frequency;
(c) permit shared mast mounting with other antennas for ease of rotation;
(d) is easy and not overly time-consuming to construct; and
(e) is light of weight and inexpensive (under $20) too?

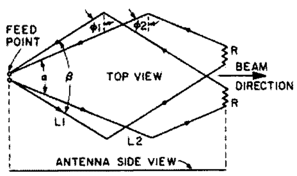


Fig. 1. Dual rhomboid antenna configuration.

A parabolic dish cannot. The optimum spaced long yagi cannot. A collinear array cannot. Nor can the log periodic, corner reflector, helix, or any other antenna. The dual rhomboid *can!*

The need for high antenna gain still exists. High gain antennas (in excess of 20 dB) are very directional antennas providing beamwidths between 5 and 10 degrees. Antenna gains greater than 30 dB produce half power beamwidths of less than 5 degrees and require very accurate pointing systems. Antennas with gain exceeding 20 dB are used on VHF, UHF, and higher. For best results at these frequencies, the antenna must be placed high and above the surrounding obstructions. Wind loading produced by such mast-mounted rotatable antennas at the top of the tower cannot be ignored if the antenna system is to survive.

Can you imagine a 21 foot diameter parabolic dish antenna[1] (required to produce 26 dB of gain) mast-mounted and rotatable on a 50 foot tower in a 50 mph wind? Even with the reflector constructed of 1 inch wire mesh? Over 750,000 foot-pounds of torque will be generated at the base of the tower. And that is without any additional antennas or any additional mast height. The dish antenna (excluding satellite work) to be effective requires a structure and platform to support it. Construction of the dish antenna is not the easiest of tasks.

The long yagi certainly has less wind resistance. An optimum spaced long yagi[2] requires a 100 foot boom to yield 26 dB of gain. It is easier to construct and could be made light in weight. But the 1 to 1.5 percent bandwidth of the operating frequency limits the usefulness, especially on the 420-450 MHz band. Stacking two 50 foot boom long yagis could be done with some ease. The stacking distance will require a mast extending out of the top of the tower in excess of 25 feet if the equivalent 26 dB of gain is to be realized. The torque loads created in starting and stopping a 100 foot boom represent an additional problem for the rotator mechanism. The swaying of a high gain long yagi antenna during gusty wind produces signal variations during both transmit and receive (similar to QSB created by atmospheric changes along the signal path).

Consider a 26 dB gain collinear array antenna. The array would have a lot less wind resistance than the dish antenna. It would also exhibit more bandwidth than the yagi. It would require, however, an array of 12 elements broadside (high) by 8 elements collinear (wide). It would take a total of 96 driven elements plus 96 reflector elements[3] to provide a gain of approximately 23 dB. To obtain the additional 3 dB for a 26 dB gain collinear array, the total array needed would contain 384 elements and a frame to support them. Even at 435 MHz, more than 384 feet of element material would be required. If the 192 reflectors were replaced with a screen mesh, more than 300 square feet would be required. Although a substantial improvement in bandwidth would be realized, a considerable increase in wind loading occurs.

The dual rhomboid antenna provides a gain of 26 dB

(an effective radiated power increase of 400 times). It has relatively low wind resistance, wide operating bandwidth, consumes little mast height, is light of weight, easy and inexpensive to construct, and is rotatable.

The dual rhomboid is of the rhombic class, but with improvements. The double rhomboid antenna[4] configuration is shown in Fig. 1. Longwire antennas always radiate large numbers of side lobes that are distributed profusely. Judicious choice of the side length and apex angle selection of the rhomboids can cause destructive interference of the unwanted and wasteful side lobes. The dual rhomboid antenna designed for a high order of side lobe suppression at one frequency retains this characteristic very well over a substantial frequency range. This is not possible with a single rhombus.

The design principles involved are the same as for the "V" antenna and the rhombus antennas. The angles (referred to as tilt angles) were expressly selected for zero angle radiation from each rhomboid[5]. Since most antennas of the rhombus class operate against ground (heights of less than one to two wavelengths), zero angle radiation tilt angles are not normally selected. See Figs. 2 and 3.

The length of sides L_1 and L_2 specifically differ by a one-half wavelength factor. The array radiation pattern is the *product* of the patterns for the component sides at all points in space.

The only connection between the rhomboids is at the common feedpoints. The antenna consists of two rhomboid elements connected in parallel at their common apex where a balanced feedline connects[6]. One terminating resistor is required for each rhomboid. The terminating resistors should be of the noninductive variety and able to withstand the weather. Each terminating resistor should be capable at least of dissipating one-fourth of the input power to the antenna. Termination values of between 600 and 800 Ohms are recommended. For example, if 10 Watts is applied at the feedpoint, each resistor should be capable of 2.5 Watts dissipation.

The list of parameters for the dual rhomboid antenna shown in Table 1 is for a design frequency of 435 MHz.

The side lengths are calculated from the following formula:

$$L\ (\text{feet}) = \frac{984\ (N - 0.05)}{\text{Freq. (MHz)}}$$

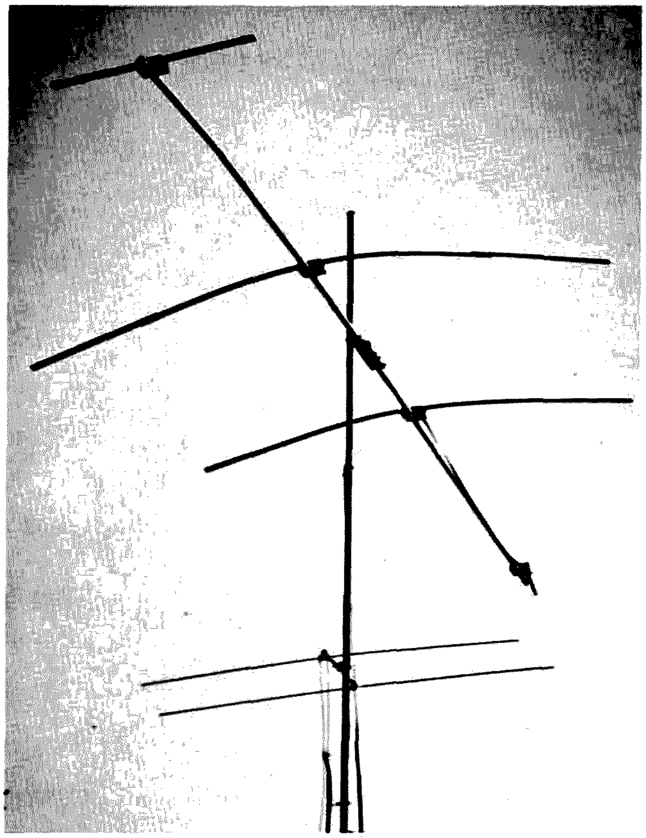
where N is the number of full waves. L_1 and L_2 for a design frequency of 435 MHz are 93.5 and 161.5 inches, respectively. The side lengths are needed to determine the boom length and the three crossarm lengths.

Apex angles α and β are derived by:

$$\alpha = 2(90 - \phi_2)$$
$$\beta = 2(90 - \phi_1)$$

and are 46 and 58 degrees, respectively. The tilt angles ϕ_1 and ϕ_2 were selected for side lengths of 3.5 and 6.0 wavelengths, as well as zero angles radiation.

The dimensions for boom, crossarms, and crossarm spacing are shown in Fig. 4.



Dual rhomboid antenna installation at WA8QQU, Reynoldsburg, Ohio.

The angle subtended between the diagonal of each rhomboid is equal to:

$$\frac{\beta - \alpha}{2} = \frac{58 - 46}{2} = 6\ \text{degrees}$$

An isosceles triangle is formed at the forward end of the beam by the rhomboids' crossover and the two terminators. Detailed specific dimensions for construction of the high gain dual rhomboid antenna whose bandwidth is essentially 420 to 890 MHz are shown in Fig. 4.

Construction

A metal boom that runs the full length of the dual rhomboid is not recommended. Excessive side lobes will be generated if this construction technique is em-

Design Center Frequency		**435 MHz**
Side length #	**$L_1 = 3.5\lambda$**	**$L_2 = 6.0\lambda$**
Tilt Angle	**$\phi_1 = 61°$**	**$\phi_2 = 67°$**
Apex Angle	**$\alpha = 46°$**	**$\beta = 58°$**
Beam Width *	**V = 5.8°**	**H = 9.7°**
Termination	**R = 820 Ohms**	**R = 820 Ohms**

***Half power level**
#L_1 = 7.8 feet, L_2 = 13.46 feet

Table 1. List of parameters for dual rhomboid.

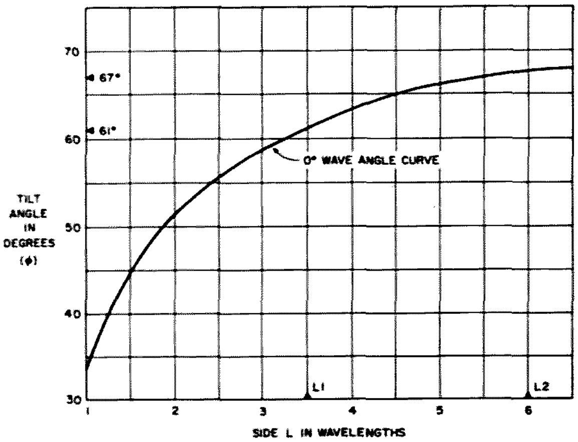


Fig. 2. Zero degree wave angle design chart.

Dual rhomboid antenna held with one hand by W8DMR's XYL. Total boom length is 20'6".

ployed. The center section of the boom should be made of metal or of material sufficiently rigid to support the nonmetallic crossarms. A total of about 86 feet of wire is required with each leg of the rhomboid being about 21½ feet long. The conductor size should be as large as the antenna frame can adequately support. Number 14 AWG solid copper, formvar coated was used in the author's dual rhomboid antenna. Even ¼ inch tubing is recommended. Although not recommended, a model used #24 AWG enameled single strand copper with some success.

The transmission line from the feedpoint to the mast should be foam 300 Ohm balanced nonshielded line. Open wire line or foam line works well. Once the feedline reaches the mast, a change to shielded 300 line or coaxial cable can be made. In the case of coaxial cable, a broad band balun should be used. If nonshielded 300 Ohm line is used, ABSOLUTELY DO NOT TAPE the feedline to any metal structure. This includes the metal section of the boom, the mast, the tower, other coaxial cables, downspouts, gutters, metal house siding, or metal sash windows. Never permit nonshielded 300 Ohm line to run along the ground or against masonry walls and floors, even if it is foam filled.

Operational Tests

The antenna has been used primarily to receive and transmit standard scan amateur TV signals. A secondary use has been to receive UHF commercial TV channels 14 through 83. The antenna has been used to receive channels 2 through 13, with less gain. The results have been excellent, with the exception that lobing was experienced on the higher UHF TV channels. The antenna has good front to back ratio. The antenna was rotated to vertical polarization to verify that the angle of radiation was truly zero. The antenna did not have a double (split) lobe in the vertical axis.

Additional Improvement

The dual rhomboid can be expanded such that it could be referred to as the quad rhomboid. This would be accomplished by adding two additional rhomboids, as in Fig. 5. There would be still a single feedpoint, but two additional terminators would

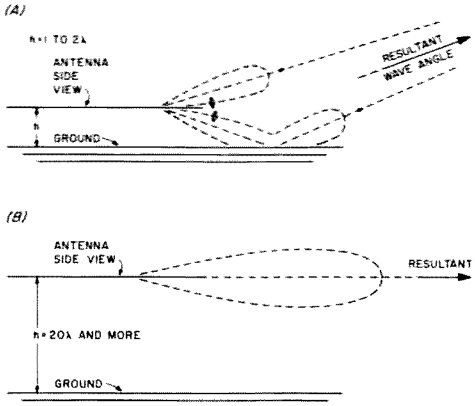


Fig. 3. Effect of tilt angle selection. (a) Non-zero angle radiation, rhombic antenna working against ground. (b) Zero angle radiation due to tilt angle selection. Note: *Tilt angle does not mean physically tilt the antenna. See Table 1.*

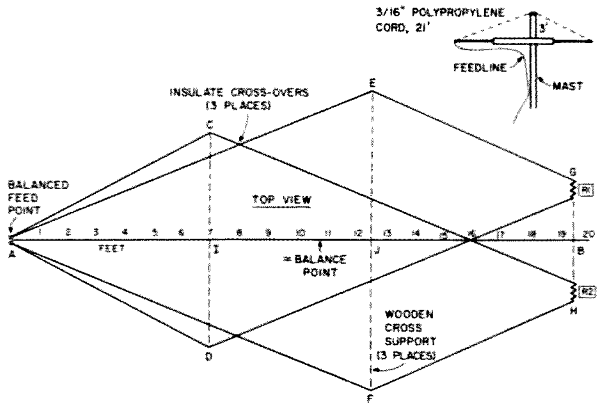


Fig. 4. Dual rhomboid antenna for 435-870 MHz. Beamwidth ≈ 10° H x 6° V. Gain over DP ≈ 26 dB. Boom length: AB = 19'6". Support spacing (see text): AI = 7'; IJ = 5'6"; JB = 7'. Support length: CD = 7'3"; EF = 10'3"; GH = 3'0". Rhomboid sides: AC, AD, EG, FH = 7'9.5"; AE, AF, CH, DG = 13'5.5". Feedline: see text. Wire needed: 14 AWG formvar, ≈ 86'0". Boom material: AI, JB = wood; IJ = metal. Cross support: CD, EF, GH = wood. Terminators: R1, R2 = 600 Ohms; Watts – see text.

be required. The feedpoint impedance would be lowered. The additional rhomboids should have different side lengths; as an example, L3 could be 2.5 wavelengths and L4 could be 7.0 wavelengths. The quad rhomboid would not require any additional mast space, as would be the case in stacking an additional dual rhomboid.

Acknowledgment

The contribution of Bob Dervin WA8QQU in field tests and experimental models is gratefully acknowledged. ■

References

[1] Parabolic Antenna Calculators, Gabriel Electronics Division, Needham Heights MA, 1959.

[2] "Yagi array length versus gain and bandwidth," *VHF Handbook*, 1956, page 104.

[3] "Collinear-broadside antenna combinations," *VHF Handbook*, 1956, page 105.

[4] "Improved Antennas of the Rhomboid Class," *RCA Review*, 1960, pages 117-119, Laport and Veldhuis.

[5] "Rhombic antenna design chart," *The ARRL Antenna Book*, 1956, page 168, 178.

[6] "VHF Rhombic Antennas," *Antenna Engineering Handbook*, N. Jasik, Editor, 1961, pages 4-30 to 4-33.

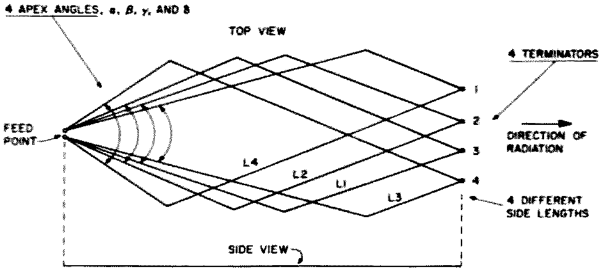


Fig. 5. Quad rhomboid antenna configuration.

Corrections

Just a note to let you know that in the June *73* issue, on page 176 ("Current-Saver Counter Display," Fig. 4), there is an error in the circuit. The outputs of the two 7400 chips should be bussed before driving the 7447 decoder-driver. The existing schematic is incorrect in that the outputs of the "Latch No. 1" 7400 do not drive the decoder.

Doug Marquardt WB2AWG
Bogota NJ

The article, "Aim Your Antenna With a Micro," in the June, 1977, issue of *73*, contains an unfortunate typographical error (of omission) and leaves implicit that which needs to be made explicit for some of us who not only cannot read "between the lines" but are having real difficulty with the lines themselves!

First, the omission. FORTRAN statement 290 correctly contains the minus sign (PL1 = -87.63*PIE/180) before the longitude. The corresponding BASIC statement number 170 omits this necessary minus sign.

Second, the implicit information which should have been quite explicit: The authors imply in the description of the FORTRAN program that the program contains the constants which represent the local latitude and longitude, as indeed it does. However, clarity of expression seems to dictate an *explicit* sentence or sentences such as the following:

"It should be noted that FORTRAN statements 260 and 290 contain the latitude and longitude, respectively, of Chicago, as do the corresponding BASIC statements 140 and 170. For other 'local' locations, change 41.87 and -87.63 to the proper latitude and longitude."

A couple of sentences such as the above would have been most helpful, but then I would have been deprived of a little troubleshooting and the feeling of euphoria which I experienced when I finally found out where the "bugs" were. Other than the problems above, the article was excellent and now I can swing my hybrid-quad with arrogant precision. Those who are familiar with that miniaturized rf choke of an antenna may well ask, "Why bother?" Because it provides valuable practice and experience for the time when I will finally have an antenna with a decent front-to-back ratio and appreciable gain, that's why. So don't bother me while I aim my two element mini-antenna right down that Zed-El's throat. Who knows, maybe someday he'll come back to me and I can casually give him his correct beam bearing to several decimal places!

Ronald W. Evans K5MVR
Fort Worth TX

Please note a correction to my article, "Two Meter Scanner" (June, 1977):

The power input driving the LEDs through a 430 Ohm resistor is incorrectly marked "+5 V." This point should be marked "+12 V," as the display will not function correctly with a five volt supply.

Carl A. Kollar K3JML
Nanticoke PA

In my article, "Sending HI on the Hooter," in the May, 1977, issue of *73*, a few things were overlooked. The relays, RY1 and RY2, do have some limitations on their choice. RY1 is driven by a TTL output and should pull in at 5 volts and 16 mA maximum. RY2 should pull in at 5 volts and 80 mA maximum and also have a contact capable of switching ½ Amp of inductive load.

James F. Reid W8LWS
Ashley OH

I feel that your magazine is the tops. I really enjoyed the article "Superprobe," but found one error. The pulse LED would stay on all the time. Resistor R9 is drawn on the wrong place on the schematic; it should go from pin 4 of IC2 to ground, not from pin 3 of IC2 to ground. R1 can be increased to about 5-10k to increase input impedance.

Allan Armstrong
San Francisco CA

Oscar Orbits

Oscar 6 Orbital Information

Orbit		Date (Aug)	Time (GMT)	Longitude of Eq. Crossing °W
N	21919	1	0154:13	90.9
NA	21931 BTN	2	0054:09	75.9
NA	21944 BTN	3	0149:04	89.7
N	21956	4	0049:00	74.7
NA	21969 BTN	5	0143:56	88.4
N	21981	6	0043:52	73.5
NA	21994 BTN	7	0138:48	87.2
N	22006	8	0038:44	72.2
NA	22019 BTN	9	0133:39	86.0
NA	22031 BTN	10	0033:35	71.0
N	22044	11	0128:31	84.7
NA	22056 BTN	12	0028:27	69.7
N	22069	13	0123:23	83.5
NA	22081 BTN	14	0023:19	68.5
*	22094 L	15	0118:14	82.2
*	22106 L	16	0018:10	67.2
*	22119 L	17	0113:06	81.0
N	22131	18	0013:02	66.0
NA	22144 BTN	19	0107:57	79.7
N	22156	20	0007:53	64.7
NA	22169 BTN	21	0102:49	78.5
N	22181	22	0002:45	63.5
NA	22194 BTN	23	0067:41	77.2
NA	22207 BTN	24	0152:38	91.0
N	22219	26	0052:32	76.0
NA	22232 BTN	26	0147:28	89.7
N	22244	27	0047:24	74.7
NA	22257 BTN	28	0142:19	88.5
N	22269	29	0042:15	73.5
NA	22282 BTN	30	0137:11	87.3
NA	22294 BTN	31	0037:07	72.3

Oscar 7 Orbital Information

Orbit	Date (Aug)	Time (GMT)	Longitude of Eq. Crossing °W
12394 A	1	0008:53	56.1
12407 B	2	0103:10	89.7
12419 AX	3	0002:31	54.5
12432 B	4	0056:48	68.1
12445 A	5	0151:05	81.7
12457 B	6	0050:26	66.5
12470 A	7	0144:43	80.1
12482 BQ	8	0044:04	65.0
12495 A	9	0138:21	78.6
12507 BX	10	0037:41	63.4
12520 A	11	0131:59	77.0
12532 B	12	0031:19	61.8
12545 A	13	0125:36	75.4
12577 B	14	0024:57	60.3
12570 BL	15	0119:14	73.8
12582 BL	16	0018:34	58.7
12595 BL	17	0112:52	72.3
12607 B	18	0012:12	57.1
12620 A	19	0106:29	70.7
12632 B	20	0005:50	55.5
12645 A	21	0100:07	89.1
12658 BQ	22	0154:24	82.7
12670 A	23	0053:45	67.5
12683 BX	24	0148:02	81.1
12695 A	25	0047:23	66.0
12708 B	26	0141:40	79.8
12720 A	27	0041:00	84.4
12733 B	28	0135:18	78.0
12745 A	29	0034:38	62.8
12758 B	30	0128:55	76.4
12770 AX	31	0028:16	61.3

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days. An asterisk (*) indicates AO-7B-6 intersatellite link.

K. W. Moak
Northwood NH 03261

Microwave Waveguide Details

-- square copper tubing?

Waveguide plumbing is the designer's choice for microwave circuits operating from 2000 MHz upwards. It's generally available at surplus stores, and often quite cheaply, yet relatively few amateurs experiment with it because of its striking dissimilarities to conventional transmission line. Actually, waveguide techniques are not difficult to master, and a properly assembled system can open up a whole new radio spectrum to the experimenter.

There are a number of different types of waveguide, round, elliptical, and other shapes, but by far the most widely used is rectangular. This last is almost the only kind usually available to amateurs, so I will confine my remarks to it.

Waveguide can be described as a double wire transmission line with an infinite number of quarter wave insulators connected along it so as to form a closed tube. The means of wave propagation along it are, however, more complex than that in a two-wire line. It consists of both an electric and a magnetic field at right angles to each other which reflect from wall to wall along its length. Different modes of operation, that is, different orientations of these fields, allow more than one wave to travel through the same waveguide at the same time making it ideal for multiplexing. Circuit elements are provided by changing the properties of the inside of the tube, by altering the dimensions, by inserting obstacles into the path of the waves, by manipulating reflections, or by making cavities for the waves to resonate in. The key fact is that with waveguide it is the space inside that carries and controls the waves, rather than wires and solid components.

All waveguide components are complete units designed to be bolted into a system. This is a great advantage at microwave frequencies where the very critical measurements involved would make construction and fitting of parts a difficult task. A waveguide system is assembled more or less in the same way as an ordinary plumbing system with the notable difference that even the plain lengths of pipe are preformed so that no cutting or other machining is necessary. There are a large number of different components available, both fixed and adjustable, in a variety of sizes, corresponding to different bands of operation. All components in a system should, of course, be for the same band, so take care to measure the dimensions when buying.

The band of operation for any given size of rectangular waveguide can be determined easily from two simple formulas. The orientation of the waves at the optimum frequency is known as the dominant mode and is generally utilized. Operation outside of the dominant mode is inefficient and usually undesirable.

To find the dominant mode, divide the longer inside dimension (in inches) into 7,376, which gives the minimum desirable frequency in MHz, and then divide the same dimension into 11,136, which will give the maximum. These two frequencies span the most efficient band of operation. However, they do not represent cutoff frequencies, so there is a certain amount of leeway possible to the designer.

Energy is coupled into or out of waveguide by short probes, diodes, horns, or openings in the waveguide walls. Many microwave oscillators incorporate a section of waveguide with a probe, so they may be connected directly into a system. Others may have to be coupled by short lengths of coax. For transmitting, the system often terminates in a dipole antenna (usually backed by a reflector, the familiar radar dish) or a simple horn which serves as an impedance match to the open air. Sometimes a horn may feed into a reflector as would a dipole, and there are still other methods used, including horn arrays that act like lenses. Given care and patience, suitable antennae and reflectors can often be fabricated by an experimenter.

Waveguide sections are joined in one of two ways, either by flat, precisely matched surfaces, or by grooved, recessed "choke" flanges. The latter, although less efficient, is often used since it enables sections to be joined without extremely fine machining of their mating surfaces, thus lowering cost and improving interchangeability. There are often O-rings or thin metal gaskets between flanges to improve both the electrical and mechanical connections. With the choke connector it should be noted that only one of the mating surfaces is provided with a groove, the other being flat.

Quick-disconnect choke couplings are available, designed for use in situations where one system might have to be alternately coupled to several others, as in test equipment, for instance.

In commercial and military applications the system is usually filled with a pressurized gas, often nitrogen, both for efficiency and reliability, but experimental installations can forego this. Just be sure to keep the inside of the waveguide clean and dry. Any dust or condensed moisture will cause arcing and power loss.

The most popular method of joining waveguide flanges seems to be with small hollow-head screws and nuts, but any suitably sized fasteners will probably do. While not necessary, some attempt at torquing the fasteners equally might result

in slightly less power loss.

I can only begin to describe a few of the many types of components available for waveguide systems, those which you would be likely to have use for in a simple setup. Movable metal slugs projecting into the waveguide are used as tuning stubs to eliminate undesirable reflections, or as filters. These are often installed just after the input or just before the output. Metal or conductive plastic plates or vanes, some adjustable, some fixed, serve as attenuators by effectively changing the dimensions of the guide, and wedges or blocks of graphite or metal in the end of a section act as terminating resistors.

By far the most important group of waveguide components is that which incorporates tunable cavities which act as resonant circuits at microwave frequencies. This group includes not only passive components, but also a large percentage of microwave oscillators and amplifiers which have built-in cavities. Some oscillators, notably the magnetron, are actually little more than resonant cavities in function. A cavity used as a discrete component will often be in the form of a relatively large cylinder with one end movable, so that the size can be changed. These units are, of course, as important in microwave systems as conventional resonant circuits are at lower frequencies.

The various waveguide components are interconnected by sections of plain waveguide, available in various lengths, straight, angled, or flexible. Some are so constructed that two or more inputs are mixed into one output, others so that a fractional part of the wave energy can be drawn off for measurement or other purposes. Mechanical switches are made to transfer a wave from one guide to another, and various electronic methods have been devised to provide transmit/receive switching. In short, waveguide can be used to implement the equivalent of almost any conventional circuit.

Often complete waveguide systems can be obtained in the form of radar test sets. Such a set might include a wide band oscillator with power supply, one or more tunable cavities, usually precisely calibrated, and an assortment of waveguide sections and components, attenuators, tuning stubs, coax outputs, and impedance matches. If you can find such a unit it makes an ideal beginning in waveguide which can be added to as you see fit.

This short article is no place to go into the complex field of microwave oscillators and amplifiers, nor that of measuring devices, nor the evergrowing number of solid state components used especially in very high frequency microwave systems. Many of the newer components are not generally available to the amateur anyway. Any good microwave handbook will provide a wealth of information on these more specialized fields. Most large city libraries will have at least one such handbook, which is also must reading for anyone interested in ordinary waveguide circuitry.

With microwaves being used more and more, now is the ideal time to learn the ins and outs of waveguide, before the surplus prices start skyrocketing. In no other branch of electronics does the behavior of waves so nearly approximate physical analogies. This makes waveguide an interesting and enlightening variation on familiar theory and technique. Even if you never plan to get on the air with microwaves you will find it worth a modest investment to experiment with this unique and fascinating branch of electronic technology. ■

LETTERS

from page 7

recently took the FCC General class exam on the 9th of May, here in St. Louis. I experienced no difficulty in passing the code portion of the exam; in fact, I found it very easy to copy the material given. Unfortunately, I failed the written portion of the test. I will be trying it again in June at the Kansas City office.

Again, your tape really helped more than any other tape I have used, and I highly recommend it to other would-be General class amateurs. I am seriously thinking about tackling your 20 wpm tape.

Patrick M. Brown WB0TTP
Hanley Hills MO

STEELY-EYED

I have been an avid reader of your publications for many a year now, and far prefer them over any of the other ham magazines. I very much appreciate your policy of accepting advertising from only the most reputable firms, and also enjoy your editorial views and opinions. I must, however, take issue with one of your own advertisements – the one for the *73* code tapes.

In your text you make mention of the fact that an extra word or two per minute in code speed is necessary due to nervousness when appearing before "the steely-eyed examiner" at the FCC. I have recently returned from the Baltimore field office, General class privileges in hand. I must state that all of the personnel in the Baltimore office are anything but "steely-eyed." From the young lady administering the receiving test, to the gentleman giving the sending test, to the Engineer-in-Charge – each was most polite, kind, and did his best to put me at ease. Each did his job in a manner designed to relax the applicant and contribute to success.

I wish you would change the text of your advertisement for your excellent tapes to state that despite the sincere efforts of the friendly examiners, an extra word or two per minute is necessary to combat inevitable nervousness on the part of the applicant. Thank you.

Mayer D. Zimmerman W3GXK
Randallstown MD

LIMARC CLASSES

The Sewanhaka Central High School District, in conjunction with the Long Island Mobile Amateur Radio Club, is sponsoring a course in amateur theory and code as part of the adult education program.

LIMARC is providing the instructors while the school district is providing the facilities. There will be *no* tuition or registration fees.

Classes will be held on Wednesday evenings at Elmont Memorial High School, Elmont, L.I.

Interested persons should contact the Adult Education Office at (516) 328-4875.

John F. Gillen WA2CWT
Public Information EMHS
555 Ridge Road
Elmont NY 11003

BACK TO BASICS

I enjoy *73*, but I would like to see more basic electronic tutorial articles (how do you bias transistors, design simple amplifiers, etc.) and save the I/O stuff for *Kilobaud* (which I also get and enjoy). I don't particularly object to the computer articles, but I am a self-taught professional systems programmer, and my electronics background (and my typing) isn't very solid. I can design and get to work digital circuits (just an extension of programming, sort of), but I am almost lost in analog areas. In any case, I approve of your efforts to make computer technology more understandable to the world at large.

Stan Webb
Albuquerque NM

Get the picture, authors? – J.M.

220–NO LOSS

As an active amateur, I am in favor of the loss of up to 1 MHz of our 220 MHz band to CB for the following reasons:

1. We amateurs would really lose nothing, as we could operate on the lost frequencies with our CB license.
2. It will reduce the price of 220 MHz radios, due to mass production for us.
3. CB really needs more room at a practical low cost frequency.

I have already written the ARRL of my proposal.

M. P. Lewton WA6PHR
Santa Maria CA

J. Tom Badgett K4MDK
1917 Washington St.
Bluefield WV 24701

Centerfed Specials

-- for the small city lot

I never believed in fancy antennas. I never read the articles on windoms and long wires and "apartment dweller" specials. Endfeds and directive arrays for the lower frequencies seemed frivolous folly. The only sensible antenna was a centerfed dipole, lovingly pruned to frequency. For years I swung these carefully constructed antennas free and clear, at a right angle to the shack, because that's what the books said to do.

Then I had to make an agonizing decision to compromise my principles or go off the air on 80 meters. I moved a proven centerfed antenna to my new house, but it wouldn't fit the lot. After days of pacing and measuring, I rationalized that it wouldn't hurt this successful dipole to – say it softly – *bend the ends just a little*. I kept telling everybody I was running a regular, run-of-the-mill 80 meter dipole, partly because I was ashamed to admit the sacrilege I'd committed, and partly because my transceiver loaded the same as always.

That first tentative transgression opened wide the door to further sin. It wasn't long before I was running drooped and twisted dipoles on several bands, and with the same good results. I reasoned these antennas succeeded because they were, after all, still the proven centerfed dipoles I had used for years even if they weren't erected by the book. Little did I know I was on the road to the ultimate sin.

In just over a year, I've moved twice and neither QTH allowed room for my comforting dipoles, no matter how I contorted them. In fact, in the first location space was so restricted (mainly because of a lease agreement) it was months before I skulled out an antenna design. In the interim, I spent the evenings hunched over an allband receiver I'd bought with proceeds from the sale of my transceiver. I strung a 20' length of wire around the room and became a shortwave listener.

A ham can listen only so long, though, so I borrowed an old Johnson Viking and hooked it right up to that same short wire. You know what? The damn thing loaded. I've got 579 reports on 40 meter CW from all over the country to prove it!

The little antenna worked so well I naturally began thinking of the companion transmitter for my state-of-the-art receiver. Before the new unit arrived, I decided to put up a real endfed antenna outdoors, a design I hadn't seriously considered before (perhaps necessity really is the mother of invention).

Now, I don't want to do anything to refuel the swr controversy – honest. But I feel compelled to write about my conversion and what I've learned about practical antenna design because of it.

I read the antenna books, then bought some 300 Ohm balanced line and a 4:1 balun. I managed to get 250' of wire in the air and fed it at the end with 100' of the balanced line, attached the balun and ran coax on into the shack. I had no swr bridge or tuner, but I got a good solid dip and could load my transmitter on all bands with no RFI problems – never mind that the books say this kind of antenna requires a matching device to function properly.

I was really corrupted by this point, so when I moved again I didn't hesitate even a day getting up an antenna. I didn't bother with the balanced line for this one. I stretched 100' of wire and endfed it with coax and the 4:1 balun. The shorter wire seems a little more sensitive to frequency change than the

Swr for Different Feedline Impedances

f	N	R	110 (Med.)	300	150	75	50
1.8	0.5	70	1.6	4.3	2.1	1.1	1.4
3.5	0.9	90	1.2	3.3	1.7	1.2	1.8
7	1.8	108	1.0	2.8	1.4	1.4	2.2
14	3.6	130	1.2	2.3	1.2	1.7	2.6
21	5.4	145	1.3	2.1	1.0	1.9	2.9
28	7.2	150	1.4	2.0	1.0	2.0	3.0

$$N = \frac{fL + 24.6}{984}$$

$$Swr = \frac{R}{Z} \text{ when Z is larger than R}$$

$$Swr = \frac{Z}{R} \text{ when R is larger than Z}$$

where f: Frequency in MHz
L: 250'
N: Number of wavelengths for antenna
R: Antenna radiation resistance (see text)
Z: Feedline impedance

Fig. 1. Swr for a 250' endfed antenna.

longer model, but I still get good loading and a solid dip on any frequency on all six high frequency ham bands. There's still no outboard tuner or swr bridge in the circuit.

I keep daily CW and phone schedules with a fellow ham in South Carolina, and we've been plotting signal strengths on 80 and 40 meters since we started the contacts about six months ago. Bill K4WGP reports that no noticeable change in signal strength occurred when I changed from the 250' antenna to the 100' model.

Now for the theory part of this discussion. If we can agree with Rayer ("Exploding the SWR Myth," *73*, Dec., '76) that as long as you get a good dip from your transmitter, a tuner won't change the amount of antenna current flowing in the line (or your signal at the other end), then we can discuss theoretical swr and make happy all those people who just won't fire up their rigs unless the swr is less than 2:1.

Swr is a factor of antenna and feedline impedance. Feedline impedance for ham purposes is easy to determine because we buy lines with published impedances for specific purposes. Antenna impedance is another matter. This figure depends on the radiation resistance, height above ground, proximity to nearby objects and conductor size. For most HF ham antennas, the practical impedance usually can be considered to be the radiation resistance. For a centerfed, half wave antenna, that figure is between 60 and 70 Ohms — perhaps higher or lower depending on influences which take the antenna away from the theoretical ideal.

The figures become somewhat more complicated when an allband design is considered. As the operating frequency is moved from resonance, antenna reactance begins influencing impedance. The change is a cyclic one and interestingly enough the rate of impedance change decreases as frequency increases, assuming the antenna length stays the same. I have found by practical experience that when using an endfed wire of sufficient length, its radiation resistance is a good enough impedance figure for ham purposes.

If we start with a half wave antenna fed at a current loop, at the end in this case, the radiation resistance is approximately 70 Ohms. If the operating frequency is increased or the antenna is made longer, the resistance also increases. A one wavelength antenna has a radiation resistance of about 90 Ohms, and a ten wavelength wire will show about 160 Ohms.

Knowing the radiation resistance and the impedance of the feedline, we can compute the theoretical swr of the system. This is done in the accompanying charts for three different antennas operated on the various HF ham bands. Obviously, if you started with a desired operating frequency and juggled the antenna length, you could improve the swr at your favorite frequency. I used the beginning frequency of the bands for computations for convenience, since everyone has his favorite band or set of frequencies.

Swr for Different Feedline Impedances

f	N	R	95 (Med.)	300	150	75	50
1.8	0.2	62	1.5	4.8	2.4	1.2	1.2
3.5	0.4	70	1.4	4.3	2.1	1.1	1.4
7	0.7	88	1.1	3.4	1.7	1.2	1.8
14	1.4	105	1.1	2.9	1.4	1.4	2.1
21	2.2	112	1.2	2.7	1.3	1.5	2.2
28	2.9	128	1.3	2.3	1.2	1.7	2.6

Fig. 2. Swr for a 100' endfed antenna.

See Fig. 1 for a rundown of swr for the 250' antenna previously described with different feedline configurations. If the formulas are correct, one could operate this antenna at about 1.5:1 on all bands by feeding it with a 110 Ohm line. The median feedpoint resistance is (70 + 150)/2. A match almost as good can be obtained by using a more conventional 75 Ohm line. This line would keep the theoretical swr at 2:1 or less on all bands. If you use coax, you probably should add a 1:1 balun at the antenna feedpoint.

Fig. 2 is a similar chart for the 100' antenna I'm presently using. Both of these antenna lengths were chosen because they represent the maximum amount of wire I could get into the air. The table shows I'd probably be better off with a 1:1 balun and 75 Ohm feedline, but the 4:1 balun is what I had.

I ran the figures for a 135' antenna because that's a length frequently recommended for a long wire, and it is about the length of an 80 meter dipole. Many hams manage to get up the conventional 80 meter antenna but don't think they have room for an allband design.

Note, too, that you get another plus as the frequency is increased or the antenna is made longer: directivity. When an endfed design is a half wavelength long, its gain is about the same as a centerfed design. The longer the antenna (the more wavelengths on the wire), the greater the gain. The direction of increased radiation is off the ends of the antenna, so at higher frequencies especially, it often helps to lay out your endfed wire with the help of a compass so you'll get greatest directivity in the direction you're most interested in working.

So practice and theory show that for getting out, an antenna tuner or swr meter is unnecessary. There may, of course, be feedline and antenna length combinations which are beyond the capabilities of a given transmitter circuit, and there is less likelihood of harmonic radiation with a tuner.

But I've shown by personal experience and theory that slavish dedication to often-repeated facts about swr and antenna design can knock you off the air. When you need an antenna you just know you don't have room for, string up something anyway. Feed it at the end using the formulas to help you choose a feedline, make sure you're not causing RFI somewhere, and if it'll load, you can work about anything you can hear. ■

Swr for Different Feedline Impedances

f	N	R	96.5 (Med.)	300	150	75	50
1.8	0.27	60	1.6	5	2.5	1.3	1.2
3.5	0.51	70	1.4	4.3	2.1	1.1	1.4
7	0.99	90	1.1	3.3	1.7	1.2	1.8
14	1.95	112	1.2	2.7	1.3	1.5	2.2
21	2.91	128	1.3	2.3	1.2	1.7	2.6
28	3.87	133	1.4	2.3	1.1	1.8	2.7

Fig. 3. Swr for a 135' endfed antenna.

Charles Klawitter W9VZR
4627 N. Bartlett Ave.
Milwaukee WI 53211

Recycle Your Receiver

-- tips for hamfest specials

I guess I'm the kind of ham that you would have to call a receiver nut. For about twenty-five years I have had the opportunity to own most of the commercial receivers available to hams. Many of these were outstanding, high quality, instruments which were a pleasure to own and use, and, of course, some were very poor, almost useless.

Unfortunately, today most receiving instruments are only a part of a transceiver. It is difficult to buy a quality receiver by itself, especially on a budget. The obvious solution is purchasing an older receiver and reconditioning it both mechanically and electrically. If you are a real receiver nut like myself, you will also consider a face lift for the old beauty. I imagine the antique car buffs would understand that quirk in my personality.

The reason I decided to rebuild the Hammarlund BC-779-B is very simple. Someone was kind enough to give me one. It also was an excellent receiver in its day, the early and middle forties – shades of Glenn Miller!

It also is an eighteen tube gem, the first of the Super-Pros, with one of my favorite characteristics, the external power supply. This is a great way to keep heat and intense magnetic fields out of the receiver proper. It has a fine quality sliding band switch which proved perfectly troublefree after all those years of use. It tunes to twenty MHz, has a good crystal filter, and enough BFO injection and stability to work reasonably well on SSB. Something like that could cost several hundred dollars new and only weigh a fraction of this boat anchor.

Now that I have established the fact that this project is worth the effort, let me give you some tips for the successful completion of this labor of love and lunacy.

I would suggest that before you begin any major work on this project that you check to see that the machine works. It does not have to be in top notch order, but it is helpful to establish this before you begin disassembly. A schematic, or better yet a manual, can be a real lifesaver. I was lucky to be able to purchase one from Fair Radio Sales. Other sources might be W3LHD for military surplus equipment, Sams Photofact, or the manufacturer.

The power supply for my BC-779-B was in terrible condition and weighed more than the receiver. It looked like it had been dropped from an airplane or run over by a tank in World War II. I built a new, much lighter supply, that I could easily store under my operating table. I added some voltage regulation for oscillator voltages and screen voltages. The screen voltage made a large change in the receiver gain for less than a five percent change in the supply voltage. I went all the way and used a three wire

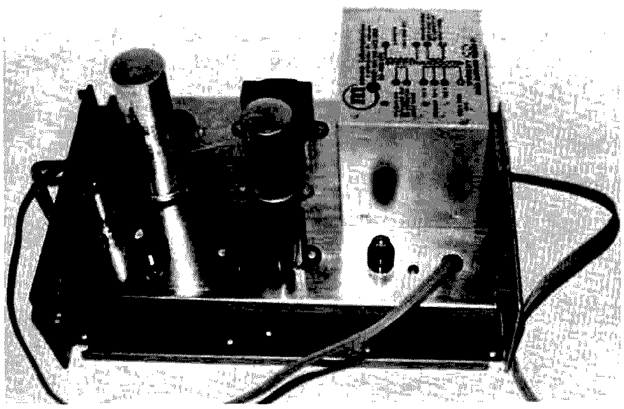


Fig. 1. The new power supply for the BC-779-B.

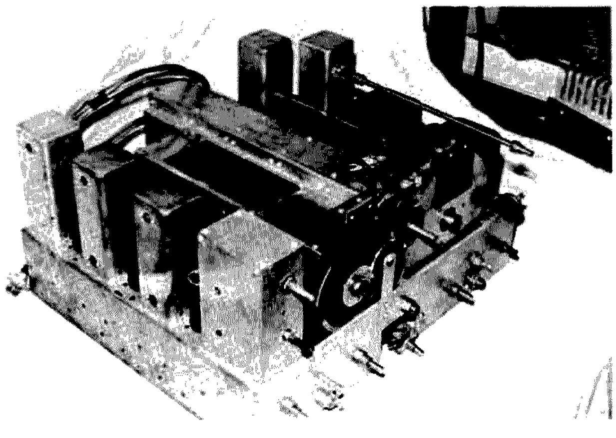


Fig. 2. "Old Faithful" with the front panel removed, ready for cleaning and repair.

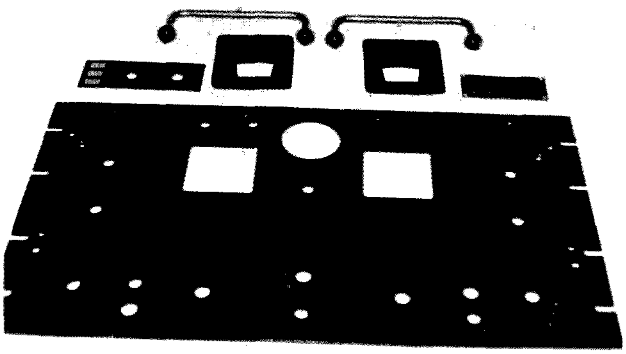


Fig. 3. Newly painted front panel with handles, escutcheons and name plate.

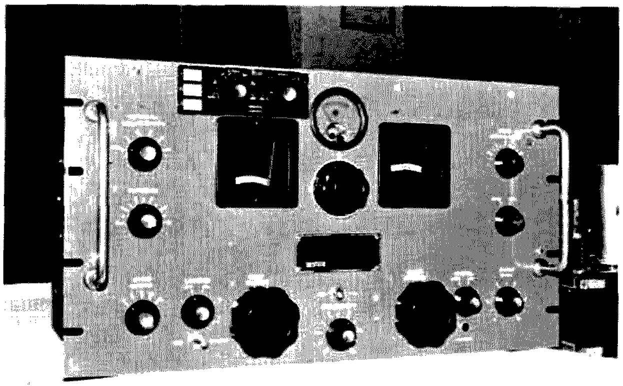


Fig. 4. The completed receiver.

line cord to complete the supply. Fig. 1 shows you how the new supply looks.

When I had the receiver working (no AVC yet, that would come later), I decided to remove the front panel and refinish it. Be careful so that you do not lose any parts. Use a plastic pan to keep track of all the hardware and other parts. If the dial markings are not etched into the panel, make a drawing of the panel and the location and names of all the controls. Fig. 2 shows the receiver after the front panel was removed. All of the panels I have worked with have been either steel or aluminum. The method of refurbishing that I will explain has worked well with both types of panels. First strip all the paint from the panel. Use a good quality liquid stripper. A pint should be sufficient. Read the directions carefully and heed all warnings. When the paint has been removed, it is a good idea to remove any grooves or burrs. Make the panel as smooth as possible. A primer is very important to getting a good final finish. Buy a good metal primer, close to the finish color of the panel. I have had good luck with auto primer. Use several light coats to prevent runs and bubbles. It is helpful to bake the primer. In winter, I put the panel on a ledge of my heating unit. If the cook in your home is rather liberal, you may be able to bake the panel in the oven at 200° for a few hours. If the first coat is not consistent, add a second coat. Be patient. Allow at least twenty-four hours in between coats of primer or finish. If you are like I am, you will have a tendency to want to get the painting done quickly to see some results ... resist the temptation! You will hate yourself in the morning if you don't. Now apply a coat of the finish color. Rub it out after twenty-four hours. I use an inexpensive auto rubbing compound. Use at least two or three coats of finish. This will give you more ability to rub out imperfections. You could use a spray paint color which is available at a paint or hardware store, or you could go custom by having a color mixed at an auto paint distributor. Fig. 3 shows the repainted front panel, escutcheons, name plate, and handles.

Congratulations! You now own a beautifully painted metal panel ready for lettering or decals. Easy now. This is your last chance to really guff-up your work of art. My panel was engraved, so all I had to do was work white tempera into the panel and let it dry. For my finishing touch, I paste-waxed the panel with Johnson's Paste Wax and lovingly buffed it until I was satisfied with the results.

Because of the weight of the receiver, and to add some aesthetic quality, I added six inch handles to the panel. The handles also make it possible to lay the receiver on its face for servicing. The escutcheons were sprayed flat black and a cracked plastic window was replaced with new plastic. The old knobs can be cleaned and small scratches removed by using rubbing compound and then paste-waxed them. New knobs, or knobs of more appropriate size, for tuning or bandspread may be added. I used larger knobs for the tuning functions. It gives the same effect as increasing bandspread. Fig. 4 indicates the modern appearance of the new paint and knobs on the thirty-five year old beauty.

Now is a good time to test the tubes and clean the chassis. I used clorethane for the chassis, along with a toothbrush and a smaller brush for all those tough corners. Some of the plated parts such as covers and chassis supports can be polished with SOS pads and then sprayed with a clear plastic such as Krylon's Crystal Clear. If there are any markings on the chassis, they should be renewed. Remark them now. If you put it off, you will never do it. Fig. 5 shows the cleaned chassis and new power supply.

After the refinished panel was again installed, it was time to complete the electrical repair. The AVC problem that I had mentioned earlier was due to a shorted capacitor in the screen circuit of the AVC amplifier. The short had opened a 2000 Ohms screen supply resistor. I felt it would be a good idea to replace all the thirty year old capacitors at this time, especially those used for bypassing and coupling. This was

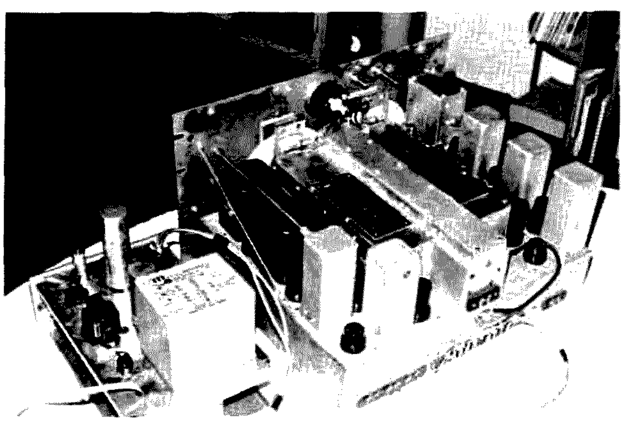


Fig. 5. Cleaned chassis, new power supply and interconnecting cables.

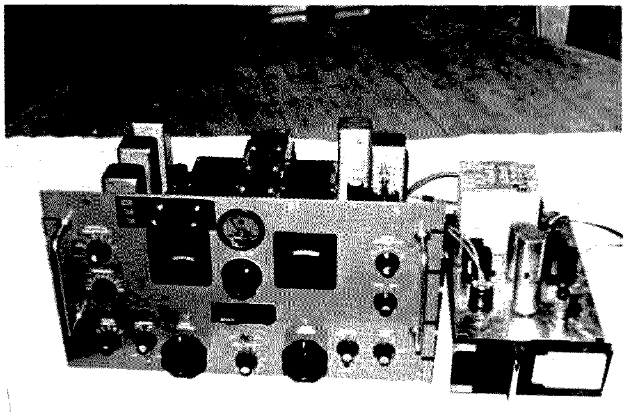


Fig. 6. The "gift receiver" recycled and ready to operate.

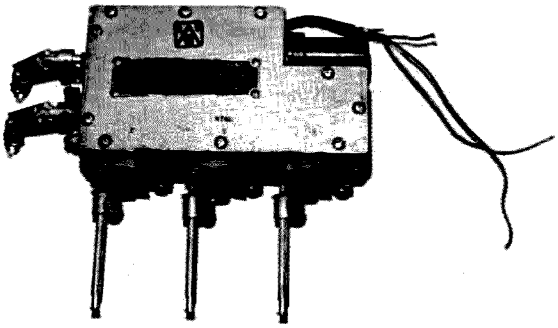


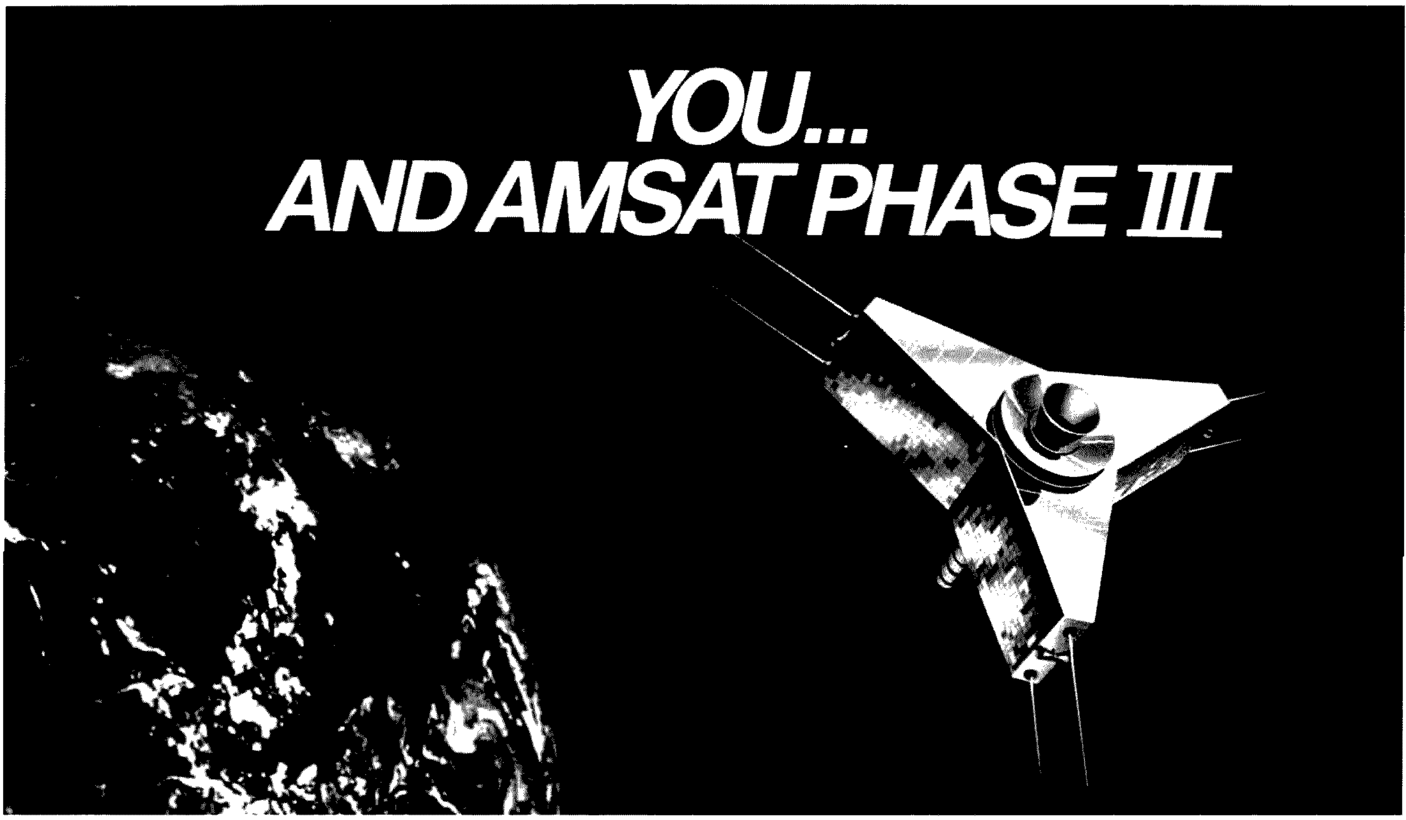
Fig. 7. The MC-531 crystal controlled oscillator modification kit.

easily done because there is ample room under the chassis. I checked several resistors and found them to be well within tolerance, so I did not replace any resistors in this set. This was quite unusual, in my experience, because I have found that older pieces of electronic gear suffer from many resistors which have changed value well beyond 20 percent. I also replaced an AM-CW toggle switch with a rotary switch so that the front panel would be authentic and have the correct number of knobs and switches. Fig. 6 shows the completed receiver and power supply prior to installation in the station console. The last modification that I made to the receiver was the removal of an earlier modification. This was the MC-531 crystal oscillator which made the receiver capable of three additional crystal controlled frequencies like its newer brother, the SP-600 JX. My reason for doing this was the poor way in which the oscillator was tied into the receiver. It extended the receiver oscillator circuits and made them vulnerable to mechanical vibration and instability. The MC-531 plate and knobs were left on the front panel of the receiver to cover up the holes. Fig. 7 will give you an idea of what this unit looks like.

Before final alignment I decided to let the receiver run for long periods of time over a two week time span. This usually will cause weak components to fail and save a lot of trouble later on. During this time I got used to the controls and the operating characteristics of the old Super-Pro. The more I operated it, the more I enjoyed it. The removal of the MC-531 oscillator cured any doubts I had about the oscillator being stable enough to use on twenty meter SSB and the crystal selectivity impressed me when using it for CW. Believe it or not, there is a phono input which gives reasonable quality audio out of a pair of 6F6s. What more could a person ask for in the well-equipped ham shack?

Now let's get to the alignment. I borrowed the best signal generator I could find, another big, heavy surplus tube-type device, called the AN-TRM/1. I allowed both the generator and the receiver to warm up for several hours, along with the basement ham shack. I have never known such a cold winter! As with most quality receivers I have aligned, this one was a breeze. The manual was specific and complete. The i-fs were tuned with air padders, real class! The rf alignment went just as smoothly as the i-f and I was able to get a nice even response across each band from one end to the other. I calibrated the S meter according to the manual, 50 microvolts gives an S9 reading at 3.5 MHz. For a change, I have some idea what the S-meter reading really means. The alignment took an evening, which was an enjoyable way for me to spend that period of time. It was the culmination of a couple months of part time labor which had a happy ending. For me, there was a great deal of pride in recycling an old piece of electronic gear into a useful and pleasant surprise which should keep going for many more years.

So far there has only been one unusual quirk in the operation of "Old Faithful." Occasionally when I am listening to shortwave broadcasts late at night, I will hear strange sounds like the music of Glenn Miller and Benny Goodman floating ethereally through the speaker when I tune to a place near 20 MHz around the old haunts of WWV. ■



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Many of you are familiar with the benefits of the AMSAT OSCAR satellites, notably OSCAR 6 and 7. These satellites, with a combined total of over 8 years in orbit, have provided communications between amateurs throughout the world. They have also provided a capability for an educational program in space sciences and many interesting experiments.

AMSAT, with members and contributing groups worldwide, and headquarters in Washington, D.C., has been responsible for our current satellite program. Many people feel that perhaps the greatest value of the amateur satellite program is the dramatic demonstration of amateur resourcefulness and technical capability to radio spectrum policy makers around the world.

The value of this aspect of amateur radio as we prepare for the 1979 World Administrative Radio Conference (WARC) is enormous.

The AMSAT PHASE III satellite program promises a continuing demonstration that amateur radio is at the forefront of modern technology. PHASE III satellites will routinely provide reliable communications over paths of up to 11,000 miles (17,600 km) for 17 hours each day. You can think of them as a resource equivalent to a new band.

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Build A Double Bazooka

-- give your signal a blast

William Vissers K4KI
1245 S. Orlando Ave.
Cocoa Beach FL 32931

An interesting fourteen page mathematical analysis of why the coaxial dipole antenna doesn't work for the average amateur appeared in the August 1976 issue of *Ham Radio.* I did a double take when I first read it. About a year ago, after having been off the air since 1935, I decided to get back on. My bright and new Yaesu FT-101-B worked fine, but a simple broadband antenna was needed for the 80 meter band. It seemed that a double bazooka, or coaxial dipole as it's also called, would be just the thing.

Before I built one, I did a bit of thinking as to just what made a double bazooka work. I realized that a very simple change would make it work a lot better than any of the ones previously described in the literature I had read. After reading the referenced article, I decided to repeat my previous experimental work and also delve a bit deeper into why my double bazooka worked so well when the theoretical analysis proved the coaxial dipole wouldn't work.

Being an old-time ham, ex-W3RN (1928), possessed of more low cunning than high math, I want to say that I won't write a long mathematical treatise as to why my antenna works as well as it does. The mathematics of the referenced article are absolutely correct, so anyone reading the referenced article can go to it and repeat any or all of the math he likes.

Instead of analyzing a theoretical thin wire dipole in free space, we'll analyze a dipole antenna that more closely represents the characteristics of one built by the average amateur. Then we'll add the coaxial stub sections and see what happens. At the same time we'll observe the improvement in lowering swr by using my new parallel connection technique as opposed to the series method previously used.

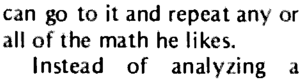

Fig. 1. Basic dipole antenna.

This analysis will be theoretically calculated and the resulting curves shown. The curves will show the antenna without any stubs connected, then with the series method, then with the parallel method just developed. And, finally, I'll show the same kind of curves as actually measured at my coax line feeding the antenna from the transmitter. This will allow each amateur to make his own decision as to whether a coaxial dipole has any reason for being.

But one of the most compelling reasons for not going through pages of math is quite practical. Most average hams like myself are more interested in seeing actual results. Besides, anyone can check the math for himself from the referenced article. And now, as an example, I'll pull some figures and values out of a hat in midair and show some results. Later I'll explain just why I chose the figures I did. This way we can show the results first and figure out the whys and whereofs later on. I guarantee it will be a lot easier that way. Lastly I'll add a few general comments when I compare a double bazooka to other antennas designed for broadband usage.

Some Basic Theory

First, to refresh our memories and see exactly what we are going to explain, let's think about a simple dipole antenna as shown in Fig. 1. It is a wire an electrical half wavelength long with an insulator in the center where our feedline will attach at points A and B. And we know that for practical purposes our antenna at resonance can be represented by the simple series circuit of Fig. 2. R_a is the antenna resistance. X_l is the inductive reactance, and X_c is the capacititive reactance in Ohms. Also at resonance, X_l is equal to X_c numerically, but of opposite sign. And so at resonance our impedance is simply R_a. The Q of the antenna is X_l/R_a. Z_c is the impedance of the feedline we will use, and for our purposes it will be 50 Ohms, as that's what is generally available and used by the average amateur. And also at resonance, the swr is Z_c/R_a when Z_c is larger than R_a, and the swr is R_a/Z_c when Z_c is smaller than R_a. And if we were really lucky and had an antenna with a resonant resistance of 50 Ohms, our swr would be simply R_a/R_c or 50/50 or 1:1, and you can't improve on that.

There is not only one fly in the ointment, but at least three big ones and a few smaller ones buzzing around, as I'm sure you have already guessed. First, our antenna resistance is not always 50 Ohms. It can be either higher or lower. Second, and more importantly, is what happens when we tune our transmitter

Fig. 2. Basic dipole antenna resonant at 3.75 MHz. Q = 10, swr = 1.25:1.

Fig. 3. Basic antenna dipole equivalent circuit at 3.5 MHz. Swr = 3.27:1.

to some frequency away from resonance. Then there is the third fly of basic antenna Q, which will have an important effect on how well our double bazooka antenna works.

But let's first stick with our basics a bit longer and see what happens, for example, when our antenna has a Q of 10 and a resonant resistance of 40 Ohms. We'll assume, and for practical purposes we won't be too far off, that our basic antenna dipole resistance will stay at 40 Ohms over the entire 80 meter band. Let's also assume our resonant frequency is in the middle of the band at 3.75 MHz. Our X_1 will numerically be equal to X_c and will be equal to X_1 = (Q) (R_a) = (10)(40) = 400 Ohms. And our swr at resonance will be Z_c/R_a = 50/40 = 1.25:1 at 3.75 MHz.

Now let's look and see what the antenna looks like at 3.5 MHz. Our inductive reactance will decrease to (400)(3.5 MHz)/(3.75 MHz) = 373.33 Ohms. Our capacitive reactance will increase to (400)(3.75 MHz)/3.5 MHz) = 428.57 Ohms. The difference will be 428.57 minus 373.33 which is equal to 55.24 Ohms. So at 3.5 MHz our antenna no longer looks like a pure resistance of 40 Ohms, but looks like a 40 Ohm resistance in series with a capacitive reactance of 55.24 Ohms, as shown in Fig. 3. And the calculations for the swr of our antenna at 3.5 MHz with the 50 Ohm coax feeder tied on turns out to be 3.27:1. As I mentioned earlier, the basic mathematics of the referenced article go into the details of how to calculate swr, and, as we didn't want to make this article too mathematical, we'll let it go at that. However, I'll do some more math calculations myself and just show the curves. It will save us all a lot of time and effort.

Well now that we've seen that our basic dipole has an swr of 3.27:1 at 3.5 MHz, we wonder if there is any way that we can reduce the swr to a lower value. Here is where the double bazooka comes in.

But before going directly to the antenna, let's see just what we are actually going to do. If we look at the characteristics of a parallel resonant circuit and compare it to the series circuit of our basic dipole, we will find some interesting things. Let us just arbitrarily take a condenser of 3600 pF and an inductance of .5 uH and connect them as a parallel circuit. It just happens that this circuit will resonate at 3.75 MHz. If we assume a perfect coil and condenser, the parallel impedance at resonance will be infinity. So if we were to place this parallel resonant circuit across the insulator of our basic dipole, nothing would happen at a frequency of 3.75 MHz.

But what happens to our parallel circuit by itself if we tune the transmitter to 3.5 MHz? With a bit of basic circuit theory, we find the parallel tuned circuit will be equivalent to an inductive reactance of 85.3 Ohms. And we already know that our antenna by itself at 3.5 MHz showed a capacitive reactance of 55.24 Ohms in addition to its resistance value of 40 Ohms. This tells us that when we look at Figs. 4 and 5, that the inductive reactance of the tuned parallel circuit at 3.5 MHz could be used in some manner to cancel all or part of the capacitive reactance of the antenna at this frequency.

Another interesting thing is that the equivalent antenna resistance will no longer look like 40 Ohms but will be at some higher value. Fig. 5 shows the total equivalent circuit impedance of the combined system. The equivalent resistance is now 116 Ohms and the capacitive reactance has dropped to the extremely low figure of 2 Ohms. So we have seen that by picking the right kind of parallel tuned circuit, we can practically eliminate the reactive component at the band edge of 3.5 MHz.

A similar action would take place if we left things as they were and tuned the transmitter to 4 MHz. And now if we were to calculate the swr of the combined circuit at 3.5 MHz, shown in Fig. 5, we would find that the swr has been reduced to a value of 2.33:1. And, as our original swr without compensation was 3.27:1, we see that there is a way to reduce swr in an antenna.

It might be reasonably asked at this point, if we can theoretically reduce the swr of an antenna system with a simple parallel resonant circuit, why go to the double bazooka system? There are two basic reasons. First, we notice that the value of capacity required is very high and that the inductance is only .5 uH. To properly tune and build such a network tuned exactly to 3.75 MHz and install it across your antenna insulator would be quite a job. Second, it would be hard to build such a system using practical components and still obtain a high Q. Since we want the Q of the parallel circuit to be as high as possible for best results, this means we want the losses to be as low as possible.

Fortunately, a shorted quarter wavelength of coaxial cable will act like a high Q parallel tuned circuit. At the same time, the quarter wave sections will also act like a portion of the antenna radiating system. As a matter of passing interest, as it does have some bearing on our further discussion, we could in this example replace our parallel tuned circuit with a quarter wave piece of coaxial cable cut for 3.75 MHz. However, this piece of cable would have to have a characteristic impedance of nine Ohms. To my knowledge, there is no such kind of coaxial cable of this low impedance on the market available to the average amateur.

We know that our antenna will have two quarter wavelength stubs, one on each side of the center insulator. If we plan to use 50 Ohm coaxial cable, we can readily see that if we were to parallel the two stubs, we would get down to 25 Ohms. However, the double bazooka antennas used up to this time have all showed the two stubs connected a series, which gives a characteristic impedance of 100 Ohms. And we know that 25 Ohms is a lot closer to 9 Ohms than the

Fig. 4. Parallel tuned circuit.

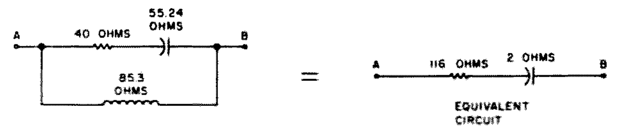

Fig. 5. Basic dipole antenna with parallel tuned circuit connected in at 3.5 MHz.

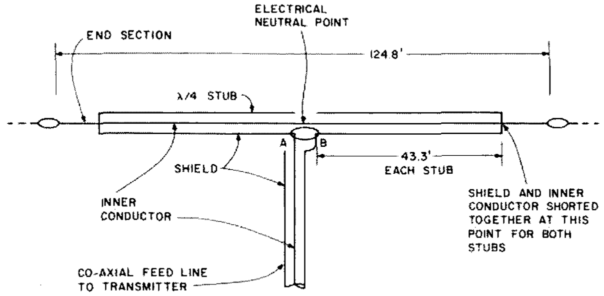

Fig. 6. Coaxial dipole series connected.

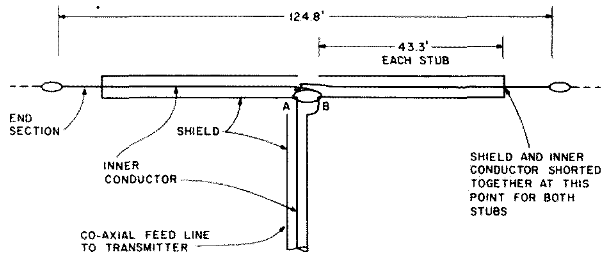

Fig. 7. Coaxial dipole parallel connected.

previously used series connection of 100 Ohms. The stub improvement ratio is a factor of four to one, which is nothing to be sneezed at in any antenna system. So if anyone already has a series double bazooka antenna up, all he has to do is to change over to the new parallel configuration and notice the marked reduction in swr. The series and parallel stub configurations are shown in Figs. 6 and 7.

The original coaxial stub antenna was designed by the staff of MIT for radar use. Their design shows a series stub system. Actually when you start from an original design and are not limited like we are to the use of 50 Ohm coaxial cable for feedline and stubs, the antenna system could be optimized using either a series or a parallel stub system. Naturally the feedline and stub impedances would be different for the two different types of antennas.

The series stub system was apparently used for a very good and simple practical reason. In the series stub system, there is an electrical neutral point where the center conductors of the coaxial stubs join, while the parallel stub system does not have such an electrical neutral. And the electrically neutral point of the series system was used as a mechanical support point. In this way the radar antenna could be easily mechanically physically supported without an expensive electrical insulating system being required. One would have been needed if the parallel stub method had been used.

Apparently, whoever first adopted the concept of a double stub antenna for amateur use just went ahead using the series stub connection without realizing that a parallel stub system is quite superior when using 50 Ohm coaxial line. But that's why I can't help but feel that basic concepts are sometimes better than high mathematics where you can easily lose sight of the basic objective which, to me, is to build an antenna with the lowest possible swr. And that's what this article is really all about.

Antenna Characteristics

Although we mentioned that the referenced theoretical mathematical analysis of a thin wire in free space was correct, there are a few things that should be further considered. There is no disagreement that the free space thin wire coaxial dipole will not work well in the series configuration using a 50 Ohm feedline and 50 Ohm stubs. But, and this is a very big but, the average antenna put up by the average amateur differs markedly from an antenna in free space. An analysis of a coaxial dipole using thin wire implies that there is such a thing as thin wire coaxial cable to be used for the stubs. There is no such thing. The very fact that coaxial cable has a finite thickness would lower the Q of the free space thin wire antenna. And we will find that the lower the Q, the better the stub sections will work.

But more important than the previous technical point is that the resonant resistance of an average amateur antenna is considerably lower than that of an antenna in free space. For a horizontal antenna to have a resistance of 73 Ohms, which is the same as free space resistance, the antenna height has to be at least a quarter wavelength high. And this, for our resonant frequency of 3.75 MHz, turns out to be 65.5 feet high. And in all honesty, how many average amateurs can boast of a pair of poles that high supporting a horizontal antenna 125 feet long? There are none in my acquaintance. Usually our average amateur is lucky if he can get up an inverted V with the center pole about 35 to 40 feet above the ground, with the ends sloping downward. Antenna resistance drops rapidly as the antenna height is decreased. Also, when an antenna is formed into a V, the resonant resistance decreases. Combining these factors and actual antenna resistance measurements, I have found that a good conservative value of antenna resistance will work out to be about 40 Ohms. And that, oddly enough, is the value we have used in our basic dipole calculations. This value is opposed to the theoretical free space value of 73 Ohms. And that is a big difference.

The other important factor is actual antenna Q. An antenna in free space does not have any losses except its radiation to free space, if we want to term it as such. Thus for a theoretical thin wire, its Q is high. However, for an antenna nearer the ground, there are a number of additional but unavoidable losses. These losses are ground losses, losses due to local buildings and bushes, and actual losses in the antenna system itself. My own measurements on amateur antenna systems have confirmed that such combined losses will have a marked effect on reducing the basic antenna Q. And after much thought, a Q value of 10 was chosen. And, as we mentioned earlier, a low Q of our basic antenna system will make the stubs relatively more effective. This fact has been known for some time in the construction of coaxial dipole antennas. Some amateurs even make the end sections of their coaxial dipoles out of open wire transmission line to reduce the Q. A very good example of this is shown in the 1975 ARRL *Amateur Handbook* in the description of a broadband dipole popularized by W8TV. He used open wire line for his end sections, and reported measured values of swr of 1.7:1 at 3.5 MHz and 1.9:1 at 4.0 MHz. But every amateur will have to make his own trade-offs in determining just how he wants to build his own antenna. In my case, I didn't use any open wire line for the end sections, but just extended the coaxial cable. And my own measured swr was a bit higher than obtained by W8TV.

Theoretical and Actual Measured Swr Curves

In the final analysis of any theoretical calculation, the best proof is correlating experimental data. The curves of Fig. 8 are the theoretical calculations of swr based upon an antenna that we had

assumed approached the characteristics of that put up by the average amateur. Curve A is the antenna without any stubs connected. Curve B is the same antenna with the quarter wave 50 Ohm stubs connected in series. And lastly, curve C shows what happens when the stubs are connected in parallel. It is very obvious that the parallel stub system is quite superior to that of the series connected system. And, as we had previously indicated, these calculations did not take into account feedline losses.

Fig. 9 is the proof of the pudding. The curve nomenclature is the same as Fig. 8. These measurements were made directly at the transmitter using two four inch Swan WM-1500 wattmeters capable of reading forward and reverse power. The meter accuracy is 10 percent at full scale. Swr calculations were made from the forward and reverse power measured. It was interesting to note that the actual measured data showed a better swr improvement than what the theoretical calculations had predicted. But the measured data clearly shows that a broadband coaxial dipole is an actual reality and not a mathematical impossibility. My own advice is, "Try one, you'll like it."

Final Observations

The final question that should be thought of is, are there any better simple broadband antennas for 80 meters than the coaxial dipole? In my personal knowledge, I don't know of any. The writer of the referenced article mentions such things as a multiwire fan shaped bow tie dipole invented by P.S. Carter of RCA and used since 1937 to obtain the bandwidth necessary for television. This is correct, but when we magnify such an antenna to the proportions needed for an 80 meter antenna, I would suspect that just the mechanical construction would be a bit formidable. He also mentions the work done by Dwight Borton W9VMQ titled, "80 Meter Bow Tie Antenna," *Ham Radio,* May, 1975. This is an extremely interesting article to read. However, from the curves shown by W9VMQ, the double bazooka antenna shows a lower swr than a bow tie antenna made of regular copper wire. It is only when the bow tie antenna was constructed out of galvanized wire, rather than regular copper wire, that the swr of the bow tie was lower than that of the coaxial dipole. Unfortunately, this fact was not brought out by the writer of the first referenced article. It should be quite apparent that the swr of any antenna system can be lowered by using wire with a higher electrical resistance than regular copper wire. But why intentionally introduce losses that are not necessary? That's a trade-off that every amateur will have to decide for himself. My final advice is to "keep your bazookas up and your swr down!"

Antenna Length Calculations

The following information is used in calculating the lengths of the stubs and also the overall length of the antenna. Calculations are shown for an antenna that is resonant at 3.75 MHz. All dimensions are in feet.

$$\text{Stub length} = \frac{(246)(\text{Velocity factor of coaxial cable})}{\text{Frequency in MHz}}$$

And, assuming we use RG-58/A, we look up in the antenna handbook and find it has a velocity factor of .66.

$$\text{Length of each stub} = \frac{(246)(.66)}{3.75} = 43.3 \text{ feet}$$

The antenna overall length is calculated using the equation:

$$\text{Length} = \frac{468}{\text{Frequency in MHz}}$$

$$= \frac{468}{3.75} = 124.8 \text{ feet.}$$

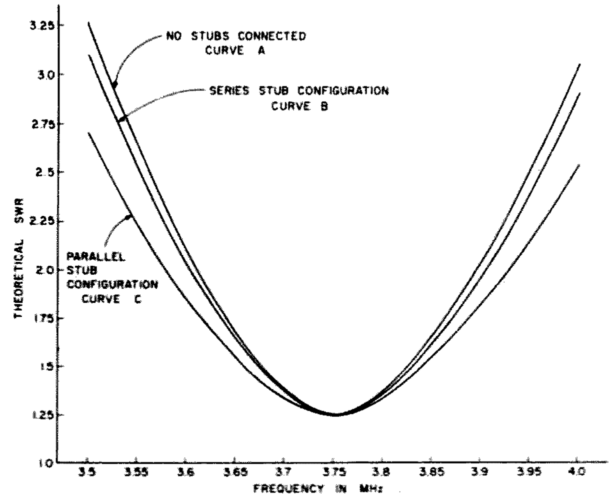

Fig. 8. Theoretical calculations for dipole antenna. R_A = 40 Ohms, Q = 10, resonant frequency at 3.75 MHz.

If it is desired to make experimental measurements to see what the swr of your antenna is without the stubs connected, it can easily be done as follows. Just connect the center conductor of each coaxial stub to its own shield. Leave the feeder connections as they were.

In Figs. 6 and 7 I've shown the feeder line of coax cable connected directly to the antenna without the use of a balun. My own antenna seems to work fine without a bulun, although a balun may make your antenna more electrically balanced.

It may be necessary to trim and adjust the overall length of the antenna to compensate for end effects and the presence of nearby objects. In my own case, I notice measurable changes in both antenna resonant frequency and swr when I even trim the hedge near the ends of my inverted V coaxial dipole. The ends are about twelve feet above the ground.

And, as previously mentioned, if you use something like an open wire line for your end sections, you will probably further reduce your overall Q and your band edge swr values. The swr you get is a function of several variables, and you'll find that experimentation is both fun and truly instructive, as it has been in my own case. ■

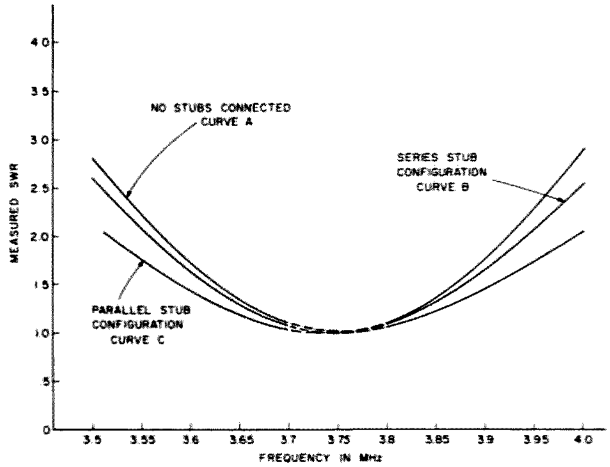

Fig. 9. Actual measured values of swr for inverted V coaxial dipole.

Dirt Cheap Directional Array

-- for the serious DX hound

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In my endeavors to achieve a halfway decent and readable signal for some rare DX station to pick me out of a pileup of California kilowatts and TH6s, I contemplated running up a $1000 bill and installing an antenna system that would give me armchair QSOs with FB8s. Other things made my early ham life as a two-bit DXer difficult and embarrassing: I am a high school student, and I have little spare cash. When I first joined PVRC, I was using a DX-60B and a vertical antenna ("What's your setup, Dan? . . ." "Well, uh . . ."). Finally, most hams would probably consider my ideas discrete at best. I thought I had a GOOD idea, though.

Well, all you other 16 year old hams who are cheap, lazy (but zealous), and with Extra class licenses but Novice minds, here's an antenna system that should cost you about one-tenth of the abovementioned price – that's including a 40 ft. self-supporting structure, antenna, and all the other junk you're going to need on the way. (Of course, this construction article is no different from the rest, so I might add here that you should adjust this liberal figure to about 1.3-1.5 times the abovementioned price if you are a conservative.)

The supporting structure (a complicated name for a utility pole) is of primary importance. I managed to give the guy down at the local electric company a combination sob story and snow job resulting in a 42 foot pole (used, of course) at 25¢ per foot. Yep, that's $10.50 for a self-supporting tower. Great, huh? With a little bit of luck, one should be able to swindle a used jobby from a local utility company for less than twice that price.

I then simply gave a construction contractor a call and had the pole installed in my backyard for $35. This was also a fervid attempt to get my money's worth. Most anyone should be able to do the same for only a few bucks more. (Optimistic, aren't I?) The gigantic tarred dowel was sunk into the ground about six feet; however, considering that my father didn't feel like having a sunlight in his roof on windy days, I made sure the pole would not decide to fall. The foreman assured me it would not . . . Whew! My parents now consider the pole an eyesore, my neighbors consider it an attraction, I consider it a status symbol, and my fellow hams consider me an idiot.

As for the antenna . . . beams are way too expensive, and a vertical would be downright stupid; I therefore decided on a quad. I managed to find a really good deal on a two element boomless – William's Antenna Company* sells a complete tri-band quad kit with everything (bracket, copperweld, insulators, gamma matches, clamps, etc.) except the bamboo spreaders for $25. It's a darn good deal.

The bamboo can be obtained by two methods. One is by going down to your friendly carpet dealer and picking up any surplus he has lying around, or one can go a la naturale as I did. I drove through a neighboring town last fall and found a whole patch full of strong, 15-20 foot high bamboo stalks. I knocked on the fellow's door, and within twenty minutes I had 15 nice straight, immaculate poles. The city slicker or northerner might find this method of obtaining bamboo spreaders difficult; on the other hand, this method is easy and practicable for those throughout the South. Bamboo is a grass and therefore sprouts quickly. If need be, you can even grow it in a wet place near your home. I don't, however, suggest this method for the supporting structure unless you have great patience. The bamboo is simply given two coats of good enamel paint, and they're ready to go.

Instructions in the WAC quad kit are extremely simple to follow, almost like Heathkit. Depending on what you want, though, one may decide to up the cost and buy a quad or beam or even down the cost by building one. I obviously preferred the compromise route and am thoroughly pleased.

Tuning comes next. I found that the easiest way of tuning the gamma matches on my quad was to mount it on a regular TV type bracket at a height of 10-12 feet up the side of the utility pole. This allows the stubs to be reached from ground level. (You ten meter buffs will probably have to use a ladder, but the effort is still a lot less than hanging off the side of the tower.) Remember that the resonant frequency of the antenna will rise three to five kHz for every foot the radiator is erected above ground, so tune your center frequency accordingly.

One feedline is all that is necessary if one uses the gamma match system. A tolerable swr can be obtained with direct feed, but cropping the wires is introduced. (This is more difficult than it seems, since there is quite a bit of tension introduced by the spreaders on the wires.) With either method, a suitable swr can be tuned in using a bridge in line at the input of the antenna. Another advantage of the quad, by the way, is that it is very broad banded and when tuned correctly, an swr of less than 1.9:1 can be expected plus or minus 250 kHz from a center frequency.

*404 Sanders Rd., S.W., Huntsville, Alabama 35802.

Finally, the hard part comes ... getting that 2500 cubic foot thing on top of that pole. Well, there's some good news and some bad news. First the good: The quad, especially if made out of bamboo, is a lot lighter than you might expect. The utility pole approach provides a strong and steadfast structure that will support the heaviest of hams. With a man on the ground and a man near the top, the antenna can be hoisted to its apogee with a simple pulley or gin pole arrangement. Now for the bad news: Climbing a wooden pole is more easily said than done. By all means, watch your step if you decide to use hooks. I, for one, though, prefer having the steel spike type steps on the tower. They make climbing easier and more sure. Don't make the mistake I did: Have those steps bolted in *before* the pole goes up; putting them in after is not impossible, but is considerably more difficult. Either way, always use a safety belt!

At last, the antenna is erected. A TV chimney mount was used in this case along with small wooden blocks (Fig. 1). A pipe or short mast is bolted to the mount so that 12-18 inches protrude from the top of the pole ... and the rotor's connected to the pipe, and the antenna's connected to the rotor.

All that's needed now is to run your coaxial lines and rotor cable to your shack. By the way, an el cheapo used TV type rotator will suffice for the quad. I must emphasize again that the weight of the antenna is extremely small. (Just don't put a 20 foot mast on the antenna ... keep the length of the mast between the quad bracket and the rotator as short as possible.)

Of course, there are many variations to this antenna scheme (e.g., a beam instead of a quad), but if the preceding information is closely followed, the whole thing can be built and erected for less than or around $100. Let's recap what has been spent...

Utility Pole	$10.50
Installation	35.00
Quad	25.00
Rotator (used)	15.00
Coax and Cables	11.00
Mounting Bracket	2.75
TOTAL	$99.25

Not bad for a truly *complete* 20-15-10 meter, 7 dB, rotatable antenna system, eh? If the price backfires, you can use this article at least for some ideas.

Performance

Even when the quad was on the ground for tuning, it exhibited exceptional gain. I made many first shot QSOs with several Soviet and European hams with mostly 58-59 plus signal reports. My rig is a barefoot HW-101, so I'm not using anything extravagant. The whole system really amazes me, and I'm sure it will amaze those who decide to try it.

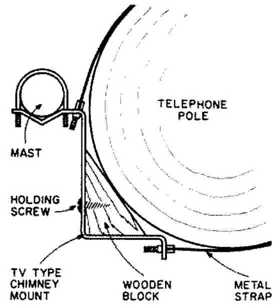

Fig. 1.

So there you have it, cheap, conniving, fervid hams of all ages. You won't be an armchair DXer right away, but give yourself some time (and the antenna a chance). Even dirt cheap directivity makes all the difference in the world. Good luck (you'll need it), and I'd be interested in hearing how your antenna party goes.

Special thanks go to WB4DHW who helped materialize the initial part of the project, to WB4TBO and W4WRJ for their technical assistance, and to my family for putting up with me. ■

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Instant PS Regulation

-- a quickie

Need an additional regulated supply in a hurry, perhaps to finish up some project which requires a special voltage, or perhaps the regular supply is just overloaded? If you have a source of dc voltage higher than the voltage you need, you can make the regulator by adding only two components, a transistor and a battery. The circuit is shown in Fig. 1 for both positive and negative output supplies. As you see, the battery supplies base current to the pass transistor, which acts as a variable dropping resistor. The battery drain is equal to the current supplied divided by the transistor gain. The output voltage is equal to the battery voltage minus the base-emitter drop.

If closer control of the output voltage is needed, it can be obtained by adding series diodes as shown in Fig. 2. Also, if better regulation is needed, it can be obtained by using a pair of transistors in the Darlington connection, as shown in Fig. 3. This connection is also worthwhile if the supply is to be operated for any length of time, since the battery drain becomes very small.

Suitable sources for the unregulated voltage are a battery charger, a car battery, or an old filament or bell transformer with a series rectifier. In many cases, the charger or transformer-rectifier does not even need a shunt capacitor to reduce ripple. ■

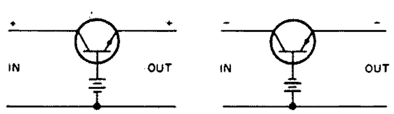

Fig. 1. Basic regulator.

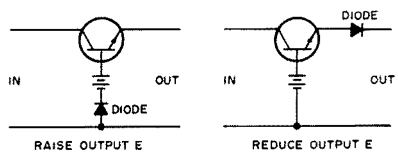

Fig. 2. Voltage adjustment.

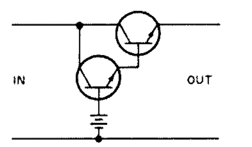

Fig. 3. Improved regulation.

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Take Cover!

-- how to prevent antenna wind damage

I had worked for five years gathering the parts for my antenna system, and two years ago I finally got it in the air. It withstood winds of 70 miles per hour last summer. But then, with winds the weather bureau said were gusting to only 45 miles per hour, the antenna system came down.

The tower was 60 feet of Rohn 25G mounted by four 3/8" stainless steel bolts to the Rohn tilt-over base plate. This hinged base plate was fastened with two bolts forming the hinge. The other two held the plate from unwanted hinging, or, one might say, they held the hinge-plate from opening away from the base plate. The base plate was fastened to a four foot by four foot by five foot deep concrete block with ½" steel bolts. The tower was guyed at the thirty foot and forty foot levels with 1/8" stranded steel wire, plus additional 1/8" steel guys to the ends of two 10 foot side mounted arms. One side arm carried a TV antenna and the other a Hy-Gain Model 341 two meter beam.

The Ham-M rotator was mounted inside the tower at the 50 foot level, with a 1½" galvanized pipe mast extending through the top section bearing. Extending upward from this mast was a 10 foot mast with a Ringo-Ranger two meter vertical antenna on top. The TA-33 triband beam was mounted just above the top of the tower. At the 40 foot level on the tower was attached an inverted vee dipole of aluminum coated steel wire for 80 meters. This inverted vee was used as part of the guying system. Just above this antenna was a 19" side arm with a two meter 19" spike ground plane antenna used with my scanner.

The top set of guys on one side was attached to the chimney at about 45° from the tower. The other two guys went to screw type ground anchors, also at 45° from the vertical. The three sets of guys were spaced equidistant around the tower (120° from one another). All guys were broken into appropriate segments with egg insulators. Each segment of guy wire was secured by making two half hitches and then a tight wrap for 3-4 inches, with the loose end secured to the guy with a cable clamp.

The system was theoretically designed for 100 mile per hour winds. However, plans were that, if winds in excess of 60 miles per hour were predicted, the tower and antenna assembly could be lowered to ground level with a block and tackle mechanism attached at the thirty and fifty foot levels with a bow of ¼" aluminum and steel wire.

In designing the antenna system I had to keep in mind two major environmental factors: 1) We are close to the Gulf of Mexico (about 13 miles) and we get considerable salt in the air, which makes the air quite corrosive; and 2) this part of the Texas gulf coast is subject to hurricanes.

The postmortem examination of the antenna system suggested, but did not establish beyond a shadow of a doubt, several possible causes for the system to fail.

Several amateurs viewing the twisted wreckage were of the opinion that only a tornado, or similar twister, could have done the damage. They speculate that the twister came low enough to strike the top of the tower, but not the house. An alternative explanation was the harmonic effect of repeated gusts of wind, each amplifying the effects of the previous gust. No one thought a straight wind could have caused the damage.

This raises a question of wind effects we do not usually consider when designing an antenna system, namely the reinforcement of wind pressure by harmonic gusts. Similarly, reflections of a blast wave, if reflected in the proper phase, can at least double the effect of the blast. You may recall a few years ago a suspension bridge in the Northwest succumbed to the effects of harmonic vibration of the wind.

Observation number one: *When designing an antenna system, consider both straight winds and harmonic vibration, and design the guying system to prevent or dampen harmonic vibration.*

This can be done by proper attention to guying and control of any side arms on the tower to prevent the wind from catching the side arms and starting them vibrating.

On a guyed tower, the use of three guys at each level, each guy at 120° points on the tower with the guy running to a ground anchor (distant from the base of the tower equal to 60 to 80 percent of the height of the tower), is more stable than the use of four guys at each level. The levels at which a tower is guyed depend upon the height of the tower and whether or not a house-bracket is used. I prefer to place the first set of guys at twenty feet above the ground or twenty feet above the house bracket, whichever is higher. Some amateurs prefer the first set of guys to be at the 30 foot level. The second and subsequent sets of guys should be placed at twenty foot intervals.

What type of guy wire should be used? In the past I have used nylon rope, sisal rope, glass rope, and 1/8" and ¼" stranded steel wire. In our area, the various ropes, including glass, are rapidly destroyed by the effect of the sun and the salt air. I have used these ropes as halyards for longwire and dipole antennas and find the rope disintegrates in two years or less. Also one must consider stretch when using ropes. Nylon is particularly bad in this respect.

Steel wire corrodes rapidly in the coastal area, particularly where two dissimilar metals join (corrosion due to electrolytic effect). I have found plastic coated stranded steel to last longer and to be more effective than other guy wires. However, although 1/8" stranded steel wire may hold telescoping masts, or hold towers in other areas of the country, the lesson I have now learned is to not trust anything less than 3/16" to ¼" noncorrosive steel wires in the Texas gulf coast.

What about aluminum wire or copper coated steel wire? Aluminum is too soft, stretches and breaks easily. Copper coated steel may be satisfactory, but I have had no experience with it and therefore cannot recommend it.

Observation number two: *Fastening of guy wires should not be sharply kinked nor pull out easily.*

A double set of properly applied cable clamps would be the most desirable method of securing guy wires. Second choice would be to take 10-12 tight wraps of the free end around the guy and then clamp the remaining free end. There should be no sharp bends in the guy wire where any strain is applied. If you get a kink in your guy wire, don't put that section up. Cut it at the site of the kink and splice with an egg insulator.

Any side arms stretching more than three feet from the tower should be separately guyed from the end of the arm in at least two opposite directions.

Observation number three: *Prevent the tower from twisting due to wind or torque of the rotator.*

Several rotators have a braking action that applies considerable torque to the tower when they stop a rotating beam. A number of years ago the idea was proposed of using a heavy spring in the mast between the rotator and the beam. This heavy spring absorbs the torque. (I apologize to the author of the idea, as I do not remember his name nor the journal in which the article appeared.) Caution should be shown in selection of the spring; it cannot be too limber nor too heavy.

A method for preventing twist in a tower uses two guys to each point of the top level of guys and separates the top end of each set of two guys by about one to two feet with an angle iron or similar strong brace. Each end of the brace should extend beyond the edge of the tower by at least six inches. A guy is fastened to each end of the brace.

Observation number four: *Do not use dissimilar metals in contact that are exposed to the effects of moist air or rain.*

I have observed that even when protected by RTV or other sealant, dissimilar metals will corrode quite rapidly. This is particularly true of coax connectors.

One way to eliminate this corrosion is to thoroughly clean both coaxial connectors and then apply silicone grease to keep out the water. (Make sure that the electrical contact is not broken by the grease.) Wrap the connection with electrical tape and spray the tape with acrylic. Cover this joint with stretchable rubber tape and cover the rubber tape with another layer of electrical tape. (The rubber tape, when applied, should be stretched to about ½ its resting width.) Again spray the electrical tape with acrylic and cover the whole joint with RTV.

Of course, there are some junctions where this method cannot be used. On these, do the best you can with alternating layers of electrical and rubber tape (as above) and coat the whole thing with generous amounts of a compound like RTV.

Where joints cannot be adequately weatherproofed such as mast clamps and tower bolts, use weatherproof hardware, and stay away from dissimilar metals.

Observation number five: *Torque and shear pressures can be tremendous at hinges and other areas where a short and long arm around a fulcrum are involved.*

I was unable to measure shear pressures on the tower, but did calculate that when the tower was lying over at a 45° angle that there were at least ten tons of pressure at the end of the hinge plate. When my tower went over, it bent the base plate and two of the ½" steel bolts holding the plate to the concrete block. It also stretched and sheared two of the 3/8" stainless steel bolts, cracked three welds (two on the hinge plate and one on the base plate) and broke one of the tower stubs which had been welded to the hinge plate.

Observation number six: *Design your tower and antenna system to fall away from the house and power lines.*

I was successful in this part of the design. The tower, in falling, fell away from the house and power lines, striking and destroying only one small tree on the way down.

When placing your tower, be sure that it is more than the height of the tower from the nearest property line or electric power lines. The guys should be placed so that if a set of guys on one side breaks, the other two sets will pull the tower away from the house or power lines.

Observation number seven: *Read your insurance policy carefully.*

When I put up the antenna system, I had a special rider put into my homeowner's policy. Since I had over $500 in the system, I thought I insured it totally with a $100 deductible policy. After the tower fell, I contacted my insurance agency and found to my surprise it was not a $100 deductible, but a $100 maximum that the agent had written.

What can be salvaged from such twisted wreckage? It was surprising to us how much we could salvage in various innovative ways. The TA-33 looked like a pretzel, and one of the traps was broken internally. It appeared that most of the twisting of the aluminum elements was the result of the wind rather than the fall. Except for the aluminum support of the driven element, five of the six traps, and a couple of tip elements, I was unable to salvage any of the beam. However, it will probably be less expensive to replace the aluminum elements and the one trap, than to buy an entire new beam.

The two meter beam had three broken insulators, all elements bent and a bent boom. This aluminum can probably be straightened, and with three new insulators will probably work as well as new. The TV antenna sheared two bolts, but otherwise appears unharmed.

At first I thought I could salvage only four sections of tower and thus have only forty feet of tower. But here is where innovation came in. The 40'-50' section of tower was broken one foot from the lower end, and the mounting stubs on the base were broken. I cut off the broken end of the tower section and the stubs from the base plate, straightened the base plate and welded the shortened section of tower to the base hinge plate. A second section of tower was only bent and can probably be straightened, but I am not sure I would trust it. if this can be accomplished, I anticipate I will lose only about three feet of tower.

I hope that this recitation of my problems with this antenna system will help other hams to design and add more safety features to their antenna systems. I have not covered safety points such as wind loading, climbing towers, and others covered in the ARRL publications and the series of articles in *73*. I would encourage you to read them before you next erect a tower or antenna system. ■

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Introducing the Intenna

-- new concept for mobile ops

The Intenna, produced by Microwave Filter Company, Inc. (6743 Kinne St., E. Syracuse NY 13057), uses the old principle of a coaxially fed slot in a metal groundplane. While the concept is not new, the application of this principle to low band communications is almost revolutionary.

Figs. 1 through 4 show the evolution of the Intenna from theory to practice. The distortion introduced by the shape of the auto body does not adversely affect the performance of the antenna. On the contrary, such distortion makes the antenna effective in the directions most favored by motorists – fore and aft.

The Intenna is quite directional. The major lobes of radiation are obvious when a vehicle equipped with an Intenna and a CB or 10 meter unit is turned in a circle while receiving a base station or other fixed transmitter. When the sides of the vehicle are toward the other station, the received (or transmitted) signals fall off sharply. Continuing the turn until the front or rear of the vehicle is aimed at the fixed station causes a dramatic increase in signal strength. As mentioned previously, this characteristic of the Intenna is hardly a disadvantage for most motorists. The vehicles behind or ahead of the operator are usually the ones that he is most concerned with.

Fig. 1.

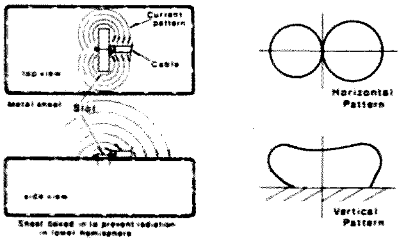

Fig. 2.

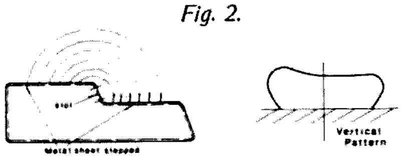

Fig. 3.

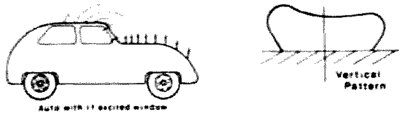

Fig. 4.

When I first heard about the Intenna, I said that there was no way that any antenna only 24 inches long could work as well as the flyer said that it could. My fellow workers agreed with me, but just for fun we decided to try one.

When I contacted Microwave Filter and expressed a skeptical interest, Glyn Bostick, President of Microwave Filter Co., promptly sent me two for evaluation. Even after seeing the Intenna and reading the poop sheet, I still didn't think that it could work any better than, say, a "shorty" gutter mount antenna. Boy, was I surprised!

It took me about an hour to install the Intenna. My 1973 Buick had no metal on the dash at the bottom of the windshield – the end of the wire which makes up the Intenna must be well-grounded if it is to work.

However, that was a detail which had been anticipated by the manufacturer. Included in the kit is a pointed brass rod with an eyelet on one end. I followed the instructions and pushed the rod through the rubber seal at the bottom of the windshield and, lo and behold, I had easy access to the rod on the outside of the car (just under the edge of the hood).

I trimmed the wire which comes down the windshield from the tiny tuner (which mounts at the top of the windshield under one of the screws fastening the inside molding to the body), and attached it to the rod as per instructions. As soon as I was certain that both ends were properly grounded, I connected the 8-foot piece of coax supplied with the kit to the tuner.

Also included in the kit are four self-sticking cable clips. These make it simple to route the coax around the inner windshield molding to the radio itself.

Now, according to the instructions, I was ready to begin tuning the tuner box for minimum vswr. Here was where I ran into trouble for the first time. I simply could not make the tuner do its thing. After running carefully through the instructions several times, I decided to call the factory and see what might be wrong.

On the front cover of the dealer package sent to us is a number to call collect – that's right, collect – if problems are encountered with tuning. When I called at about noon on a Saturday, I was given an "800" number (inward WATS) to call. The technician who came on the line was quite courteous and sincerely interested in helping. He asked me a few questions, offered a few suggestions, and told me to call him back and let him know how I came out. He also told me that if I couldn't get it working, he would try to arrange to come down and tune it himself.

When I asked whether I was being put on or not about him traveling over 1000 miles to tune an antenna, he assured me that his job was doing just that. I later talked with Glyn Bostick

about this. Glyn told me that he was doing whatever was necessary to see that all Intenna customers were happy. He said that he felt that early adverse publicity would be much more expensive in the long run than would be an all-out customer relations program. (I was reminded of the policy of a few manufacturers of much more expensive items — fly a man around the world if you have to, but make him happy.)

After talking with the technician (Mr. Tuner, he is called), I went back to my tuning. I found that the best adjustment was obtained with one of the tuning screws backed all the way out. I decided that perhaps my particular automobile has characteristics which need less capacitance than the minimum provided by the tuner. Experimentally, I removed one of the tuning screws and reinstalled the tuner. This time the vswr went down to zilch at the center of the band and to about 1.2:1 on either end.

I put it on the air and found that performance in the fore and aft directions was roughly equivalent to that which I had been getting from a 3.5 foot base-loaded trunk mount antenna. Best of all, I now had no external advertising of the CB in the car. From 20 feet, the small black wire running from the top to the bottom of the windshield is almost impossible to see.

Does it work? You bet. Is the Intenna the answer to everyone's 10 meter or CB needs? Hardly. Does it have any drawbacks? A couple.

The manufacturers of more traditional antennas need have little fear that everyone will throw away his longer antennas in favor of the Intenna. The Intenna will never set any records for long-range communications. It will never take the place of co-phased dual CB antennas for many heavy-duty truckers. But for the guy who only uses his CB on the road talking to other drivers a few hundred yards ahead or behind him, the Intenna is excellent.

For the person who wants CB or 10 meter communications but doesn't want to let every thief within eyeball distance know about it, the Intenna is well worth considering.

The drawbacks are few, but should also be mentioned. Aside from relatively short range and sharp directivity, the amount of rf energy in the car is a minor problem, particularly when there is a windshield antenna for the car's AM/FM radio.

The energy level is nowhere near high enough to be a health hazard, but it does tend to cause interference on the AM/FM radio when you are listening to music and key the mike. In some cases, you get a feedback squeal; in others, only a squelching of the AM/FM unit. Glyn admits that this is common, but also mentioned that most people turn off one radio when using the other.

The last drawback is that the Intenna should be professionally installed. If your dealer has installation facilities, this is no drawback at all. The Intenna is simple to install, but the tuning is a little critical. However, with the "Mr. Tuner" backup and the well-written instructions, any competent technician should be able to handle the job. In any event, any sale of the Intenna should be topped off by a warning to either have the Intenna professionally installed or to read the instructions very carefully. For example, the instructions state that any other *antenna* installed on the car should be removed before tuning. I found the effect on tuning nil, but the performance of the Intenna is definitely better without another antenna installed. ■

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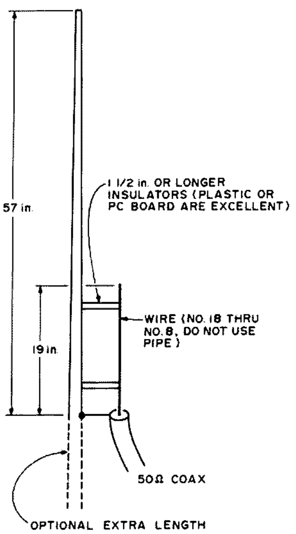

The Zeppy Vertical

-- a perfect 2m antenna

Believe it or not, a CBer came up with this antenna. Electrically it looks like a ½ wave endfed Zepp antenna with a ¼ wave section of open wire line to obtain a match to 50 Ohms.

After a couple of days I realized that here was the perfect 2 meter antenna. The main 57" element can be directly bolted to a car frame, be the top of a flagpole, or be a piece of wire directly bolted to the rig. It is better than a 5/8 wave antenna because it doesn't require a ground but has about the same gain.

I built a 57" stinger on a PL-259 plug and found that waving around the mike or touching the radio didn't affect the swr or received signal strength. A 19" piece of wire performed miserably when compared with this antenna. It's also easy to build and easy on the pocketbook. ■

A Cure for Antenna Self-Destruct

- - a mod for your Ham M

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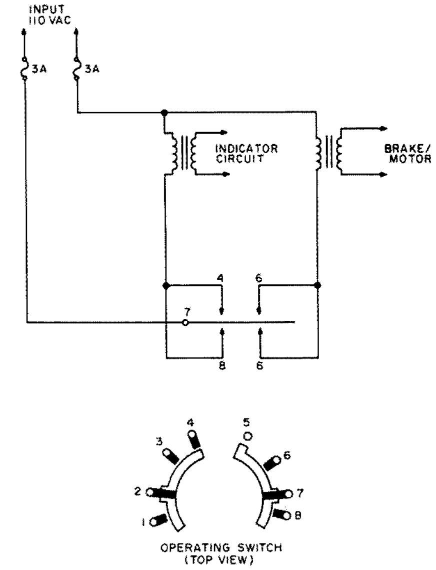

Fig. 1. Original circuit with diagram of operating lever switch as viewed from the top.

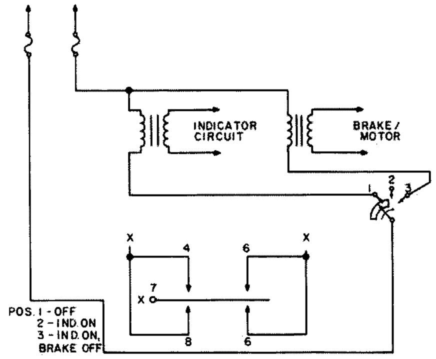

Fig. 2. Modified circuit using 3 position progressive shorting type rotary switch. Original connections are removed from lever switch at points designated by X.

During the 1971 annual meeting of W9DXCC in Chicago, there was a discussion concerning the problems involved in "instantaneous" braking of antenna arrays. This discussion was quite an eye-opener, and provided much food for thought, and no little worry, as the figures mentioned concerning the stresses involved when a rotating antenna is suddenly brought to an abrupt stop by a mechanical brake were really quite astounding. This sudden strain can be damaging to the rotator, mast, antenna, and not least, the tower itself.

This article will present a simple modification to the Ham M rotor control box which provides manual control of the brake position, and also allows indication of antenna direction, with or without rotation.

All that is needed to complete the modification is a switch and the rerouting of three wires, with no external circuitry outside of the control box required.

The three position switch provides:

1. Off: No primary power to control box.
2. Indicator meter and lights on: Provides continuous indication of antenna direction without rotation, and with brake applied.
3. Brake disengaged, meter and lights on, ready to rotate using normal lever switch.

It must be mentioned here that the transformer which supplies power to the indicator and the lamp circuits is rated for continuous duty, while the transformer which supplies the rotor motor and brake solenoid has a duty cycle of only 10%. This means that it is important that, after watching your antenna coast to a nice smooth stop, you return the switch to position 2 for continuous indication with brake applied, or to position 1, power off. A spring return switch might be useful here, but not absolutely necessary. If you like, a small neon indicator lamp with a 100k series resistor could be wired from position 3 of the added switch to the other side of the ac line to indicate that the brake is disengaged, and to remind you to return the switch to position 1 or 2.

Fig. 1 shows a portion of the original circuit, while Fig. 2 shows the modified circuit, using a rotary three position progressive shorting type switch. Fig. 2(a) is an option, if you prefer using a 2 pole three position rotary. A DPDT toggle switch, with center off position and a long mounting bushing, could also be used.

Modification is done as follows:

Unplug the ac power cord to the control box and remove the multiconductor cable from the terminal board at the rear of the unit. As you remove the conductors from the terminal screws, make a note of the colors and the corresponding terminal numbers, for ease of replacement later.

Remove the screws in the four mounting feet, and lift off the control box cover. Note that there are two blank holes provided just below and to either side of the meter. You will use the right hand hole, viewed from the front.

The switch you use will mount in this hole, and must be small enough to maintain

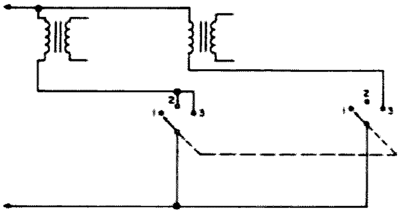

Fig. 2(a). Modified circuit using a 2 pole three position rotary switch.

good clearance between the switch terminals and surrounding metal parts and components. A hole must be drilled in the cover to clear the switch shaft. Be sure to drill this hole in line with the existing hole.

Refer to Fig. 1 for a diagram of the existing lever switch. Remove the wire from terminal 7, and connect to the center arm of the new switch. Remove the wire from terminal 8, and connect to position 2 of the new switch. Remove the wire from terminal 6, and connect to position 3 of the new switch.

That's all there is to it, unless you wish to use the indicator lamp mentioned earlier. You can now watch your antenna coast to a smooth stop, instead of coming to a jarring, metal-shearing, abrupt halt. You will soon learn to anticipate the amount of coast after you release the rotate lever, in order to reach the desired direction. The amount of coast or "gear down" will depend on factors such as the size and weight of your antenna, and the wind velocity.

Remember to switch the brake back on to "stow" the antenna when you are not rotating it. ■

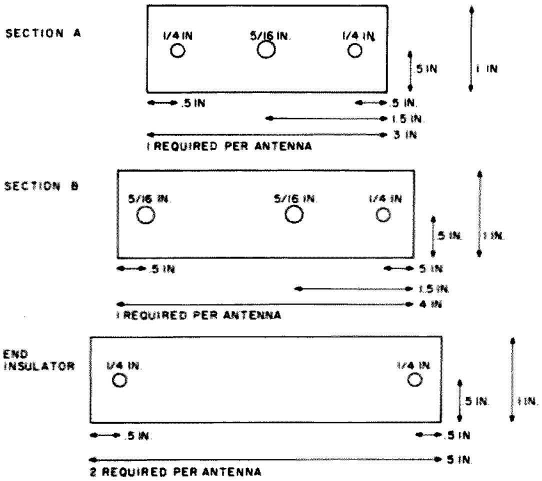

Fig. 1.

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Quick Antenna Insulators

-- when DX won't wait

Recently, while I was building antennas, my supply of insulators ran out. As Murphy's Law would have it, none could be found in town. The result was that I could order replacement insulators, overpay, and be delayed several weeks, or I could figure out another alternative. Since I was anxious to get on 20 meter CW as quickly as possible, I decided to build some myself. This resulted in a method for using plexiglas to fabricate insulators quickly and cheaply.

Thanks go to Larry K8ZSQ, who donated a strip of plexiglas 10' x 1" x ¼". The plexiglas was cut and drilled according to the dimensions given in Fig. 1. Sections A and B were joined using epoxy cement. After the epoxy had been allowed to cure, the dipole elements were added and soldered. The RG-58/U was added and joined to the elements beyond the point where the elements joined the center insulator in an effort to reduce strain on this connection and, hopefully, to prevent it from breaking.

Finally, the entire center insulator was weatherproofed with bathtub caulk and taped well.

To date, three such dipole antennas have been built on the HF bands and perform well. ■

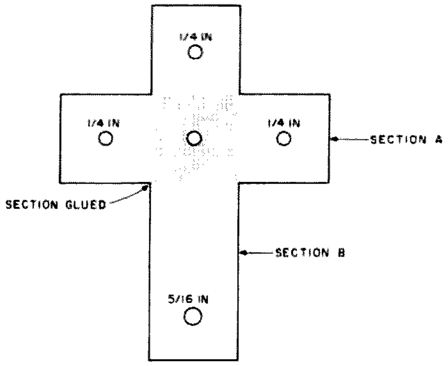

Fig. 2. Completed center insulator.

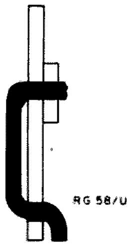

Fig. 3. Side view showing RG-58/U inserted in the insulator.

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Raising A Tower?

- - don't forget zoning!

As amateurs, most of us have zoning problems only when we try to put up our antennas. While the FCC regulates our indoor activities, local land use controls affect antenna sites outdoors. We have all heard horror stories about former DX chasers reduced to the 2 meter ranks after moving to an area which prohibits towers, or expensive towers staying up only long enough for the neighbors to complain to local officials. Such disasters don't have to occur and, with a little knowledge of zoning, you can avoid similar problems.

Your best opportunity to deal with zoning regulations is when you are moving to a new home. In such cases, you have the opportunity to choose the regulations you would like to live with. The first step is to familiarize yourself with the zoning ordinance for the new area. Visit the local planning department, which is usually located in or near the city hall, and explain your situation. Tell the planner you talk to that you are moving into their jurisdiction and describe your antenna installation to him. The planner should be glad to talk to you; it is always easier for him to explain the regulations to somebody before they have their tower up in the wrong zone. Ask which zones towers are permitted in and where they are not. The planning department will have a map which shows the zoning district boundaries. Look the map over and get an idea where you can locate. You might want to mark a few zoning districts on a city map to take with you when you look for a house.

You will probably find the ordinance treats towers in the following ways, depending on the particular zone in which they are to be located: 1. permits them outright; 2. permits them with conditions; 3. permits them only with a special permit; or 4. prohibits towers.

The first situation is obviously the best. Simply go to the building department, get your building permit (the Uniform Building Code requires a permit for towers or poles), and put up your tower. Don't forget the building permit; it's your insurance policy. If your neighbors complain or the laws are changed, your tower is safe only if you have the permit.

Not many people will have the ideal situation. Most jurisdictions permit towers only when certain conditions are met. For example, I recently moved from a city where towers were allowed only when located at least 20 feet from my property lines. Where I live now, towers are permitted only after the building department has reviewed the tower plans to be sure the structure is safe. Some zones have height limitations on structures, including towers. The list of possible conditions is long, but the important point is to be sure your particular installation can meet the requirements. If so, go get your permit and consider yourself almost as lucky as those whose towers are permitted outright.

The other zones, those where special permits are required or where towers are prohibited, should be avoided. However, I suppose an unfavorable zoning restriction is like TVI; sometimes it's there, so you have to deal with it.

Overcoming an unfavorable zoning obstacle is generally done in one of three ways: with a variance, a conditional use permit, or a rezone. Each remedy is useful for certain types of problems. Usually, variance provisions are only established to provide flexibility from dimensional regulations in special situations. In other words, setback or height restrictions can sometimes be eased through the variance process. Don't ask for a variance to build a tower in a zone where it isn't permitted, because a variance is the wrong tool for that situation (it's like trying to measure current with a voltmeter). If you think you might be a candidate for a variance, ask the planning department if there are special conditions which have to be demonstrated before the variance can be issued. Realistically evaluate the standards and if you still feel you qualify, apply for the variance.

Conditional use permit provisions are sometimes in zoning ordinances for an interesting reason. When the city council first considered adopting the zoning ordinance, there was a group of citizens vehemently opposed to allowing a certain use (such as towers) as a matter of right in a particular zone. Another group was equally outspoken in its desire to have the towers allowed. The council, in its wisdom (it was

probably an election year), didn't want to make either group angry, so they voted to allow towers in that district only after a public hearing for each proposed tower.

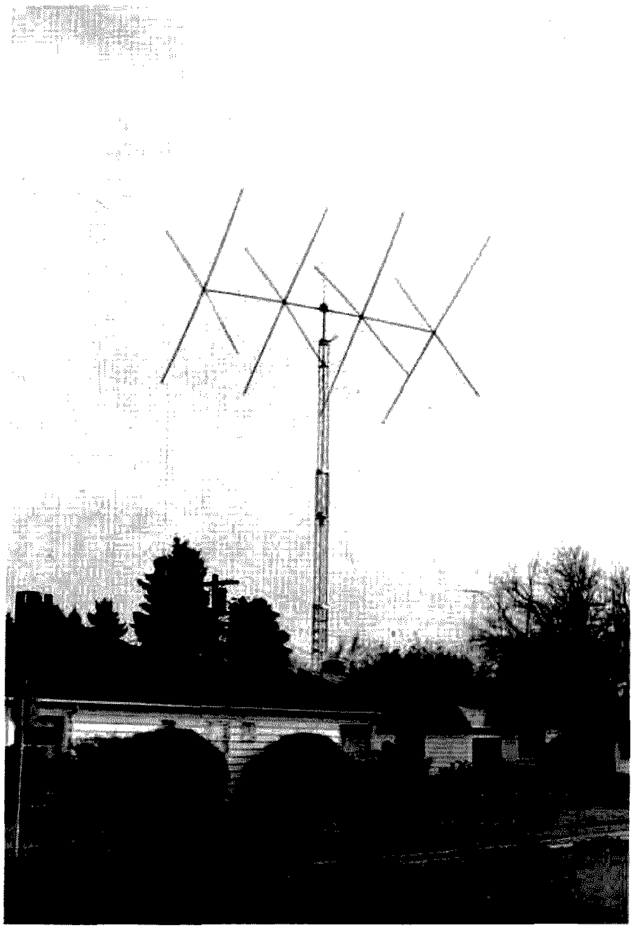
Try to assess your chances for a conditional use permit before you apply. Ask the planners if others have obtained permits in similar situations. Also, look around in the neighborhood for antennas. It may help you obtain a permit if there are other antennas in the same area. Last, talk to the neighbors, explain what you want to do, and see how they react. If you are lucky, the neighbors may sign letters indicating support for your project. If your chances for a permit look good, apply.

Remember, your odds for success are helped by favorable testimony at the hearing and by your ability to design your particular tower installation so that it is compatible with the neighborhood. You should be prepared for the hearing with pictures of your tower and antenna at similar installations. If necessary, offer to keep the tower cranked down behind the garage or to limit the size of the antenna array. If you can anticipate the arguments of those opposed to your tower, you can defuse much negative testimony before it occurs. For example, most neighbors are concerned about possible TVI. Be sure to tell the hearing board early that the FCC regulates and monitors your activities to prevent interference with other services.

Rezones are generally a last resort, to be applied for only if towers are prohibited outright or after you have tried and failed to obtain a variance or conditional use permit. Simply, the object of a rezone is to have your property placed in a different zone, one which permits towers. However, a zone which permits towers may also permit undesirable uses that would prevent the rezone. Generally, unless you are immediately adjacent to an existing zone which you would like to extend to your property, chances for a rezone are small. Ask the local planners or your attorney for advice before you apply for a rezone.

There is one other tool which is often overlooked. If your attempt for a rezone fails, it is sometimes possible to amend the ordinance provisions for the zone in which you are located. Possibly, a prohibition in the ordinance could be changed to a requirement that all towers be less than 50 feet high. Talk to the local planners about the procedures to follow in initiation of a proposed zoning ordinance amendment. Often, it is easier to change the ordinance then it is to obtain a rezone.

There are a few final points to remember. First, zoning regulations are not the only restrictions on land use; often subdivisions have restrictive covenants placed on the lots. These restrictions can be found on file with the county auditor and you should read them carefully, because restrictive covenants can be very powerful and hard to change. Second, if you have found a house you want to buy and don't have time to check the restrictions, you can make an offer subject to the ability to obtain a building permit for your tower and to locate a tower within the subdivision. Last, good luck, and remember that most zoning ordinances are easier to read than you think, especially when compared to the FCC's regulations. ■



The author's recently erected tower and antenna. An inquiring neighbor was told by the local building department, "He has a building permit; it's perfectly legal."

Remote Rain Gauge

- - for gauging remote rain

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For those of you who have a rain gauge, and would like to know how much rain fell without going out and checking, build this simple indicator for use inside the house.

Drill very small holes at whatever markings you want on your gauge. Use stiff copper wire and epoxy. Use about a 100 Ohm resistor for current limiting to the LEDs.

Make up any type of indicator panel for use inside the house with the LEDs. Label next to each LED the same reading as on the rain gauge so when that light comes on that will be how much rain you have in the rain gauge. ■

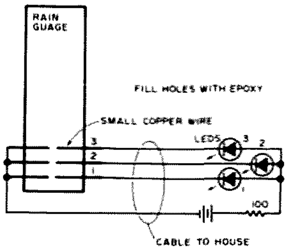

Fig. 1. When the water gets up to the first marking, water will short across wire and turn on LED #1 inside the house.

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Super Loop Antenna

- - great for apartment dwellers

To the urban amateur or apartment dweller, operation on the 80 and 40 meter bands often is out of the question. The main problem is where to put the antenna. Various schemes, some of them ingenious, have been tried with varying degrees of success. Each has had its drawbacks. In preparing a book on amateur antennas, I felt that there was a need for a simple indoor antenna that the average Novice could build economically, that would produce the results needed to encourage the neophyte further into the hobby. The worst problem exists on 80 meters, and it was there that this experiment centered.

After trying numerous configurations, it was decided that a closed loop offered the best hope. Loop antennas are often treated as a specialized class. Little has been written on them, in comparison to the volumes written on other configurations, so little is known of them by the average amateur. Except that they can be a bit tricky to tune, there is no rational reason – it's just a class of antennas that has never been fully explored.

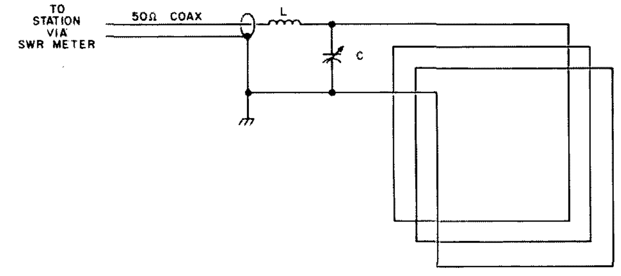

Fig. 1. 130' wound in 3 turns 2" apart. L – 7 uH, 24 turns, 3/4" diameter, 1-1/8" long. C – 365 uF.

One thing that is known, however, is that a loop can be a very efficient radiator *if* it is properly matched to the transmitter. There is where the big hole is; few loops are matched to their associated equipment, and the consequent poor results quickly discourage the user.

In spite of its apparently large size, the loop described here is in the class known as small loops. A small loop is one in which the total length of the wire used is small compared to a wavelength. Current in a small loop is all in one direction, and is fairly uniform in magnitude. This loop uses a full 130 feet of wire – just ½ wavelength. It is consequently about as big as you can get and still have a small loop.

Small loops behave as large inductors. They can be tuned to any frequency at which they're still small loops with the appropriate capacitor. Their radiation is polarized perpendicular to the plane of the loop, and nearly omnidirectional in the plane of the loop, with virtually no radiation in the directions perpendicular to the plane of the loop. This may seem a contradiction to the next statement because of the polarization. A small loop is considered in engineering circles to be a magnetic dipole. That is, it does with the magnetic component of the wave what a dipole does to the electric component. Being primarily magnetic in its behavior, it is relatively insensitive, when receiving, to lightning and man-made static.

The Super Loop, then, is the largest possible small loop, positioned horizontally, and matched to the transmitter with a simple L network. It is made with common doorbell wire, since it is used indoors. Doorbell wire comes in standard lengths of 65 feet, so two rolls make a nice half-wave antenna. It was wound around the wall of the room near the ceiling, the turns spaced about two inches apart. Where the ends came together, the L network was mounted, and 50 Ohm coax fed down to the equipment.

The L network consisted of a 365 uF "broadcast" variety variable capacitor, one of the few parts still easily obtained, and a 7 microhenry inductor. The inductor was made by winding 24 turns of #18 wire on a scrap of ½ inch PVC pipe, also easy to obtain (½ inch pipe has an *outside* diameter of ¾ inch). When close wound with #18 wire, the length of the winding is 1-1/8 inches. If other wire size is used, it should be space wound to fill the specified

length.

The initial tune-up of Super Loop can be a stinker, and a reflected power meter is recommended. Set the antenna tuning capacitor to about 2/3 of its full capacity. With your transmitter set for reduced drive, tune it up as you would a conventional installation. Then set the reduced power meter for swr and tune the antenna capacity for a dip in swr. Finally, repeak the plate tuning capacitor of the transmitter. Because of the relatively small impedance transformation, the output tuning capacitor (sometimes called the load capacitor) of the transmitter can interact considerably with the antenna tuning capacitor. It is here that things can get sticky. The trick is to find that point where the two seem to produce minimum swr. Once that point is found, the loop can be relatively easy to use.

The first experiments with the loop brought almost fantastic results until it was discovered that the loop was proximity-coupling into my outside wire. When the outside wire was taken down, results seemed more rational. Good signal reports were obtained with satisfactory QSOs as far as 1000 miles or more. The worst results came from just over the horizon, which is to be expected, since the loop is a low radiation angle device because of its horizontal position.

Swr averaged around 1.4 throughout the band, thanks to the L network. I have good reason to suspect that the dimensions of the loop have some tolerance, since it has the variable capacitor across it. There being no "ends" in the wire, the so-called end effect does not apply, and the loop dimensions are governed by the wavelength in space. As long as there is a fairly small side-to-end ratio, the form factor isn't too important. Simply adjust it so that the half wavelength of wire makes three full turns.

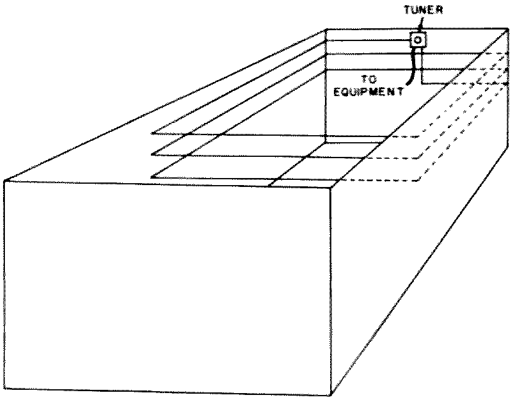

Fig. 2. The loop is wound three times around the room near the ceiling. It's nice if it just fills the room, but it doesn't have to. Also there's no reason why it cannot be mounted on the roof.

I have good reason to suspect that the behavior of the loop will vary somewhat from one location to another, since there is no way of predicting what length of conductor will be within its field to affect it. Nonetheless, based on the reports I've had, I think I might be on to something. The only truly valid test is its use in many different locations, and while I have several amateurs working on loops, it will be quite a while before the results can be fully evaluated. Based on the results to date, I feel it safe to at least offer the amateur world what I've done so far and hope that those who use this antenna will feed back their results. ■

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Rock Bottom 2m Antenna

- - uses converted CB components

Surprisingly good results can be had in low power 2 meter mobile work by using a 5/8 wave whip as the radiator rather than the standard ¼ wave whip, as is generally well-known. In practice, I've found that actual on-the-air results are much more favorable to the 5/8 wave whip than the roughly 3.4 dB theoretical gain improvement would suggest, to say the least!

Home brewing a 5/8 wave mobile antenna is a simple proposition, but presents a few mechanical problems as well as occasional difficulty in getting a good match to 52 Ohm coax, so most fellows tend to purchase the antenna as a complete package from one of the major mobile antenna manufacturers. Costing $25-40 or more, these units do an outstanding job of upgrading that mobile signal, but a very professional-looking, good-performing 2 meter antenna can easily be fabricated for a few dollars, particularly if use is made of some low cost CB-type antenna fittings and components.

The antenna described in this article consists of a standard CB-type, "no-holes" trunk lip mount, a modified CB loading coil, and a 47" stainless steel whip. In my case, the entire installation was completed for $11, using a budget-priced CB antenna ($10 at Olson Radio) and a 47" whip obtained for $1 at a local hamfest.

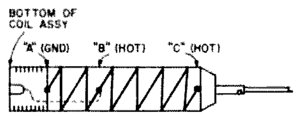


Fig. 1. Point A-B: impedance-matching shunt coil (at dc ground); point B-C: loading coil. Although "hot" for rf, note that the coil is at dc ground, since the shunt, connected to B, is at ground dc potential. Note: "Hot" center pin of coil assembly is factory connected to point B internally.

To modify and install the antenna, first carefully follow the CB antenna manufacturer's instructions for installation of the trunk lip mount. The optimum antenna location (other than roof-mounting) is usually on the forward trunk lid, at the center of the vehicle. The RG-58/U coax can be brought forward through the rear deck to the operating position. Be sure to inspect the coax carefully — some CB antenna manufacturers furnish a very inferior product. If the braid appears thin and the inner conductor can be seen through it, discard the coax and replace it with a 16-18 foot length of high quality RG-58/U. Also, ensure that the set screws in the mount make a good dc contact with the trunk lip, and that the coax isn't pinched as it emerges from the mount. Check the mount and coax for continuity and shorting.

Next, discard the short CB whip furnished with the antenna package. (In the case of the Pace CB antenna I used, the very short 34" whip included was cut down to 19" to make a ¼ wave handie-talkie antenna for improved performance over the usual "rubber ducky," or it can be base loaded to form a ½ wave HT whip as described by K3VNR in July's *73 Magazine.*)

In any case, replace the short CB-type whip with a 47" stainless steel whip of the type usually available for a dollar or so at hamfests, flea markets, and various surplus outlets. Be sure to obtain a whip that will slip into the stud provided with the CB antenna; a collapsible rigid whip is not recommended.

The next step is to disassemble the loading coil. When the plastic cover is slid off, you will find two coil windings, a small shunt-wound impedance-matching portion at the base, and a dozen or so turns of #14-16 wire which constitutes the loading coil proper, as shown in Fig. 1. Both windings must be removed. Once this is done, wind five (5) turns of #14 or #16 PE wire around the coil form between points "B" and "C" as shown in Fig. 2. An impedance-matching shunt coil isn't required for the 2 meter antenna.

The antenna is tuned using a good VHF-type swr bridge at the transceiver, adjusting the coil spacing slightly and/or the antenna length using the set screw adjustment in the stud at the top of the loading coil. In my case, 5 minutes worth of simple "tweaking" adjustments produced a very nearly "flat" 1:1 vswr over 146-148 MHz. Once adjustment is completed, the plastic coil cover can be slid into place, swr rechecked, and the coil cover cemented and sealed for weather protection.

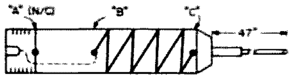
At W8FX/m, the inexpensive Pace CB antenna kit used did not use a spring;

actually, a spring is unnecessary and may in fact cause some radiation efficiency loss at 2 meters if used. However, the installation could be varied to include the spring and, if the CB whip used were a relatively long one (some are 39-41"), the added spring length could obviate the need for acquiring a new whip. If a spring and slightly shorter whip are used, then some experimentation with the number of loading coil turns would be required (try 7 turns for starters).

This article points out a specific mobile antenna design, but it also serves to highlight the "gold mine" of antenna fittings and parts which have been mass-produced for the CBer but which can, with some ingenuity, be readily "appropriated" for ham use. Similar construction possibilities exist with respect to 10, 6, 1¼, and ¾ meter antennas. For example, a turn or two off the original CB coil will resonate the antenna nicely within the 10 meter band; a few turns on a cannibalized loading coil will turn the same 47" whip into a dandy ¼ wave 6 meter mobile antenna, merely requiring interchange of the loading coil itself. And, a mag-mount, mirror mount, or gutter clip-on might be just right for your van or VW installation instead of the trunk lid mount. But consider that the overall effectiveness of the antenna depends to a great extent on getting a good ground to the auto body and getting a good, fairly symmetrical ground plane under the antenna. For these reasons I'm leery of using these other types of mounts.

A real boost for this kind of project comes from the fact that mobile CB antenna kits are now available in discount stores for as little as $10-15, making cannibalization painless, and both Olson and Radio Shack (among other distributors) are now selling individual replacement CB antenna parts (coils, mounts, whips, studs, springs, etc.). Another source of CB antenna components is the local CB dealer who may have lying around "junked" antenna coils, springs, mounts, etc., available at a bargain price, and which may be "rehabilitated" for your purposes. Of course, if you already have a CB mount installed, and who doesn't these days, all that is required for this 2 meter antenna is an extra coil and 47" whip.

Fig. 2. Note: Shunt winding between points A and B is removed, as is original loading coil between points B and C. A new coil of 5 turns of #14-16 PE wire is substituted from B to C. Coil and antenna rod are now "hot" and no longer at dc ground.



As with any antenna project, the "proof is in the working," and work it does. I use this antenna with a Wilson HT at 2.5 Watts output, consistently working several Dayton area and out-of-town repeaters out to distances of 40-50 miles. Side-by-side comparisons using a ¼ wave whip on the same vehicle invariably favor the 5/8 wave antenna, both on receive and transmit. Gratifying results have also been obtained in simplex work.

In addition, the installation has, as a bonus, the feature that fittings are compatible with regular CB antennas; at W8FX, the same mount doubles as a base for the ol' CB antenna, with a 2 position coax switch on the dash switching the antenna lead from the 2 meter rig to the CB set. Future plans call for making similar interchangeable antennas for 6 and 1¼ meters, using the same mount and coax lead-in.

Who says CB hasn't produced some good side benefits for hams? ■

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Antenna Gain Facts

-- don't be misled

This will be a short article to discuss the gain of antennas. I always get confused when someone quotes me a gain of a particular antenna. The confusion arises because I don't know what baseline or reference point he is using. Normally, in measuring HF antenna gain, the figures are referenced to those obtained by using a horizontal dipole (halfwave). In the FM communications field, the reference for gain is still a halfwave dipole, but mounted in the vertical plane. As far as the FCC rules are concerned, antenna gain is based on a halfwave dipole as a reference. This can be important because many antenna manufacturers use an isotropic source as a reference for listing the gain of their antennas. A common antenna (and the simplest) is the 1/4 wavelength whip perpendicular to ground plane. By comparison to an isotropic source, this antenna shows a gain of .3 dB. Additionally, the 1/2 wavelength antenna shows a gain of 2.1 dB over isotropic or 1.8 dB gain over a 1/4 wavelength antenna. The common 5/8 wavelength antenna, that we see so often on the mobiles, has a gain of 1.2 dB over the 1/2 wavelength or 3.3 dB over isotropic. Higher omnidirectional gain is usually accomplished by using stacked halfwave dipoles. As an example, four stacked halfwave dipoles on 146 MHz can provide approximately 6 dB gain. Usually the maximum number of halfwave elements stacked vertically will be eight (8), which should provide an omnidirectional gain of about 9 dB. ■

Antenna Type	Gain
Isotropic	.0
1/4 wave	.3
1/2 wave	2.1
5/8 wave	3.3
Collinear	6.0

The 8JK Array Revisited

-- inexpensive and effective

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Being an antenna nut and cheap also makes one look for inexpensive and effective antennas capable of getting the most out of the rig. A good example of such an antenna is the "8JK". Various articles in the past have treated this type of antenna as a rotary beam on the higher bands (20, 15, and 10), but very little material has been available for the lower frequencies. Since the estimated gain of such an antenna is 3-4 dB, it becomes an attractive alternate to running higher power. I shall attempt to examine various configurations of such an antenna and provide some insight into possible uses. The *ARRL Antenna Handbook* devotes some space to the 8JK (p. 207). The spacing outlined in the handbook is .1 wavelength, which in the case of the handbook antenna is used to reduce the antenna feedpoint resistance. It should also be noted that the radiating elements are cut as a driven element/reflector combination. This may be fine when such an array can be rotated, but the idea of building such an antenna for the lower bands soon leads to problems. The thing that isn't too readily realized is that the directivity of such an antenna, if both radiating elements are of equal length, is governed primarily by the antenna feed phasing. When this premise is understood, one can then see that a 3-4 dB 80 or 40 meter bidirectional beam can be readily constructed. See Fig. 1.

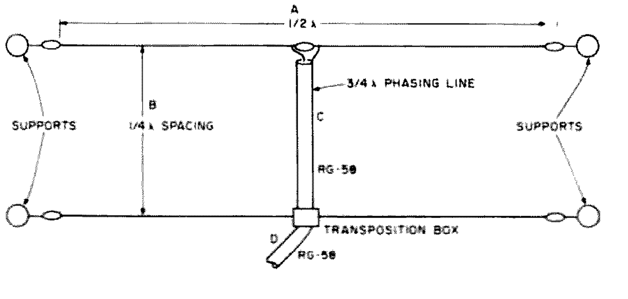

*Fig. 1. A = 468/fMHz; B = 234/fMHz; C = (702/fMHz)(V); D = (468/fMHz)(V). V = line velocity factor. Values for a 3.9 MHz: A = 120'; B = 60'; *C = 118.8'; *D = 79.2'. *Based on a .66 velocity factor.*

The thought of sinking four poles and cluttering up the landscape probably won't enchant too many people, so let's look at a less painful way of achieving the same result. How about just two poles (trees, etc.)? Okay, how about a bidirectional inverted V beam? Would you believe just two 30 foot poles? The normal inverted V with a 90° apex angle has predominantly a vertical angle of radiation, so let's use a 120° apex angle to enhance the horizontal radiation characteristic. On 80 meters, this means the support for the antenna apex will be approximately 30 feet tall. This would be easily handled by TV masting, since the antenna elements can be used as guys. See Fig. 2.

The inverted V arrangement also provides a plus in that trimming of the antenna to resonance is facilitated due to the accessibility of the element ends.

The key to this antenna is the transposition box. This little jewel provides the necessary phasing line transposition to change the directivity

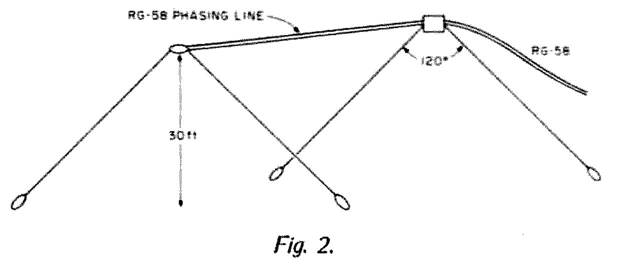

Fig. 2.

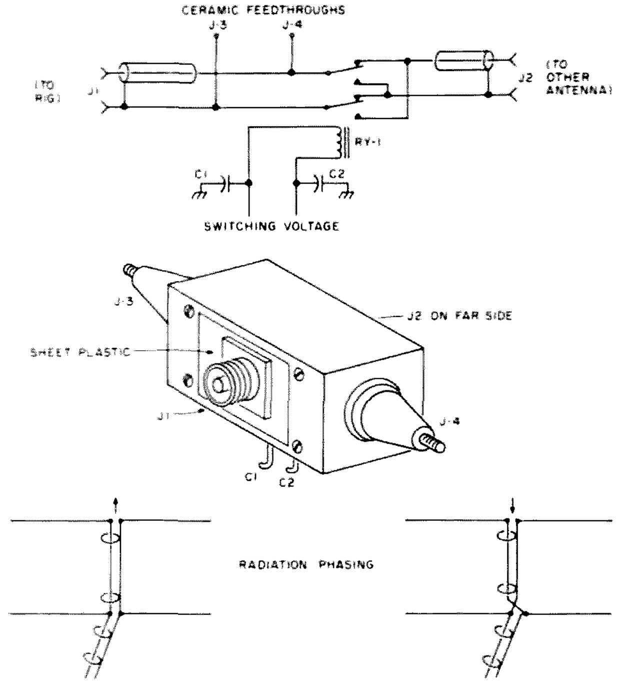

Fig. 3. RY-1 – latching relay; C1, C2 – .001 uF feedthrough. Note: J1 and J2 must be mounted on insulated bracket or plastic wall in minibox.

of the beam. Fig. 3 details the construction and wiring of the box.

The dimensions outlined are for 75 meters, but may be adjusted for other bands. The antenna feedline should be in multiples of an electrical half wave (don't forget the velocity factor). The 3/4 wave phasing line length must be computed using the same techniques.

The same approach may be used vertically with line transposition providing the directional capability. Of course, if you really want to get wild, the addition of a coaxial relay and an additional antenna along with its attendant 3/4 wave phasing line will enable you to punch up 3-4 dB gain in the north/south or east/west directions. See Fig. 4. ■

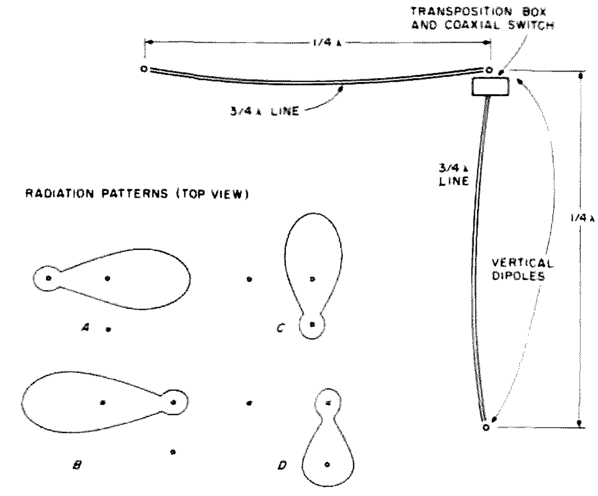

Fig. 4.

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Tower Installation Techniques

-- using rope guys!

Many self-supported towers and beam antennas are blown over and lost each year unnecessarily, causing insurance rates to escalate for all tower owners. Those who lose towers are frequently at fault because of excessive top loading, excessive mast height, or lack of indicated guying. Inexpensive rope guys can save costly replacement of towers and beams in almost all cases, and it is very satisfying to be worry-free during windstorms.

Many years ago a guy wire untwisted at an egg insulator on a rooftop tower, and a new Telrex beam was lost when it dove into an oak tree. A 60' Easy-Way tower, crank-up, tilt-over type, was installed next at ground level with a ground post support. The tower seemed rather flimsy to hold a beam without guying, so at the suggestion of another amateur, WB4QPH, who already had a similar tower, ¼" polypropylene rope, from Sears mail order, was installed in six directions at the top of the tower.

These original rope guys are still in service after about eight years, but two more rope guys were added in the NW, W, and SW wind directions and one additional guy added in the NE, E, and SE. The additional guys were added after the tower was nearly lost when a guy rope was inadvertently cut at the rotator mounting plate during a windstorm. Also, the tower was increased to 70 feet when an Easy-Way top section and a 10/15 Duobander beam were added, a tribander beam was changed to a 204BA monobander, and a 2 meter 8 element beam was added on top of the mast.

The top section, including the 10 foot extension, was bent roughly 15°, just above the second section, when the rope guy was cut at the rotator plate. The top section could not be lowered, and there was no room to tilt the tower over because of trees. However, it was possible to lower the second section inside the lowest section, so the bent tower point was only about 20 feet above ground. All of the guy ropes were brought around to the proper position, and the tower was carefully brought back to plumb after several sitings vertically along the tower. The top section could then be lowered and still is in use. This shows that with guy ropes, a tower can be straightened sometimes, without dismantling. But extra guy ropes should be immediately installed.

A few years later, a 100' Heights tilt-over aluminum tower was obtained from an amateur who moved away. While this tower was of heavy duty construction, with the topmost section spaced wider than the lowest section of the Easy-Way tower, six x ½" polypropylene rope guys were installed for added safety. One of the reasons was the questionable reliability of the 5' high tilting arrangement with its small boat winch and quadruple pulley. The boat winch was immediately replaced by a two speed Gold winch. One of the guy ropes was over the top of a 70' oak tree, and this was used to ease the tower down initially and hold it if anything happened to the tilting arrangement. Then, when the tower was tilted about 45°, it was eased down with a rope sling between two trees, for added safety in the position of greatest torque on the tilting device.

After about a year and a half, the ½" rope guys on the 100 foot tower completely disintegrated, probably from the sun's rays. However, a full refund was obtained from Sears when the ropes were returned. These polypropylene ropes had blue and yellow strands, while the original ropes, still in use, have black and white strands. It was then urgent to obtain new guy rope because I was in the midst of the 80 meter part of 5BDXCC on two-way SSB. A heavy 80 meter beam was on the 100' tower, consisting of tunable 80 meter cliffdweller driven elements, spaced 32'.

Fortunately, through a nautically inclined amateur, WA9NUQ, I obtained a catalog from West Products, 161 Prescott St., East Boston MA 02128. This firm offered a utility grade ¼" nylon rope at a very reasonable price, and I ordered 2000 feet, with an explanation of the intended use. The order was quickly filled as requested, but with ¼" Dacron rope, at only slightly increased cost, and the suggestion that this was much better for the application. In view of the increased rating and less stretching of this rope, I installed only 6 guy ropes on the 100' tower, along with pulleys for various antennas

on the 70' and 100' towers.

Since then, two other amateurs have benefitted from the extra rope I ordered. We are all very satisfied with Dacron rope for tower guying because it is stronger, has less stretch, the knots don't slip as with polypropylene, and, finally, it is softer and much easier on the hands. It can be coiled up without gloves, when a tower is dropped.

There are several advantages with rope guys, other than keeping towers up in windstorms, which may not be realized. Perhaps the most important, and possibly most controversial, is complete freedom from guy wire reradiation effects and any loss of front-to-back signal ratio, as well as front-to-side ratio. Regardless of the use of insulators in guy wires, various resonances occur, and these can be verified with a grid dip meter along each guy wire. It is difficult to prevent reradiation effects from guy wires over all amateur bands.

Rope guys also eliminate even closer coupling effects between wire guys and 40 or 80 meter "slopper dipoles," inverted V antennas, quads and delta loops. Another advantage with rope guys is the protection against lightning discharges following down a guy wire and jumping to a house. Recently, in a neighboring town, an amateur's house and contents, including a large station, were badly damaged by a fire caused by a guy wire conducted lightning discharge. And, of course, guy wires are hazardous near power lines, and especially with crank-up towers.

Finally, the cost of rope guys is minimal considering all of their advantages and the added safety factor in preventing loss of towers and antennas from wind damage. But liability and property damage insurance is still needed for coverage of unexpected, catastrophic losses. ■

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An Ultimate Invisible Antenna

-- works well when it's not raining

The arrival of the first transmitter at the home QTH raised two problems. How would the neighbors react? How does one get an antenna away from trees? The trees were too close together for a dipole on 80 meters and too tall for an inverted vee anywhere near the transmitter. As a joke, one student suggested using the downspout and gutter.

From 1972 through 1976 this was the only antenna I used. It put out enough signal to work both coasts on 40 meters and work several foreign countries on other bands with a very limited home operating schedule.

The antenna is quite simple. The gutter is nailed to the eaves of the house in the normal manner. A drainspout runs down the side of the house from the eave trough to a tile in the ground. The drainspout was cut off just above the tile and a hole drilled in it for a self-tapping metal screw. A single feed wire was run from the rig in the basement to the downspout and was attached with the self-tapping screw. As a Novice, I was limited to 75 Watts. Fortunately, feeding the wire directly from an SB-102 resulted in no ill effects to the finals. The move up to Advanced allowed me more power, so I used a home brew ultimate transmatch to lower the swr.

At the present cost of parts for a transmatch, the beginning ham might use a tuned feeder. Tuning is done by taking a long piece of wire (maybe 10 feet more than necessary) and cutting short sections off the wire until the antenna loads on the desired band with a low swr. If more than one band is desired, another lead-in wire can be used. One lead wire may be necessary for each band desired, but sometimes one is lucky, and one lead-in might serve 2 or more bands. The lead-in wire used here is solid copper insulated wire.

Allband operation can be achieved by using tuned feeders for each desired band and connecting them to the output of a rotary switch. The transmitter is connected to the switch (which should be in a well grounded metal box) by a piece of coaxial cable. The operator selects the band simply by moving the switch.

I took the time and effort to tune a feeder for 40 meters and have an swr of 1:1 at 7.15 MHz and an swr of 3:1 at the band edge.

I have a continuous aluminum gutter and have not tried this on a gutter made in sections. The sections may cause some TVI, but there has been no problem here except on channels 2 and 5. My well-tuned dipoles cause the same amount of problem. The transmitter should be well grounded when using this antenna. Otherwise, rf builds up on the case and can lead to serious shocks. ■

Mountaintop Special Antenna

-- fits in a backpack

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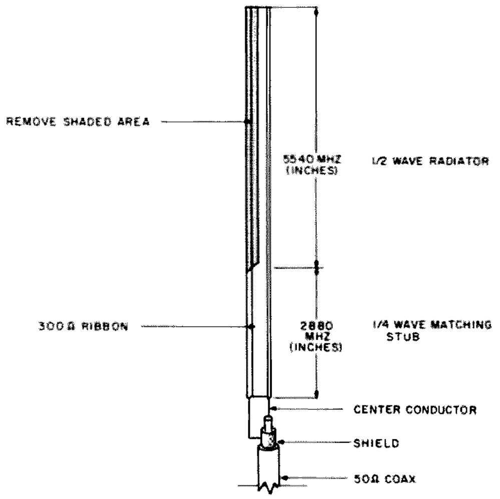
If you like to camp, mountaintop, operate portable on vacation, participate in Field Day activities, or possibly need a quick temporary antenna at a new location, the antenna described in this article will be just what you are looking for. Although this antenna was designed for ten meters, it can easily be adapted for six and two meter use by adjusting the length according to the table which accompanies the diagram.



J-pole antenna.

The antenna is the good old standby – the J-pole. It was selected because it has a half wave radiator, nice low angle of radiation, could be constructed of inexpensive 300 Ohm ribbon, has its own simple, built-in quarter wave matching stub, can be directly fed with 50 Ohm coax, has a low vswr over a large bandwidth, and can be rolled up into a light small package. How can you go wrong with all those advantages? It's almost like perpetual motion.

The diagram shows its general construction. Use either a knife or heavy shears to split or cut the 300 Ohm ribbon down to the matching stub, and then carefully remove the unwanted portion. The coax is simply soldered to the end of the 300 Ohm ribbon, weatherproofed with a plastic spray, and then wrapped with black plastic tape for additional weatherproofing and strength. RG-58/U cable was used to keep down the weight and should be satisfactory for lengths of thirty feet or less. The top end of the matching stub and the half wave radiator were also sprayed and taped. To mount the antenna, I tape twenty-five feet of nylon rope onto the end of the antenna. A nylon cord could be passed through the dielectric at the top of the antenna for its suspension.

When trees are available, tie a rock around the rope and use a strong arm to get the antenna mounted. This may take a little practice. From personal experience, I would make these suggestions: Watch out for windows, wear a football helmet, make the points on the antenna where you have added tape as smooth as possible, and try to stay a quarter wavelength away from large pieces of metal. I think those suggestions are self-explanatory. Even after I had taken all of these precautions, the rock came loose from the rope, fell on the 300 Ohm ribbon, and cut the antenna in half.

Well, I still think it is a good idea, and it has proved successful. I have also included a table determining the antenna length for those of us who flunked fifth grade math. ■

Frequency (MHz)	28.0	28.5	29.0	50.0	51.0	52.0	144	145	146	147
Radiator (inches)										
½ wave	197.8	194.3	191.0	110.8	108.6	106.5	38.4	38.2	37.9	37.7
Stub (inches)										
¼ wave	102.8	101.0	99.3	57.6	56.4	55.3	20.0	19.8	19.7	19.6

Table 1. Antenna length.

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Fiery Endfed

-- keep antennas ice-free!

The winter of 1977, so I've been told, was the worst in over 100 years, at least for the Midwest and the East Coast. Coming from California where the weather is always warm, I was led to think that the simple endfed random length wire was the ideal solution to the problems of operating in a dorm room or apartment. But moving out to the snowy, icy chill of New England left my ideals in a frozen heap of wired snow, collapsed ignobly on the ground. The results were a badly mismatched transmitter and disastrous signal reports.

Every place in which I've had the fortune to dwell always has had at least one window looking out toward a tree, pole, or other building. With a little bit of nighttime or early morning rock-throwing, arrow shooting, or flycasting, I've been able to secure a nylon line to that remote support. Then, a wire is slinked out, made fast, and a primitive but effective matching network employed to fool my poor FT-101B into thinking that a 37 foot piece of copper is a 50 Ohm dummy load.

This works great until you find out that snow, a funny white stuff which apparently falls freely all winter everywhere except California, is made out of water. Water weighs over 8 pounds per gallon — it doesn't take much snow to accumulate on a skinny piece of wire and make it *very* heavy. After a particularly nasty storm blew its way into Boston in our wonderful winter of '77, guess what happened? My lovely wire antenna snapped under its unwanted icy-white burden, leaving the transceiver in grave doubts as to whether its pi-network would ever be duped again by coils, capacitors and random copper.

There are three solutions to this problem. One is to move back to California as any sane person would do. However, in my case at least, the phenomenon known as graduate school prevents me from being counted among the sane. The second is to do what the power company, Ma Bell and the rapid transit people do — use enormously thick and strong cables with reinforced supports so that even if the frozen Charles River were encased around the wire, it wouldn't give a bit. But thick copper wire can get very expensive and cumbersome and also violates the ideal of having as invisible an antenna as possible, so that the RFI complaints get directed elsewhere.

The third way is to take advantage of the slightly higher resistance of thin copper wires over the big fat ones. I ran a twisted pair of #24 insulated wires out to my support with the ends soldered together at the far end. When I use the twisted pair as an antenna, I merely connect the two ends together at my end and feed the whole mess as a single wire. But come the ires of Mother Nature and buildup of ice on the line, I disconnect and separate the two wires at my end and feed some current (dc or 60 cycle, not rf) into the resultant loop to make it toasty warm. The ice melts, and the strain is off the antenna. This heated antenna idea really does work. All you need is a variac and a hefty filament transformer (whatever is handy), and you can power the thing up. Once the ice is off, relatively little current (wires not even warm to the touch) is needed to keep the antenna clean of white stuff.

Use a copper wire table to determine the resistance of the wire and be sure to double the figure for the measured length of the antenna, since it's a loop out and back. Don't get carried away with the heating juice, or you'll burn up your snowbound antenna and really be the victim of fiery irony!

Some excessively clever soul will no doubt come up with a tension-actuated switch which would automatically disconnect the antenna, separate the two ends of the loop, and feed in the heating current once the pull of the line increases with snow buildup.

The light weight of the #24 twisted pair and its ability to shrug off snow at the turn of the knob result in an antenna which is durable and resistant to wind and storms. It even serves to radiate rf power quite effectively from its associated transmitter, heating up the ether and, on occasion, the coldest winter in a long time. ■

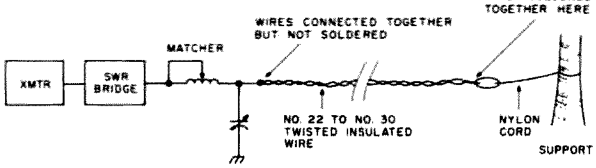

Fig. 1. Fiery endfed antenna in normal use.

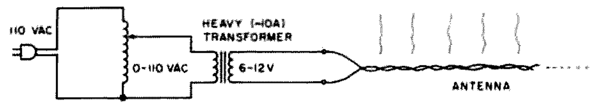

Fig. 2. Heating the antenna when things get icy.

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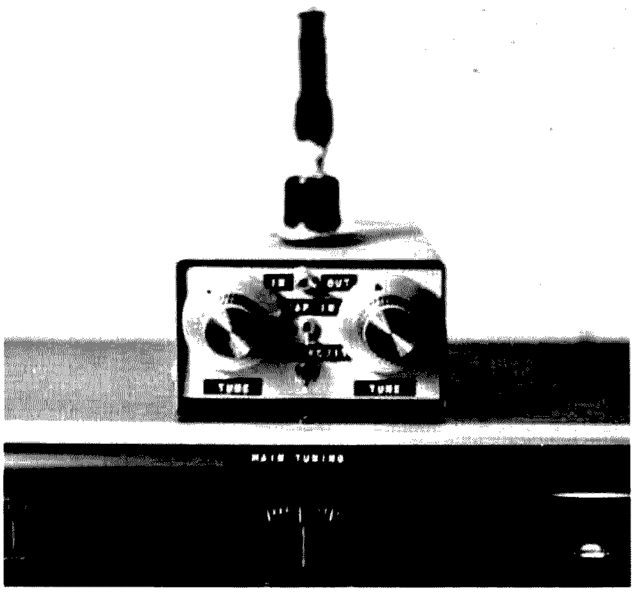
Build A Vacation Special

-- portable antenna systems

Frequent moves and periods of extended travel associated with Air Force duty bring to focus the need for a compact combination receiving antenna and rf preamplifier system.



The circuit shown in Fig. 1 combines the requirements of compactness, portability, and low cost in a unit that can be built for roughly $10-$15, using mostly junk box parts. The unit, housed in an attractive aluminum and gray mini-cabinet, makes a handsome and very professional-appearing adjunct to any general coverage receiver.

Transistors Q1 and Q2 may be substituted for. If an RCA 40468 FET is substituted for Q1, a fourth lead (a shield wire) will be found coming from the body of the transistor. This should be connected to ground. Other component values are not critical. The three mini-toggles are relatively expensive, but often can be found at local surplus outlets or at swapfests for as little as 35¢. The 47" stainless steel whip was obtained at a local hamfest for a dollar.

Though solid state, the unit is probably most easily constructed using conventional wiring techniques, using the switches and a couple of multiple terminal strips as convenient mounting points. Most of the components are mounted in the area formed by the "U" shape of the lower portions of the mini-box. The rf input coil and tap selector switch are conveniently mounted on top of the cabinet, as is the type F, BNC or SO-239 chassis mount antenna connector – use whichever type you prefer.

The whip selected can be inserted into the cable connector selected and epoxied into it – at W8FX, type F connectors are used, so that the 47" whip doubles as a 5/8 wave 2 meter antenna for high performance work with a Wilson handie-talkie.

A single pole, 20 position rotary switch is used to select the optimum tap on the input coil. While a switch having fewer or more positions could be substituted, the 20 available tap positions allow good continuous coverage with the 47" whip from 160 to 10 meters, including the SWL and utility bands in between. The coil is wound on a 1/2" wooden dowel with about 150 turns of #28 PE magnet wire, tapped at 3, 7, 12, 18, 25, and then about every 10-11 turns. After connection to the rotary selector switch, the coil can be epoxied into place.

A short length of RG-58C/U coax terminated in a PL-259 connects the unit to the receiver. The only internal adjustment required is setting the optimum value of R1, the 2k Ohm potentiometer. This is done by turning the unit on, peaking the antenna switch for maximum received signal strength, and then peaking R1 for maximum gain. Check all bands to see if any oscillation is encountered – if so, back off R1 slightly until it

disappears. The setting of R1 can then be left alone.

L1, C1, and C2 form a pi network input circuit, while S1 allows the capacitors to be switched out of the circuit if desired. (C1 and C2 are not strictly necessary and may be omitted if desired, with little performance degradation. S1 would then be omitted.)

Transistor Q1 is a MOSFET type with very high gain, which is protected against excessive gate voltage caused by nearby transmitters; Q2 serves as an emitter follower to match the medium output of the MOSFET (Q1) to the low input impedance of most receivers.

One caution in construction is to exercise care in the handling of Q1. Its gate is quite sensitive to static charges, and therefore it should be handled with a short circuit across its leads until just before power is applied to the circuit. Also, don't apply a soldering iron to Q1's leads unless they are shorted to one another.

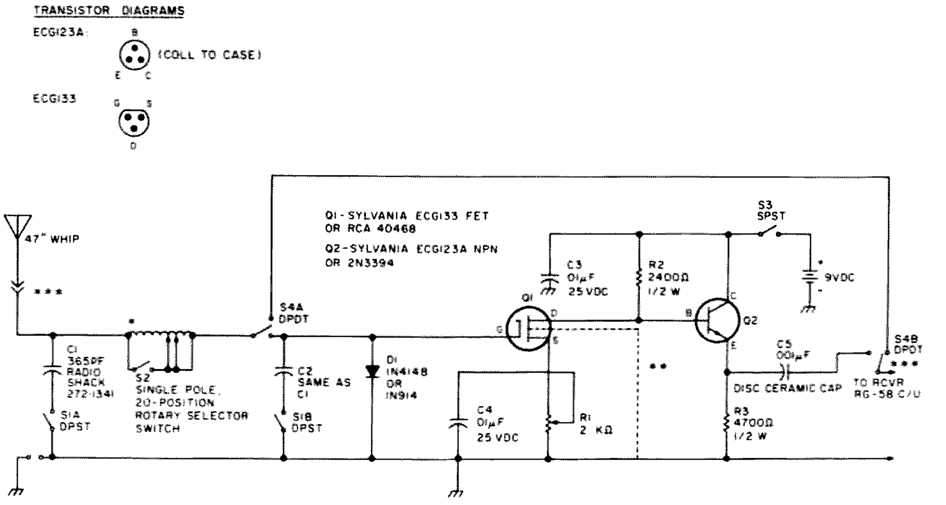


*Fig. 1. *150 turns #28 PE (see text). **Shield wire if RCA 40468 is used. ***See text for type connectors.*

A standard 9 volt transistor radio battery powers the preamp. A source of 9-12 V dc could be obtained from the receiver, but current drain is so small that this is unnecessary.

The overall result is a super sensitive, versatile receiving system featuring an overall gain of more than 30 dB. It has been used with good results on several communications receivers, such as the Yaesu FRG-7 and Allied/Radio Shack SX-190. In fact, results seem to equal those obtained from the 20-50 foot random wire usually strung out for casual portable listening. Of course, the unit can double as an allband preamp used in conjunction with the regular station antenna, although cross modulation and overloading effects may be troublesome unless an rf attenuator is used ahead of the FET input. ■

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Apartment Antenna Specials

-- next, hide your Mod 19

All you apartment dwellers – get ready. Here are a bunch of ideas for how to hide antennas, run cables and set up a shack. (The nosy body on the fifth floor will never know you're there.)

The biggest problem for apartment dwellers is usually how to put up an antenna. Actually, we apartment owners have it made – in my case I have an antenna height of 190 feet. Not bad, eh?

To start off, if you have access to the roof, that's great! But, of course, we all know that most apartment owners are not even allowed to put any protruding objects outside of their windows. "Protruding objects" means antennas. One of the best ideas for an apartment owner is a long wire or dipole. With that there's only one problem – how to put it up. Stringing the antenna between two buildings would be ideal. If that's not possible, the next best thing, and probably most common, is a wire antenna strung along the apartment windows. To start with, there is absolutely no way you can have an apartment shack without a transmatch.

When you are putting an antenna up try to keep the antenna from touching the building. If this happens chances are it will short out. Also, always get as much wire out as possible. Use the thinnest, most durable and least likely to be seen wire that you can find. If possible, paint the wire the same color as the building. Try to get the antenna at least four or more feet away from any obstructions. Any antenna you can get outside is better than an antenna inside. Don't let the antenna dangle; always pull it tight.

One of the best ways I know of to support the antenna is to put 1" x 1" x 4' strips of wood on the window. Put screw eyes in these strips to attach the antenna to, but don't tie the antenna directly to the screw eye. There should be an insulator between the antenna and the screw eye. Galvanized wire going from the tip of the strip to the top of the window helps to support the antenna. Don't hesitate to pay for a good support. A well constructed antenna won't come down until you take it down.

Now, I have a word to say about coax. Try to keep coax runs shorter than 15 to 20 feet. If you must make a run longer than this use RG-8/U. Usually when you string an antenna around an apartment you use RG-58/U since it is much more flexible than 8/U. If you have to go around corners with coax, use 58/U and try as much as possible not to put sharp bends in it.

If you are putting up a dipole, have the coax come straight out of the bottom of the antenna. Try to insulate the center of the dipole. (A Plexiglas™ block is ideal for this purpose.)

Let's get off the subject of antennas before we get dizzy from the height. A lot of people ask how to get a good ground in an apartment. To tell the truth there is no really good ground. The best thing to use if you can't knock a ground rod a couple of feet into the ground is a water pipe. If your shack isn't in the bathroom then you probably don't have a handy water pipe. The next best thing is a radiator pipe. For a good connection to the pipe, scrape away all the paint. The best thing to use to connect the wire to the pipe is a hose clamp.

When you set up your shack always try to put up shelves above the desk. Try also to get all your equipment within reach without having to get up. Standard connectors throughout the shack are absolutely necessary. Don't bolt your paddles or key directly to the desk. And, as for a desk, just about anything will do except a collapsible table. They usually can't hold the weight.

Your shack should be close to a window and water pipe of some kind. Try not to have your entire shack plugged into one outlet or . . . "Standby OM, the circuit breaker just went!" Don't put any wires under carpets. Don't even think about not getting lightning protection devices. When possible try to keep your power output as low as possible.

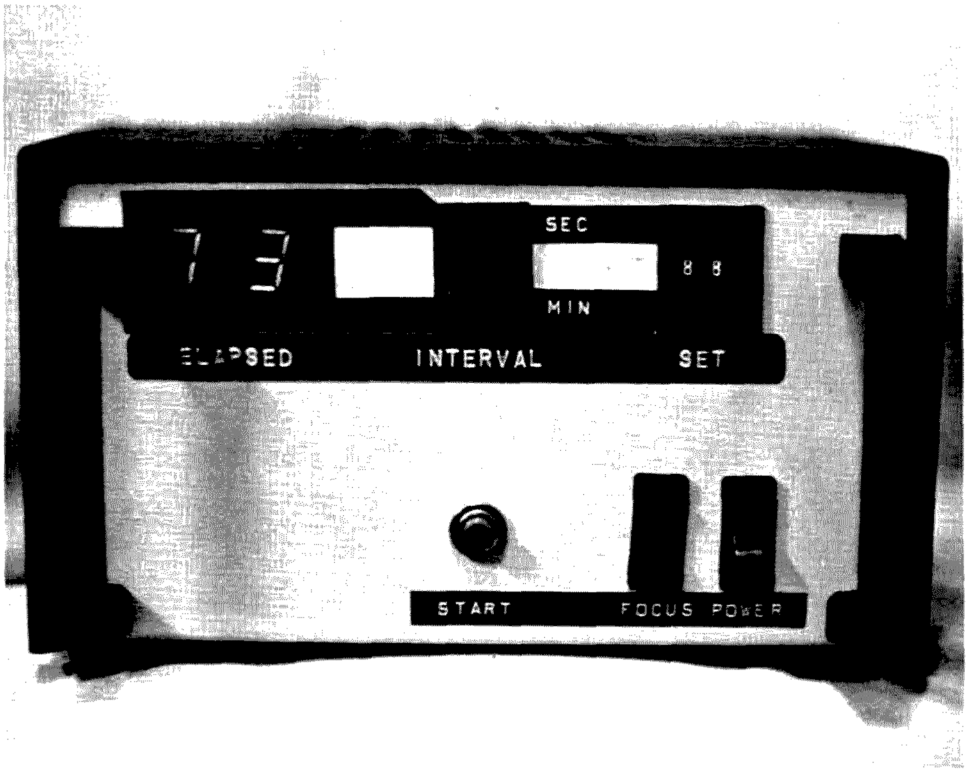
At all times do everything in your power to prevent TVI. The fewer people who know you're a ham, the fewer people there are to blame you for TVI. Stay away from 6 meters.

To sum it all up, it isn't so bad living in an apartment. Just try to use every bit of space you have. I hope you are able to use some of these ideas to help you put up a better antenna and enjoy amateur radio. And, if you have any ideas or inventions for apartment dwellers, please send them to me. ■

Build A Unique Timer

-- for the ham photographer

Front view of unit.



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Randallstown MD 21133

The need for electronic timers must be ubiquitous. One certainly gets this impression from the number of timer articles published in the various electronic magazines. There are repeater timers, identification timers, phone call timers, Polaroid timers, and egg timers. One even suspects there are timers that are intended for uses which could not be discussed in a family magazine. Many have been suggested for photographic work; however, each of these has certain defects which prevent it from being an ideal enlarging timer. The ideal timer for darkroom use must accomplish several tasks:

1. Timing in seconds to at least one minute for routine exposures;
2. Timing in minutes to at least 15 minutes for mural or special work;
3. A rapid, foolproof way of entering time interval desired;
4. Indication that the time cycle is progressing, and elapsed time;
5. Automatically extinguish safelight when enlarger is on;
6. Allow for "focus" or non-timed on state;
7. Allow interval to be interrupted for "burn-

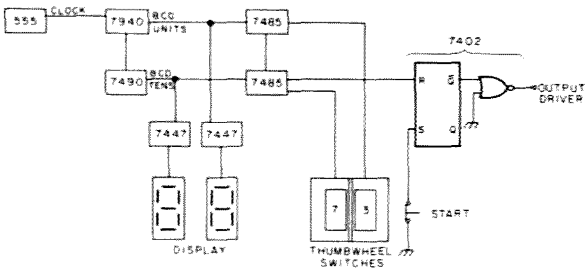


Fig. 1. Block diagram.

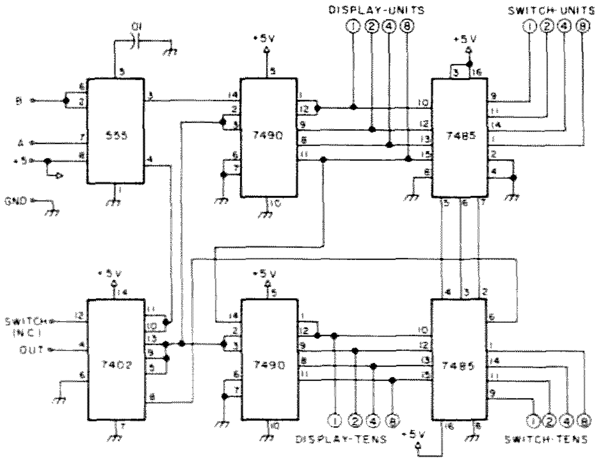
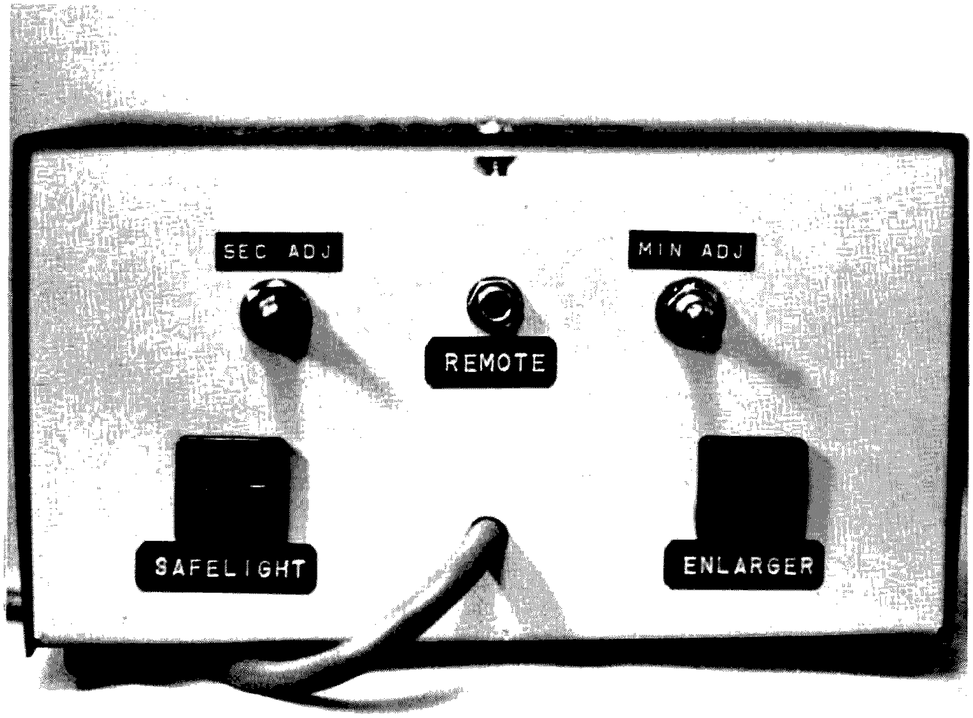


Fig. 2. Main board schematic.

ing-in."

By an amazing coincidence, the timer described in this article does just these things!

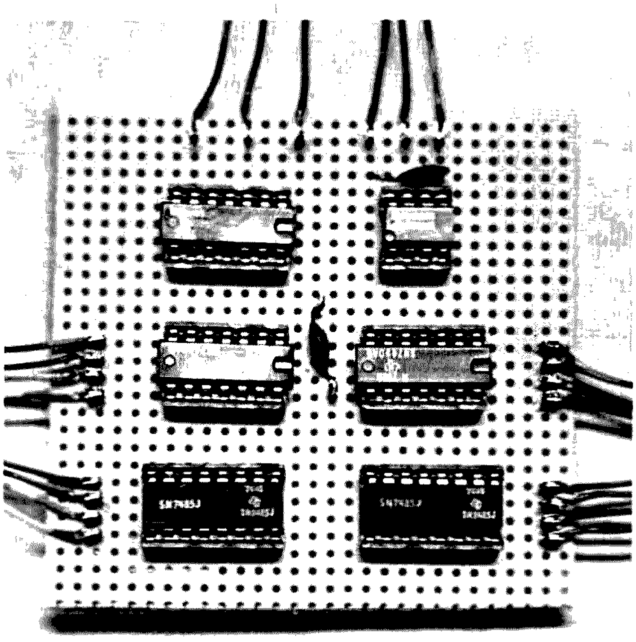
A glance at the completed unit will illustrate the major features of the timer. Time desired is entered through two binary coded decimal (BCD) thumbwheel switches on the upper right corner of the front panel. A two digit, seven segment light emitting diode (LED) readout, located in the upper left corner, begins at "0" and counts up to the time preset, then automatically resets to zero. A large rocker switch in the upper center of the panel selects an interval of seconds or minutes. A "center off" position stops the count, to allow for a "hold" in the timing interval. Timing itself is started by depressing a momentary contact push-button in the center of the panel. A second rocker switch, located next to the power switch, activates the timer output, to energize the enlarger socket and extinguish the safelight *without* disturbing the timing interval, for as long as needed for focusing and composition. On the rear panel, grounded ac



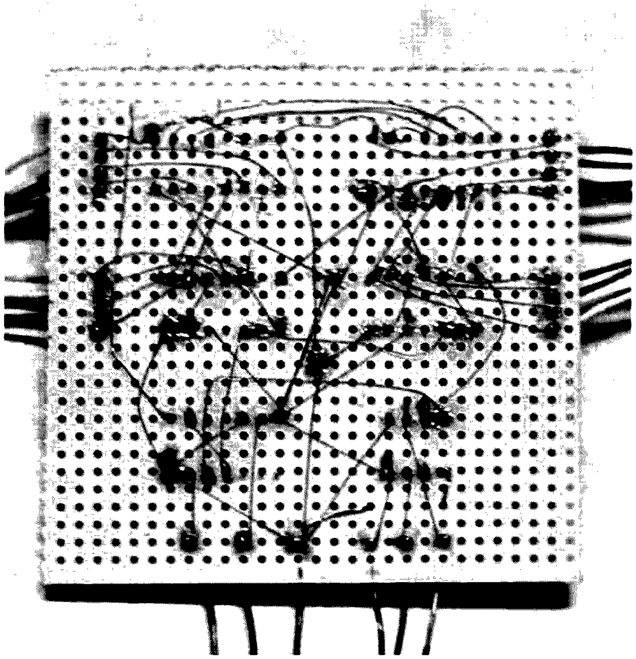
Rear view of unit.

sockets are provided for ENLARGER (*on* during timing interval) and SAFELIGHT (*off* during timing interval). Additionally, a phone jack is provided for footswitch or remote triggering of the timer operation. Potentiometers adjusting second and minute intervals are also located at the rear panel.

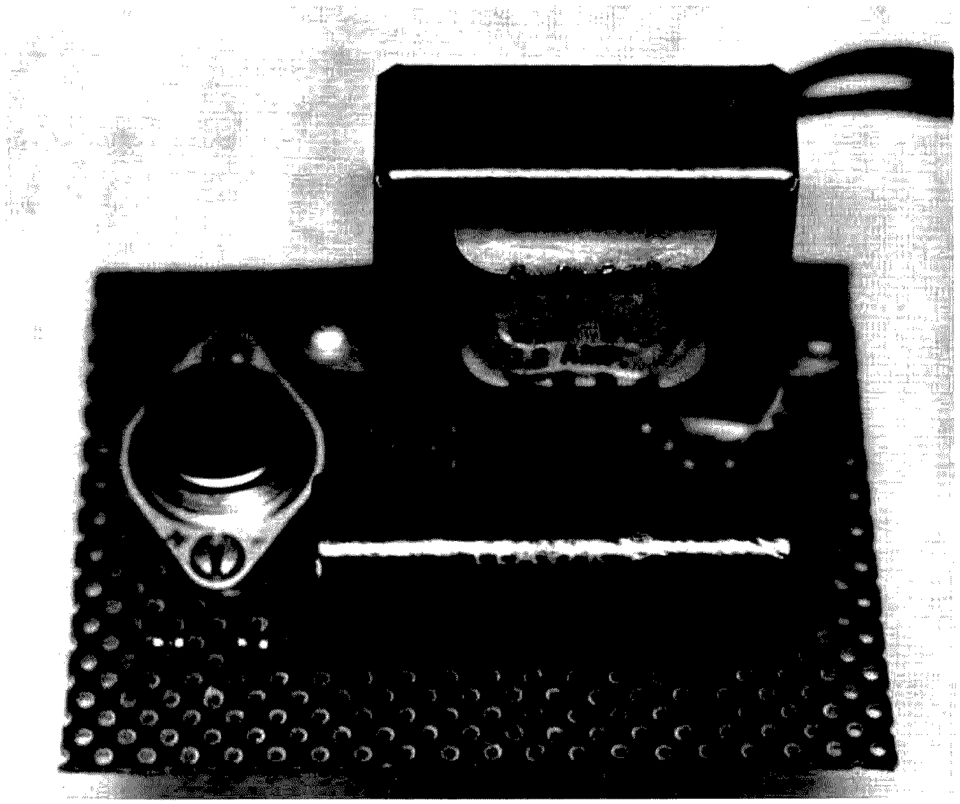
The timer is designed in a modular format, with separate circuit boards for each subunit. The power supply, main timer board, display, output, and complement generating sections are individual perfboards in the prototype. This allows flexibility in construction, and ease of modification or updating in the future. Printed circuit layouts for the



Main timer board, component side.



Main timer board, underside, showing wiring done with Vector wiring pencil.



Power supply board.

major boards are included for readers who wish to duplicate this method of construction.

A look into the circuitry of this unit is interesting, and provides a practical lesson in TTL logic devices. The versatile 555 timer chip sets the pulse for this circuit. Either 1 Hz (one pulse per second) or 1/60 Hz (one pulse per minute) is derived from suitable components in the astable mode. This clock output then goes to a pair of 7490 decade counters, connected in cascade. The BCD output of the 7490s is available at the board edge for coupling to the display board. Internally, the output of each 7490 is routed to the A input of a 7485. This chip, which has seen little use in amateur publications, is a four-bit binary comparator. Taking two four-bit binary "words," and BCD is just such a "word," it will give a "1" output if the four bits at the A input are identical to the four bits at the B input. Alternately, "greater than" or "less than" outputs may be selected so that the output is high with A greater than or less than B, respectively. Cascade inputs and outputs are available, and are used here, so that output from a

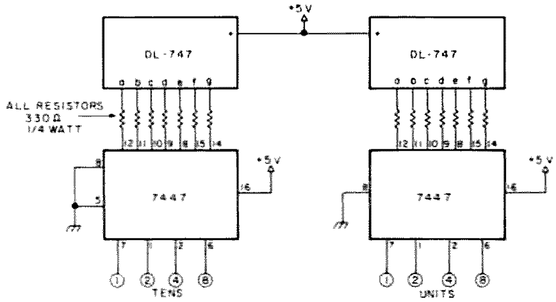


Fig. 3. Display board schematic.

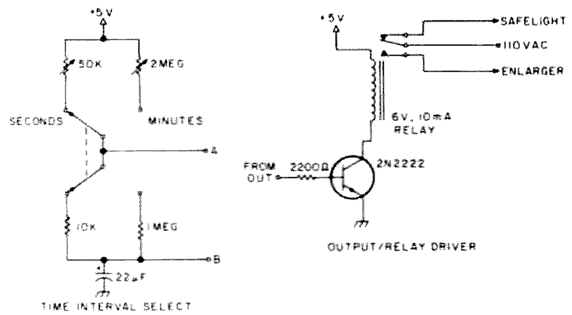


Fig. 4. Peripherals.

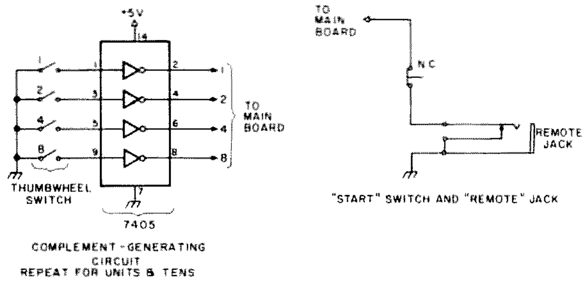


Fig. 5. Options.

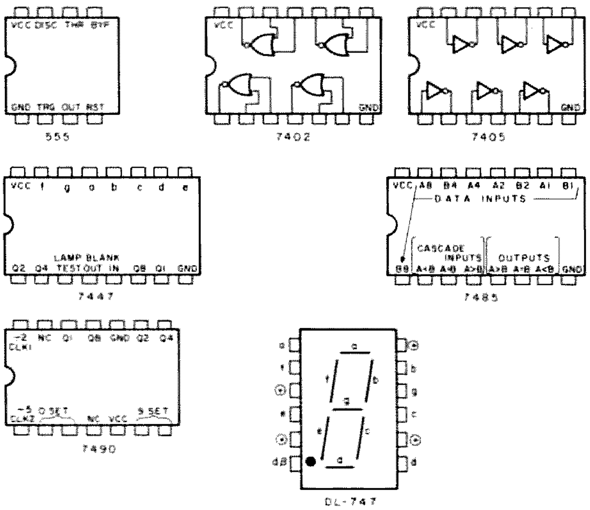


Fig. 6. IC and device basing diagrams (top view).

given chip is dependent on the next chip up the line. Here, the "1" from the "tens" (most significant) A=B output is only available when *both* the "tens" and "units" (least significant) A and B inputs are equal. The B input to each 7485 is provided by user-defined selector switches located on the front panel, and is connected through contacts along the edge of the main board. Interface with the outside world is provided by a 7402, which has two of its NOR gates connected as an RS type flip-flop. Lifting the ground on the S input raises the 555 reset line to logic 1 (high) and starts the clock. The logic 1 output of the 7485, when the BCD count from the 7490 agrees with the preset count, triggers the R input of the flip-flop, grounding the reset line to the 555, stopping the count, and clearing the 7490s to zero. An output state is then available, which is inverted with another NOR gate in the same chip, and presented for triggering outside equipment. The condition at the connector is "0" when not counting and "1" while counting.

Display is provided by a conventional seven segment LED display, with 7447 decoder-drivers. Observant readers might note the ICs on the prototype are marked SN38841. These are pin for pin equivalents of the specified 7447s. The "tens" digit is hard wired to zero blank to improve display legibility and lower current drain. Although large 0.6 inch type 747 displays were used in the prototype, any common anode display could be used. In fact, any readout capable of presenting the BCD data could be built, from four LEDs to nixies. The display could even be omitted entirely if not desired.

The B input to the 7485 requires BCD complement. Although complement mode thumbwheel switches are obtainable, only straight BCD switches were available to this writer. A small board with two 7405 hex inverters was put together to generate the complement of the number selected. If complement switches are used, omit this board entirely, and connect the switch directly to the main circuit board.

The driver/relay circuit is straightforward tradition. A 2200 Ohm resistor couples the output from the 7402 to the base of a 2N2222. The emitter is grounded, and a 10 mA, 6 V dc relay is connected from +Vcc to the collector. The power supply is also an unadorned five volt regulated supply, and no special comments are warranted. The experimenter is invited to use my circuit, or any favorite of his own.

Construction may be by any technique desired. While perfboard wired with a wiring pencil was used on the prototype, printed circuits are certainly more convenient, and layouts are included for those desiring same. Standard TTL precautions of lead dress and bypassing should be followed. Particular care should be taken in wiring the ac sockets on the rear skirt. Cabinet, placement of controls,

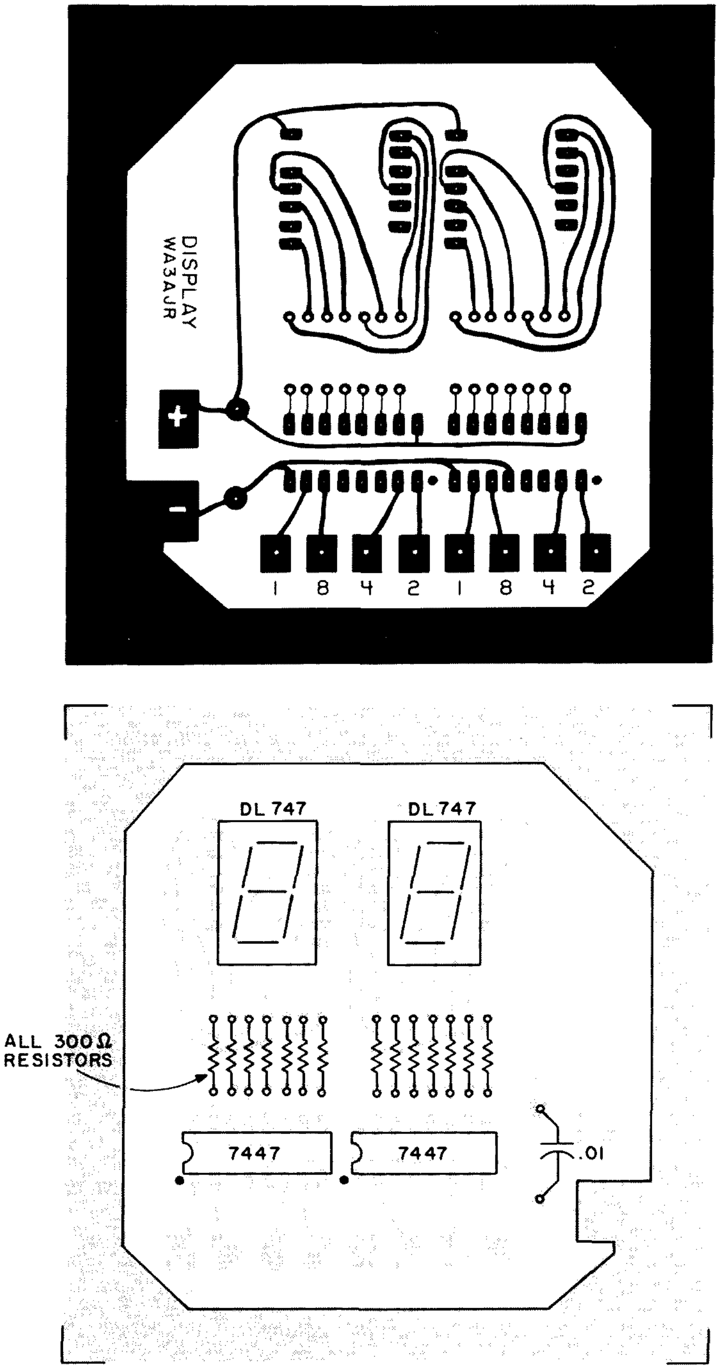
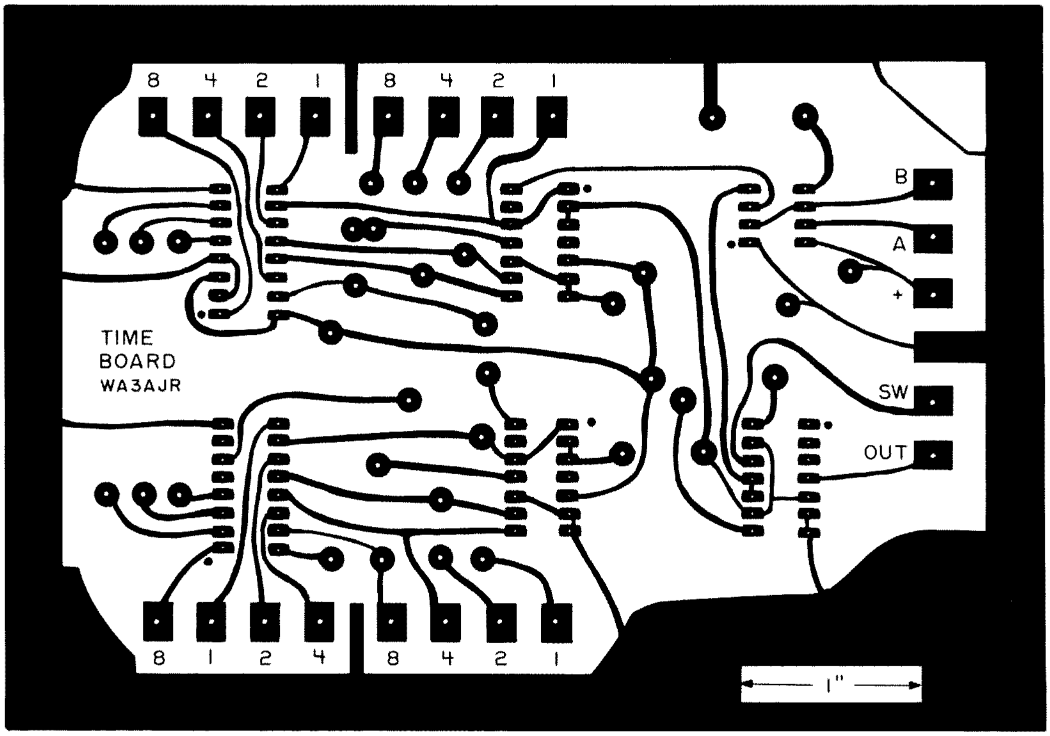


Fig. 7. PC layout, timer board.



painting, etc., are left to the whims of the individual.

Once completed, the only task remaining is calibration of the timer. With the unit turned on, and the interval set to "SECONDS," plug an electric clock with a sweep second hand into the "ENLARGER" socket. Set the time to ninety seconds, and push the "START" button. Adjust the "SECONDS ADJUST" potentiometer to accurately time the 1½ minute interval. Similarly, with the timer interval set to "MINUTES," adjust the appropriate potentiometer to the correct number of minutes indicated. This does, by necessity, take a bit longer! It is important to note that, because of peculiarities inherent in the 555 timing circuit, the *first* interval will be somewhat longer than all succeeding ones. In the prototype, the difference is about 33%. Thus, the first second is really 1.33 seconds, with each

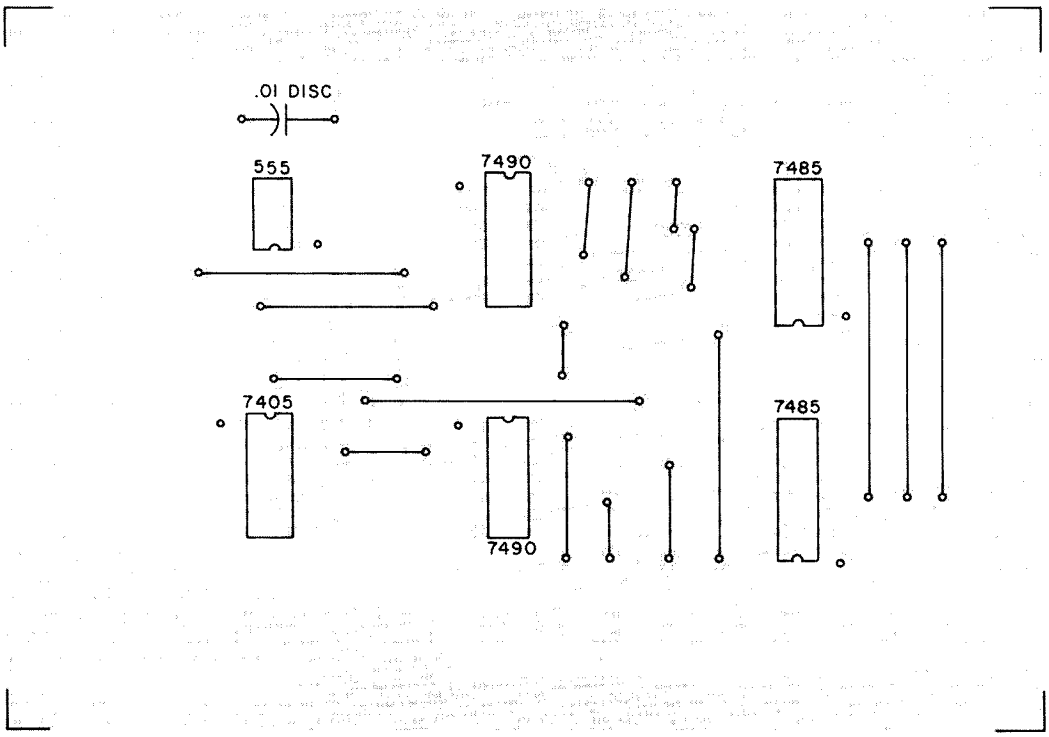
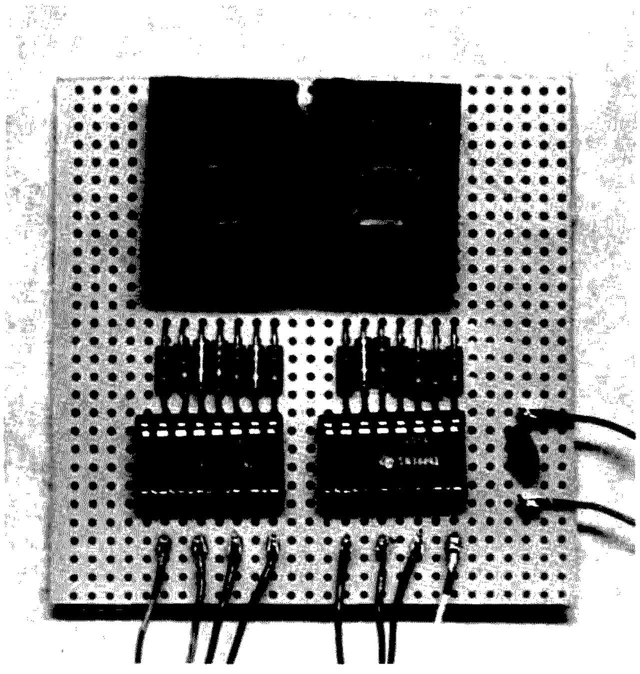


Fig. 8. PC layout, display board.

succeeding second 1.0 second. In the minutes mode, the first interval is 80 seconds (1.3 minutes) with each succeeding minute 60 seconds. For all but the most critical applications, this error, once acknowledged, is acceptable. Further, remember that the stated accuracy of a 555 is 3%, or within about two seconds per minute.

All right, already, "I've built the timer," you say, "now how do I use it?" Well, that all depends on what you plan to do with it! Let me assume, for the moment, that darkroom use, for enlarger control, is desired. Plug it in and turn it on; look at the display, where a single "0" should be evident. Connect the enlarger to the ENLARGER socket and the safelight to the (you guessed it) SAFELIGHT socket. Note that with the relay specified, not more than 100 Watts should be drawn from either socket. After going through the appropriate photographic manipulations to determine correct exposure time, set the desired interval on the thumbwheel switches. Interval selection would normally be SECONDS. The FOCUS mode may be used for composition and focusing as desired. When all is ready, making sure the FOCUS mode is off, hit the pushbutton and sit back to watch the numbers flash by. As the enlarger is on, the safelight should be off. At the completion of the timing interval, this situation should reverse itself.

But what else can you do with it? Set the timer to ninety minutes and plug your television (under 100 Watts, please) into the ENLARGER socket and fall asleep to Johnny Carson. Or plug a bell into the SAFELIGHT socket and let your wife use it for an expensive (although not very) cooking timer. Who knows what you might do with it? This thing is so useful, you can let your mind run wild!



Display circuit board.

So go have a ball with this darkroom and every room accessory. If you have any questions, or just want to let me know that you built one, or like the article, feel free to write. But *please*, if you want a reply, enclose an SASE. (And maybe a picture?) ■

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Cooling Your Relays

-- for peace of mind

Some of my wire antennas have relay direction switching. Consequently, the relay holding times may be up to a couple of hours or so! Plus, the thought of those relays baking in the afternoon sun tends to give me nervous jitters.

I borrowed this circuit from my model railroading hobby. The basics are used to operate track switching machines. With a change in values of R and C, I found that my antenna relays operated normally, but were drawing less current, while being held open — therefore, cooler running.

Most dc relays will remain fully operated at one-half to three-fourths of the rated coil voltage. The problem is to still get the relay to snap-close under full rated coil voltage, and then shortly after, have this voltage automatically reduce to about three-fourths, to give a reduction in holding current.

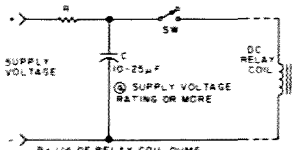

Fig. 1.

When your dc relay supply is on, and relay control switch SW is open, capacitor C will charge to full supply voltage. When SW is closed to operate the relay, the charge in C will *operate* the relay normally. However, when C's full charge is reduced by the relay coil, further full charging is prevented by the current being drawn by the coil through R. Now, the relay - coil is receiving a reduced voltage and current to hold it operated in its fully closed position.

A couple of extra components are certainly worth a little peace of mind. ■

A Look At Soviet Test Gear

-- what you're missing

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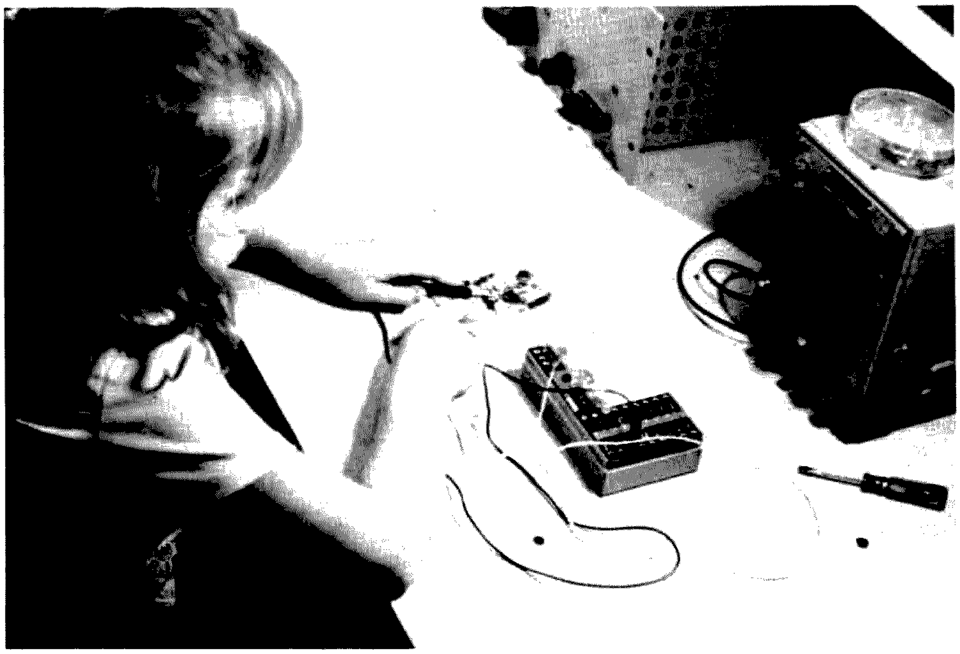
One of the more enjoyable benefits of being an electronic engineer is the opportunity to meet engineers from other countries, many of whom are hams. While working on an international program, I met engineers and trade specialists from the Soviet Union. They are anxious to improve trade relations with our country to help with their balance of payment problem. So far, the bulk of trade has been in raw materials and commodities, very dull stuff to the electronics enthusiast. Not knowing much about their equipment, I was very curious about its design, the type of semiconductors used, how good it is, and the prices. They have a state monopoly on all manufacturing industries, so all electronic equipment is sold through state trading organizations. Test equipment (VOMs, counters, scopes, etc.) is sold by Mashpriborintorg, electronic components by Elektronorgteknica, and communications equipment by Sudioimport. This approach results in a high degree of standardization throughout their country. It also results in fewer innovative designs by their engineers.



The simple panel layout and absence of switching make the U-4323 ideal for the younger experimenter.

From my contacts, I received two pieces of test equipment for evaluation. Both of them had useful features not found in instruments currently on our market. The first was a small multimeter, the U-4323. It is designed for the hobbyist and ham radio operator. It is similar in appearance and outward construction to many Japanese import instruments in its price class. Range selection is done by plugging the test prods into the appropriate tip jacks. Unpacking the instrument, I discovered a small package with spare diodes and a spare meter fuse. A comprehensive operating handbook — in English — complete with circuit diagrams and maintenance data was included.

A quick glance at the panel revealed that in addition to being a conventional VOM, it contained an audio oscillator and signal generator! The output of the audio oscillator is a 1000 Hz square wave. The rf output was fixed

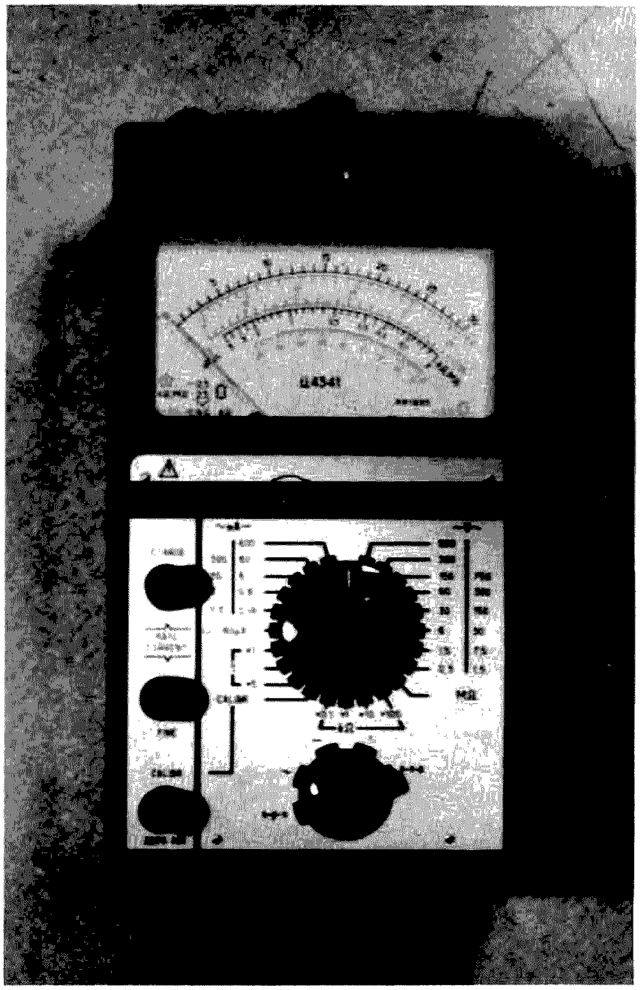
at 465 kHz, the standard i-f for their country. It was modulated by the 1000 Hz square wave. A quick check with my communications receiver revealed that the harmonic content was quite rich. It was usable as an alignment source to well above 30 MHz. The output level of each of the outputs was a good solid 0.5 volts. The circuit is quite clever, using three germanium PNP transistors. Two are used for the 1 kHz multivibrator, the third is an L-C controlled oscillator which is base modulated by the multivibrator. The packaging of the transistors was quite distinctive, being a combination of the T0-5 style and the old "top hat." All components appeared to be very well made, particularly the meter movement, which is a rugged taut band type of construction. Diode protection is also provided.

The little handbook is quite comprehensive, going into the theory of operation for the oscillator circuit. The 40 microamp meter movement is described in such detail as to permit field repair and rewinding of the meter coil. A section is devoted to the variation of readings due to changes in ambient temperature, battery voltage, meter position, and the frequency of ac voltages. All measurements are illustrated by simple one function drawings. It was evident that the manufacturer realizes his instruments will be used in a wide range of climates by people who may not be too well trained.

The U-4341 is a combination instrument that incorporates a transistor tester with a high quality conventional VOM. It is a quality instrument that would be classed as a bench test instrument adequate for commercial service work. It is housed in a black plastic case designed for tabletop use. Rated accuracy is 2.5% for dc and 4% for ac ranges. Ac frequency response is from 45 Hz to 20 kHz. Both ac and dc currents are measurable. The instruction book is very comprehensive and, like the one for the U-4323, provides a lot of information for the user working in out-of-the-way places.

Another nice feature is the inclusion of special low range scales. The lowest ac current range is 300 microamps, dc is 60 microamps. The lowest dc voltage range is 300 millivolts full scale. The most interesting feature is the built-in transistor testing circuit. The meter will measure Icb, Ieb, and Ici (defined as initial collector current as measured in the common emitter configuration with zero emitter-base voltage) with an accuracy of ± 2.5%.

The quality of the instruments is quite good when the price class is considered. Both instruments are well sealed against dust and moisture. Battery replacement is accomplished by removing the back plates. All instruments have manufacturing seals placed by their quality control department to reveal any tampering that might void the warranty. A separate certificate of inspection giving the performance specifications and quality assurance signoff is packed with each instrument.



The U-4341 has a neat straightforward panel layout. Note the universal transistor socket at the top.

Reading the manufacturer's literature provided insight into the type of equipment available to the Soviet ham. There appears to be no production of strictly amateur radio equipment in the Soviet Union at this time. This means that the Soviet ham has to build his own or modify military surplus equipment. This is made available to him through DOSAFF, an organization that has no American equivalent. It is a civilian auxiliary for supporting the armed forces, and would be roughly analagous to having MARS, civil defense, the National Rifle Association, sport parachuting, and other paramilitary activities rolled into one super organization. Soviet defense policy places significant emphasis on having a trained cadre of civilian radio operators available to assist the military in the event of war, so they supply individuals and clubs with equipment much in the manner that our MARS program is supposed to operate.

In browsing through their equipment catalogs, I came across a number of test instruments that would be of interest to hams in this country. Among these was a neat little 3 inch scope. It had a calibrated triggered sweep, 10 MHz bandwidth, built-in calibration, and a number of other desirable features. Again, there was a design twist — this scope was designed for the hobbyist with limited facilities to maintain his test equipment. Although of recent design, it was designed around a series of high reliability vacuum tubes to minimize the number of components.

If and when these products appear on our market will depend on the political situation. One of the major stumbling blocks is the lack of a "most favored nation" treaty with the Soviet Union. Lack of such a treaty results in drastically higher import duties that would price the products out of the market. There has been a great improvement in relations between our two countries in the past few years. Hopefully this will continue so that we will avoid blasting each other off the face of the earth! With the ever-increasing prices of Japanese electronics, we may see a day when the USSR will be a major supplier of popular electronic equipment. ■

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Surplus Goodies Are Still Around

- - what to look for

Almost everyone in electronics makes liberal use of surplus material, not only because of the price advantage, but also because there are a number of surplus items which aren't generally available in ordinary stores. In the past, most surplus outlets dealt primarily in radio equipment, with a certain amount of radar components and maybe an occasional computer unit turning up. In those amazingly remote days before solid state electronics and computer technology, the surplus buyer could identify just about anything he might run across, and if he couldn't, the man who ran the place could look it up.

All that has changed, for better or worse. Browse around a surplus store today and you'll be lucky to recognize half the stock; even the store's owner will often throw up his hands in a "you've got me" gesture. The new space age technologies have spawned a flood of incomprehensible components that tend to pile up in the back room simply because nobody really knows what they are.

It's a real shame that more people don't know, or don't care, about these unknowns, because they're *good*. For one thing, they are often a step ahead of state-of-the-art, utilizing principles that commercial products haven't gotten around to yet. Microwave technology in particular has entered the twenty-first century, and much aerospace surplus involves microwaves. They are generally built to incredibly high standards, especially if they come from NASA; some of those components make the proverbial Swiss watch look like a dime-store can opener. Finally, and most importantly, they are cheap compared to the usual surplus fare. A few cautious purchases can yield a small fortune in cannibalized parts alone, and if luck is with you, you might walk away with a fine UHF amplifier for the price of a bag of capacitors.

So how do you figure out what is good, or even what something is? While there isn't any cut-and-dried method, there are a few rules of thumb that can help turn surplus shopping into a real treasure hunt.

Suppose you have, while browsing through your local surplus emporium, come upon a whatsit that looks interesting. After checking it for identifying marks and finding none, you take it up to the cash register, where the man says he doesn't have any idea what it is, but you can have it for five bucks. Should you get it? After all, five dollars in these days is rich food for a junk box stuffer.

The first thing to look at is the provision for input and output. This might likely be in the form of plugs, sockets, or waveguide flanges. The number and type of connectors can tell you a lot about the unit. If there are a good many plug-in contacts and no waveguide, there's a good chance you've got some kind of logic device. If there is one or more BNC connector, expect high frequency circuitry. If there are waveguides but no wires or plugs, don't bother with it unless you like to work with waveguides, because you won't find anything else inside. If there are waveguides and electrical connectors, then you might have an amplifier or oscillator. If there are very small coax connectors, you probably don't want it, since the odds are it is a stripline unit, and that whole field is generally outside the reach of a hobbyist.

Next look for identifiable parts. A sticker reading "Danger, Magnetic Material," or the like will usually be affixed to a magnetron or traveling wave tube. In addition, the latter, of which there are a bewildering variety, are often relatively long and thin metal tubes. If you see waveguide involved with gearing or other mechanical linkages, expect a tunable cavity, which might indicate an oscillator or measuring device. A rotating cylinder or drum with movable pins or tabs might be a programming unit.

If, after examining the device, you decide to buy it, don't forget to make the same checks you would for a conventional component. Look for evidence of water soaking or heat discoloration, not to mention dents and other physical damage. Remember that even the rarest find isn't worth a cent if it's broken.

After you get your treasure home, you'll probably want to delve around in its insides. One word of caution: Some microwave tubes use a very poisonous beryllia ceramic inside. They are usually marked with a warning, but to be on the safe side, don't open anything that looks like a traveling wave tube, even though there may be some very inviting setscrews on the end. Even a few

particles of beryllia can cause cancer if inhaled. There is also a slim but real possibility of radioactives being used in some aerospace equipment. Any component containing even a slight radiation source will be marked with the purple trefoil. If you see it, it might be prudent to return the unit to the store; you certainly won't have a use for it.

The odds are against finding either of those things. Probably you'll uncover some conventional PC boards with conventional, high quality components on them, various waveguide devices, and perhaps some stripline units. These latter will probably be slim metal boxes, anywhere from one to five inches square. Inside the boxes you're likely to find only conductors and junctions. If you're very lucky, you'll recognize the innards of your buy as a whole unit, say an amplifier, and be able to use it as is. If you're very unlucky, you'll find all the circuitry encapsulated in cement, or incomprehensible stripline boxes, or something you still can't identify. In between these extremes, you'll find some good usable parts or some that may be usable someday — junk box stuffers.

If you can find a manufacturer's name and a model number, you might try writing for information. Some manufacturers are very helpful, some are not so helpful, and some are helpful but charge for spec sheets. Remember that an SASE is always called for.

With a little practice, anyone can come up with other rules of thumb, taking into consideration size, materials of construction, and geometry. But if you do buy something that neither examination nor requests can identify, don't feel too bad. Someday you may see that gold-plated, waveguide-studded, epoxy-potted treasure in a catalog for fifty dollars. And if you don't, it will still make a fine bookend. ■

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The Touchtone Connection

-- quick mod for the Standard HT

Two years ago I installed an older version Data Signal touchtone pad on a Standard. It was very difficult due to the thick metal I had to cut through in addition to the plastic thickness. It was hard to take out of the carrying case, but the alternative was to cut an opening in the case. This idea I rejected, since I thought it would ruin the appearance of the case. Since convenience is the main purpose of having a handie-talkie, I was pleased to discover that Data Signal's newest touchtone pad (TTP) is only .050 inches thick and made of a mylar-covered mask with stainless steel wells and gold-plated circuits. With this pad there is no need to cut the carrying case at all, giving the project a more professional look. I recently purchased a new Standard HT and installed the new trim TTP. I found that I could operate the new keyboard (KBD) with the HT inside its case. Those who may not be able to or want to do this will be glad to know you can apply a "peel and stick" facsimile of the TTP on the leather case directly over the actual TTP on the HT. I was lucky enough to acquire a "peel and stick" mask of the KBD from Data Signal which is located here in town. Now I will do my best to explain the installation of the TTP and give you some of the reasons I think it is a good idea.

This time I decided to place the TTP very low on the front panel of the HT. I chose this position because all you have to cut through here is plastic, and this placement looks best. Here are some things needed for the project other than the HT: Data Signal TTP kit*; file — very small; electrician's knife; two base, clear epoxy; masking tape; soldering iron and solder.

Remove all knobs and the main PC board from the chassis. Lay the TTP circuit board on the inside front for approximate final placement. Check for fitting and then install the crystal near the top as close as possible to the TTP circuit board. Lay some sort of insulation tape on the metal sub-chassis and then solder the wires to the circuit board. Care should be taken not to get solder in the holes on the bottom of the KBD. Now solder the other wires to the TTP circuit board. Next place tape over the circuit board to insulate it from the HT's main board. The extra wires should be taped down too. Three wires are run to the right side of the HT up to the PL socket where #1 is "ground," #3 is "power on transmit" and #8 is "external audio input." The leads are tinned and stuck in the socket. Also, a 50k helipot is used here to control the audio into the HT. The center wiper arm on the trimpot is the audio input from the encoder, and one lead should go to ground and the other lead to #8 PL socket.

The pad is glued firmly on the HT with epoxy. This must be used sparingly and with much caution not to allow the epoxy to get into the holes on the bottom of the KBD. These are for breathing. Allow the pad to conform to the curvature of the HT as the KBD is flexible. After gluing the KBD on the HT, tape it down with masking tape and let it stand overnight until glue is completely dry.

Try to put the HT into your desk top charger if it fits without pressing on the KBD. If not, take the knife and cut the ribs out of the inside of the charger. Then file this area down to a smooth finish.

I hope others will enjoy this project as much as I did. I think this is by far the easiest TTP arrangement and most professional-looking installation for the Standard HT. ■

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Build A Phone Exchange

-- using dial telephones

The telephone is one of the most useful devices available for communicating around the house, farm, or place of business. Unfortunately, most of us are usually forced to either rent equipment from the local telco, which can be rather expensive, or settle for war surplus magneto phones. There is another solution, however – that is, to construct your own dial telephone system.

This may seem to be an awesome project for many; however, the exchange doesn't have to be a ten thousand line crossbar unit with push-button dialing. A simple but efficient switching system can be built at reasonable cost, and with only a few hours work. In order to keep the cost minimal, and the construction simple, we are going to forego some of Ma Bell's luxuries, which are really unnecessary anyway. What we will be left with is a streamlined version of a commercial telephone exchange which will be best suited for private use.

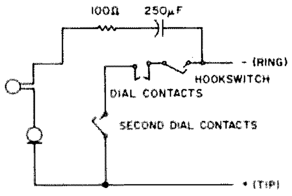

Fig. 1.

The theory behind our exchange is basically the same as with commercial systems, that is, circuits to distinguish between on and off hook conditions, supply talk voltage, count the impulses from the dial and make necessary selections, and provide a way to apply ringing current to the desired bell. In most commercial exchanges, the talk voltage used is 48-50 volts dc, while the ringing current is 90-105 volts ac, at frequencies between 20 and 50 Hz.

Most commercial switching equipment also operates from the talk voltage. In the majority of professional systems, the ringing current is obtained from motor-driven ringing machines, or from static ringing generators. In our exchange, we will use 26 V dc for talk, and steal the 110 V house current for ringing the bells. Most telephone ringers will operate satisfactorily at this higher frequency with only minor adjustments. This is really the easiest method of ringing – as you do not have to change the bells in your phones. We will also make use of the three wire system – that is, three conductors leading to each subset. This alleviates the need for more sophisticated equipment, and saves on expense.

In general, our switching system operates using the following pattern: All telephones in the system are connected to the exchange at the terminal block. There are three conductors per station, which are broken down to color codes red, green, and yellow. The red and green wires of all stations are interconnected in parallel with the dc power supply, with the positive going to red, and the negative to ground. The yellow leads are separated – and given their own terminals. The talk circuit and the dial impulses use pair red-green, while the 110 V ac ringing current goes over conductors yellow (+) and green.

In series with the dc power source is the line relay – which responds to the off-hook condition, and also relays dial impulses to the connector. I chose to have the uniselector powered directly by the 110, although this is not mandatory. The uniselector coil voltage is controlled by the line relay. When a telephone is lifted from its rest, the line relay closes, and provides talk voltage. At the same time, it causes the uniselector to advance one step, which is the "start" position. Additional pulses will drive the stepper until it rests on the desired contacts – causing the 110 V to be applied to the yellow ring line.

Our exchange makes use of the common talk-selective ring principle, which is very economical for low use applications. There is no need for a busy signal in this system, as you can tell immediately upon lifting the handset if the system is being used.

Due to the fact that our system uses a three conductor wiring plan, it may be necessary to alter the connections at the subset. In my exchange, I use imported

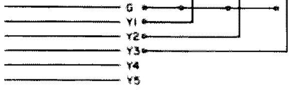

Fig. 2.

Ericsson-type telephones, which are intended for use with either two or three wire systems. No modification is required. Also, the European telephones have high frequency "straight line" ringers which do not need retuning. Other types of telephone sets will operate equally as well, but, as mentioned earlier, it may be necessary to retune the ringer. This may be accomplished simply by adjusting or removing the weighted striker, or experimenting with the screw settings.

If the telephone is of the type which is normally intended for use with standard U.S. two-wire networks, you may have to change around some of the wires on the phone's transmission network, so that the ringer will be connected to both yellow and green. There will be no problem with the talk circuit – just remember that the conductor codes are red and green for this, and that green is shared with ring.

It is also possible to rewire the telephones so that the receiver element will buzz loudly instead of having the bell ring. This would only occur while the telephone was on the hook, and the receiver would be used for regular speech upon being lifted. Fig. 1 gives you a representative schematic for "receiver ringing."

With regard to the types of wire and cable used for connection, I used eight conductor cable leading to the subsets, with three conductor cable tapped into it where needed. In order to save on wire, I used one pair as the talk circuit for all stations, but gave each station its own ringing line. This practice is illustrated in Fig. 2. I would definitely recommend that terminal blocks be used at the subsets, if possible. This is only good wiring practice, and saves a lot of grief. With our mini-exchange, I do not really recommend that this be done, as speech quality is diminished greatly. For best results, use metallic paths on all circuits. Remember that you are using 110 V ac for ringing, and make certain that all wiring is suitable for carrying this.

I should mention that the speech quality of your exchange will depend to a great degree upon the wiring job. That is to say, loose connections and this sort of thing will cause scratchy, almost unintelligible circuits. Also, the type of dc power supply used will play a great part in the speech quality. There will be some noise from the ac parts of the exchange, and the moving parts, but this should not impair conversation.

In my exchange, a ringing signal may be heard in the receiver; this is derived from the 60 Hz hum present on the line when the uniselector is connected with it. As was previously mentioned, there is no need for a busy signal.

Before you start construction of your own exchange, you should plan carefully in order to determine your telephone needs. The basic exchange circuit is intended to take care of ten numbers, or telephones, although with modification more could be used. It would be helpful if you had the telephones which you will use in the system on hand during construction.

Building the exchange is really a "trial and error" process; that is to say, you build a stage, test it, and hook a couple of stages together to see if it will all work properly. As you build your exchange, you may find certain modifications which will better suit your needs. This project is of the type that lends itself to further experimentation.

Now that we have discussed the theory and applications of our exchange, we can venture into the construction end of the project. You will notice that there are but a few parts used in the system, all of which can be obtained without much difficulty. It is important, however, to use a uniselector (stepping switch) which has ten positions, with automatic reset. The counting operations in this exchange are on a decimal basis, and therefore it is important that the counter correspond likewise. There are many different types of steppers available, but I have found that the only one usable in our system is the unit with ten positions.

The inexpensive 25 position uniselectors which flood the market are generally not used as connectors, but are employed in the line-finder stages of commercial exchanges. Other than this note on the counter, components may be as varied as need be. Most of the exchange can be put together from junk box parts.

Construction itself is remarkably simple; just use good wiring techniques, as you would with any project. The components used in the exchange are rugged, and will take lots of abuse. I have never had to replace a single part in the three years since I built the unit. Another thing to remember when assembling the exchange is that the green wire serves as a common ground, and must be connected to all areas requiring low voltage negative. If you have problems with the phones not ringing, I would check the green wire to make sure that it links all stages of the system.

When you are ready to wire the uniselector, choose the station numbers using digits two through ten. This system uses digit one as a starting point, and the line relay automatically sends the connector to this point. Also, if digit one were used, jiggling the hookswitch could accidentally call a station. Fig. 3 gives you the complete schematic for the exchange.

Once you have completed wiring the exchange, you should test it, looking for possible short circuits and connections which might rub against each other. This is especially necessary at the

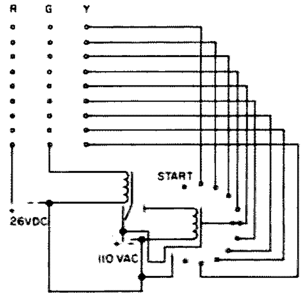

Fig. 3.

uniselector. Make sure that the correct voltages are reaching the subsets – and that the talk circuit uses red-green, and ring has yellow-green. Accidental reversal of these color codes could result in your telephones being damaged.

With the automatic reset, the uniselector should return to the rest position when you hang the phone up. Some adjustment of the stepper may be necessary. Again, trial and error adjustments will be required from each exchange. I have used phones up to a half mile from the exchange without appreciable loss in transmission volume or ringing. This system is quite flexible in its uses, and provides much for very little money.

The characteristics of operation are as follows: On picking up the handset, the line relay closes and a dc hum may be heard in the receiver. The uniselector has also stepped to its first position, and is ready for your instructions. When you dial, the stepping switch moves forward in synchrony with your dial pulses. Immediately at the end of the pulse train, 110 V ac is connected to the bell of the called telephone and it rings. The ringing will continue until the called party answers, or until you hang up your telephone.

This telephone system *should not* be interconnected with any commercial systems, as the dc from your exchange will cause problems for the switching equipment at the telco, and perhaps give you a chance to meet some of Ma Bell's attorneys. ■

Build A Brute Power Supply

-- completely regulated and protected

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Having recently purchased a new solid state 80 through 10 meter transceiver, I couldn't bring myself to lay down some additional long green for a +12 V dc power supply. Check the prices and you will see what I mean. So I got busy and looked through stacks of my ham magazines to find a supply that would suit my purpose. That is, +12 to +15 V dc at about 20 Amps intermittent and 9 to 11 Amps constant current that is well regulated. I had built one such supply last year for my 2 meter amplifier which was good for about 8 Amps. This was an article in *73 Magazine* by Warren MacDowell in the May, 1975, edition. I would suggest to anyone desiring to build this type of power supply to read that article whether or not you are going to build that supply or some other, as it contains some very good technical information laid down at ground level.

While having no problems with the circuit, I did have trouble finding the parts locally. What I ended up with was not as attractive as the one pictured, but it did a great job and still does. All of the parts on the regulator board are very easy to find if you substitute ½ Watt resistors for the ¼ Watt ones. Radio Shack and Lafayette seem to keep an ample supply. The same with the LM723 chip. I could not, however, find the MJ3000 Darlington anywhere locally. Good high current pass transistors will work as well as the Darlington for this purpose, and I might add that that is what we use in our computer power supplies for the most stable operation. The best you can get is the 2N3055 or equivalent, as they are less susceptible to going haywire with some rf feedback. You can drive 4 of these goodies with a single 2N4911 or equivalent and, by putting .3 Ohm resistors on the emitters of the 2N3055s, you can safely draw up to 25 Amps of current at +13.8 V dc intermittent and about 18 Amps continuous (that is, provided you heat sink all 5 transistors, driver and pass).

I used two 15,000 uF capacitors for better regulation, but they don't have to

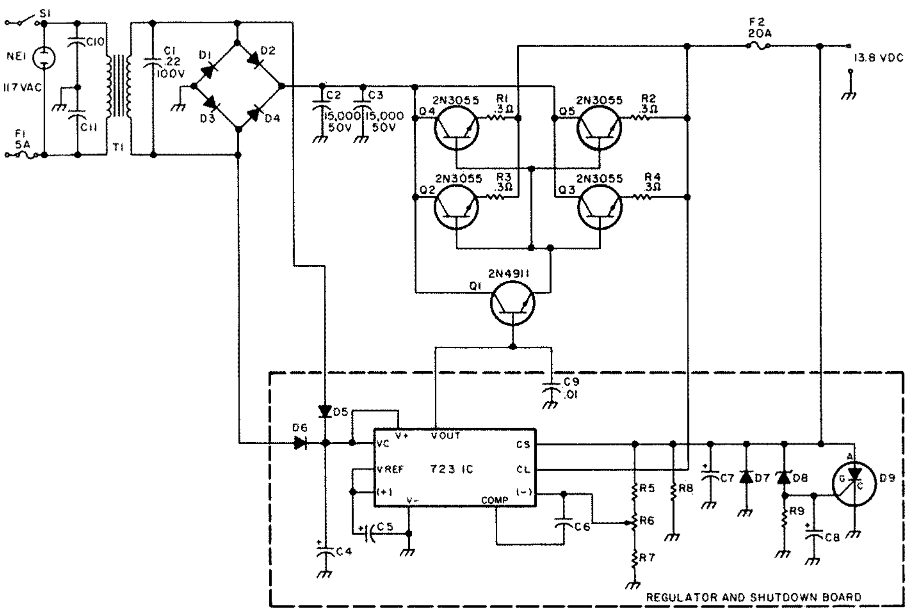

Fig. 1.

be two of that exact value. You can use what you can find and, as long as they total up to between 25k and 30k uF, you will be OK. The voltage ratings should be at least 40 V dc and 50 V dc surge.

I had a couple of old TV transformers around and I put them in series to get about 19 V ac; with a bridge rectifier and all the capacity, I had my 25 V ac for good regulation. One of the transformers had a single 6.3 winding at about 8 Amps and the other had both a 6.3 winding and a 5.0 winding both rated at 7.5 Amps. This works out fine, but I was able to find a single transformer at a hamfest with the secondary rated at 25 V ac at 12 Amps; it works very nicely.

Some other things I did differently were:

(1) Fuse both the input and output of the supply for 100% protection.

(2) Put .01 uF caps across the primary of the transformer to ground for good transient protection.

(3) Put a .22 uF non-electrolytic tubular capacitor rated at 100 volts across the secondary and bridge rectifier to aid in noise and rf.

(4) Put a .01 uF disc capacitor on the output of the voltage regulator terminal Vo to bypass noise that will be passed through the output transistors (incidentally, this shows up as sounding similar to ac hum if you have an FM rig connected to the supply, and it gives you an echo on your voice on SSB peaks).

(5) The last change that I made I feel is by far the best. I have a 15 volt zener diode constantly monitoring the output voltage. If anything happens and the voltage exceeds 15 volts, the zener conducts and fires the SCR and immediately crowbars the supply from the transceiver. It is extremely dangerous to solid state transceivers (any band) for the input voltage to exceed 15 volts. The 5 volt and 8 volt regulators in the rigs will not take it and you will fry one very easily. When the voltage does exceed +15 volts and the crowbar shuts it down, what has probably happened is that the regulator chip and the high speed diodes are blown for some reason, and by not permitting the 2N4911, your pass transistors will be saved. A parts layout is not shown, as it really is a simple circuit that can be etched or point-to-point wired easily, and again you can refer to the past article. ■

Parts List

R1-R4	.3 Ohm 10 Watt
R5	1.8k ½ Watt 10%
R6	2.5k trimpot
R7	2.7k ½ Watt 10%
R8	1.5k ½ Watt 10%
R9	1k ½ Watt 10%
C2-C3	15,000 uF 40 V dc
C1	.22 uF @100 V dc tubular
C4	250 uF @25 V dc
C5-C6	1.2 uF @35 V dc tantalum
C7	220 pF @25 V dc
C8	100 uF @25 V dc
C9-C11	.01 uF @500 volts
D1-D4	1N3492 or equiv. (100 piv @ 18 Amps)
D5-D6	1N4607 or equiv.
D7	1N4002 or equiv.
D8	1N965A or equiv. (15 volt zener)
D9	2N4441 or equiv.
Q1	2N4911 or equiv.
Q2-Q5	2N3055 or equiv.
F1	5 Amp fast blow fuse @ 125 volts
F2	20 Amp fast below fuse @ 125 volts
NE1	115 V ac neon indicator lamp
S1	Switch — single pole, single throw @ 115 V ac

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Drake Touchtone Review

-- dial as you drive

One of the most useful accessories for your 2m FM rig is a touchtone™ pad for use while operating mobile. A lot of repeater groups have installed touchtone functions ranging from telephone dialing to direct weather reports. Recently, the Drake Company introduced a new mike with a built-in touchtone pad that should be of considerable interest to many amateurs. The mike is specifically designed for use with the Drake TR-33, but can be used with other gear that is compatible with a 500 Ohm, dynamic microphone.

The feature that makes the Drake mike so interesting is that you can turn it over and tap out a telephone number from your car. What's more, the physical dimensions are only 6.6 x 8.9 x 4.3 cm (2.6" x 3.5" x 1.7"), which makes it just about the same size as a regular microphone.

The Model 1525 specifications are pretty impressive. The frequency response is 300-5000 Hz. The encoder audio level is internally adjustable from 1 mV to 5 mV and is factory adjusted for Drake gear. Finally, the supply voltage requirements are 7.5 to 15 V dc.

After receiving the mike, I had to rewire the panel socket on my Drake TR-22C. The adjustments took about one hour and involved providing the necessary voltage to pin number 4 of the panel jack along with relocating a ground connection. On a TR-33 no rework is required; just plug in and it is ready to go.

On-the-air performance has met all of my expectations. The audio quality has been found to be comparable to the original mike. The tones were tested and found to be on the correct frequency and at the proper level. I had no trouble accessing my local repeater on the first try.

The mike has interested a number of local amateurs who want a microphone and touchtone combination but don't want to build a kit. At $49.95, I think that Drake has a real winner. ■

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Marine Radiotelephone Conversion

-- remember the 80-D?

Photos by K8LKC.

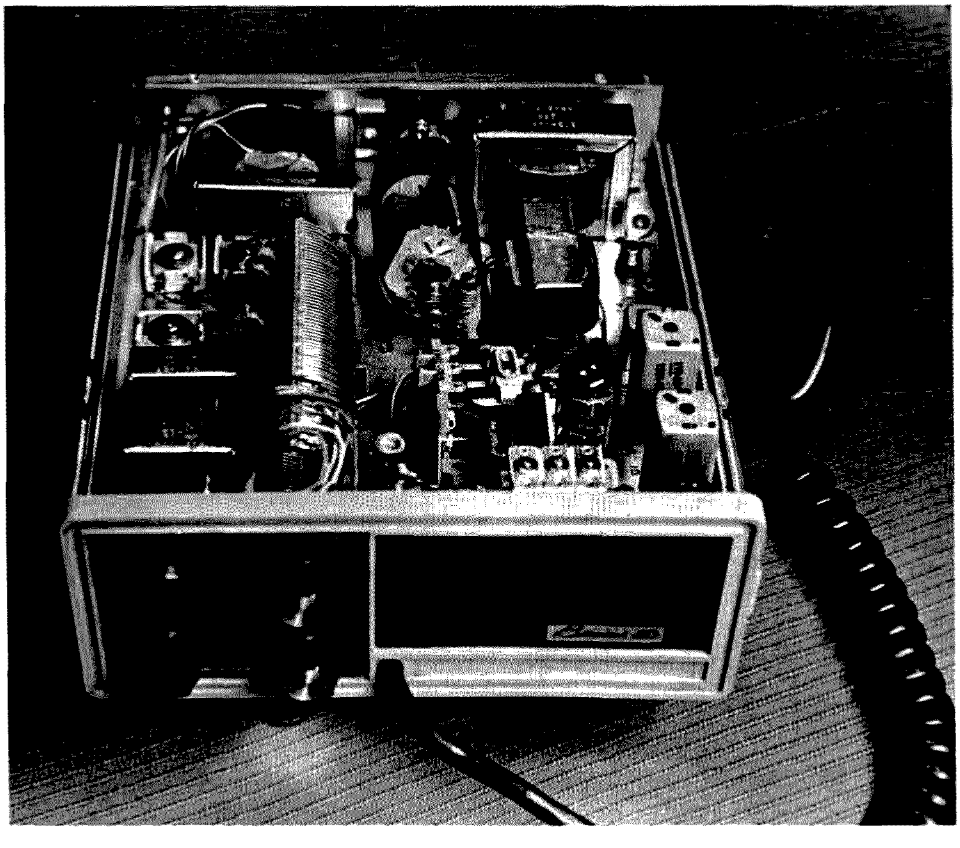

Fig. 1. The author's BIMINI 30 with top cover removed. This 30 Watt three channel model is one of several Pearce-Simpson AM marine radio telephones.

Would you believe a 50 Watt AM transceiver for 160 or 75 meters – or a CW transmitter – or a 12 to 375 V dc solid state inverter – or a dandy collection of parts for your junk box – for $20 more or less? Hard to believe in this age of inflation, but read on . . .

This year marked the end of AM operation on the 2 MHz marine band (which includes that venerable 2182 kHz calling and distress channel) in the U.S., with marine radio shifting to their new VHF FM band. Boat owners now find their AM radio telephones useless and may junk them if a ham doesn't get there first! Some rigs have already been deep sixed, so you had better act fast if you want one.

This article is based on my experience with Pearce-Simpson units used by many pleasure and business boaters on the Great Lakes. They are similar in size to 2m FM transceivers, designed for 12 V dc and draw half an Amp on receive and up to 17 Amps on transmit. The receivers are

olid state except for the f/converter stage which is a ube for protection against tatic picked up by the tall boat antenna. The trans- itters are two tube oscil- ator-power amplifier type sing a 12JB6 final with a olid state modulator and run 5-50 Watts input power with late modulation.

Both transmitter and eceiver are crystal controlled nd FT-243 holders work ine. The receive crystal is 455 kHz above the desired requency. Various models ave three to five channels, nd some include a standard broadcast receiver. A switch llows monitoring with trans- itter filaments off to save power. You may find a carbon push-to-talk micro- phone or telephone type nandset. A pilot lamp ndicates relative rf output ("tune for maximum bril- iance") and a 0.635 cm (¼ nch) phone jack is on the back for checking final cathode current.

The transmitter output circuit is a pi-network plus a arge loading coil in series with the antenna terminal, designed to load short vertical tennas below their resonant requency. (A typical boat tenna is a vertical mast about 6 meters high with at ast its upper half being a helical coil.)

The channel switch not only selects the receive and ansmit crystals, but also elects individual plate tuning capacitors and taps on the plate and loading coils for each channel. Thus all tuning preset. Some models have a front panel rotary switch connected to the first twelve urns of the loading coil for a ine tuning adjustment.

Most of the wiring is point-to-point and easily raced if you can't get a chematic. The channel election wiring to the crystal ockets, tuning capacitors and coil taps is all color coded Ch. 1 is brown, 2 is red, 3 is orange, 4 is yellow ... cognize that code?). Some units have the receiver i-f and

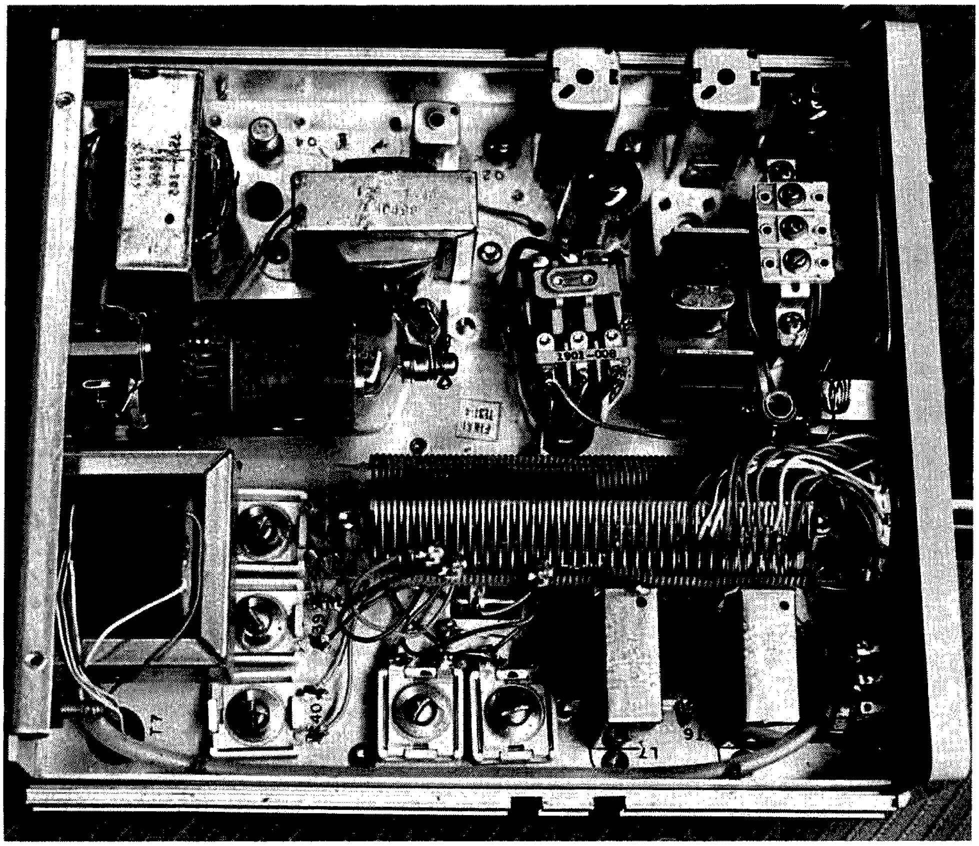

Fig. 2. Top chassis view of the BIMINI 30. The compression capacitors C38, 39 and 40 are the plate tuning capacitors for the three channels. The paralleled antenna loading capacitors are seen at the lower center with the series antenna loading coil above them. A ferrite bar inside the coil increases its inductance. The receiver section is along the top of the picture with the receiver's rf trimmers mounted above the speaker. From left to right across the center of the picture are the 12JB6 final, T-R relay, crystal sockets, receiver converter coil and the rf output indicating lamp assembly.

audio on a circuit board.

No Modification Needed

Now – how can we use these rigs? For openers, just change crystals, retune, and you are all set for 160 meter AM, base or mobile. If you use a car battery for your 2m FM rig in your shack, you are all set for power – just charge it more often! These rigs are great for party line operation with your friends. Here in the Kalamazoo area, we use 1985 kHz and reduce the power to 25 Watts (the maximum nighttime power for this segment in Michigan). Even with modest antennas we can reach several states and have even heard complaints from a tight-knit group in zero-land for using "their" frequency!

Best results will be obtained with a vertical antenna (top or continuously loaded) with plenty of radial ground wires. Check various antenna books for more information. However, a single wire not exceeding one quarter wavelength and run as vertical as possible will load and work over short distances. If your lowband dipole has a parallel conductor feedline, just tie the two conductors together and use it as your antenna. The ground system is very important. Use several ground rods connected together or a water pipe if you have nothing better, and keep the effective ground lead as short as possible. In technical terms, the antenna load must have low resistance and any reactance present must be capacitive to be loaded with the original tuning setup. Other loads would require external tuning devices.

Heat Up Your Soldering Iron

Now for some easy modifications. Like CW? Disconnect the +12 V dc feed to the modulator, short the modulation transformer secondary and plug a key in the meter jack. Remember this old-fashioned cathode keying method puts the B+ on your key when it is up! You can build a simple 455 kHz BFO for the receiver.

How about 80 meter CW? Use a receive crystal 455 kHz below the desired frequency and open the receiver trimmer capacitor. Some of the original receive crystals may be usable here; just add 455 kHz to the crystal frequency and see if it is in the band. Use an 80 meter transmit crystal and tap up on the plate coil.

Don't like crystals? Build a simple vfo.

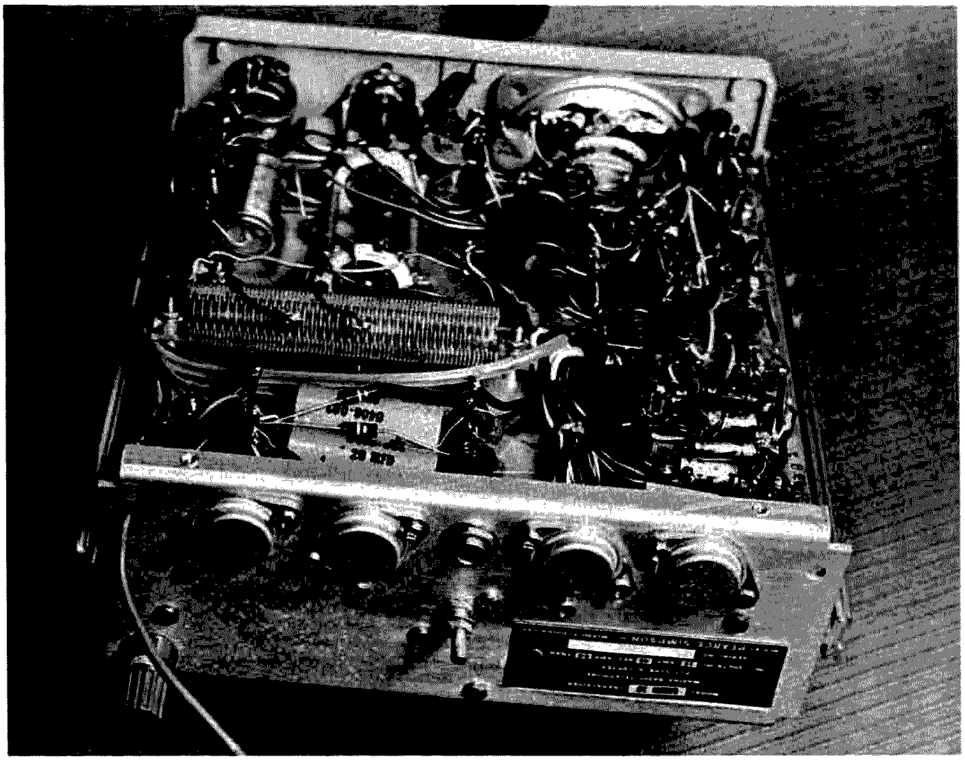

Fig. 3. Rear and bottom view of the BIMINI 30. From left to right across the rear panel are the modulator transistors, meter jack, B+ inverter transistors, 12 V dc lead and the antenna binding post. The final plate coil is seen beneath the chassis across the end of the channel selection switch.

Still not satisfied? Remove everything except the B+ inverter and build whatever you like!

Where To Find Them

See your boating friends or marine radio dealer. While bargaining, remember that AM on the 2 MHz band is of no further use to the boater. While you are at it, try to get the HF boat antenna. It makes a good vertical if you put some ground radials under it. Don't wait, however – these rigs may not be kept by their owners very long.

If you cannot find a rig locally, send an SASE for information on what I have available or know about. A dollar will bring you copies of schematics, tuning procedures and other information. I would also be interested in hearing about your experiences with these little gems. Please mail all requests for information to PO Box 2664, Kalamazoo MI 49003. ■

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Solder Soldier

- - sniff your heart out

Here is a handy gadget for picking up solder from a printed circuit board when you are trying to remove a component or excess solder. There are commercial solder removers available for about five dollars that are easier to use, but unless you need one quite often, this one works fine.

The large end is turned on a lathe to fit inside the metal tube on the end of the XYL's vacuum cleaner hose. A bit of plastic electrician's tape will hold it there.

When you are ready to remove the solder, put the tip near the solder and melt it with the iron. Put your finger over the 3/8" hole and the suction will remove most of the solder. If the solder sticks to the inside of the 3/16" hole, you can dislodge it with a nail.

The material was teflon, but you can use any plastic that will not melt if you accidentally touch it with your iron. ■

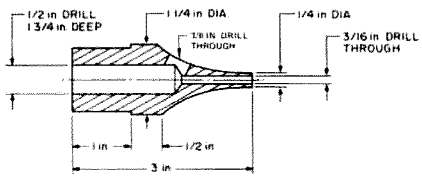

Fig. 1.

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When the Lights Go Out

-- prepare yourself

There is always a "hurricane season" in the future, so it is never too early to consider proper preparations.

Persons who have experienced severe hurricanes have greater respect for the threat, and more generally comply with warnings and evacuation advisories. A survey immediately following Hurricane Camille (1969) found that those who evacuated comprehended the danger of a storm surge much better than did those who stayed behind.

It is difficult to comprehend the magnitude of a hurricane disaster without having had personal experience with disasters. The "voices with experience" are strangely ignored, and the volumes of statistics and warnings do not "sink in."

As the years increase since the last major hurricane, respect for the storm and the flooding grows more dim. The influx of people into the area who have no personal experience of hurricanes further dilutes the "voice of experience," and warnings now fall on "deaf ears."

More disturbing is an emerging pattern which suggests that our society is fast losing its resilience and its ability to deal with the long-term dislocations and frustrations of a natural catastrophe.

This is demonstrated in the sharp increases in alcoholism, anxiety, depression, and other emotional problems following recent natural disasters across the nation, and around the world. We are facing a mental health crisis.

This spreading pattern of maladaption to disasters, and the ignoring of potential disasters, is spreading like a cancer across the face and mentality of the nation.

What can be done to prepare the community and nation to meet widespread natural disasters? We know natural disasters are on the increase – earthquakes, tornadoes, floods, landslides, blizzards, hurricanes. One of these, as a major disaster, will strike in our community within the next few years.

We are getting better at predicting certain disasters, and hurricanes are the most accurately predicted and followed of any natural disaster. But does this prediction help? If we do not study and understand proper preparation and planning, all the warnings and predictions are useless.

A policy of maximal information, and responsible and visible community leadership, is a top priority item. Without appropriate leadership, our disaster preparations themselves will be a disaster. The role of radio amateurs is generally not that of "leader," but that of "communicator for leaders."

Home preparation must be integrated with community preparation, and community preparation must be coordinated with society as a whole. Mental preparation is even more essential than physical preparation if we are to survive as a society when the next major disaster strikes.

Perhaps the two greatest factors to produce casualties in a disaster are inertia, both individual and governmental, and the mental attitude of "if we ignore it, it will go away," and "it won't happen here."

Disaster planning in its current stage of development to a large extent is based upon civil defense plans for nuclear attack, or a minor modification of these plans. This type of planning, and thinking, is diametrically the opposite of planning for natural disasters.

Plans for nuclear attack preparedness assume that outside help would not be available (because the whole country would be stricken) and evacuation would not be feasible. Natural disasters are rather localized, and outside help would be available if planned for properly; evacuation before and after a natural disaster is feasible if there are places nearby that are not affected by the disaster.

A recent survey (1971) following a natural disaster issued a set of six recommendations for local government agencies. Some of these recommendations could apply to amateur radio, and to us individually.

1. *Local governments should establish emergency operating centers in the event of a serious disaster.* These should not only be established, but also thoroughly tested periodically. Who will man the center? How will the families be cared for if a person is at the center?

2. *Local governments should ensure the existence of emergency communications for any foreseeable emergency.* Without "eyes and ears" to gather information, and without a "voice" to communicate with sources of help, the emergency coordinating center is dead. These lines of communication should also be tested periodically.

3. *Local governments should evaluate and update plans, procedures, and preparedness measures.* An extension of this would be that these plans and procedures should be conveyed to the public in adequate time; don't wait until a disaster strikes before informing the public what to do.

4. *Provisions should be made to improve interjurisdictional coordination in future disasters.* This is a big problem in many areas, with each jealous jurisdiction wanting to do it "his way," or he won't cooperate with the other jurisdictions. We must all work together to help one another, and, with knowledge and forethought, make area plans. A hurricane, for example, does not strike an isolated jurisdiction and stop at the boundaries of that

jurisdiction, but affects a wide area and knows no political boundaries.

5. *Officials should develop a country-wide emergency transportation plan.*

6. *A study should be undertaken to ascertain the best disaster communication system.*

What can we as radio amateurs do to prepare for a disaster, and to aid in a disaster? One of the mandates of amateur radio is to be a source of communications in case of disaster or emergency.

Our area of competency is communications, particularly during and after a disaster. Before a disaster, commercial radio and TV, we assume, adequately communicate with the public, and public service radio is adequate. During and immediately after a disaster, much of the "eyes, ears, and voice" of the community will have been lost. Amateur radio will have to step in with mobile and portable communications to fill this loss of the other services.

What can we as amateurs do to prepare for and meet our obligations? (Incidentally, in making our preparations, we also improve our own mental attitude, which in turn helps the community.)

Two basic areas of preparation must be considered — our communications equipment, and how we are going to live in the disaster area.

We must assume we will have to bring our equipment, including power, and our food and lodging from outside the disaster area into the area. We should be "self-contained" to operate for at least five days. This means all of our own food, water, and lodging, and our equipment — antennas, rigs, power, and spare parts. We should coordinate with local authorities before, during, and after the disaster.

Communications Equipment

Although solid state equipment is more difficult for the average amateur to work on than is tube-type, it is more reliable and requires less power than does the tube-type.

Except in really isolated areas where "long haul" is needed from the disaster area, I would not recommend taking HF equipment into the area. In 1970, this recommendation would have been otherwise, as the nation was not so well covered with VHF capability.

Utilizing a battery, trickle charger, and a well-filtered power generator provides a well-filtered power source and steady power to the rig. The rig should be capable of working off a 12 volt battery. The new "sealed batteries" would provide an excellent source of power, and eliminate the danger of spilling battery acid.

Since disaster areas are rather localized, and we now have a large repeater network, two meters would be the equipment of choice for going to a disaster area. CB clubs all over the country are making preparations for providing communications in a disaster, but I believe in most areas two meters would give better coverage. Although 10 Watts output would probably be adequate, higher power would be better. Using a 40 Watt amplifier would not put too much additional drain on the batteries. At 10 Watts transmit power, and only a 50% duty cycle, a regular or heavy-duty car battery would probably last for several days.

Surrounding the disaster area there should be two meter stations and repeaters operating from commercial power to intercept and relay messages from the mobiles and portables in the disaster area.

Besides requiring less power, two meter equipment does not require as extensive an antenna system as does HF equipment. A Ringo-Ranger, or similar antenna, can provide up to 6 dB gain in a small antenna, and is easily mounted on a high point. Ideally, the shorter the coax run the better, but the loss with 100 feet of RG-8/U is only about 3 dB and this is more than compensated for by the antenna gain and elevation.

Why two meters instead of "220" or "450"? Mainly because there is much more two meter equipment available.

One must also consider that it would be easier to carry a spare VHF rig than it would be to carry necessary repair equipment.

Living Equipment, Supplies, and Transportation

Food, water, and lodging are scarce in disaster areas. If we do not want to be an additional drain on scarce resources, we should enter the disaster area as a self-contained unit. In some areas, officials will not let a unit enter the disaster area unless it is self-contained, or carries its own supplies.

A "high-centered," four-wheel drive, closed truck or van would probably be best for negotiating debris-strewn roads, and could go even where roads are impassable. From the standpoint of creature comfort, the self-contained motor home would be the first choice. Pickup campers and vans would be less desirable and camping trailers and travel trailers least desirable, due to problems with pulling, parking, and navigating.

Whatever your choice of transportation, there are certain basic supplies which you must carry — food, water, cooking utensils, stove, bedding, and first aid equipment.

It is always desirable to have hot food, but this means you also need cooking utensils and a stove. There are many types of camp stoves, using various types of fuel. Remember to carry the proper type of fuel for the stove which you use. Simple cooking utensils are best.

Food is a personal choice, but there are some basics to remember:

1. If you take canned food, be sure to take a can opener.
2. Highly seasoned or salty food requires more drinking water.
3. Certain foods, such as canned tomatoes, are "thirst quenchers" and reduce the amount of drinking water you need to carry.
4. Food should not require refrigeration for preservation, or you will have to worry about power or ice for refrigeration.
5. Don't carry food or water in glass containers; they might get broken.
6. Water for drinking should be not less than one-half gallon per person per day, and one gallon/person/day would be better. ■

Check-off List

—— Transceiver	—— Vehicle
—— Backup transceiver	—— Tow cable
—— Connecting cables	—— Jumper cables
—— Power cable	—— Car tools
—— Amplifier (if desired)	—— Spare tire
—— Power supply (batteries)	—— Jack
—— Power generator	—— Tire tools
—— Trickle charger	—— Spare gas
—— Antenna	—— Water
—— Coax	—— Canned food
—— Antenna mast	—— Bread
—— Mast guy lines	—— Jelly
—— Soldering iron	—— Camping stove
—— Solder	—— Bedding
—— Spare wire	—— Fuel for stove
—— Microphone and spare	—— Toilet articles

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Ten-Tec Mods

-- improving a popular transceiver

The Ten-Tec Argonaut has proven itself to be a reliable high performance rig, ideal for portable/emergency as well as fixed station use. Even so, there are several modifications that can make the Argonaut more enjoyable to use.

Relocation of Drive and Mike Gain Controls

One of the major aggravations in operating the Argonaut is the placement of the important drive and mike gain controls on the back panel, while the relatively useless meter sensitivity control is on the front panel. If the drive control were easily reachable so that it could be turned down while the resonate control is peaked, there would be no need to desensitize the meter.

Fortunately, it is a relatively simple modification to move the drive and mike gain controls to the front panel by replacing the meter sensitivity pot with a dual concentric 25k pot. The procedure is as follows:

NOTE: These instructions assume that Ten-Tec has always used the same color coding in the wiring harness. Since this may not be the case, protect yourself by tracing the wiring to R14 and R16 and making notes of the colors and locations of each wire before disconnecting any of them.

View of front panel after modification, showing new dual drive and mike gain control. The main tuning knob with spinner is the one used on the Triton IV and is a direct replacement for the Argonaut knob. The Triton knob is available from Ten-Tec for $1, postpaid.

1. Remove the knobs, top and bottom covers, end pieces, and false front panel.
2. Remove all of the plug-in circuit boards, but before doing so, take a Sanford Sharpie or other fine point, non-watercolor, marks-on-anything marker and put an "F" on each board on the end closest to the front panel to avoid getting them in backwards during reinstallation.
3. Remove the meter sensitivity pot from the front subpanel. Tack solder a small 25k trimpot to the back of the meter switch where the wires from the sensitivity pot attach and discard the old wires.
4. Remove the nuts from the mike and speaker/phone jacks and swing them out of the way. Unsolder the wires from the drive and mike gain pots. Remove the pots from the back panel and fill the holes with 3/8" hole plugs (such as Radio Shack #21-920). Replace the mike and speaker/phone jacks.
5. The wires for the mike gain control all originate on the top of the chassis at the rear socket for the sideband generator/filter board. Pull them through to the top of the chassis and twist them together for identification.
6. The 2 grey and 1 white wire from the drive control should be fed to the top of the chassis through the same grommet that the mike gain wires were just pulled through.
7. The yellow wire that went to the drive pot connects to the bias pin on the socket for the rf power amp board. Remove the yellow wire and solder a new longer one to the bias pin. Feed the new yellow wire up through the space in front of the rf front end box and then route it along with the existing bundle of wires that runs along between the rf front end and VFO and then goes down behind the VFO and under the edge of the TX-RX mixer board.
8. Now that all of the wires for the two pots are in the correct general area, route them next to the chassis between the front sockets for the control board and the sideband generator/filter board and on over to where the pot will mount.
9. Dress the wires, trim them to length, and solder them onto the dual pot. (It is easier to wire the pot before it is mounted on the subpanel.) Refer to Fig. 1 or to the notes you made earlier for correct placement of the wires. Bend the resistor protruding from the side of the meter switch 90° out of the way and mount the dual pot on the subpanel. At this time, the 22k resistor (R15) associated with the drive control

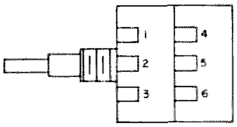
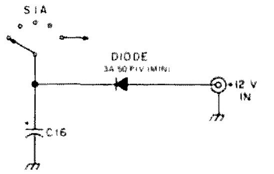


Fig. 1. Wiring the dual pot. Mike gain: 1. Yellow wire from sideband generator rear socket, pin 2; 2. Green wire from sideband generator rear socket, pin 3; 3. Black wire from ground lug near sideband generator rear socket. Drive: 4. 2 grey wires (1 from wiper of S3B, 1 from R13), 1 yellow wire from rf amp, pin 5; 5. White wire from S3B, contacts 2 and 4; 6. R15 to ground.

Fig. 2.



can be grounded to the pre-existing lug near the edge of the chassis. The dual pot that I used was a Centralab Fastach® II series snap-together unit consisting of an F1-25K and R1-25K, both taper C-1 (linear taper) and suitable snap-in shafts.

10. Double check your wiring. Replace the circuit boards, being careful to put them in the right way, and fire up the rig to check it out. Ensure that you have the pots wired so that clockwise is the increasing direction. Adjust the meter sensitivity trimpot to give a full scale reading at the rated power output.

11. Replace the covers and knobs. This completes the modification.

Reverse Polarity Protection for the Argonaut

With care, a reverse polarity accident need never happen. However, anyone can have a bad day now and then, and enough Argonaut owners have blown up their rigs with reverse polarity that Ten-Tec has a pre-packaged kit that includes replacements for everything that pops when the Argo is powered up backwards.

There are two approaches to reverse polarity protection. The quick and dirty way is to install a silicon rectifier diode between the center pin of the power jack and the junction of C44 (1000 uF 16 V) and the black wire. The diode should be conservatively rated (3 A 50 piv will do) and installed with the cathode

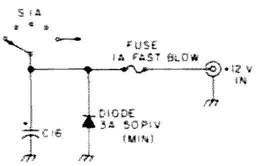
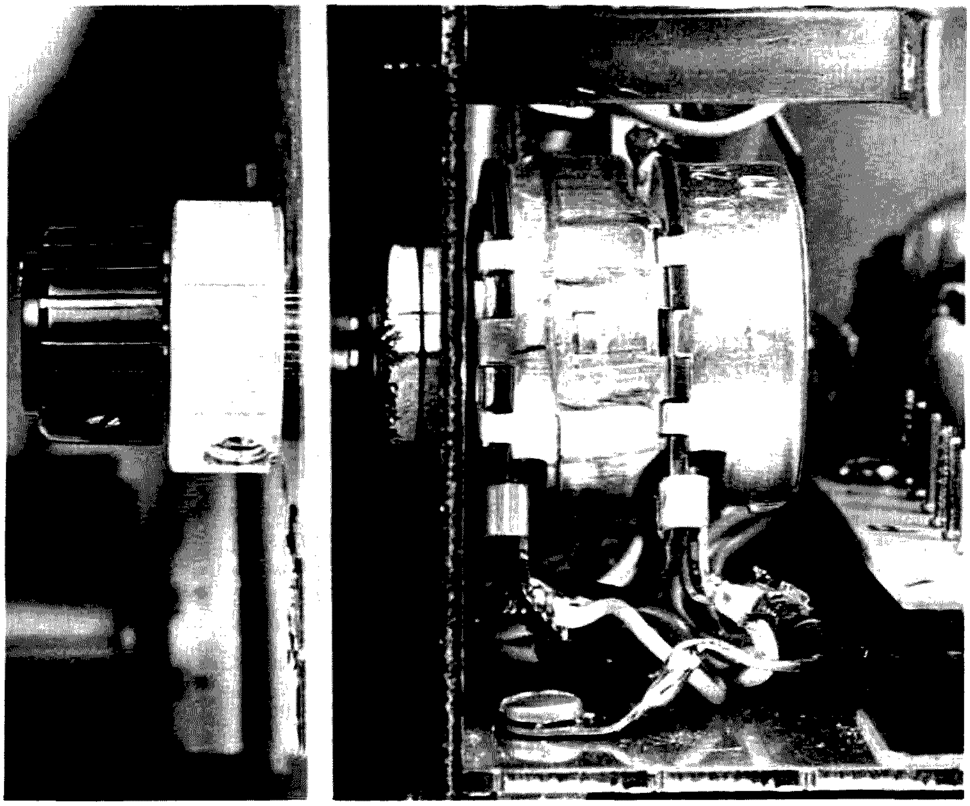
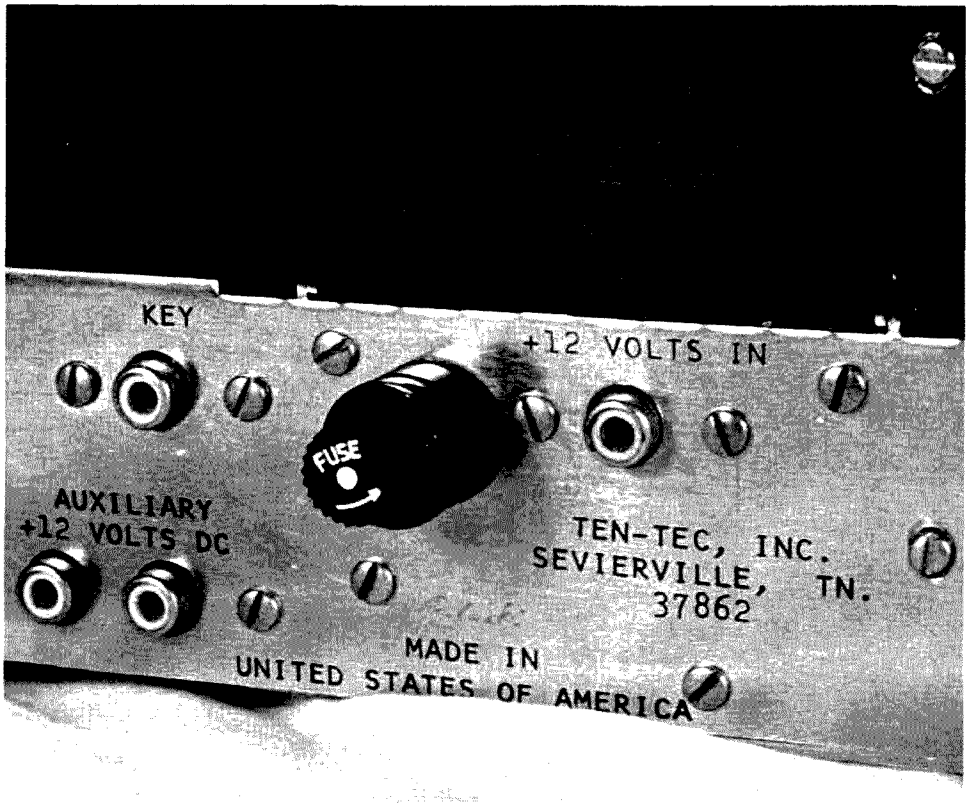


Fig. 3.

Detail showing the dual pot after installation. As can be seen, there is plenty of room for the larger pot. The solder lug at center bottom is factory installed and provides a perfect place to ground R15.

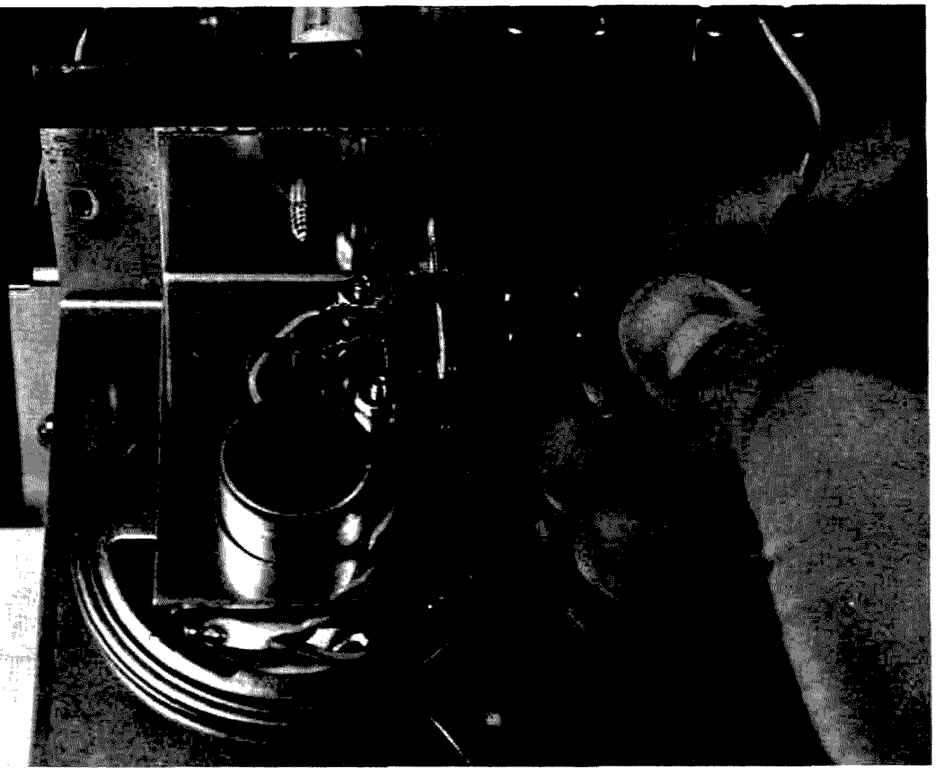


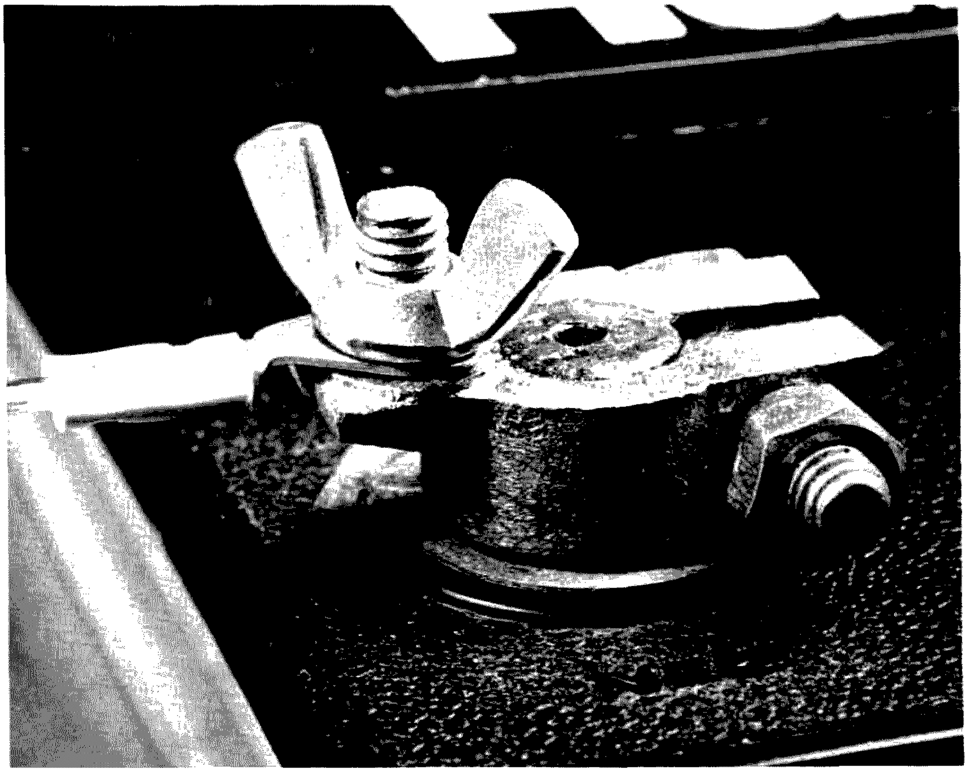


Rear panel view showing the location of the fuse post.

Aug 1977

Argonaut speaker as modified by homemade "L" bracket and 2 pin plug and socket set (Radio Shack #274-342), allowing cover to be detached for added convenience while working on rig.





A good low resistance connection to a car battery being used as a power supply is important, especially if you are powering a high current load device such as the Ten-Tec 405 Linear. A good way to get such a connection is with a battery post clamp with stud and wing nut terminal. Shown here is a Belden #7495 from a NAPA auto parts jobber. A similar item is available in the Sears catalog.

(banded) end toward the + side of C44 as shown in Fig. 2.

The drawback to this method is the approximately .7 V forward voltage drop exhibited by silicon diodes. When operating on weak batteries or other marginal power sources, this voltage drop could cause chirp or loss of VFO voltage regulation.

A better approach, offering more protection to the rig, is the method used in the Model 405 linear and other models in the Ten-Tec line. The power lead is fused and the fuse is followed by a reverse biased diode between + and ground, as shown in Fig. 3. Under conditions of correct polarity, the diode has no effect, but if polarity is reversed, the diode conducts heavily and blows the fuse.

It would be possible to install the diode inside the rig and make up an in-line fuse power cord, but a neater installation results from the use of a panel mount fuse holder. The space available for mounting is tight, so select a fuse holder that does not stick too far behind the panel (a Radio Shack #270-364 is satisfactory). The mounting location is slightly to the left of the power jack. It will be necessary to remove the top and bottom covers and the end piece closest to the power jack. Also, remove the screw that holds the receiver output trimmer strip and swing the strip up out of the way.

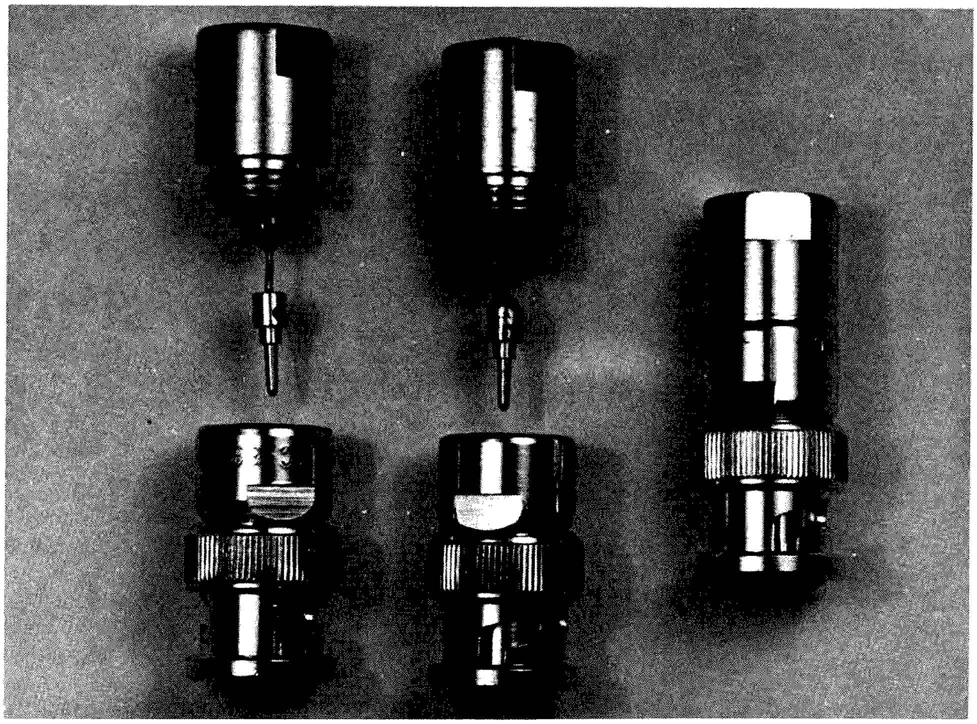
A ½" hole is needed for the fuse holder. Use of a Greenlee punch will minimize the amount of metal chips that fall inside the rig. You may have to snip the edge off the bakelite plate on the power jack to provide clearance for the fuse post.

Run a wire from the center pin of the power jack to the side connection on the fuse holder. Connect the + side of C44 and the black wire to the end connection on the fuse post, and place

the diode (at least 3 A 50 piv) in parallel with C44. The diode's cathode (banded) end goes to the + side of C44 and the other end goes to the grounded lug on the terminal strip where the - end of C44 grounds.

Shake out the drill chips and swing the trimmer strip back down and replace its screw. Check to make sure that none of the bare wires from the trimmer strip are shorted to each other or to anything else. Reinstall the covers.

Put a 1 A fast blow fuse in the holder. Under no circumstances should you use a slow blow fuse; to do so might result in the diode popping before the fuse does. Since the Argonaut does not actually draw a full 1 A of current, a 1 A fuse allows enough headroom to power small, low current accessories such as an audio filter and crystal calibrator from the rear panel auxiliary power jacks. ■



Converting Kings KC-89-66 BNC Video Termination into a QRP dummy load. Left is stock unit with 75 Ohm ¼ W film resistor. Middle shows installation of 51 Ohm 2 W carbon resistor. Because of the 2 W resistor's larger lead size, it is necessary to enlarge the holes in the center pin and case. Right is assembled unit. Because of the heat sink effect of the case, the dummy load can handle up to 5 W for short periods.

Computer Logger

-- for those who keep log books

James C. Berets WA1UOU
33 Arrow Head Drive
Stamford CT 06903

```
READY

LIST

  5 REM PROGRAM BY JIM BERETS
 10 PRI"AMATEUR RADIO STATION LOG BOOK. HOW MANY PAGES";\INPN
 20 PRI"A1 INPUT POWER(WATTS)";\INPC\PRI"A3 INPUT POWER(PEP)";\INPS
 30 PRI"YOUR FIRST NAME";\INPA$
 40 PRI"FIRST 6 LETTERS OF LAST NAME";\INPB$
 50 PRI"NEXT 6 LETTERS OF LAST NAME";\INPC$
 60 PRI"FIRST 6 LETTERS OF CITY NAME";\INPD$
 70 PRI"NEXT 6 LETTERS OF CITY NAME";\INPE$
 80 PRI"STATE";\INPF$
 90 PRI"CALL";\INPG$
100 PRI "QSOS PER PAGE";\INPA
105 PRI\PRI\PRI\FORI=1 TO N
110 PRI\PRI\PRI\PRI"AMATEUR RADIO STATION LOG FOR ";
120 PRIA$;" ";B$;C$;", ";G$,"LOCATED IN",D$;E$,F$
130 PRI"EXCEPT AS NOTED ALL A1 QSOS";C;"WATTS, ALL A3 QSOS";
140 PRIS;"WATTS."\PRI
160 PRI"                  TIME   EMISS    RPRT
170 PRI"DATE STATION START END  FREQ  HIS  MINE  OTHER              QSL
180 FORJ=1TOA
190 PRI"    I        I      I     I     I      I     I               S R
205 PRI"---------------------------------------------------------------------

210 NEXJ
215 PRI\PRI\PRI
220 NEXTI
230 PRI\PRI\PRI\END

READY

RUN
AMATEUR RADIO STATION LOG BOOK. HOW MANY PAGES? 2
A1 INPUT POWER(WATTS)? 180
A3 INPUT POWER(PEP)? 240
YOUR FIRST NAME? JAMES
FIRST 6 LETTERS OF LAST NAME? BERETS
NEXT 6 LETTERS OF LAST NAME?
FIRST 6 LETTERS OF CITY NAME? STAMFO
NEXT 6 LETTERS OF CITY NAME? RD
STATE? CONN.
CALL? WA1UOU
QSOS PER PAGE? 4


AMATEUR RADIO STATION LOG FOR JAMES BERETS, WA1UOU  LOCATED IN
STAMFORD     CONN.
EXCEPT AS NOTED ALL A1 QSOS 180 WATTS, ALL A3 QSOS 240 WATTS.

                  TIME   EMISS    RPRT
DATE STATION START END  FREQ  HIS  MINE  OTHER             QSL
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------


AMATEUR RADIO STATION LOG FOR JAMES BERETS, WA1UOU  LOCATED IN
STAMFORD     CONN.
EXCEPT AS NOTED ALL A1 QSOS 180 WATTS, ALL A3 QSOS 240 WATTS.

                  TIME   EMISS    RPRT
DATE STATION START END  FREQ  HIS  MINE  OTHER             QSL
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
    I        I      I     I     I      I     I              S R
-----------------------------------------------------------------
```

Fig. 1.

After reading the article by Robert Hatch WØTBL (*73*, Holiday, 1976, page 84) on the use of a computer to print log sheets, I decided that this sort of project was one which I might pursue. Unfortunately, I do not have access to a computer using FORTRAN, haven't the foggiest notion of how FORTRAN IV works, and was reluctant to impose on people who do. However, I have just finished a half-year course in BASIC programming on the PDP-8/e and decided that this was more my speed. This final fact placed the objective within my grasp.

The program, as shown in Fig. 1, is relatively straightforward for anyone familiar with BASIC. Almost all commands in the program have been abbreviated to their three letter abbreviations. The back slashes allow more than one command to be placed on a line. Inputs are provided for the number of QSOs per log page and number of pages desired, while string variables are input for the printing at the top of each log page of name, QTH, and callsign of the operator. These inputs allow for the user's own information and allow more than one person to use the same program.

I found the elimination of a column for "power" necessary due to the fact that standard teletype paper is only 8½ inches wide. Not enough room would remain for other information if I included a column for power. Since most people usually use the same power on any given mode, I included the power designation at the top of each page for CW and voice modes. If desired, the power to be used could be entered in the "other" column.

The judicious use of semicolons, commas, and quotation marks containing a number of spaces creates the proper spacing in the page heading. This technique also extends the last name of the operator and city name to a maximum of twelve characters (string length is a maximum of six characters with the PDP-8/e).

Obviously, the most efficient way to execute the program would be on a high speed line printer. However, it would be just as easy to set the computer to its task and have it print your log book on a TTY while you sleep (if you can stand the noise).

One final note: This program is by no means hard and fast. It is readily adaptable to the whims of the user. From this basic (no pun intended) format, one could print special contest logs to accommodate for special exchanges or print a log expressly for the traffic handler. The possibilities are almost infinite. ■

Troubleshooting A Micro

-- not as bad as it sounds!

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While we are often bombarded with propaganda from Wayne Green and the manufacturers proclaiming the wonders of microprocessors and what they can do to automate our station or figure our income tax, we sometimes overlook the problems associated with trying to troubleshoot an ailing system. There is a good reason for this, based on the complexity of the functions that are being performed and the unavailability of test points within the chip. You must be somewhat of a detective to determine what is happening inside from the sparse information that is available to you externally. Fortunately, few of the problems are found within the microprocessor chip itself, but that possibility does exist. While there may be some exceptions to this, it has been my experience that, if the microprocessor will fetch and execute one instruction, it will probably fetch and execute all instructions.

Before starting the troubleshooting procedure, it is important to note whether or not the system is home brew or from a manufacturer. It is also significant whether it has been running and just died, or whether it has never run properly. While the troubleshooting that follows is applicable to all of these cases, there are certain problems that can be ruled out, depending on the previously mentioned conditions. For example, if it is a manufactured system that you are merely assembling, then it is unlikely that it is a wiring error on the cards that you have purchased. If it is your own handwired system, then the likelihood is that you've forgotten some interconnect or connected something up incorrectly.

If the system has been running but now fails, the problem can usually be traced to a faulty bus driver/receiver on the data or address bus. If the system is intermittent, look for temperature effects changing the response of memory, or look at that new interface or memory board that you just hung on the system. Much troubleshooting can be done by merely removing one memory or interface card at a time.

Before continuing, it may also be necessary to note those minimum pieces of test equipment that are required for troubleshooting a system. While some rudimentary checks can be made with a VOM, the system must be looked at dynamically with at least a 10 MHz bandwidth scope. This scope should have at least external triggering and preferably dual trace. Yes, you can look at the buses with slower scopes and see the transitions, but we are looking for problems that may be associated with 50 ns pulses of noise riding around on signal lines, and you will never see them without the prerequisite bandwidth. The microprocessor should also be set up with a hardware restart switch connected directly to the chip itself (or through a peripheral chip designed to do this), so that it can be repeatedly restarted. The reason for this will be evident in later discussion.

There is also one class of problem that is not discussed here, and that is the passing of misinformation by the manufacturer. Occasionally, errors are made in the manuals, or changes are made in the chips that cause them to not function as advertised. This, of course, pertains mostly to the

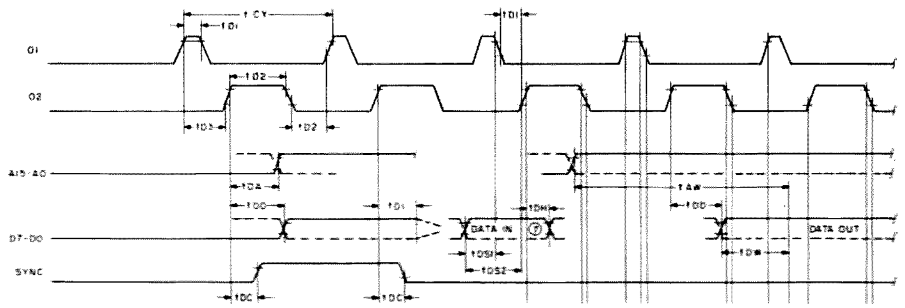

Fig. 1. Timing diagram for an 8080A microprocessor. Intel specifies $t\phi 1$ as 60 ns minimum, tCY as 480 ns to 2 microseconds, $t\phi 2$ as 220 ns minimum, tD3 as 130 ns minimum, and tD2 as 70 ns minimum.

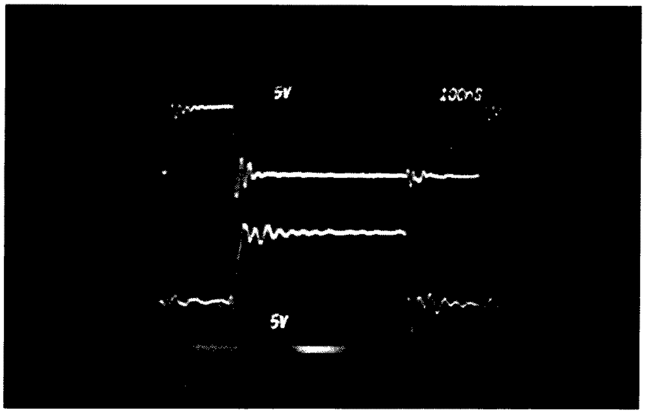

Fig. 2. Scope photograph of an 8080A's two phase clock. The top trace is phase one and the bottom trace is phase two. Note that the clocks are not TTL signals and that they meet the timing requirements as outlined in Fig. 1.

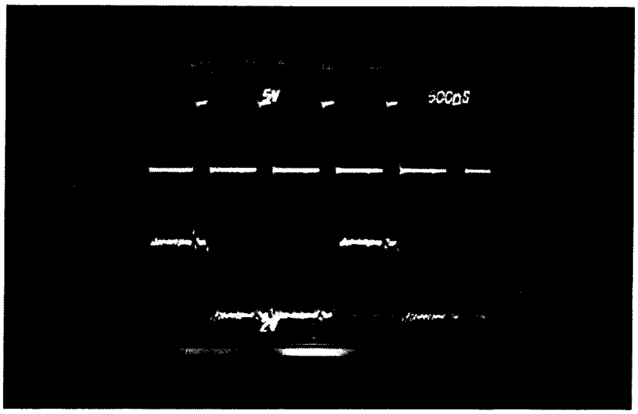

Fig. 3. Timing relationship between phase one and synch for an 8080A running at a crystal frequency of 9.5 MHz.

home brew systems. Don't be afraid to call up the local field applications engineer for the company that made the chip and explain your problem. They are, in general, knowledgeable about their product, and may have actually encountered the problem before. If it is a long distance phone call, call them before they are in the office and leave a message with their answering service to have them call you. It may save you quite a phone bill.

Enough of the boilerplate. As with all electronic problems, beware of the obvious. That is, whether it is a microprocessor that just plain refuses to work, or one that intermittently fails to execute its program properly, start with some of the basics which are often taken for granted.

Power Supply Voltages

The tolerance on power supplies is ±5%, or 4.75 to 5.25 volts for the 5 volt supply and 11.4 to 12.6 volts for the 12 volt supply. And that is a clean five/twelve volts and a clean ground line. While you wouldn't expect it, most of the digital noise that is found is on the ground line. It should be the first suspect for intermittent faulty operation, assuming that it has never yet worked completely right. Adequate current reserve in the power supply and sufficient bypass capacitors are required for proper operation. As ballpark numbers, 10 microfarads per twenty chips and 0.1 microfarad (for high frequency bypassing that the electrolytic can't handle) near each chip that drives signals off of the card or over long distances (e.g., bus drivers) should be sufficient.

Another point to remember about checking power supply voltages is to check them at least on the card, if not near the chips themselves, for two reasons. The first is that if a power supply with no voltage sensing is used, the voltage at the power supply may be set to five volts. But, because of losses due to the high currents and small gauge supply wires, the voltage at the chips may, in fact, be below the 4.75 volts minimum. Secondly, if remote sensing is used, the sense line may be open, or the regulating circuitry not operating properly.

Clocks

To operate properly, microprocessors must be supplied with clock signals, since all of the internal functions are performed synchronously. Not only must these signals be present and of the proper duration, but they also must be free from glitches and in the proper timing relationship. Fig. 1 shows a timing diagram for an 8080 showing a two-phase clock. Note that the duration of phase one must be a minimum of 60 ns, the delay between the rise of phase one and the rise of phase two a minimum of 130 ns, and the delay between the fall of phase two and the rise of the next phase one 70 ns minimum. An actual photograph of an 8080A's clock signals is shown in Fig. 2. While the clock was being run at 9.5 MHz, rather than the maximum of 18 MHz, it can be seen that the minimum times are met. A measurement like this can not only be made on a dual trace, 10 MHz scope triggered only by the phase one input, but can also be done on a single trace unit with external trigger. First, phase one is displayed and checked in terms of glitches and minimum pulse width and maximum pulse interval. The triggering is now set up for this signal, and it is moved to the external trigger input (with the scope triggered from this source). Phase two is now connected to the vertical input and displayed, relative to phase one. It may make it easier if phase one is written in on the face of the display with a grease pen.

Instruction Execution

We are now assuming that the microprocessor is hard down and won't do anything. First, disconnect all cards/interfaces/memory, except for Read Only Memory (ROM); then program a ROM with a jump-to-self instruction. In the case of an 8080, the instruction would be as shown in Table 1. It is, quite literally, Jump (C3H) to the address (0000H) which follows.

While this can be done with other instructions on different machines (such as those with program counter relative addressing), the principle is the same: Try to get the machine to do the minimal amount it can do and still keep fetching and executing a predictable instruction. Now, how do you know if it is running? Look at the synch signal out of the microprocessor. (In the case of the 8080, there is one synch per instruction execution.)

The first check, in this case, is to look at the synch (see Fig. 3) while the reset (a hard reset to the microprocessor through a switch closure) is activated. This reset should set the internal program counter to the starting address where the first instruction will be found (0000H in the case of the 8080), and the microprocessor will run for one, two, or a number of instructions and then halt. Each of these has a significance. One instruction execution (or synch pulse) means that the microprocessor recognized the reset and has gone out to fetch the first instruction from its starting address. If you don't see at least one synch, it is probably a microprocessor chip problem. If a second synch pulse is found, it means

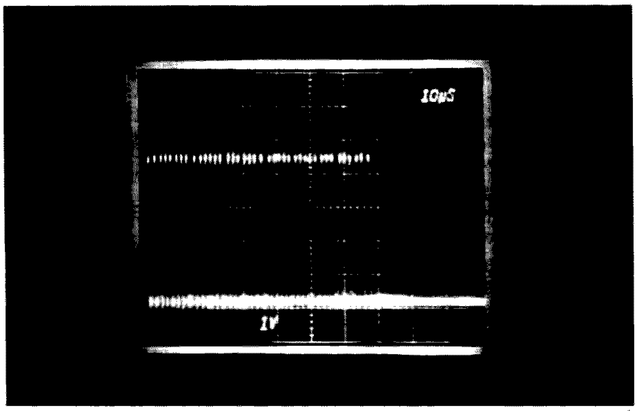

Fig. 4. Synch pulses showing the effect of a microprocessor fetching several instructions and then dying. This can be one of the hardest problems to diagnose. It is usually attributable to slow memories.

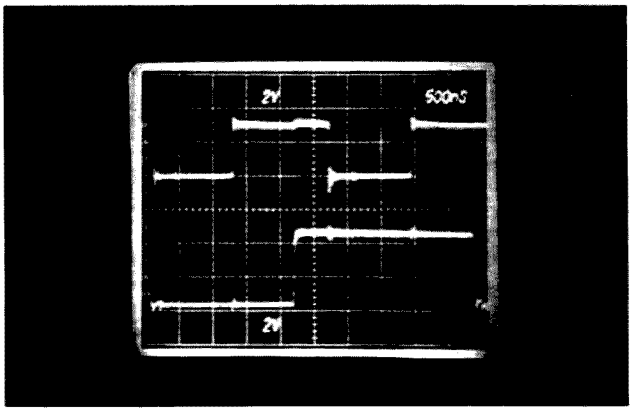

Fig. 5. The top trace is read memory bar (low is true) pulse. Address information should be stable during this time. The lower trace is an address line showing a solid zero during RM pulse one and a one during RM pulse two.

that the microprocessor has output an address, and something has come back. What you don't know for sure is what actually was read from memory. But, you do know that it is going out and fetching. If our dummy instruction is being fetched a number of times (this could be into the hundreds – see Fig. 4), and then dies, this can probably attributed to slow memories. To test for this, slow down the system clock. "How?" you say. "It's crystal controlled." First of all, there is nothing that says that it has to be crystal controlled and, second, any ham should have miscellaneous crystals around that are less than the value (preferably ½) of the crystal frequency currently being used in the system. Insert the crystal, verify that the clock is running, and see if the microprocessor still dies. If it does, we have to look further.

Address	Contents
0000Hex	0C3Hex
1H	00H
2H	00H

Table 1.

Address Bus

Whether we are at the one, two, or three or more synch pulse stage, it is advisable to check the address bus for proper operation. We are, of course, assuming that the ROM with the jump-to-self instruction is still in the system at the starting address of the microprocessor. One method of checking for proper operation of the address bus would be to synch to the read memory pulse, as this must occur during the time that the address bus is stable. In any event, we should alternately push the restart button and look at each of the address lines to see that the desired starting address is being presented to the ROMs during the time of the read memory pulse. Fig. 5 shows a read memory bar (low is true) on the top trace and an address line on the lower trace showing a good zero. No read memory pulse? Probably a bad CPU chip. What you may find is that the leading edge of one of the address lines, either rising or falling, occurs during the read memory pulse. Since this pulse says that the addresses are stable, something is awry. Since there should be nothing on the address bus other than the microprocessor itself and the ROM, the problem is probably not excessive capacitive loading of the bus.

More probably, it's a faulty bus driver/receiver chip if one is used, or a short to Vcc or ground. A lack of noise on an address line is a good indicator of a short to ground. Usually, one address is found to be at fault, and this quickly isolates the offending chip or shorted line. Should all of the address lines be pulling to the required one or zero during the read memory pulse time, then we must look elsewhere for the problem.

Data Bus

The troubleshooting of the data bus can be somewhat more tedious than the previous problems, and so it is left to last. Part of the problem is due to the fact that it is a bidirectional bus and can be transmitting data either to or from the microprocessor. Since the bus is bidirectional, some means must be maintained to keep track of whose data is on the bus at any given time. In a simple system this is easy, because the microprocessor is controlling the bus, and the interfaced hardware has only specific times during which it can put data on the bus.

To digress a moment, although the reader may be familiar with TTL (transistor-transistor logic), to understand the concept of a bidirectional bus, tri-state logic must be brought in (not at the expense of open collector buses, but it is easier to see what is happening on them). Not that understanding them is difficult, for when it is enabled, a tri-state output looks like any other TTL signal. When the chip is not enabled, the output assumes a high impedance state. Referring to Fig. 6, it can be seen that the normal TTL output is a totem pole arrangement of two transistors, one of which is nor-

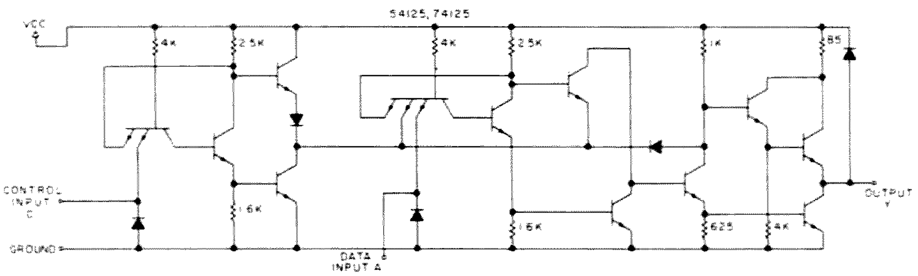

Fig. 6. Schematic diagram of a Signetics 74125 quad bus buffer gate with tri-state output. During the tri-state condition, both output transistors are in the high impedance state.

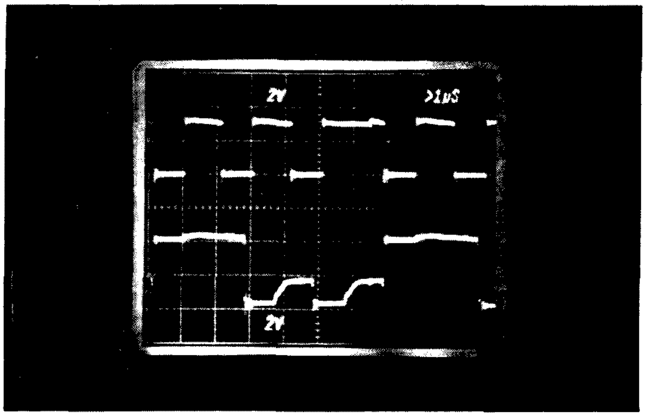

Fig. 7. The top trace again shows the read memory bar ($\overline{RM}$) pulse to allow proper interpretation of the data bus information on trace two. Note that during the first two $\overline{RM}$ pulses the data bus line shows a good one, but during the third $\overline{RM}$ pulse the line shows neither a good one nor a good zero, indicating that the microprocessor was addressing nonexistent memory or the memory at that location was malfunctioning and putting nothing on the bus.

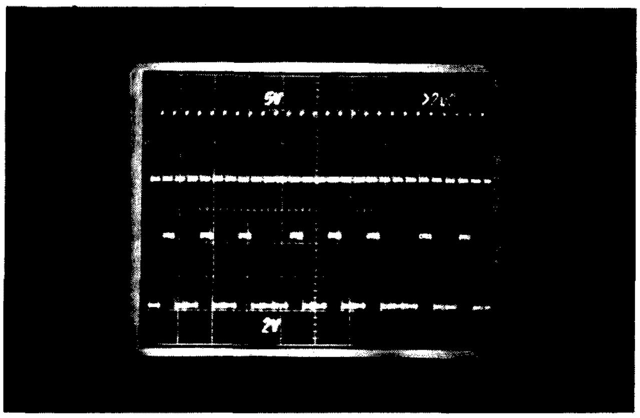

Fig. 8. The top trace is phase one of the clock and the bottom, the synch pulse of a normally operating system. Time between synch pulses will vary, depending on the instruction being executed.

mally on while the other is off. In fact, what accounts for the large noise spikes in TTL circuitry is that for nanosecond periods of time, both transistors may be on, causing a direct short to ground from Vcc. Looking at it binarily, there is only one other possible state for the two transistors, and that is with both of them off. In this case, looking back into the output of the tri-state device, we see a high impedance to both ground and Vcc and, hence, a very low loading of the data bus.

In the simple case of our jump-to-self instruction, the microprocessor releases control of the data bus during the read memory pulse (and slightly before and after). It is this pulse (read memory) that is logically combined with the decoded address on the address bus to provide a chip enable signal to the ROM so that its tri-state output is enabled and the next instruction put onto the data bus. So the first thing we must do is to look at the pin on the ROM for the chip enable to see if it is, in fact, being enabled. A lack of a chip enable signal says that the problem can now be localized to the chip-select decoding circuitry. If it is present, we continue by looking at the data bus, bit by bit, in synch with the read memory pulse. (At least one should be generated each time the microprocessor is reset.) While it is typically the case that all of the data lines are pulled high (through externally supplied pull-up resistors) so that they go to a known state while they are not being enabled, this is not required, and you may see a data bus without them that looks like Fig. 7. Note that the information on the bus is only valid during the read memory pulse time, so both signals must be displayed, or at least synched. Check, as with the address lines, to see that the data is fully a one or a zero during the time that the read memory pulse is there. Fig. 7 also shows the effect of nothing being on the bus during a read memory pulse. [During the third read memory bar (low is true) pulse, the data bus is neither high nor low.]

If All Else Fails

About the only thing left that can give you fits is an unpredictable interrupt being forced onto the microprocessor through a faulty interrupt controller, an interrupt line that is going low, or one that is not tied high through a resistor (allowing noise to pull it low). Check all interrupt lines for noise. If the chips are mounted in sockets, remove them, use solvent, and reinsert them to allow for a possible faulty interconnect. The same goes for the insertion of the board into its socket. This can be a great source of intermittent aggravation, when it dies every twenty minutes and then starts up with no problems. Another somewhat elusive problem is changing chip parameters with an increase in temperature, especially if the device is being run at close to its rated speed.

So, let's assume that life is not being cruel to you, and the first time that you put the jump-to-self instruction in, the synch pulses look like Fig. 8, and everything else appears to be operating normally. Now is the time to put your rudimentary monitor program ROM back into memory and see if the monitor functions (e.g., reads memory, changes registers, etc.). If not, recheck with a scope all of the address lines, data lines and interrupt lines. After a while, you can tell when a line looks correct, even without doing all of the synching, etc. You may want to still check them while you synch with the read memory pulse to check for a slowing of the response of the address and data buses due to capacitive loading increases when additional ROMs are added. If you don't have a small monitor program, put in the minimum amount of software and interface that you need and see if it will work. Slowly add interfaces and memory until the problem occurs. If you are lucky, you should be able to look at each of the address and data lines and see the one that is degraded by the malfunctioning board. If those show nothing, look on the most recently inserted interface/memory board to ascertain if signals are getting through to it. Perhaps it is being enabled all of the time, or conversely, never, due to faulty logic on the board. Hopefully, the insertion of boards one at a time will point out the defective board, and a look at all of the lines going to that board will give you a starting place for troubleshooting.

Read the Manual

Since you probably plugged the thing in before you really understood it, and it (miraculously) worked, or it worked after you only read half of the book, read the other half. Experience has shown that the microprocessor is probably not running because you forgot to read footnote number three at the bottom of page sixty-seven, which says that pin five of board six must be grounded for proper operation. ■

Super DVM

-- uses the MC14433 and LCD

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Austin TX 78744

I have, for a long time, wanted to replace my old reliable Simpson 260 due to its rapidly deteriorating condition. My first thought, thanks to some free samples from various companies, was to go the route of a voltage to frequency converter. Well, by the time I decided to start development on it, I had been transferred to Austin, Texas, where I was introduced to the new Motorola chip, the MC14433 analog to digital converter (DVM) chip. My first attempt was an LED version, with limited functions (volts only). The current demand on the batteries was not too bad – about 60 mA. With nicads, this could be taken quite easily. But, wanting to expand my horizons and to know what makes those funny liquid crystal displays work, I decided that the next voltmeter would contain only devices which wouldn't suck up all the juice out of the batteries. Before we get into the actual circuit construction, let's start from the top with design theory.

The Display

The operation of a field effect liquid crystal display depends on changing the optical properties of a liquid crystal by applying an electric field. The best short description of a liquid crystal is that it is an ordered fluid. Crystals of this type (liquid) which are used in displays belong to a class called *nematic;* fluids of this type consist of cigar-shaped organic molecules with the long axis of each molecule pointing in the same direction. There are three main types of chemicals which are used in displays. These are Schiff-bases, esters, and biphenyls. At the present time, the Schiff-bases are the best choice for displays, taking into consideration switching times, reasonable threshold voltages, lifetimes, good temperature ranges and expense.

The Motorola MLC 400* is constructed from two pieces of glass coated with transparent indium oxide conductors. These conductors are shaped to form the segments of a numeric display. The glass surfaces are also specially treated to align the liquid crystal molecules in a particular direction. Alignment is parallel to the plane of the glass, with the alignment direction of the top rotated 90° relative to the alignment of the bottom plate. This causes the liquid crystal molecules in the cell to assume a twisted orientation, when viewed from top to bottom. The plane of polarization of plane-polarized light will follow this twist and emerge from the cell rotated ninety degrees. Thus, if the cell is placed between crossed polarizers, the polarizers will transmit light. Where an electric field is applied, the liquid crystal will align parallel to the field, twist will be destroyed, and that portion of the cell will

*From Motorola Communications Engineering Bulletin #42, ***Motorola Field Effect Liquid Crystal Displays – A light look.***

appear dark between crossed polarizers. Now I bet you didn't think all of that could fit inside a watch case, did you?

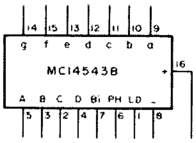
The MC14433

The MC14433 is a high performance, low power, 3½ digit A/D converter combining both linear CMOS and digital CMOS circuits on a single monolithic IC. The chip is designed to minimize use of external components. With two external resistors and two external capacitors, the system forms a dual slope A/D converter with automatic zero correction and automatic polarity. The MC14433 is ratio-metric, and, by itself, may be used over a full scale range from 199.9 millivolts to 1.999 volts. Systems using the MC14433 may operate over a wide range of power supply voltages for ease of use with batteries. In addition to DVM/DPM applications, the MC14433 finds use in digital thermometers, digital scales, remote A/D, A/D control systems, and MPU systems and has an input impedance of greater than 1000 megohms!

This A/D system performs a ratio-metric A/D conversion; that is, the unknown input voltage, Vx, is measured as a ratio of the reference voltage, Vref. Therefore, a full scale voltage of 1.999 V requires a reference voltage of 2.000 V, while a full scale voltage of 199.9 mV requires a reference voltage of 200 mV. Both the Vx and Vref are high impedance inputs.

OK, now that we have gone through the dry stuff, let's dig into the actual meat of the article.

The circuit in Fig. 3 performs parameter-to-voltage conversions, scaling and function switching. The ac/dc DPST switch changes the input path and the signal is then fed into the MC14433. A 10 megohm voltage divider consisting of three precision resistors provides 2, 20, and 200 volt ranges. Three precision shunt resistors are connected directly from the input to ground, providing 1 A, 200 mA, and 20 mA scales.



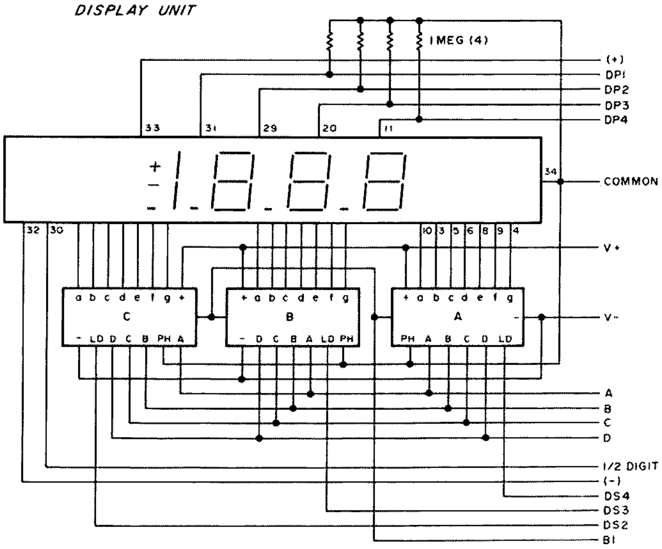


Fig. 1.

The resistance scales are established with calibrated current sources using the MC78L05 and MC79L05 voltage regulators. A stable 5 volts above the minus supply is produced by the 78L05 positive regulator. The current sources are simple base emitter biased transistors. A 2N930 with a guaranteed beta at 1 microamp is used for the 2 megohm scale, and an MPS6513 is used as a .1 mA source for the 20k Ohm scale. Each is adjusted by a single ten-turn pot. The 200 Ohm scale current source uses a 79L05 negative regulator. Its input is connected to the negative supply and a scaling resistor is placed between the common and output pins. When not in use, this circuit draws only a few microamps of bias current, even though it sinks 10 mA when measuring a connected load. All current sources are biased from the minus supply to increase battery life; thus, all resistance scales produce a negative sign on the display.

When I first was breadboarding the circuit, I took the minus supply for the input circuitry from the common -6.2 V bus. The only problem with this is that the 78 and 79L05 regulators require about 2 to 3 volts over the output voltage to work properly. Thus, the regulators will require at least 7 to 8 volts on the input to give 5 volts on the output. No wonder I was getting funny readings! For this reason, I recommend the use of 9 volt batteries. Note that absolute maximum voltages on the MC14433 are + and - 8 V, so be sure to drop that portion of it somehow.

The real substance of the project is shown in Figs. 1 and 2. Three MC14543N LCD latch/decoder drivers are used to demultiplex, decode the three digits and drive the LCD. The half digit and polarity are demultiplexed with the MC14013B dual D flip-flop. Since the LCD requires an ac signal across it, the low frequency square wave drive for the LCD is derived from the MC14024 binary counter, which divides

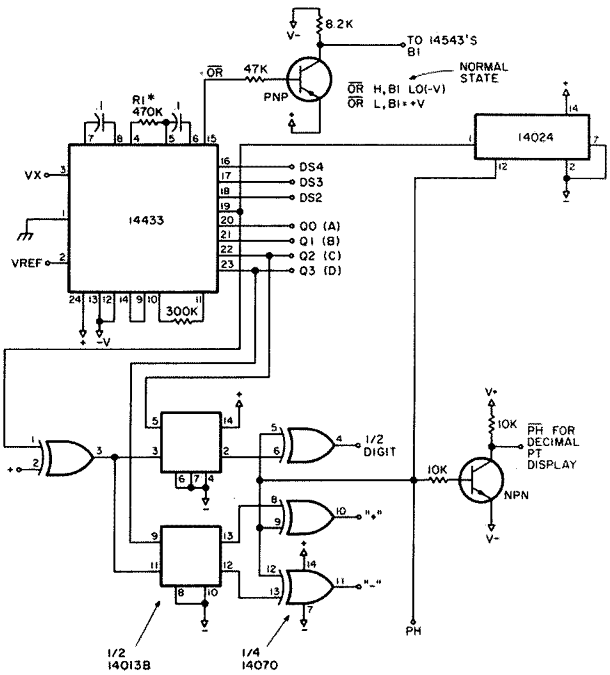


Fig. 2. For V full scale = 199.9 mV, set Vref = 200 mV and R1 to 27k Ω. For V full scale = 1.999 V, set Vref = 2 V and R1 to 470k Ω.

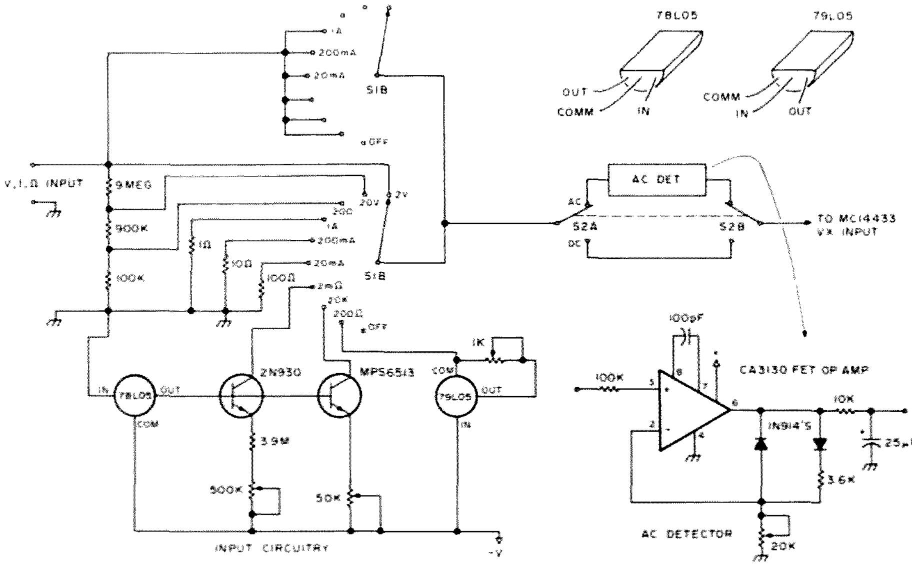


Fig. 3.

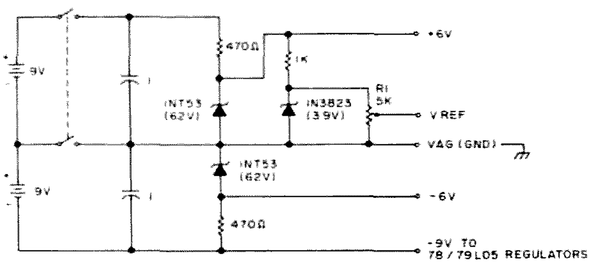


Fig. 4. Power distribution. Set R1 for an output voltage of 2 V. It must be accurate and with load connected. Any zener diode of equivalent value may be used.

the digit select output from the A/D. Although this is a convenient way to obtain the required square wave, it is not necessary to take it from here. The frequency should be about 4 kHz, as this will provide for the best contrast on the display unit. This low frequency square wave is connected to the backplane of the LCD and to the individual segments through the combination of the output circuitry of the 543B and the exclusive OR gates at the outputs of the 013B. All of the decimal points are tied to PH through a 1 megohm resistor, and, to display a particular DP, it is switched to $\overline{PH}$.

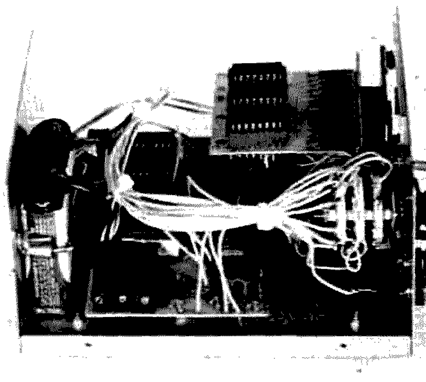
The overrange pin (15) goes low when Vx exceeds Vref. It is normally high. The 543Bs require a ground on pins 7 (blanking) to display. In our case, the ground is actually the most negative supply (to get the maximum amount of voltage swing on the output). This normally high $\overline{OR}$ pin on the 433 is tied to a PNP transistor, which is tied between -V and +V. In its normal state, the transistor is not conducting, thus allowing the -V to be on the collector. When the input goes low, indicating an overrange condition, the transistor conducts and places a high (+) on the blanking input of the 543s, thus blanking them. Note that the first digit has no provision for blanking.

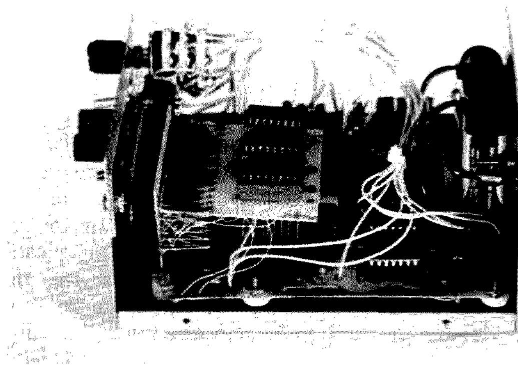
In my version, I wire-wrapped the LCD socket and the 543Bs. I did this for a couple of reasons. The first reason is because the pins of the socket of the LCD are very close together, and I didn't want to hassle with the artwork. The second reason is that my wife gave me a hobbywrap tool for Christmas, and I wanted to try it out. It would, of course, have been permissible to etch the whole board, but I elected to go with the wire-wrap method. I later found out that Teledyne Kinetics, the maker of the LCD socket, also makes a socket that would allow construction on a single board.

Calibration

The first thing to do in the way of calibration is to set the reference voltage. Note on the schematic that it can be set up for 2 volts or 200 mV full scale. I recommend that it be set for 2 volts due to possible noise problems, but, even with the 2 volt scale, it can be read to .001 volt. Be sure to be accurate with this reference voltage, as the accuracy of the entire instrument depends upon it. A short word about the quality of components used in the frequency determining resistors and capacitors, especially in the capacitors. These .1 uF caps should be of the high quality polyester or mylar. Using cheap caps here can lead to inaccurate readings.

If you used precision resistors for the voltage divider network, the next step is to calibrate the Ohms scales





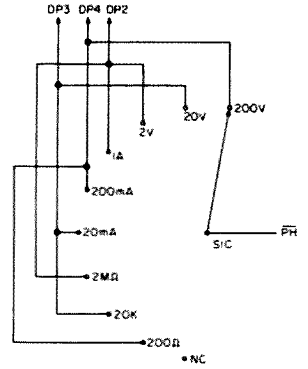


Fig. 5. Decimal point switching. To energize DP, tie line to $\overline{PH}$.

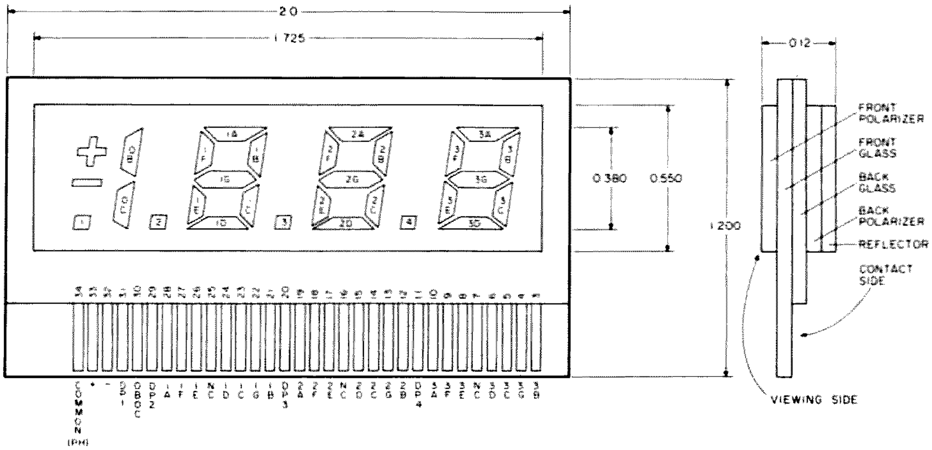


Fig. 6. Diagram of MLC400 liquid crystal display. Use connector Teledyne Kinetics S202U.

against known resistance values. Just tweak the control until the correct value is displayed. If you used pots in place of the precision resistors (in the interest of saving money), you must set these up. The way to do this is to get a calibrated voltage source. Set the voltmeter to the 200 volt range, and adjust the 100k pot for a correct reading on the meter with about 90 to 120 volts applied to the input. Watch out, as the 433 doesn't really like all that voltage, especially if it is applied directly to the 2 V scale. It might blank out forever! After you have calibrated the 200 volt scale, don't touch that pot again. Apply about 16 volts to the input, and adjust the 900k pot for a correct reading. Next, do the same thing for the 2 volt scale, using the appropriate voltages. After this, you will probably have to touch each of the pots up, as each will interact with the other. With a little time, you can save yourself a little money, and probably have a more accurate meter than if you were to buy precision resistors!

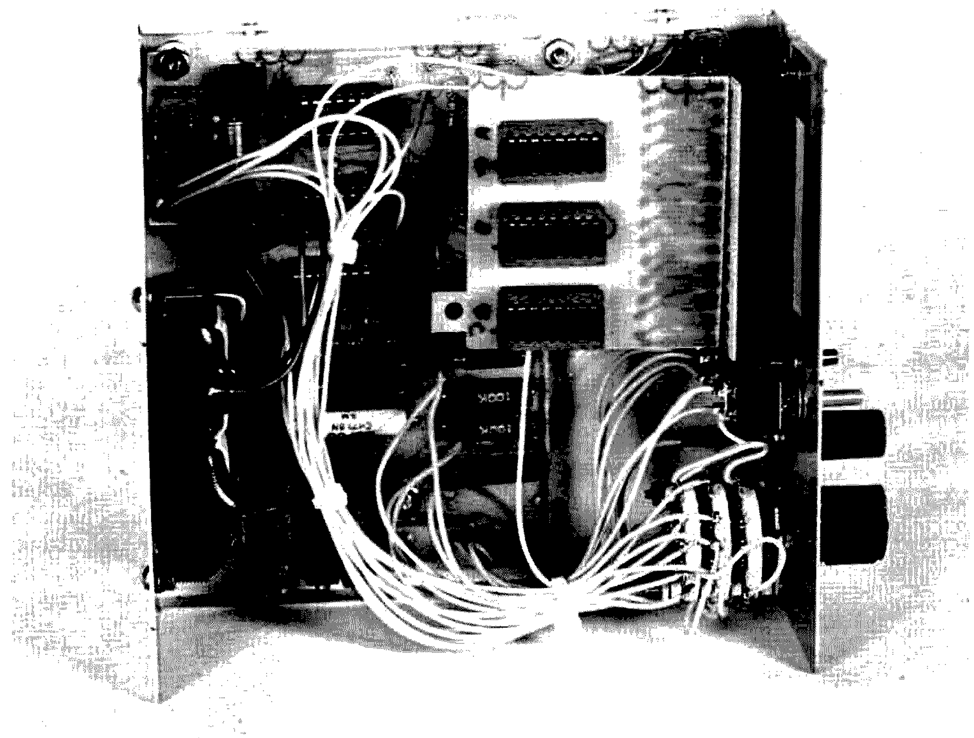
There are a few things which you should be on guard for, and those are in the area of the ac detector circuit. Since this is essentially an amplifier/detector circuit, anything that is placed on the input will show up as a dc potential on the output. This little lesson was painfully shown to me, as the ac detector circuit took more time to refine than did the rest of the DVOM. On the switch assembly, I ran the PH and $\overline{PH}$ lines with unshielded wire. This was a real no-no, as the input is a very high impedance, and therefore doesn't take very much to drive it. So, a little shielding and careful placement took care of it.

To calibrate the ac scale, the easiest way is to set up the voltmeter to the 200 volt scale and the measure the line voltage of your house. If it does not read correctly, turn the pot until it does.

Another little hint — be sure not to hook up the analog ground to chassis ground as if you are measuring current in a high voltage circuit. This will place a high potential on the bare metal chassis. In my DVOM, the chassis is floating and not connected to anything. At the present time, I do not know where the display unit can be purchased, but a rough price estimate for it would be about $14.00. The chip is available from Tri-Tek for $18.95.

PC boards for a basic 2 V DVM using LEDs can be purchased from Dactron, Inc. 12609 Blackfoot Trail, Round Rock TX 78664.

In addition to this basic 3½ digit 2 volt LED DVM, this company is coming out with the following items: plug-in board with full function, autoranging capabilities, LCD version, and a digital thermometer. ■



Build A kW Linear

-- a 4-1000 provides the punch

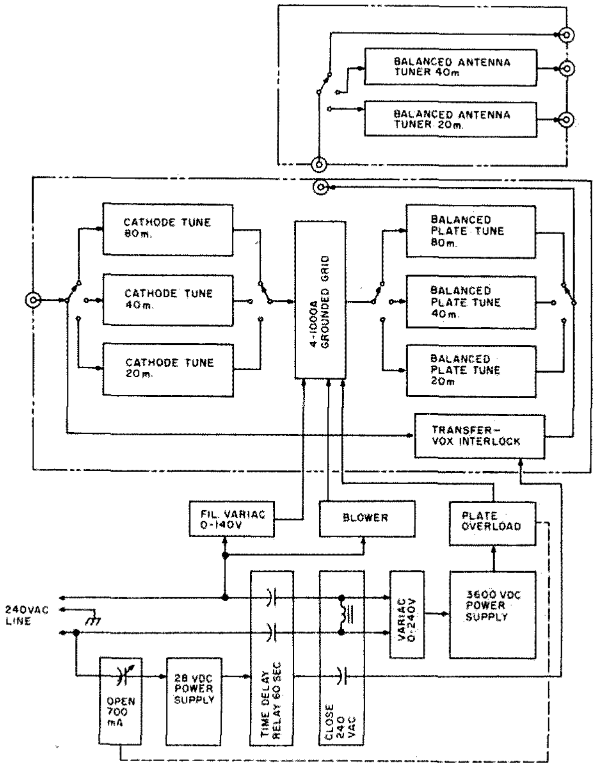


Fig. 1. Amplifier system.

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The ultimate station, from the viewpoint of most of us, would be one located on a hill remote from noise sources, having separate, large, highly elevated antennas for each band. The ham shack would contain a separate kilowatt transmitter for each band, pretuned and correctly matched to its separate antenna by means of an rf bridge, and ready for instant use. Unfortunately, not many of us can afford such an arrangement.

This article describes a compromise available to all who have the desire and perseverance to learn and build. This is a kilowatt linear amplifier of highly efficient and conservative design employing band change by the simple actuation of three switches. In its design, space has been conserved; however, size has not been restricted at the expense of efficiency, reliability, or signal quality.

Quite common in the 1930's and 40's was the push-pull output circuit using two tubes, a balanced tank circuit, and link coupling, well known for its high efficiency and for cancellation of even order harmonics. The grounded grid circuit was known but not commonly used. In this amplifier, the balanced tank circuit is adapted to use with a single 4-1000A tetrode, used in a grounded grid, grounded screen circuit with link coupling. Harmonic distortion products are minimized. Efficiently tuned and correctly matched input circuits are used to improve signal quality and reduce drive requirements. The 4-1000A is run at an efficient plate voltage and loafs at a kilowatt dc input.

System

Fig. 1 is a block diagram showing the functional arrangement of units for power supply, signal amplification, and antenna matching. The amplifier input and output circuits are continuously tunable across the 80, 40, and 20 meter bands. A tuned link for each band feeds the output to separate antenna tuners for 40 and 20 meters, which in turn feed 95 Ohm balanced coaxial lines. The 50 Ohm unbalanced input to the antenna tuning unit is fed straight through on 80 meters to a 50 Ohm unbalanced line.

Sixty seconds is allowed for filament heating before high voltage is applied. For tube protection, the high voltage is removed from the tube when plate current ex-

ceeds a value which has been preselected by the operator. Simultaneously, exciter drive is transferred to the antenna tuner (still correctly matched to the exciter output) and the VOX relay is rendered inoperative. The sixty-second time delay then recycles, the antenna is transferred back to the amplifier, and plate voltage is reapplied together with exciter drive. If a fault continues to exist, the system will continue to recycle until operator intervention occurs.

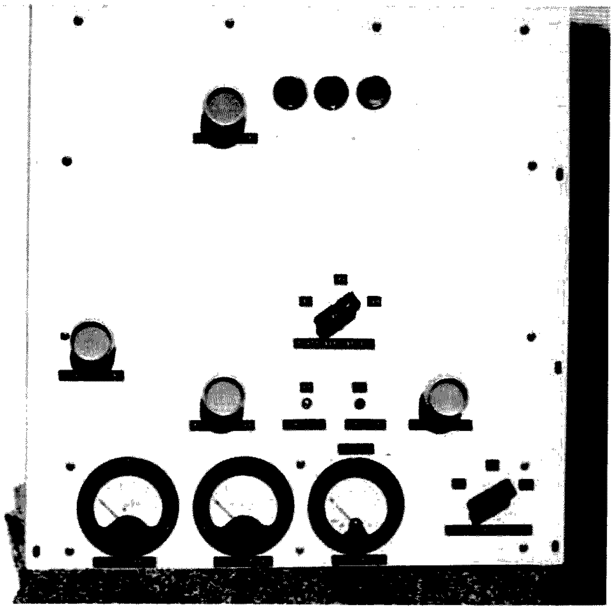
A large capacity heavy-duty blower is contained in an enclosed box at the bottom of the amplifier cabinet. An air filter is provided. Air from the blower is discharged into a plenum chamber and thence through a flexible hose to the pressurized amplifier chassis. Separate meters provide full monitoring of the tube voltages and currents. The system is contained in a 23" wide by 24" deep by 62" inch high metal rack cabinet mounted on casters. Total weight is 450 lbs. Cost, including 2 4-1000As, is $350.

Input Tuned Circuits

The input circuits are shown in the Fig. 2 schematic. Table 2 contains the values of all components and the number of turns for inductances. The input circuits are series tuned by means of small broadcast type variable capacitors. Variable capacitors provide a straightforward method of correctly adjusting the networks to a correct impedance match between the line and the cathode to grid load of the tube at the selected resonant frequency. Considerable interaction exists between components of the tube input circuit, and fixed capacitors are not recommended as a means of establishing correct tuning. The input capacity of the 4-1000A is a nominal 27 pF and series tuning works well in this application. Qs of the tuned circuits vary from 1.5 to 3, and once the input circuits are tuned to the band center (or other selected frequency), they need not be readjusted. The 20 and 40 meter coils are number 14 DCC (double cotton-covered) wire, close wound on 1½" diameter coil forms. The 80 meter coil is number 22 DCC wire wound on the same size form. The input line winding is wound on top of the cathode winding starting at the cold end of the coil, which is the end to be connected to the tuning capacitor. Allow enough dangling wire to make connections to the tuning capacitors and to the selector switch S1.

The only practical means of evolving the input tuned circuits was found to be one of cut and try. Originally, the input circuit values were calculated for Qs of two, and a complete subassembly consisting of the three coils, six tuning capacitors, and switch S1 was built up on a sheet of 1/8" aluminum. The subassembly was then tested using the following procedure:

A load of 100 Ohms in parallel with a 30 pF capacitor was connected from S1B (see Fig. 1) to ground. The ANT terminal of a noise bridge was connected from S1A to ground and a receiver S-meter was used to measure signal strength versus resonant frequency for a 50 Ohm line input. The inductances were tailored to resonate at the band center. After the amplifier was built, it was found that the input circuits would not resonate correctly and that the input impedance values were far from the 50 Ohms desired. The input subassembly was removed and, with the tube in its socket and a 100 Ohm resistor connected from one side of the filament to ground, the input impedance of the complete input circuit was measured with the noise bridge. The impedance was found to be 135 Ohms at 3.8 MHz, 120 Ohms at 7.2 MHz, and 85 Ohms at 14.2 MHz, rather than the 100 Ohms I had expected it to be from the manufacturer's data for the tube. The published data is the dynamic load impedance only of the tube.



Amplifier panel showing controls. 80 meter tune at top, 80 meter link tune extreme left, 20 meter tune and 40 meter tune centered left and right of plate bandswitch with screwdriver adjust link tune between plate knobs. Cathode band select at lower right. Meters from left to right are plate current, grid current, and filament voltage.

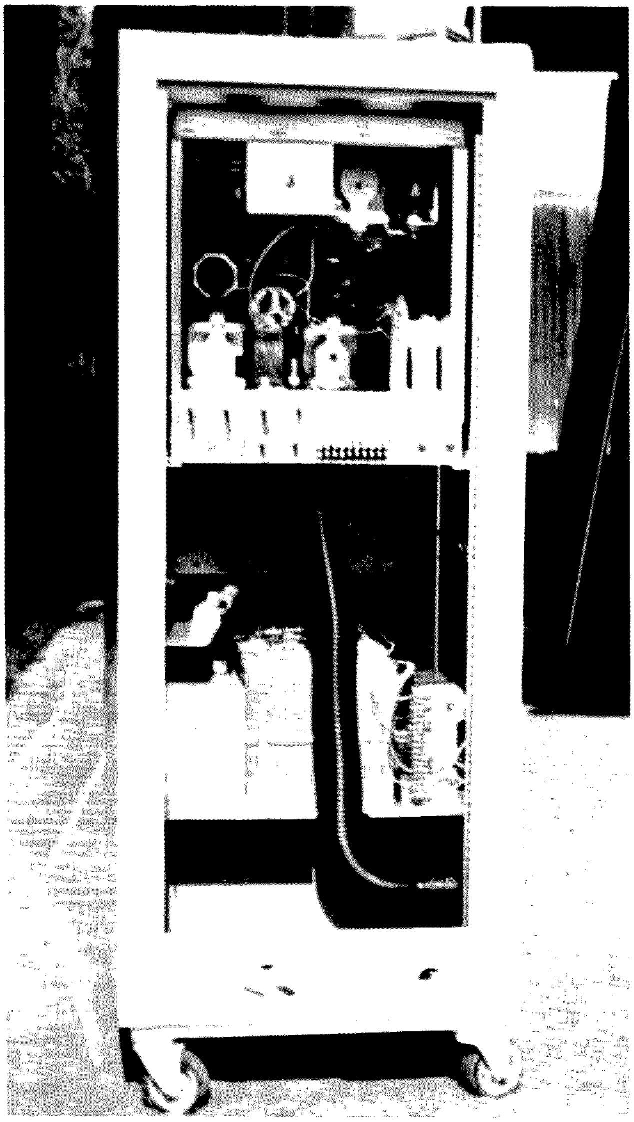
At this point, I resorted to the cut and try approach. Inductances were varied until resonance was obtained at the desired frequencies with close to a 50 Ohm load presented to the exciter line input connection. It was learned that one cannot obtain a given value of Q at a chosen resonant frequency and match a tube input load to a 50 Ohm input line impedance when using fixed coupling. This is the reason that the Qs vary from about 1.5 to 3, as previously mentioned. However, the Qs are quite acceptable, and the amplifier is very easily driven. The variable capacitors were found to be invaluable in evolving the input networks and in tuning them.

Output Tuned Circuits

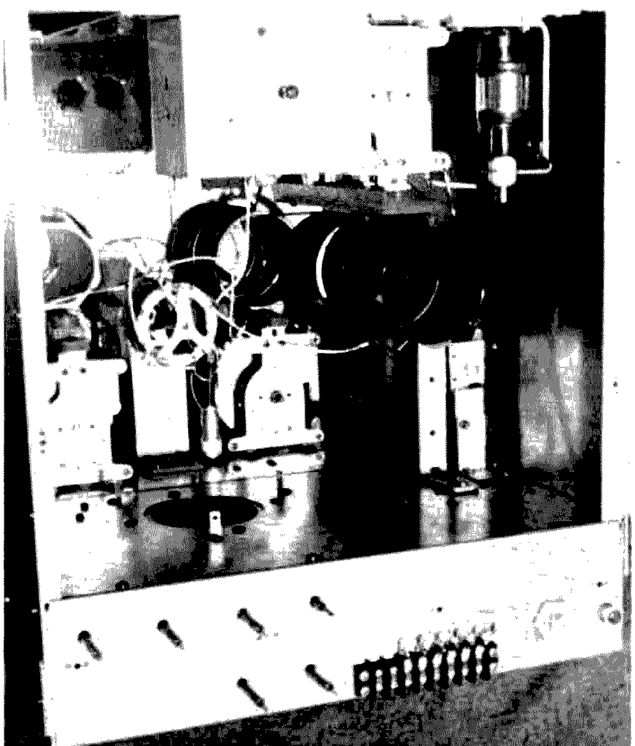
The plate tank circuits are balanced and use split-stator grounded rotor capacitors. The Qs of each half of the resonant circuits are a nominal 6. The output links are series-tuned circuits having Qs of about 3. The links of this amplifier were made variable for the 20 and 40 meter coils and fixed for the 40 meter coil; however, it is suggested that the 40 meter plate coils be air wound and a swinging link used in lieu of the fixed link. I experienced the same impedance matching problem with the fixed link as previously discussed for the input networks. The impedance of the 40 meter output link ended up at 40 Ohms instead of 50 for the selected Qs. The swinging links are a pleasure to use. If the impedance presented to the line is incorrect, the coupling is increased to raise it, or decreased to lower it. In the photographs, the 80 meter tank coil is suspended upside down. The 20 meter tank is the large wire air wound coil on the right side looking from the back. The 40 meter tank is on the left side. Mounting method for the supplementary 50 pF fixed vacuum capacitors used with the 80 meter variable capacitor can be seen at the extreme right.

Output Coil Construction

The entire 20 meter coil is 12 continuous turns of number 4 soft drawn copper wire. It is close wound over a 3" diameter tube and the coil allowed to spring to about 3-1/8" inside diameter when winding tension on the wire is relaxed. The center turn of the coil is spread to a pitch of 1¼" so that the link will swing in and out from one side. The remaining turns are spread so that the overall coil is 5½" long. Large soldering lugs are used to connect the coil to the variable capacitor and the coil is supported on a 3/8" x 1" x 9" long plexiglas strip. This size plexiglas strip is used to replace the aluminum top bar on the National Model AMT split-stator capacitors in all three tuned circuits. The 20 meter coil can be easily silver plated using Cool Amp silver plating powder. Plating instructions are printed on the container (see Reference 1). The 20 meter link is 4 turns of #16 wire, 2½" OD x ½" wide. The link is silver plated and is mounted on a plexiglas strip off the capacitor frame for pivoting. The entire 40 meter coil is 19 turns of #10 enameled wire 3" OD (outside diameter) x 3¼" long wound on a ceramic form. The 5 turn link is wound over plexiglas strips cemented to the wire. The link is 3-3/4" OD x 7/8" long. The 80 meter coil is wound in two sections. Each section is 17 turns of #10 wire, 3-7/16" OD x 3" long. Close wind the coil on a 3" OD tube and allow it to spring out when winding tension is released, then insert three 1/8" x 1/4" x 5" strips between the 3" tube and the inside of the coil spaced equally around the diameter. Wind .06" diameter insulated flexible wire around the form over the strips, as spacers between the coil turns. Stretch the spacing wire tight enough that it forms a straight line between the spacing strips and the result will be a clearance space between coil turns and the spacing wire at three locations around the circumference of the coil. Plexiglas strips 1/8" x 1/4" x 3-1/8" long can now be cemented to the outside of the coil wires using DuPont Duco Cement. Let dry overnight, then slide the spacer strips out and remove the coil from the tube. The spacer wire will fall out on the inside of the coil and more Duco cement can be applied across the plexiglas strips from inside the coil to complete the job. The two coils are cemented to a 3/8" x 2" x 9" long plexiglas strip so that the center line of the coil is offset 1-1/4" from the capacitor shaft center line when the coil is mounted on top of the capacitor. This construction allows the capacitor to be placed close to the chassis edge yet spaces the coil away from the metal enclosure. A two inch space is allowed between coils at the



Rear view showing blower box at bottom with flexible hose to amplifier chassis. Amplifier slides in/out on supporting angles. Rear cabinet door and rear amplifier panel are removed for the photo.



40 meter tank at left, 20 meter tank at right bottom, 80 meter assembly right top. One of the two 80 meter fixed capacitors is visible at right top. The box at top center contains the plate rf filter assembly. The three small angles around the tube socket center the chimney.

center for the swinging link. The link is 8 turns of #10 wire x 1-1/2" long of the same diameter and construction as the main coils. A piece of 3/8" x 1" x 3" long plexiglas is filed to the coil radius and cemented to the coil as a swinging arm. The arm is supported from the chassis on a 1/8" x 1" aluminum bracket as a pivot support.

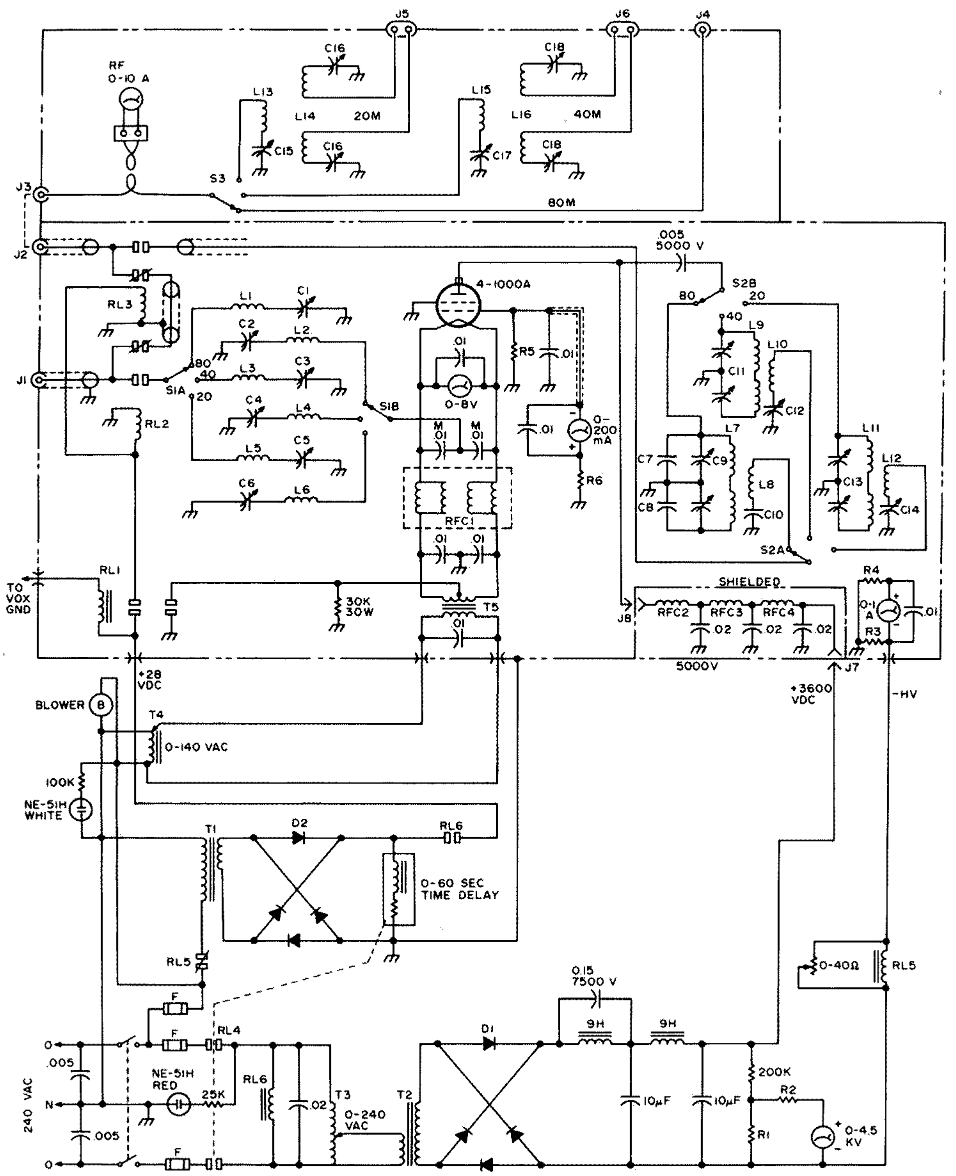


Fig. 2. Amplifier schematic.

Antenna Tuners

The antenna tuners use commercial coils: Johnson 500 HCS40 on 40 meters and Johnson 500 HCS20 on 20 meters. Although these are 500 Watt coils, they are more than adequate for use in a series-tuned 1 kW circuit. The antenna tuner links are fixed. They are cemented to plexiglas strips and supported from the main coils at the center of the main coils. These links are #16 wire of 2-1/2" OD, 4 turns (3/8" long) on 20 meters, and 8 turns (3/4" long) on 40 meters. If you wish to wind your own, simply duplicate the 40 and 20 meter plate tank coils, except #10 wire may be used for the 20 meter coil instead of #4 wire, if desired. An advantage of the #4 wire is that the coils are self-supporting and very simple to make as compared to the #10 wire coils reinforced by plastic strips. The variable capacitors used for tuning the plate and antenna tuner links should have a minimum spacing between plates of 20 thousandths. Screwdriver adjustable types are suitable since they need only be tuned occasionally. The split-stator capacitors used in the antenna tuner output circuits can be of 20 thousandths spacing if series tuning is used, as in this tuner. If the flexibility of parallel output tuning to match high impedances is desired, use a capacitor having plate spacing of at least 1/8 inch.

Metering

Filament voltage, plate voltage, grid current, and plate current are indicated by means of separate meters. The advantage of separate meters is that overall performance of the amplifier is apparent at a glance and, particularly, grid and plate current can be monitored simultaneously.

The grid must be held very close to ground potential to avoid the generation of high frequency parasitic oscillations. The most commonly used method of accomplishing this and yet of obtaining an accurate measurement of drip current is to raise the grid slightly above ground potential by means of a low value resistor and to measure the voltage drop across the resistor (as grid current flows through it) by means of a voltmeter calibrated to read grid current. Mock up the grid metering circuit consisting of R5, the meter, a variable dc voltage source from grid to ground, a variable resistance in place of R6, and a second milliammeter in series with the grid current meter. Vary the supply voltage and the variable resistance to arrive at tracking of the two meters. Measure the value of R6 required and substitute a fixed value.

The filament voltage meter leads are connected directly to the tube socket for accuracy of measurement. Shielded wire runs from the socket to the meter. Use a one percent accuracy meter for this application.

The values of resistance required for plate voltage and current metering can be calculated simply and accurately. For example, assume that plate voltage is to be measured using a 0-15 milliammeter with the legend on the meter face changed to read 0-4500 V dc. Then 15 mA must flow through the

Dc Plate Voltage	3600
Ac Filament Voltage	NOMINAL 7.5 (7.13 to 7.87)
Filament Current	22.7 Amps. MAX.
Zero-signal dc Plate Current	110 mA
Single Tone dc Plate Current	685 mA
Single Tone dc Screen Current	90 mA
Single Tone dc Grid Current	160 mA
Single Tone Driving Power	115 Watts PEP
Driving Impedance	105 Ohms
Load Impedance	3050 Ohms
Plate Input Power	2470 Watts PEP
Plate Output Power	1725 Watts PEP

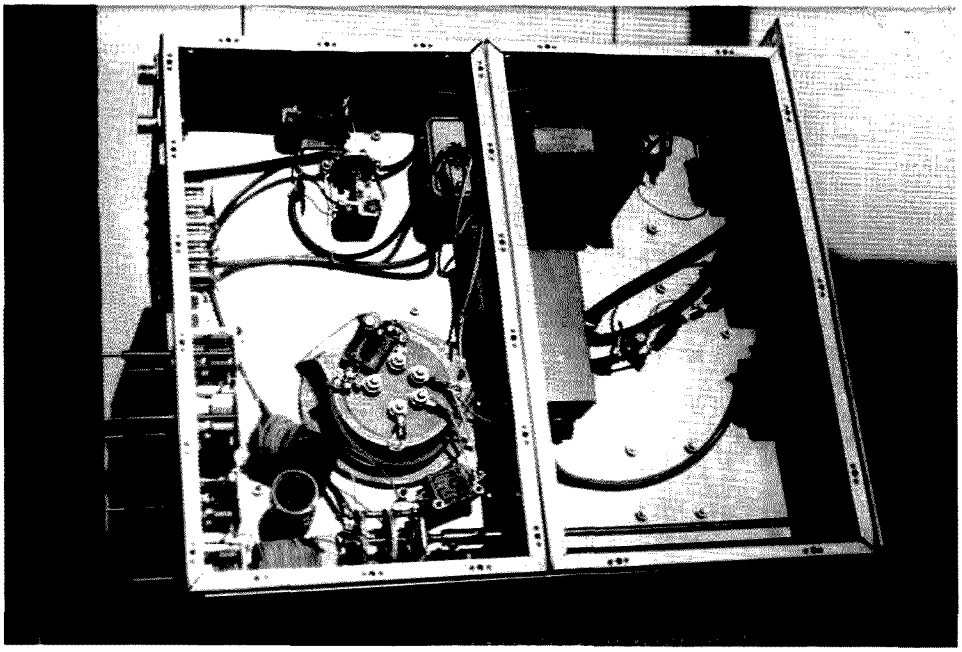
Table 1. 4-1000A characteristics.

meter for full scale reading. Choose a value for R1, assume 4500 V dc output from the HV supply across R1 in series with the bleeder resistor, and, using Ohm's Law, calculate the value of R2 required to allow 15 mA to flow through the meter. A little trial and error is necessary with this method, but the calculations go very rapidly using a low-priced calculator.

A 0-10 milliammeter was used to measure plate current. The legend on the meter face was easily changed to read 0-1 Ampere. Since 10 mA of the one Ampere must flow through the meter and R4 when 990 mA flow through R3, the value of R4 is easily calculated once R3 is assumed. A series milliammeter can be inserted in the circuit to check accuracy of the plate milliammeter.

Cooling

Cooling requirements are graphically depicted in Fig. 3 in terms of blower air flow, static air pressure, and operating frequency. For application of the tube below 30 MHz, use the 30 MHz values of 20 cfm of ambient air flow required into the pressurized chassis, under which conditions the static pressure drop across the tube socket and tube in its chimney is 0.6 inches water gauge. The blower must be capable of supplying the air at 0.6" pressure as a minimum. A good-sized blower is needed to cool the 4-1000A if the blower is to run at a slow speed for quiet operation. The surplus blower used in this amplifier is a Torrington AD508 Airrotor having two 5" diameter x 3" long rotors with forward curved vanes. The blower is belt-driven by a ¼ HP motor. The air discharges into a sheet metal box and the 2½" diameter flexible hose which carries air up to the pressurized amplifier chassis connects to the box at the rear of the cabinet. Automobile air conditioning hose is suitable for conducting the cooling air. The only constraint on the plenum chamber (box) is that the distance from the forward edge of the blower wheel to the side of the box opposite the wheel discharge be about 5 to 6 inches. This particular blower supplies the required air when running at 1400 rpm. It is being run at 2150 rpm because doing so only required reversing the belt pulleys, and the extra factor of safety in cooling air supply yields a conservative operating condition. On the amplifier chassis, bring the cooling hose connection in at a point remote from the cooling inlet to the socket, and, if you use the Eimac SK500 aluminum socket as I did, cut off the entire air inlet tangent to the machined circular surface to increase the efficiency of air flow. In addition, drill ten ½" diameter holes through the socket side wall to admit air.



Bottom of chassis showing switching relays at top left, feedthrough filters and input tuning capacitors at left. The right half of the chassis contains the meters, filament transformer, and filament choke. Note the advantage of the two chassis arrangement for shielding.

Power Supply

The power supply section contains the components indicated on the schematic. It is of conservative design using parallel resonant choke input followed by one section of brute force filtering. The first section is tuned to the main ripple frequency (120 Hz) and presents a sufficiently high impedance at this frequency such that a low bleeder current of 20 mA provides good no load to full load (500 mA) regulation. The low bleeder current conserves power and avoids a problem of bleeder heat in the equipment cabinet. The HV rectifiers are silicon stacks (see Table 2) and were obtained from R.E. Goodheart Co. (see Reference 2). If you build up your own, a peak inverse voltage rating of 5650 volts is necessary at 140 mA average current using bridge rectification. The rectifiers are mounted on a sheet of aluminum which acts as a heat sink. The 28 V dc relay supply, protective relays, and terminal board are submounted on a 5" x 8" x 1½" chassis from the ¼" x 20" x 20" aluminum plate which supports the overall supply. The plate is mounted in the rack at four corners using steel angles. The power supply panel is 19" x 12" high. It contains the on/off switch, fuses, panel lights, HV voltmeter, and the two variacs. More filter capacitance has been used than is absolutely necessary. A capacity of 4 uF from each choke section to ground is about minimum for a 3600 volt supply used on SSB. Fig. 4 shows the power supply regulation.

Mechanical Construction

The amplifier box is 17" wide x 20" deep by 20" high.

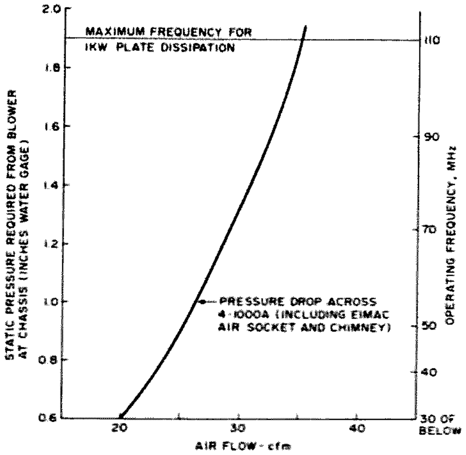


Fig. 3. Cooling requirements for 4-1000A tetrode using Eimac air socket and chimney at 1000 Watts plate dissipation.

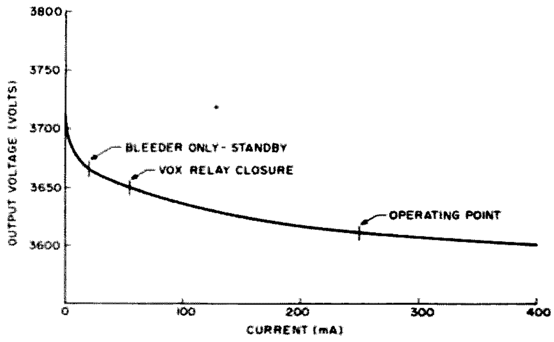


Fig. 4. HV power supply regulation.

It is made up of aluminum top and bottom chassis held together by four aluminum panels – front, back, and two side – plus one 17" x 20" bottom plate. The bottom chassis is made up of two 10" x 17" x 4" deep chassis fastened together by means of number 8 machine screws. The top chassis is made up of two 10" x 17" x 2" deep chassis fastened together. I could not obtain 17" x 20" chassis; hence, this construction. The top chassis is turned upside down, presenting what would be the normal chassis top surface to the inside of the box. Four ¾" x ¾" x 14" aluminum angles are mounted vertically between the top and bottom chassis to support the front and back panels and to form an rf tight enclosure. The side and front panels are fastened using through machine screws with nuts and lock washers. The back panel and bottom plate are held in place by means of number 8 nut plates.

The meters are mounted in the front of the lower chassis, which simplifies shielding and wiring. Since the meter holes extend through both the chassis and front panel, it is advisable to fasten the front panel to the chassis and then cut the meter holes straight through using a hole cutter of the adjustable arm type. The chimney for the tube is held in position by three 1/2" wide pieces cut from 3/4" x 3/4" x 1/8" aluminum angle. Allow 1/32" clearance between the angle and the glass chimney to allow for expansion. The input networks and selector switch are submounted on a sheet of 1/8" aluminum. The filter network for the HV, which consists of RFC2, RFC3, RFC4, and three .02 microfarad capacitors, is contained in a 5" x 5" x 4" box. J7 and J8 are insulated binding posts mounted in the box prior to wiring. Ten 1" diameter holes are drilled in the back panel to discharge air from the tube compartment. Aluminum screen wire can be used for shielding over the holes, or one inch diameter screened inserts can be purchased. The inserts contain tabs which are bent over to hold the insert in place in the hole. All shaft extensions are 1/4" diameter brass. Panel bushings are used for all front panel control shafts. All controls and meters were labeled using a Dymo tape marker obtainable in most drug stores. The entire rack and all front panels are painted with low-gloss off-white enamel. The aluminum panels were given one coat of etching undercoat prior to enameling. This is necessary so that the paint will adhere to the aluminum. Air leakage from the pressurized chassis must be minimized by use of a gasket between the bottom plate and the chassis. I used a sheet of plastic covering the entire bottom plate and cemented it to the plate in a few places to hold it in position. Using a sheet the full size of the plate is much easier than cutting a gasket to the width of the chassis flanges and then trying to position it properly for alignment with the holes in the chassis. Three one-inch holes containing shielding inserts are cut in the front panel for viewing the tube.

Practices of importance in rf amplifier construction are as follows:

1. Ground components directly to the chassis by the shortest route. Do not use a single point ground.
2. Use coaxial connectors and feedthrough capacitors or filters to bring conductors into the enclosures. Sprague 0.01 uF high pass capacitors are good as are a number of surplus line filters.
3. Use shielded wire for filament, power, and metering leads inside the amplifier chassis.
4. Use 0.01 or larger filament bypass capacitors. Use mica capacitors for the two marked M on the schematic.
5. Keep the lead from the plate cap to the switch and from the switch to the plate tuning capacitors as short as possible to minimize parasitics. The leads from the plate tuning capacitors to their respective coils can be longer, although if the construction practice used here is followed, they will be quite short.
6. Place coils at least one coil radius away from metal panels to keep eddy current losses at an acceptable level. The end of the plate coils opposite from the plate lead are intentionally placed ¾" from the adjacent metal panel to provide a 8 pF capacity to ground to balance the output capacity of the 4-1000A.

Tuning

Tuning of the amplifier input and output networks and adjustment of the antenna tuner is performed at this QTH using an antenna noise bridge. The following procedure is used. Remove the amplifier from the cabinet and remove the bottom plate. Place the 4-1000A in its socket and connect the lead to the plate cap. Connect a 3000 Ohm non-inductive resistor from the plate connection at S2B to ground. Connect a 100 Ohm non-inductive resistor from one side of the filament at the socket to ground. Connect the noise bridge antenna jack to S1A at the exciter input line connection points using leads as short as possible. Place S1 in the 80 meter band select position. Set the receiver (which is connected to

C1 – Small broadcast variable 300 pF
C2 – Small broadcast variable 150 pF
C3 – Small broadcast variable 200 pF
C4, C5 – Small broadcast variable 100 pF
C6 – Small broadcast variable 50 pF
C7, C8 – 50 pF vacuum from Command Set Antenna Tuning Unit (surplus)
C9, C11, C16 – National type AMT split-stator 50-50 7500 V
C13 – National type AMT split-stator 25-25 7500 V
C18 – B&W split-stator 100-100 4500 V
C12, C14, C15, C17 – 150 pF variable 0.020 plate spacing
C10 – 350 pF variable 0.020 plate spacing
L1 – 80 meter line 21 turns No. 22 DCC (see text)
L2 – 80 meter cathode 40 turns No. 22 DCC (see text)
L3 – 40 meter line 14 turns No. 14 DCC (see text)
L4 – 40 meter cathode 25 turns No. 14 DCC (see text)
L5 – 20 meter line 5 turns No. 14 DCC (see text)
L6 – 20 meter cathode 9 turns No. 14 DCC (see text)
L7, L8, L9, L10, L11, L12, L13, L14, L15, L16 – see text
J1, J2, J3, J4 – UHF receptacle JAN type SO239
J5, J6 – UHF receptacle (twin) JAN type UG-102/U
J7, J8 – HV insulated binding post from Command Set Antenna Tuning Unit (surplus)
RL1 – surplus 28 V dc, two sets N.O. contacts required
RL2, RL3 – Ceramic insulated relays 28 V dc from Command Set Antenna Tuning Unit (surplus)
RL4 – Leach 0-60 second time delay relay 24 V dc (surplus)
RL5 – Basco SRIC2A2, 11000 Ohm coil dc relay
RL6 – 240 V ac relay, 2 sets N.O., 10 Amp contacts
T1 – 120 V primary, 32 V secondary, 1 Amp
T2 – 240 V primary, 4200 V secondary, 500 mA
T3 – General Electric Catalog no. 9T92Y14, 0-240 V
T4 – 0-140 variable transformer
T5 – 120 V primary, 7.5 V secondary, 23 Amps
D1 – Silicon rectifier, Slater Elec. Co., Part No. SLA08-2, 400 mA, 8000 PRV (Ref. 2)
D2 – Silicon diode 0.5 Amp, 75 PRV
RFC1 – Barker and Williamson FC-30A
RFC2 – kW HF choke
RFC3, RFC4 – Ohmite Z50 VHF choke
Filter capacitors – use at least two, 4 uF 4000 V dc working voltage
S1 – 2 section, 3 position small ceramic
S2 – 2 section, 3 position heavy-duty ceramic (surplus)
S3 – 1 section, 3 position heavy-duty ceramic (surplus)
Blower – see text
Rf ammeter – General Electric from Command Set, 0-10 Amp
Chassis – 17" x 20" x 4", made up of two 17" x 10" x 4" chassis fastened together with machine screws
Chassis – 17" x 20" x 2", made up of two 17" x 10" x 2" chassis fastened together with machine screws

Table 2. Component list.

the noise bridge) to the band center or other frequency at which it is desired to resonate the amplifier input network. Set the bridge to 50 Ohms and rock C1 and C2 to minimum dip of the receiver S-meter. Repeat the procedure for the 40 and 20 meter input networks.

Connect the noise bridge ANT terminal to the antenna connection (J2) of the amplifier. Apply 28 V dc to RL1 to actuate RL2 and RL3, or close RL2 and 3 mechanically so that S2B is connected to J2. Set S2 to 80 meters. Set the receiver to the band center or other frequency at which it is desired to resonate the 80 meter output network. Set the bridge to 50 Ohms and rock C9 and C10 to the minimum dip of the receiver S-meter. Tune the 40 and 20 meter networks in a similar manner.

Connect the antennas to the antenna tuner and the bridge ANT terminal to J3. Set the bridge to 50 Ohms and S3 to the 20 meter position. Tune C15 and C16 for a dip. Repeat for the 40 meter antenna. This completes the tuning procedure. Remove the 100 and 3000 Ohm resistors. Replace the bottom cover, replace the amplifier in the cabinet, and connect up all cables and the cooling hose.

Operation

In operating the amplifier, set S1, S2, and S3 to the desired band, check that the two variacs are turned to zero, turn on the power, and bring the filament up slowly to 7.5 volts. When the 60 second time delay actuates and the red panel light comes on, turn up the plate variance to 3700 volts reading of the panel voltmeter (HV will drop to 3600 under load). At this point, the plate and grid current meters will read zero. Actuate the VOX relay by grounding the VOX lead to the exciter. Grid current will read zero and plate current will read about 55 mA. With the exciter in the CW tune position, turn up the exciter drive control until the plate current meter of the amplifier reads 260 mA and grid current reads 50 mA. Allowing for feedthrough power from input to output, the input power to the plate circuit is now just under one kW for CW operation.

Grid current for single tone input runs 70 mA with plate current at 280 mA. The SSB input for this condition is 1 kW PEP. To correctly adjust the amplifier for 2 kW PEP, a two tone generator is required. If you do not have a generator available, adjust the amplifier for 2 kW PEP input by talking into the microphone at your normal voice level and distance from the microphone and increasing the drive until the plate meter peaks reach 265 mA. Grid current peaks will be about 60 mA for plate current peaks of 265 mA. The actual current peaks are approximately double the values of the meter readings. Table 1 shows maximum tube ratings at a plate voltage of 3600 V dc. ■

References
[1] The Cool Amp Company, 8603 S.W. 17th Avenue, Portland, Oregon 97219.
[2] R. E. Goodheart Co., Inc., Box 1220GC, Beverly Hills, California 90213.

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N. 6707 Standard #3
Spokane WA 99208

Build a $2 Drill

-- and put your razor to work

If you need to drill small holes, this little motor is handy and inexpensive. It easily drills through 1/8" of bakelite, fiberglass or aluminum. It beats putting a #60 (.040") drill in a motor and immediately breaking the bit. Small sizes need speeds up to 7000 rpm or more.

The following describes conversion of Sunbeam "Shavemaster" razor motors into useful hand-held drills. Model "W" seems to be plentiful at local salvage stores of Goodwill Industries, St. Vincent dePaul and Volunteers of America, at prices from 15¢ to 50¢.

The procedure is as follows: Remove two screws from the bottom of the plastic case and lift out the works. Brush off any dust and clippings. Remove the retaining washer from connecting rod and take off the nylon rod. Remove 4 screws and discard all oscillating shaver parts, but retain the large diecast plate.

Unsolder two wires from ac power input post.

Remove two brush holder clips, keeping your fingers over the holes to prevent the brush springs from flying away. Remove the 4 hex nuts holding the end bell to the motor frame. Slide out the armature.

Carefully remove the two motor brushes. If they are less than ¼" in length they should be replaced (shaver repair stores have them). Brush out carbon dust, etc.

Place the armature in a vise and unscrew the crank (counterclockwise). Discard the crank. Run a 4-40 tap into the hole in the shaft. This is preferably done in a metal lathe but can be successfully performed by hand. On the reverse end of shaft, saw a screwdriver slot with a miniature hacksaw blade. File off any burrs left by the saw.

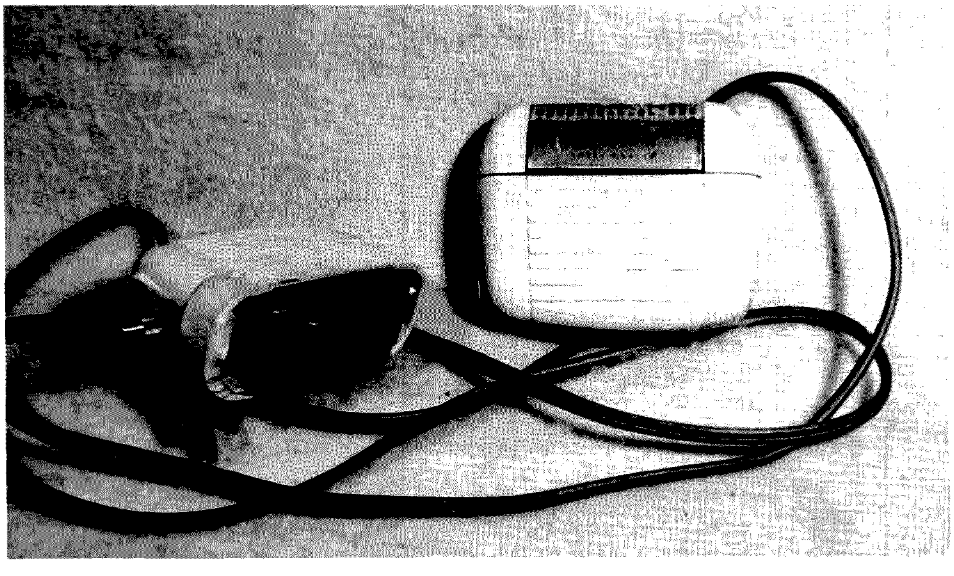
Place a drop of oil on each bearing and, if there are spacer washers on the shaft, put at least one on the commutator end for a thrust bearing. Reassemble the motor and solder the wires back on power input post. Now, test the motor.

Take the plate saved from shaving mechanism and saw off the bosses or projections that held the shaft. File it smooth, and round off all corners and edges as you hold this in your hand after assembly. Replace on the motor frame.

Drop the motor back in the plastic case and measure points on the housing even with ends of the armature shaft. Drill ¼" holes in each end. Enlarge the crank opening to ½", preferably with a tapered reamer, as it is very easy to split plastic with a large drill.

Obtain a steel 4-40 machine screw about one inch long, and cut off the head, leaving it about ¾" in length. Smooth the threads in a 4-40 die if possible. Screw this into armature shaft.

If you have the original power cord with the special



plug, put the motor back in the case. If the cord is not available, use an ordinary lightweight zip cord and solder it onto power post.

Purchase from your local hobby store a No. 22B-C X-Acto drill chuck adapter. If not available in your area, you can order the chuck from X-Acto Corp., 48-31 Van Dam St., Long Island City, New York 11101. This size chuck accommodates No. 63-50 drills.

Place the chuck shaft in a 3 jaw chuck on a metal lathe and tap it with a 4-40 tap about 3/8". This can possibly be done by hand, but risks going in crooked and breaking the tap.

File two flat places on opposite sides of the shaft where the X-Acto name is stamped. I made a small wrench from a scrap of 1/8" steel to fit the flats. Screw the chuck onto the armature shaft, holding it with a screwdriver in the slot. Put a small drill in the chuck and tighten it with your fingers, holding the chuck shaft with a wrench.

Plug it in and put it to work. This gadget is quite useful for cleaning out solder from holes in circuit boards which have had parts removed.

If desired, a push-button switch can be made using the hole over the power post. This is not easy, but does make it more convenient. It is necessary to make a plastic push-button on a lathe. Drill a hole in it to slip over the concentric power post. I took contacts off a small discarded relay and soldered them onto the power post terminals, so that the button pressed the contacts together. Then one wire to the motor is disconnected from the post and goes directly to the power cord (which comes in from a new hole drilled in the opposite end of the plastic case). The other wire goes in series with the switch contacts. ■

Unique Power Supply Tester

- - uses a load bank

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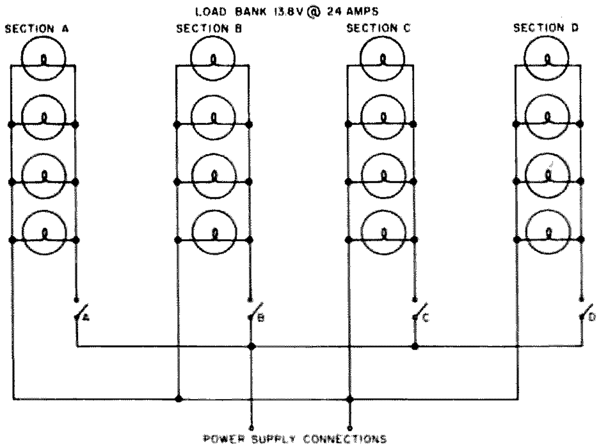
The first question asked might be, "What is a load bank?" The term is taken from the electrical power industry to explain a device to simulate a load on various power sources in order to check the load performance of those sources. In this case, the article covers the building of two simple load banks or dummy loads for small and rather large sized dc power supplies that are finding present usage with hams and hobbyists. This article shows how it can be done economically and with readily available parts. Also, using the basic ideas presented here, load banks for most any type of low voltage power supply can be built.



Section	*Load*	*Current in Amps @ 13.8 volts*
A	*33%*	*8*
A & B	*66%*	*16*
A, B, & C	*full*	*24*
A, B, C, & D	*133% of full*	*32*

Fig. 1. All bulbs #1073. All wire #14 TW. A, B, C, D – 10 Amp relay contacts or 10 Amp switches (optional since connections can be made directly).

In order to properly evaluate the performance of a power supply (whether home built or commercially built), the supply must be tested at various degrees of loading – that is, no load, half load, full load, etc. The major requirement for a suitable load bank is that it be capable of providing these various load conditions. Thus, several load elements are required, or at least one large variable element is required, in order to cover several different load conditions. These load elements would typically be large fixed or variable power resistors. If the power supply is of any size, the load elements have to be of high power rating (10, 25, or even 50 Watt). A look at a parts catalog will show that power resistors get expensive as the power rating goes up and the different ohmic values available go down. Also, power resistors present the problem of how to get rid of the heat and how to conveniently mount the resistors.

Instead of using the regular power resistor in the design of these load banks, automotive bulbs and pilot lamps were used. These are readily available at auto parts stores, electronic parts houses, and even department store electrical parts sections. Bulbs are selected on the basis of voltage and current requirements and typically work out very nicely in regard to both values. The problem of power dissipation is very minimal and mounting can be very simple. With the load elements decided, the actual construction of the load bank can begin.

The first load bank requirement was for a rather large 13.8 volt dc 24 Amp dc supply. It was decided to check one third, two thirds, full load, and 133% of full load. Voltage and ripple were observed under the various load conditions. The #1073 automotive bulb was selected with a nominal rating of 12.8 volts @ 1.8 Amps. Typical cost is less than 30¢. Since the power supply voltage was to be a volt higher, the current at that voltage was approximated to be about 2 Amps. This is a fine feature of these bulbs – the voltage can be increased up to 20% of nominal rating without any problem in this application.

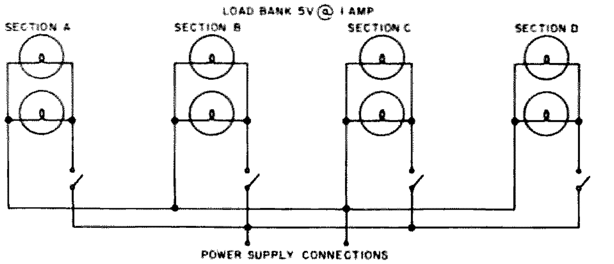
The bulbs were arranged in four groups or sections of four each. See Fig. 1 for the circuit diagram. Each group presents a load of about 8 Amps at nominal voltage to simulate four load conditions. In order to keep costs down and construction simple, the wires consisting of #14 TW wire were soldered directly to the bulb bases. The start and end of each section wire were wrapped around a nail which was driven into the wooden base board. This eliminated expensive sockets and, after all, a load bank is not a device that is normally on display in the shack.

Since this load bank was to be used for a considerable

amount of testing and since four surplus relays were available, each load section was wired through relay contacts as shown in the diagram. Any combination of loading can be quickly selected. This extra feature can be eliminated with just the use of solder connections or switches with proper current rating. The switching feature is certainly handy if considerable testing is to be done, but adds considerably to the parts cost if the junk box is not well stocked.

The second load bank was for a much smaller dc power supply with a rating of 5 volts @ 1 Amp. Following the same design features of the previous load bank, a #502 bulb was selected as load element in four sections with two bulbs in each section, giving 30%, 60%, 90%, and 120% of full load. Since the current requirements were much less, about 0.3 Amps per section, regular #22 solid hookup wire was directly soldered to the bulb bases and toggle switches (or even slide switches) used for controlling the load sections. A small wood base board was again used for mounting the bulbs and wiring with a small 1/8 inch pressed board panel (nailed to the edge) to support the switches. This supply is most useful for checking logic power supplies used with ICs. Overload or current foldover characteristics can be checked on supplies designed with that feature. See Fig. 2 for the circuit.

There are many advantages to these simple load banks besides the cost and ease of construction. The bulbs present a large amount of light under full load to leave no doubt that the supply is working. Also, there are no burn marks from power resistors on the workbench or, even worse, the dining room table. Buying the bulbs by the box reduces cost, and automotive type bulbs are readily available, even at gas stations.



Section	*Load*	*Current in Amps @ 5 volts*
A	*30%*	*0.3*
A & B	*60%*	*0.6*
A, B, & C	*90%*	*0.9*
A, B, C, & D	*120% of full*	*1.2*

Fig. 2. All bulbs #502. All wire #22 solid. A, B, C, D – 0.3 Amp switches.

The purists may argue that the bulb is not a constant load resistance due to the filament characteristics. This sudden heavier than normal load when voltage is first applied to the bulb is very short in duration and provides an even stricter load test of the supply being tested.

The load bank ideas presented here can be extended to other sizes and types of load banks by changing the bulb types and the number of bulbs in a section, and even the number of load sections.

These load banks have been used to check voltage and ripple conditions on a variety of home brew and commercial supplies. The cost is certainly cheap if proper shopping around is done on the choice and source of bulbs. ■

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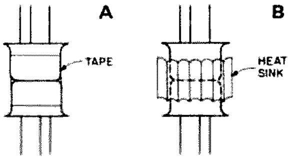
Instant Spares

-- for those after-hour repairs

The time required to restore failed equipment depends often on locating the spares. The simple scheme described insures that replacement plug-in devices are always available at the exact point of need.

Fig. 1. Self-storage of spare TO-5 devices. (a) Bonding with transparent tape. (b) Bonding with a common heat sink.



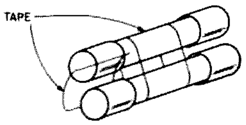


Fig. 2. Cartridge-type fuses, bonded with transparent tape.

The method is to combine the operating unit and an identical spare into one double-ended package. The example shown in Fig. 1(a) joins a pair of identical transistors back-to-back, using transparent tape, so that identifying data remains visible. TO-cased devices requiring heat sinking may be joined using only the heat sink as in Fig. 1(b).

When equipment failure occurs, the plug-in packages are simply flipped over one at a time, to isolate the problem to the device or other components.

Equipment using several identical plug-in units may not justify the cost of a spare for every socket, and a lesser quantity would be adequate.

Many other plug-in units, ranging from DIP ICs, automobile fuses and flashers, to household plug fuses and fluorescent starters lend themselves to this sparing technique, as suggested in Figs. 2 and 3. ■

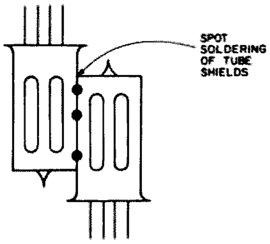


Fig. 3. Method of storing spare miniature vacuum tube.

Light Up Your Bench

-- versatile power distribution system

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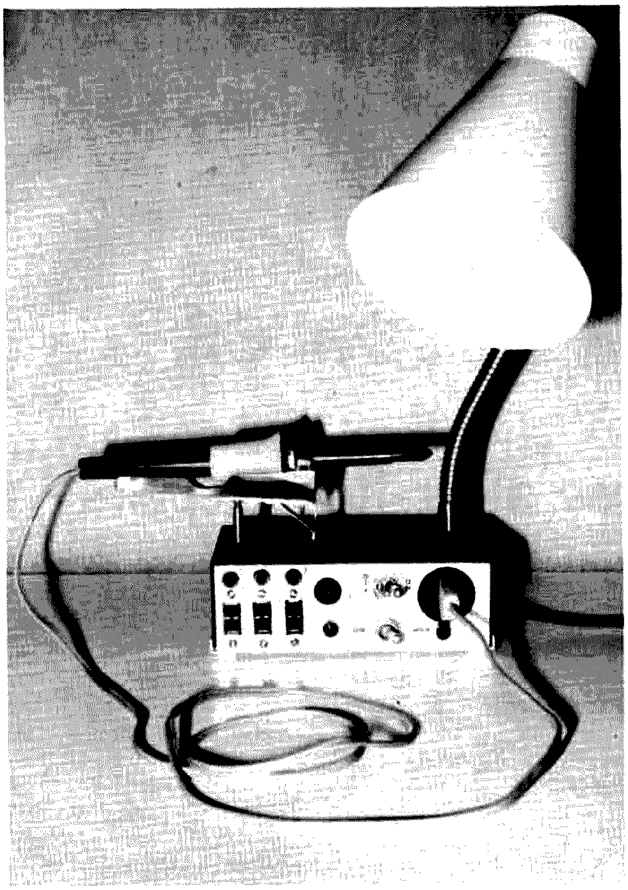
My workbench becomes a mass of ac cords just about every time I dig into a project, leaving limited work space. In the middle of the confusion, I entertain the thought of constructing an ac receptacle that will be portable on the bench and at the same time have some fuse protection for equipment under repair or construction.

Another nagging workbench item is the soldering iron. It would be difficult to determine how many times it sat on the bench cooking for days, or how many times I accidentally burned myself or damaged material lying on the workbench.

Well, thanks to *73* and Arny WB4FDQ, I got off dead center and built my magic box. Now I have a portable switched 3 outlet ac power source with 2 of the outlets fused, directional control light source, soldering iron power source with high/low heat, and removable heat shield stand for the soldering iron.

This was another junk box project from start to finish. Selection of components is not critical as long as they can handle 115 volts at 5 to 9 Amps. In addition to the basic tools, a small punch set and nibbler were needed. If you don't have access for borrowing one, Lafayette Radio usually has them in stock at a modest price.



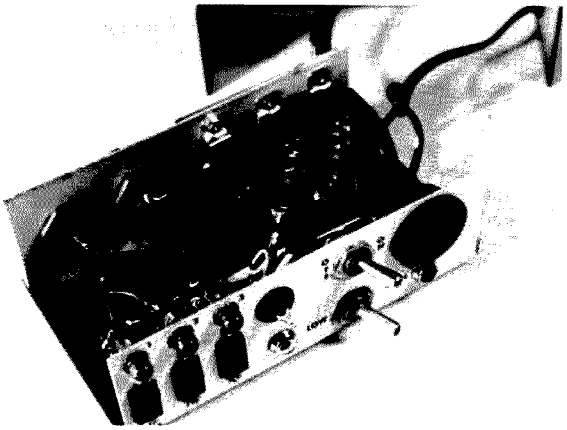
Workbench magic box with soldering iron in place and plugged in. Although the switches and fuses are on the rear panel, I elected to locate the indicator lights above the respective outlets. If the receptacle for the soldering iron was relocated to the left side panel, the cord might be easier to handle.

The project began with Arny's article and circuitry in *73*'s July issue. I did replace his S2 switch with a DPDT switch and eliminated the number one position as he suggested. In addition, I utilized a three prong safety cord to ground the case.

Fig. 1 is the schematic circuitry of the magic box. I decided I wanted a few luxuries not really needed. A neon indicator light is always on as long as the box is plugged in. The indicator lights for outlets 2 and 3 are wired behind the fuses to indicate when a fuse is blown. If the builder is working with very low current fuses, the indicator light load should be placed in front of the fuse so as not to increase the current drain at the outlet.

My aluminum case was 3" x 5" x 2" and was used in several earlier projects. I tried to place all the wiring in the lower half to simplify construction. The cradle microswitch support is the frame of a broken rocker switch.

The soldering iron cradle was constructed from sheet aluminum. The microswitch is operated by a plunger-type rear support. A standoff



Internal parts placement should allow working space for top cover microswitch assembly. The light unit had its own power switch, eliminating the need for a switch on the chassis.

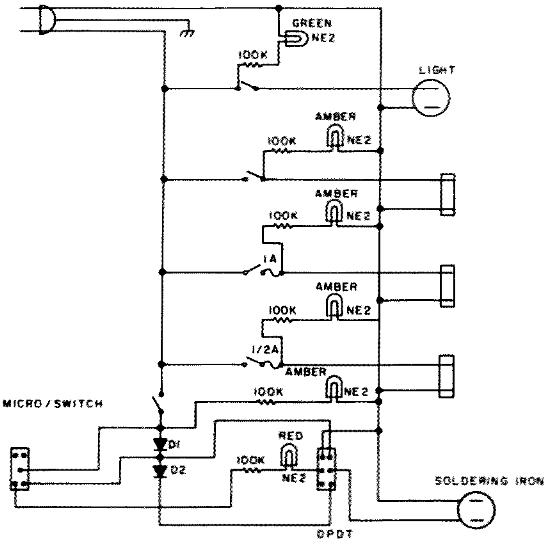


Fig. 1.

spacer with bolt for plunger works well. The plunger was designed with 1/8" travel, allowing plenty of movement to insure switch operation and still protect from excess weight being placed on the cradle.

The light source is an old desk lamp fixture. Placement of the light should allow free access of the soldering iron for right- and left-handed users. A high intensity light unit would make a better light source.

Parts placement is not critical.

With a little effort, your magic box can be made to look store-bought. Remove all dirt and grease from aluminum and use a good primer base. Aerosol lacquer spray paint is easily found in auto supply houses and hardware stores. I used rub-on lettering that I bought at the ham store and then sprayed with a clear lacquer for added protection. Painting and labeling should be done before component assembly. Allow a day or two after painting for finish to reach maximum set.

Don't let the simple wiring circuitry mislead you into not checking before attaching to ac line. The accompanying photos were supplied by Don Smith WA3VEA.

The completed project will provide invaluable service on or off the workbench. ■

Hang Ten

-- relay slow release circuit

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These are old phone company central office equipment circuits that are still used in today's modern electronic exchanges. Perhaps you may need only a slight or a very slight amount of delay-release in a relay(s) control circuit of yours. One way is to re-tension the relay springs by bending or "kinking." This practice (also used in C.O. equipment) is subject to the aging process and, with time, will change its characteristics. Here are two simple ways to have *stabilized*, short-delayed release in a relay.

The circuit in Fig. 1 gives very slight delays. The amount of delayed release is subject to the amount of current drawn by the coil and the coil's resistance.

Want a little more delayed release time for a given coil? Try Fig. 2. This one can be discernible to the naked eye in delayed releasing, dependent upon the coil current and resistance. Note the diode polarity; otherwise, you may end up with a short circuit!

"Ah-ha," you say, "but Fig. 2 is used to suppress the coil's inductive voltage kickback, for solid state or contact protection." That is correct! This is why sometimes electronic keyers can't follow high-speed sending when using reed relay outputs.

Maybe this bit of info will help solve your "knotty" relay timing problem(s)? ■

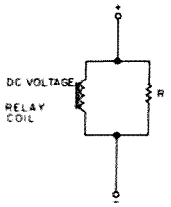


Fig. 1. Simple, compact, dc relay delay circuit. Shunting resistor should be five times the dc resistance of the relay coil. Wattage rating of resistor equals ¼ the power (in Watts) drawn by coil.

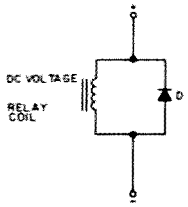


Fig. 2. Note polarity of shunt diode! Also observe diode's piv rating.

73 Magazine *Staff*

Using the Atlas Transceiver

-- practical experiences

The Atlas 180/210 series of transceivers has been used by now in every conceivable type of portable and mobile application from bicycle portable on up. This article presents a few operating notes and simple modifications for the transceivers which have been developed out of experiences using several of the units over the past year.

Fig. 1. A size comparison between a 210 and a Globe-Union battery pack which will power the unit at almost full power for several hours of intermittent operation.

For fixed station operation, the transceiver can be powered from anything from an automobile storage battery to one of the power supplies sold by Atlas. The automobile battery approach costs about $30 for a suitable battery plus the cost of a commercial or home brew charger. A standard Sears 60-80 Ampere/hour (20 hour rate) battery will easily keep the rig going for 4 hours of operation at full power. A relay can automatically switch in the charger. The advantages are a completely hum-free power source and a rig that is always ready, even if commercial power fails. The only disadvantage is the need to observe the usual requirements for ventilation, etc., when charging the battery. Home brew transformer type power supplies can also be built as long as they can supply 8 Amperes continuously and 16 Amperes peak while holding the output voltage between 12 and 14 volts. A minimum of 25,000 mF output filtering is necessary to keep hum at an acceptable level.

Moving towards portable operation, several power supply options exist. Atlas does sell a compact $100 110/220 supply which weighs about 15 pounds and will supply full power input. Some amateurs who have been willing to operate portable at the opposite end of the power scale have taken out the speaker in the transceiver and installed a simple 12 V dc supply in the space that will power the rig to a few Watts.

Also, the approach has been used for QRP portable, using a hefty wall plug type transformer and then placing the power supply filter components around the speaker (leaving the speaker installed) for portable operation where ac is available. However, for reasonable power output and true portability at an economic price, some form of rechargeable battery pack is probably best. Nicad batteries, if they can be found at a suitable price from a surplus outlet, are always a good bet. 4.5 Ampere/hour units (20 hour rate) will power the transceiver, although a heftier size up to 7.5 Ampere/hours is preferred. The Eveready or Gould rechargeable batteries being sold to power portable TV sets are a good economical approach. Lastly, one can use a gelled electrolyte type battery pack (such as the Globe-Union GC-1200 type, available from Burstein-Applebee at $60.00) which

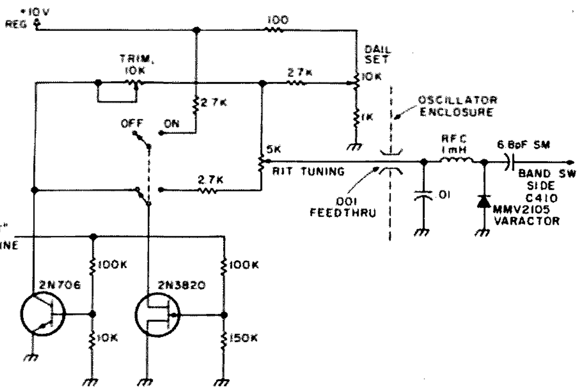


Fig. 2(a). This is the original RIT circuit developed for Atlas. Note the "Dial Set" capacitor is also replaced by a pot. With RIT on and RIT pot centered, zero beat calibrator signal with the "Dial Set" pot. With RIT off, zero beat signal with the 10k trimpot (mounted internally).

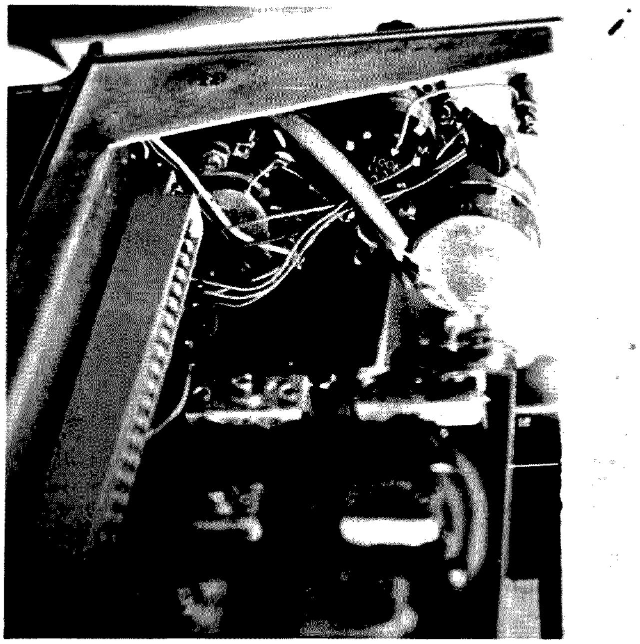


Fig. 2(b). This photo shows how the RIT potentiometer has been placed between the function switch and the ALC/MIC gain control. One of the trimpots for the RIT circuit is mounted directly on the potentiometer.

combines really compact size with good power capacity and a life of about 300/500 charge/discharge cycles. Such a battery pack is shown in Fig. 1 for a size comparison with the transceiver. The operating time that can be obtained from *any* battery setup depends on the input power level and the ratio of transmit to receive time. A QRP enthusiast can operate all night from a 4.5 Ampere/hour battery pack while, if using full power, the time would be about one hour. The microphone gain on the transceiver controls the PEP input level, of course, on SSB, but also the carrier level on CW. So, the decision is up to the operator as to the choice between operating time and the power input used.

Fig. 1 shows also an oversize tuning knob being used. The basic 15 kHz/revolution tuning rate seems to be convenient, but it is made even easier to use by a larger knob. A simple hole drilled partly into the knob with a large drill provides a simple "finger hole" for quick spin-type tuning across a band.

Improvements for SSB operation are hard to suggest for this rig. It has a fine sound on SSB and one of the sharpest filters used in an HF transceiver. But, a few simple items can improve operator convenience greatly. For instance, the aircraft pilot Plantronics type headsets, which essentially consist of a small transducer mounted over one ear with acoustic tube coupling for a pencil type microphone and a flexible tube fitting in the ear for a headphone, are now becoming available (see Godbout ads in *73*). These units are not cheap ($60), but they are excellent quality units, provide very sharp shaped speech response and, of course, provide complete "hands-free" operation. These headsets will be covered in some detail in a future article, but they are very easily adapted for use with the Atlas transceivers. Basically, the amplifier which comes with the headset need not be used, and the headphone element can be connected directly and the microphone element used via a 1k Ohm to 20k Ohm stepup audio transformer.

VOX is always a handy feature, especially for mobile operation. It can be added for $7.00! The key is the use of a simple Radio Shack "Science Fair" Voice Controlled Relay Kit no. 28-131. This kit is meant to be wired on a rather large perfboard moulded chassis, but it can be wired compactly on regular PC board and tucked in a corner of the transceiver. It was meant to be powered from a 9 volt battery, but operated well from the 12 volt line in the transceiver via a 220 Ohm dropping resistor. The kit, as it comes, has a sensitivity control, but not an adjustable time delay control. The latter feature is easily added by placing a 250k PC type potentiometer across C5 (the only 100 mF capacitor used in the kit). The relay that comes with the kit is wired to activate the PTT line. The first two stages of audio amplification used in the kit circuit can even do double duty as a microphone preamplifier, if desired.

Receiver Incremental Tuning (RIT) is one of those convenience features which can be debated on a transceiver. Obviously it is not needed for home station operation if a separate VFO console is purchased. It can be lived without for portable or mobile work, but it is handy to have. Atlas thought about RIT and paid to have a suitable circuit developed. But, how many controls, switches, etc., can you fit on the front panel of the Atlas rigs? For mobile operation, a noise blanker is a useful accessory, and Atlas opted to provide a front panel control for this accessory item. However, if the blanker is not installed, the available front panel space can be used to install an RIT circuit. The RIT circuit developed for Atlas is shown in Fig. 2(a). It is completely electronic. The MMV2105 varactor diode can be substituted by one from the Motorola MV series or even *some* ordinary 1N4001 rectifier diodes have worked. The original part, if you want it, is available for $1.50 from

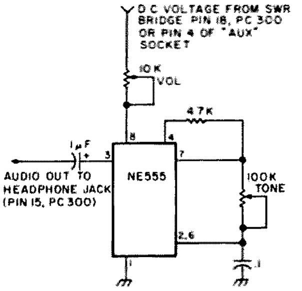
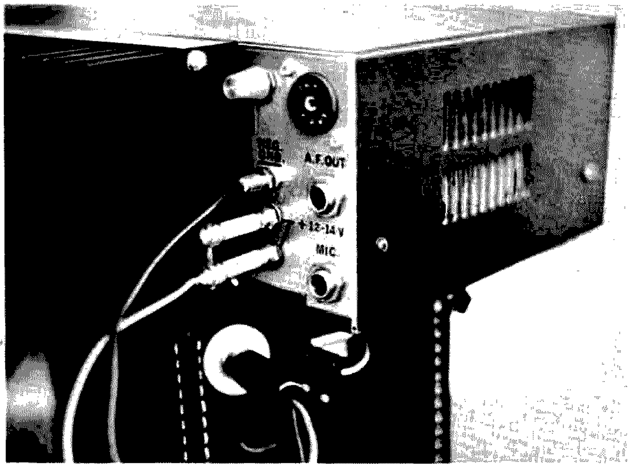


Fig. 3. The NE555 does it again, this time as a simple CW monitor for the Atlas transceivers with adjustable tone.



This photo shows how a miniature pot can be mounted on the rear panel as a volume control for the CW monitor of Fig. 3. It also shows the method of connection for the transceiver to a battery pack for portable operation.

Circuit Specialists, P.O. Box 3047, Scottsdale AZ 85257. The 5k tuning control provides a plus/minus tuning range of several kHz, although it is not uniform on each band. The tuning control is mounted on the front panel between the microphone gain and function switches. The photo of Fig. 2(b) shows how the potentiometer is mounted behind the front panel and how one of the PC type adjustment pots is mounted. Since only dc wiring is involved *outside* the oscillator enclosure, some liberty can be taken in the placement of the various components. Inside the enclosure, the varactor diode and 6.8 pF coupling capacitor must be securely fastened. A miniature DPDT toggle switch can be mounted any place panel space is available to turn the RIT on and off, on a 5k tuning point can be added with a switch to control a DPDT relay performing the same function.

The Atlas rigs are oriented towards the phone man, but they can make an excellent CW rig. In fact, for a rig so extremely well suited for portable emergency operations, it is a pity that the most fundamental mode of emergency communication, CW, wasn't a bit more emphasized. However, a few features to make CW operation enjoyable are easily added.

If one wants to go all the way, a complete electronic keyer can be built into the rig, such as the miniature Mini-MOS keyer described by WA6EGY in the Aug. 76 *73*. This keyer includes a monitor which also nicely takes care of the lack of the latter in the Atlas rigs. If one wants to add a monitor and use a hand key, the circuit of Fig. 3 is very suitable. The circuit is actually rf powered, although this is not obvious since pin 8, via the 10k pot, is actually connected to an rf rectified voltage point of the swr bridge built into the transceiver for swr protection of the output stages. Both volume and tone of the CW monitor are adjustable. These controls can be PC board types, adjusted once and left alone, or they can be brought out as back panel controls.

Finally, for enjoyable CW, one does have to add more selectivity. Abundant active audio filters have been described to suit the purpose and so this point won't be belabored. Fig. 4 shows one very suitable low cost active audio filter which peaks about 750 Hz. It can be connected in the Atlas audio chain by breaking the leads before the af gain control or used as a separate circuit only when headphones are plugged in. There are enough contact possibilities on the headphone jack to arrange this. Used this way, the problem of providing an in/out switch for the peaking filter is avoided. As with almost any active audio filter, the key to obtaining the best performance from it is not to overload it. Driving it too hard will considerably broaden its selectivity peak and produce a "mushy" output.

Those using Atlas rigs with some of the earlier Atlas ac power supplies have noted a disturbing dimming of the panel lamps during modulation. Atlas has produced a power supply modification which takes care of this problem. Fig. 5 highlights the modifications necessary to improve the power supply regulation so no dimming is apparent. The diagram also shows the complete power supply diagram, in case one wishes to try to duplicate the circuit. A neat construction procedure is used in case of the 1N3491R diodes which form the full wave rectifier for the "high amp" (transmitter) power supply line. These diodes have their anode as a screw stud so they can be bolted *directly* to the chassis of the power supply to form a heat sink for the diodes. The simple 1N4005 diodes handle only the approximate 500 mA load of the transceiver when in the receive mode and require no special care. ■

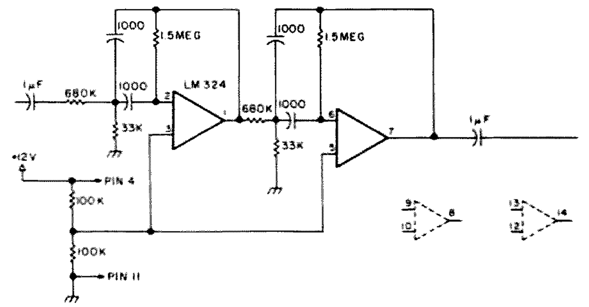


Fig. 4. Audio peaking filter for CW to be installed before the AF gain control or in the headphone lead. Note the two stages are the same. The IC contains two unused amplifiers (dotted lines) and these can be used also for a somewhat sharper filter. The 1 mF coupling capacitors are needed only for in/out coupling, not between the stages.

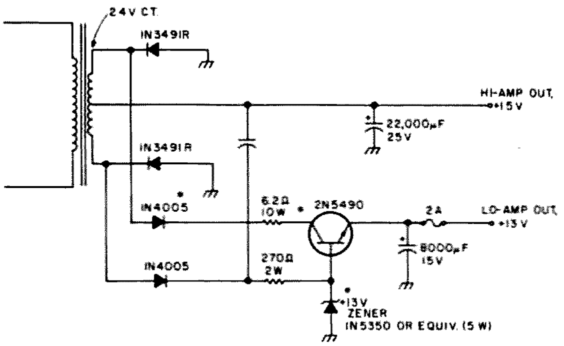


Fig. 5. Diagram of the Atlas ac power supply. The three components marked with an asterisk can be added to earlier model power supplies to improve regulation and eliminate dial lamp blinking during modulation. Home brewers can duplicate the supply if a good 24 volt center-tapped transformer can be found that will deliver 8-10 Amperes continuously.

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PC Layout Tips

- - next time, do it right !

Many easy methods for printed circuit board fabrication have been published before, but most of them are limited in that only simple boards can be produced with them. In these days of IC keyers, IC frequency counters, etc., this is rather undesirable.

I recently ran up against this problem when building the K2BLA keyer (*73 Magazine*, December, 1973). Not possessing a drill press or the fancy photographic equipment that seemed to be necessary for construction of a PC board accommodating ICs, I came up with another method using neither. It will produce a PC board with a minimum of effort.

Assuming that no circuit board plan or template is available, one can be made in the following manner: Lay a sheet of paper on a flat piece of styrofoam or similar material. Now, using actual components, stick them into the styrofoam as they will appear on the finished circuit board and draw connecting lines and pads on the paper. Because of the nature of the styrofoam, components can be shifted and rearranged until a pleasing template is obtained. Here are a few general hints that should help when doing this:

1. Remember that circuit diagrams don't always show Vcc and ground connections for ICs; these must be included on the board for the device to function.
2. Try to bring all outside connections to one side of the board – this looks neater and is easier to work with.
3. A list of interconnections between ICs often helps to place these parts.

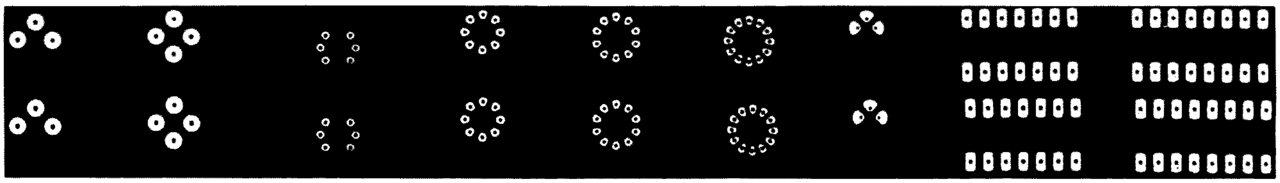
Once the circuit board template is finished, remember that it was made for the component side of the board and is the reverse of the foil side. To get the foil side template, first lay a sheet of paper on a piece of face-up carbon paper. Now lay the completed circuit board template on top of the sheet of paper and trace over the template with a pencil or blunt instrument. The reverse of the template will be transferred to the sheet of paper.

Now locate the points on the board where ICs will be located. Find a pattern that corresponds to the case style of one of the ICs. Remove it from the page (or better yet, make a copy of the page) and tape it by the edges to the place where the IC will be positioned. Now take an awl or a similar tool and position it on one of the small black dots on the pattern. Tap gently on the awl with a hammer or just press down on it until an indentation in the foil is made. Repeat this for each pad on the pattern and then remove the pattern and drill through each indentation with a small drill bit. A #60 bit is good for this purpose.

When the above procedure has been followed for each IC, draw pads around each of the holes – a resist-ink pen will work well. Then draw the rest of the circuit on the board (or use paint, tape, or another suitable resist). Let it dry, and then etch the board.

When etching, try to keep the etchant warm or even hot. This will speed the process a great deal and can be accomplished with a double boiler arrangement (with hot water surrounding the container where the board is etched). Another way to speed etching is to continuously agitate the container.

Now get that keyer – or whatever – on the air! ■



3-lead TO-5 Patterns	4-lead TO-5 Patterns	Dual Transistor TO-5 Patterns	8-lead TO-5 Patterns	10-lead TO-5 Patterns	12-lead TO-5 Patterns	TO-18 Patterns	14-lead Dual In-line Patterns	16-lead Dual In-line Patterns

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Radio Equipment Insurance

- - foil the Hamburglar

Proper insurance on your ham equipment can prevent painful headaches when you have a loss. Proceeds paid out on the loss of ham gear often do not represent actual replacement cost of the equipment.

As a property and casualty agent for an insurance company, I've learned a considerable amount about "proper coverage."

Until recently, most insurance companies have included losses of this type under the comprehensive portion of your auto policy. Due to tremendous losses of CB radios (mostly by theft) reported nationwide, nearly all companies are now excluding two-way communications equipment from this coverage. This is now an optional coverage which can be purchased for an additional premium on your auto policy. And this coverage applies only to equipment which is permanently installed in your vehicle. The rates will vary from state to state, but I've seen $10 per year to $500 per year, depending on the state and the company and the equipment insured.

Most homeowner's, renter's, and mobile homeowner's policies include coverage for ham gear under the personal property section of the policy. This coverage is in force when the gear is located at the insured's permanent home and can be extended, on a limited scale, to cover other locations.

Both the coverage under the auto policy and that afforded under the homeowner's, renter's, and mobile homeowner's policies are good.

But disappointment, disgust, or anger may result when you have a loss to a hamburglar or fire. Depreciation is a factor which all insurance companies use in determining loss to personal property, and this includes ham gear. In the eyes of an insurer, you have possession and use of that gear for one, two, five, or even ten years. So, when arriving at a settlement figure — the check the insurer writes you — dollars of value will be taken off the actual replacement cost of that gear. Depreciation is coupled with any deductibles which almost always apply, and the final settlement may be very disappointing as well as costly for you.

The best way to save grief is to insure your gear on an Inland Marine Floater Policy. This floater is usually attached to the homeowner's, renter's, or mobile homeowner's policy. The premium is not prohibitive, either. Again, depending on your state and your company, premiums per $100 of value may vary from as low as 25 cents per $100 of value to $2 or more.

The biggest advantages of insuring your gear on a floater are that the coverage literally floats with the equipment and depreciation is usually not a factor. As a result, the amount you are paid at loss time has already been determined. This agreed-upon amount is stated right in the policy. And the deductible clause is usually low or non-existent.

Before you run down to your local insurance agent, you should have some facts and figures to present to him. First, write down the make, model, and serial number of each piece of gear to be insured. A brief description of each piece will be required. And, of course, the fair replacement cost of each item must be included. Cancelled checks, bills of sale, or other proof of purchase and/or value will be helpful too. Finally, your agent may require photographs of the equipment to be insured. Even if he doesn't need photos, it's a good idea for you to snap photos of your equipment and file them with your policy and the list of serial numbers. These pictures need not be any more than a sharp Polaroid. Visual identity of the items is the key here.

This may seem like a lot of effort and trouble just to get insurance. But I'll guarantee you that the effort is worth it. You see, all this compilation of info, pictures, values and all has been determined ahead of time — before the loss. And the agreed-upon amounts are what you'll be paid.

With the floater policy, you have protection wherever you may haul that prized gear. It's covered at the ham shack. It's covered while installed in your vehicle. And if you haul it to a hamfest or to a vacation spot, your gear is protected.

And when you have that loss, there is no hassle about depreciation, deductibles, or any of the usual problems involved in handling this claim under standard insurance policies. For the few extra bucks you pay in premium for the floater, you can save on headache and nerve pills when the hamburglar or fire strikes your QTH. ■

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Information Management System

-- organize those articles!

Electronic hobbyists have more information available to them today than ever before: reference books, catalogues, manufacturers' data sheets, magazine articles. And the range of information is wide: stereo, ham radio, computer, CB, SWL, radio control. Even if you're into only one of these electronic hobby fields (and how many of us have only *one* interest?), keeping up with the information you need to stay current can be difficult. Unless you have a photographic memory you can't keep all this information in your head, so how do you get the most out of what you read, and how do you find this information later when you need it? I've developed a technique which may not be foolproof, but for me it is far ahead of what's in second place.

How often have you remembered a magazine article or advertisement, wishing you could recall some pertinent data from it? You can remember the magazine, perhaps even which side of the page it's on, but repeatedly leafing through its pages doesn't turn up the information. The first part of my retrieval technique handles this problem nicely.

Whenever you pick up a magazine or catalogue, be sure you have with you a "Highlighter" or "Vu-Thru" pen. These wide-tipped felt markers use a clear ink and allow you to augment a sentence or word with a colored stripe. I like yellow, but they come in a variety of colors, including blue and pink. They usually cost less than four bits.

Most of the technical publications I read get several readings, each with increasing attention to detail. The first time I'm looking for articles I want to read closely later, advertisements for new products, prices, formulas, or anything unusual or interesting. These items get a liberal swipe with the highlighter pen. This ink rarely bleeds through magazine pages and in no way hurts the future readability of the ads or articles. Highlighting just makes important information easier to retrieve — it'll leap off the page at you.

You'll also need a fine-tipped ball-point or felt-tipped pen to take notes in the margins. Have an idea on how to use an advertised product or how to customize a construction article for yourself? Jot down enough information so you'll know what you meant when you see the note again. Wayne Green talks about how *73* readers can make money with their ideas by telling others, so when you think of a way to make a construction project better, write down a few ideas in the magazine margin. You can develop the idea more fully later with no danger of losing your train of thought. Good ideas sometimes flash and are gone, never to be retrieved.

By the second time you read the publication, you have a new use for the fountain pen. Always check out the "Error" or "Feedback" or "Corrections" sections of the magazine and go back — right then — to write in the correction in the previous issue. It is important to do this even with articles you haven't read or don't see any immediate need for. The surest way to need the information you have available is to let it slip through your fingers. Remember that oddball capacitor you'd saved for ten years hoping to find a use for? When did you need it, finally? Why, as soon as you decided it was cluttering up your junk box and threw it away. Usually a need for the discarded item develops within 48 hours of its departure. Technical information is the same way. Keep everything as up-to-date as possible and you increase the reference value of each of your publications.

I know it is very popular these days to downgrade the value of advertising, to be distrustful of advertisers. What a narrow view. Especially in the technical fields, you usually find out as much or more about a manufacturer's product from his ad as you could from talking face-to-face with a sales person. You learn when new products are introduced, "bigger and better" than the old model; you learn how products from different manufacturers stack up with each other (assuming the advertising is honest — and most of it is); you discover a great deal about product utilization — how to put a given product to work filling your particular needs. And there are ways to gather even more information from the manufacturer, and ways to put the information you have to better use.

Again the old yellow pen comes in handy. Highlight pertinent information such as price, specifications which make a given product unique or uniquely applicable to your needs or addresses of local suppliers. Use your fountain pen for notes in the ads, too. Suppose you're looking for a new 4K memory board for your hobby computer. Everybody is offering a 4K memory board, so to help you compare specs write yourself notes alongside the ads, something like: "See page 116. 4K for $10 less."

The manufacturers themselves want to help us learn as much about their products as possible, yet many of us rarely make full use of the information services available. Most technical magazines, for example, have a reader service card bound into the back of the publication — you know, the card with all the numbers on it? Though I don't have firm figures, I imagine this service costs both the publisher and the advertiser a great deal of money. But it costs even more if we don't use it. As you peruse a magazine and see an interesting product advertised, flip to the back and circle the appropriate number. Don't send in the card until you're sure you've circled all the numbers you want, because most publishers won't process more than one card from

each reader. Even if they did, that would increase the cost of getting the information to you. We can help in a small way to keep down product cost by trying not to tax the resources of the advertisers. Don't send in for information you don't really need, and do use your highlight pen to indicate which advertisers you've asked for data so you won't mistakenly request the same information twice. This could happen if he promoted a different product in next month's issue or had a different ad in another publication. Usually if you circle a number from an ad for a 4K memory board, for example, the advertiser will send you his general catalogue or whatever he has available, in addition to the information you specifically requested. There's no need to send in multiple requests to the same company.

You'll find, too, that most manufacturers are quite helpful in answering specific queries. Write a to-the-point letter explaining where you learned about the product — why you need more information. Then list your questions one at a time and leave adequate space for the company reply. You get quick service this way, you have a record of your questions and the company's reply, and you've saved someone the trouble of writing a personal letter. While not as formal, this technique ultimately provides you and others better service by saving the advertiser or manufacturer time, and since time is money . . . well, you get the idea. You may find that enclosing an SASE with your letter will speed up the reply from some companies.

Now you've got all this information carefully marked and annotated, and your mail box is filling up day by day. What are you going to do with this flood of stuff? An inexpensive filing cabinet and a stack of manila folders are what you need. If you don't already have an office of sorts set up in your ham shack or computer room, you ought to start one. Pick up a cheap cardboard, two drawer filing cabinet from Sears or your local discount store. I paid $5.95 for mine a few years ago. They are lightweight but strong, and will last for years (Sears' latest catalogue lists a two drawer steel cabinet for $19.95, if you want more permanence). One two drawer cabinet probably will last the average hobbyist a long time if he's just using it to store technical information.

Use whatever system is helpful to you, but arrange the information according to subject so you can find it later. I have folders labeled variously: "Clock circuits," "Computers, general," "Memory boards," "Specialty catalogues," "IC data sheets," "Antennas," "Receivers," "Transmitters," "Hi-Fi, stereo, general," etc. Now when you get somebody's poop sheet, give it the highlighter and fountain pen treatment (perhaps cross-referencing the data to the original ad or article that prompted your interest). Then stick it away in the appropriate folder. I usually keep a sheet of notebook paper in the folder, with subjects on it that I reference most frequently. If I learn a useful tidbit of information (a formula, a source for equipment, a building technique), I jot it down on my sheet. I don't have to remember where I saw it when I need it again; I just go to the appropriate folder and look at the latest entries on my hand-written data sheet.

Treat your catalogues the same way. Arrange them on a bookshelf according to subject, highlight portions you find most interesting, cut out and save product information from catalogues you're discarding. Many companies publish IC data sheets, circuit diagrams and the like with their catalogues. This information can be invaluable when filed so you can retrieve it — and it's free. Too, mark the date you received each catalogue near the address label. This helps you decide which catalogues are out-of-date as new ones arrive.

Use a copying machine. Many people have access to a copier at work, or you can find one at the local post office, library or other business establishment. My bank offers a copying service, giving very good quality for a modest price. Expect to pay about a nickel a page for info-only quality, and about a dime a page if you really want that circuit to be as good as the original. If you make a great many personal copies on your business machine, it is only fair to make arrangements to pay for them — probably at a reduced rate. Otherwise, you're stealing from yourself and others who work with you, raising business overhead for personal gain.

By using copies of articles and ads you can file this information away with your mail-outs while keeping the magazine or catalogue intact. There are, however, some publications which you might not keep forever. I take so many magazines that I can't possibly keep all of them on file. So, regularly I go through them and tear out ads and articles I want for reference and throw the rest of the magazine away. This cuts down on the storage problem, while giving you good access to needed information. I usually wait until the year is out, however, before making the decision to rip and file.

Many publications regularly provide instructive articles in a series ("How Do You Use ICs?", in *73*, for example). If the subject is interesting and the articles are well done, why not make up the series into a booklet when it is completed? You can either rip out the originals or make copies. Staple the pages together with a stiff cardboard cover, use a commercial binder you can pick up in the school supply section of your grocery store or discount outlet, or simply put the series in a manila folder and label it. You'd be surprised how useful it can be to have the whole series together so that you can reference it like a book when you need the information. A note on copying: If you think you might want to copy something, don't highlight it first. The highlighted portion sometimes copies dark and is hard to read. So copy the material first and highlight it as you re-read. Of course, you can make your margin notes before copying if you don't use a red pen. Most copiers don't do a very good job of copying red ink.

Another excellent information retrieval aid is the year-end listing of articles provided by many magazines like *73*. Usually published in the last issue of the year, these listings are well cross-referenced and are a great help in finding just what you need for that next project. Again, I find a copy machine helpful. Copy the list, then cut it up according to subject and file the listings with the appropriate material in your filing cabinet. You may not have copied the full article the first time around, but having the cross-indexed reference on file can be almost as good. Alternately, you can hand copy the most interesting references on your notebook paper sheet in each file. If you know enough about your individual needs, you can transfer in a reasonable time all you're likely to want.

One more thing. Keep a card file, 3" x 5" or 4" x 5", depending on your needs. Have you ever spent a long time researching a subject, finally found just the right source, wrote off for the information, and then lost the address? When your query is lost in the mail or in the paper shuffle at its destination, you might have to start all over again with your original research. So keep a

file card copy of what you learned the first time and there won't be a second time.

Long distance telephoning is easy and relatively inexpensive these days, and some of us tend to use it to get technical aid with a specific product. When you have talked directly with someone at a given company, be sure to find out the name of the individual who helped and make a note of the type of information provided, the department in which the person works, the telephone number and the department extension. File away this information on two cards: one with the company name and another under the subject involved (memory boards, to continue our example).

Sound like a lot of work? For someone who isn't used to getting things organized it might, but once the ground work is laid it's easy. Once you get the system operational – i.e., when you've purchased a filing cabinet and manila folders, when you have the yellow (or blue or pink) marker in hand – then the system mostly takes care of itself. You'll likely start out simply, with large subject designations in your files. But as you get more information you'll do away with such general labels as "Computers" in favor of folders marked: "Computers, mainframes," "Computers, memory," "Computers, interface," "Computers, power supplies," and so forth.

You'll soon wonder how you built even a simple code practice oscillator without first researching available circuits from your file cabinet memory. But if you're an addicted saver and organizer like me, you'll have to learn, too, how periodically to sort through your bulging files and tearfully toss out a few sheets you haven't used in a long time – and won't need, until you see the trash man driving with them down the street. ■

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CW Keycoder Improvements

-- visual space indicator

The CW Keycoder 1 authored by WA9VGS in the July, 1976 issue of *73* was excellent. However, there are a couple of modifications that I myself incorporated, and made the project very pleasing. References will be made several times to the above article.

When I went parts searching, I found that the SCR described as a 2N889 or equivalent was hard to find. In fact, in looking through some old catalogs (Deeco, Cedar Rapids IA), they indicated a price of $38.00 each. That, of course, was back in 1968. Recent prices of around $16.00 proved to me that there must be another SCR that would work without putting a dent in my billfold.

Sylvania's ECG 5404 did the trick. There are changes in the circuit, but nothing drastic. See Fig. 1.

Another problem that I encountered was the type of keyboard that I purchased at a flea market. This keyboard was built for National Cash Register by Sanders Associates, Inc. My experience was that only some of the characters would activate the SCR. This had me going for quite some time as all the switches checked out ohmically perfect. Keys that wouldn't function were like the "M" and "N", but "A", "B", "0" would work. In tearing down those that wouldn't work, I found absolutely no difference electrically or mechanically. After a few tests, I found that increasing the cathode current of the SCR helped, but other problems arose. This was not the solution. I finally realized that the particular keys which didn't work also had upper case functions. These glass enclosed reed switches had a different propagation time element. My only solution to this problem was to exchange these switches with extra keys that I wouldn't be using, such as "INSERT FORMAT," "DELETE FORMAT," "SEND BLOCK," etc. There were enough to complete the alphabet and numerals. The moral of this is to be sure of the type of keyboard that you may purchase, and know what type of switches are used.

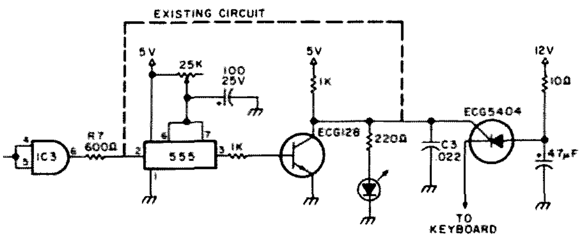

Fig. 1.

I installed the second modification after I used the Keycoder for a while. With the speed control, you are able to control the speed of characterization, but not of the spacing between the characters. Since I use the Keycoder for teaching CW in our amateur classes at our club, it was desirable to be able to send CW at precise words per minute. To meet this requirement, I installed an NE555 timer between the 600 Ohm resistor (R7) and the gate of the SCR. In Fig. 1, you will find that when a low is present on the output of the gate IC3 pin 6, during characterization, this causes a low on the input of the timer pin 2. This starts the timer into operation and a high is then present on the output of the timer. This high turns the inverter transistor on (saturated) and, in turn, the collector voltage drops to zero. This low is applied to the gate of the SCR, which disables the keyboard. With the space adjust pot adjusted properly, the keyboard will not function until the timer has reset. Even when the high is returned to the input of the timer, after characterization, the timer has to reset before a low is presented to the base of the transistor. When this occurs, the collector voltage will go up to the power supply voltage and ready the gate of the SCR. An LED was installed in the collector circuit so a visual indication would be given as to when the keyboard was ready. When the LED is turned on, it means that the keyboard is ready for characterization.

As you can see, this enables one to be able to control the spacing of his characters visually. A calibrated dial can be placed around the space control to indicate the wpm.

Another change that I made to the Keycoder which I feel was worth the time was to install a phono jack on the panel for external keying with a telegraph key. This jack *must be insulated* from the chassis if the chassis is common to the power supply. With a 1k resistor connected between plus 5 volts and the center pin of the jack, and the outer pin connected to pin 4 of IC2 (555), this will permit keying of the sidetone generator and also the relay. With this, we are able to use this keyboard with versatility, especially when we have Novices learning to send CW. It's a beautiful instructor's aid.

I wish to thank WA9VGS for the very fine article and *73* for publishing it. I would like to also thank Hobby Industry in Council Bluffs, Iowa, for their fast parts procurement of the Amidon cores used in this project. ■

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Heath HW-2021 Review

-- a lot of HT for the price

Photos by Jim Gerritz WA4FMA.

When the Heath 2 meter FM HT appeared on the scene, I was in the market for an HT. Many things about the Heath interested me, not the least of which was the price. One hundred seventy dollars ($170) for a 5 channel receive, 10 channel transmit, 1 Watt HT with "rubber duckie," nicad pack and charger seemed like quite a deal – so I ordered one.

My kit arrived and I was really impressed (and a little intimidated) by the piece of Swiss cheese referred to as a circuit board. After checking the parts, I started on construction. Two things became immediately obvious: First, Heath's warning about this kit being "for the experienced kit builder" is very true. It is very easy to make a mistake and constant checking of component installation is a necessity. Second, they make a little remark about taking "a short break after completing each half or full section" of the board. The board is a double-clad glass board with plated-through holes. The side of the board where the soldering is done is coated with some goop which is supposed to, and does, keep solder from flowing where it doesn't belong.

The board is marked into six sections. Almost all of the circuitry is on this one board. I found that one section a night was all I could handle without having a fatigue problem. I would recommend that those of us whose arms get a little shorter each year invest in one of those circular fluorescent lamps with a magnifying glass in the middle.

I had the charger, battery board, and four of the six sections done when it came to my attention that all was not as it should have been. A little investigation and a phone call to Heath showed me my problem. I had an early model with a 00 series number. A little word on the Heath series numbers. These are NOT serial numbers, but identify when the kit was manufactured. The series number is a five digit number, the first two digits of which indicate the revision number. Hence, a series number starting with 00 is an original issue. The third digit is the year of manufacture and the last two digits, the week of that year. The HW-2021 I have *now* is series number 01607 which means it is the first revision, manufactured in the seventh week of 1976.

Well, back at the workbench, Heath offered to send me all the changes in parts and instructions to make my kit up-to-date, but I was a little "gun-shy" and asked for a whole new kit, which they promptly shipped upon return of my partially built kit. The new kit had several circuit and part changes, a whole new instruction book, and three pages of changes to the new instruction book. The early kits had problems with the battery saver circuit, the diode antenna switching, and a lack of drive in the transmitter. There were also problems in the instruction manual. However, the 01 series kit corrected all these problems and my kit was assembled and aligned by the book with no problems. There were a few shortages in the parts list, but these were promptly supplied by Heath.

Circuit Description

Referring to the block diagram, you can see that the receiver is a rather conventional single conversion receiver. Diode switching is used in the antenna circuit (look Ma, no relays or multipole PTT switches). The rf amp consists of two 40673 dual gate MOFETs in common source configurations. A third 40673 is used as a mixer. Two monolithic crystal filters are used at the 10.7 MHz i-f to give a 4 pole filter response. A single bipolar transistor and an RCA CA3089 IC is used as the entire i-f chain and detector. A rather novel circuit innovation is the use of a 10.7 MHz crystal to raise the Q of the quadrature detector. The audio amp is a Motorola MC1454 IC.

The oscillator chain consists of a 15 MHz crystal

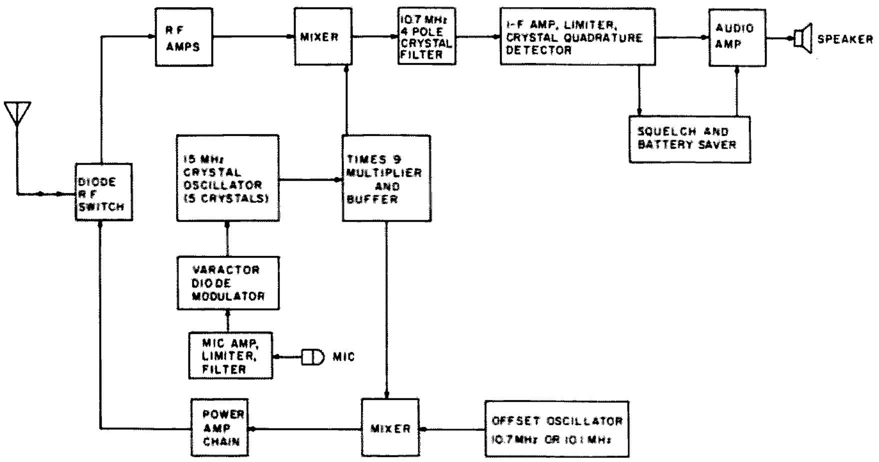


Fig. 1. HW-2021 block diagram.

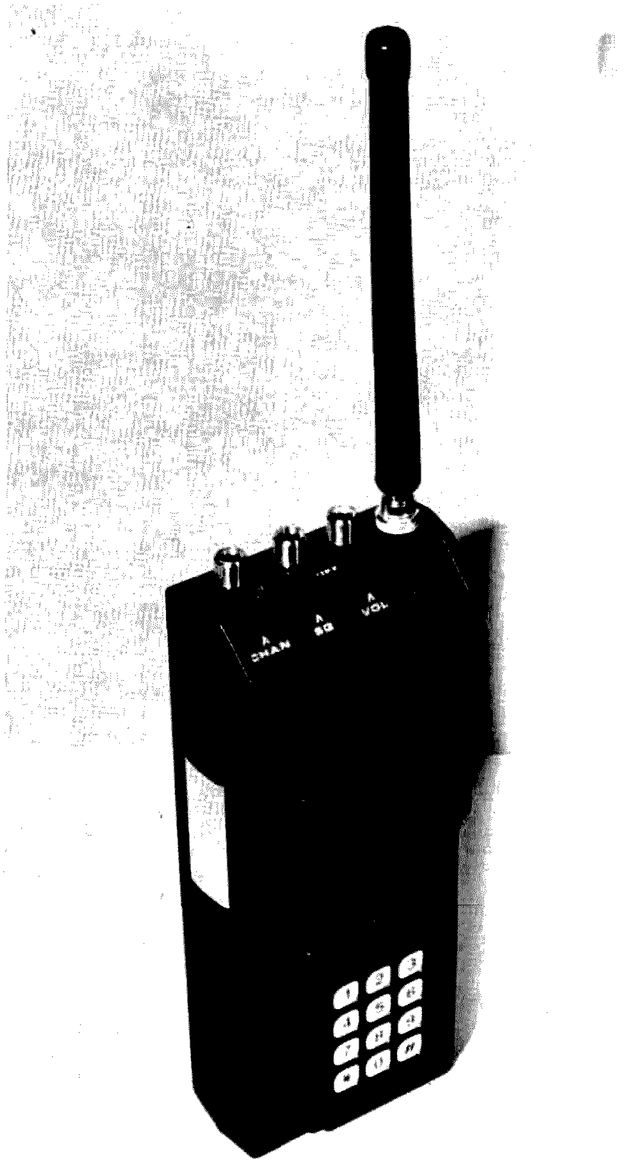
oscillator followed by two triplers and a buffer. There are five diode selected crystal positions, each with its own netting capacitor. The output of the chain is 10.7 MHz below the receive frequency. The squelch and battery saver circuit is one of the unique features of this HT. As long as the receiver is squelched, there is an oscillator that runs at about 3 Hz. The output of this oscillator turns on the entire receiver for about 20 ms three times a second except for the crystal oscillator, which runs continuously. So for 313 ms out of every 333 ms, the load on the nicad pack is just the crystal oscillator plus a small load in the battery saver circuit itself. The audio amp is not controlled by the battery saver but by the squelch, and when squelched, the load is small. All this adds up to a minimal load on the nicad pack when no signal is being received.

When a signal is received (during one of those 20 ms receiver on periods), the squelch is opened, the 3 Hz oscillator disabled, and the battery saver turns on the entire receiver as long as the squelch is open. The audio amp is also enabled. The signal goes away and the battery saver resumes operation. All in all, a rather cute circuit. (Hmmm – a squelch operated 3 Hz clock oscillator and diode switched crystals. Sounds like half a scanner!) There is an LED on the front panel that flashes when the battery saver is in operation and is on solid when the squelch is open. The squelch itself is a signal amplitude operated circuit rather than the more conventional noise operated squelch.

The transmitter is less conventional. The same crystal and oscillator chain is used as is used by the receiver. There is an offset oscillator with 10.7 MHz and 10.1 MHz crystals supplied with the kit. The output of the main oscillator chain and the offset oscillator are mixed in another 40673 dual gate MOSFET to give the transmit frequency. The mixer is followed by five bipolar transistors to bring the output power up to the proper level. Note that one crystal will give one receive and two transmit channels and, once one of the transmit channels is trimmed on frequency, the receiver and the other transmit frequency are on frequency within 250 Hz. Purists could probably trim the offset crystals, but I really don't think it is necessary. With my unit there is about a 130 Hz error on one transmit frequency if the other is set on exactly. As an example, the crystal supplied with the kit is 15.1377 MHz, which gives 136.24 MHz (when multiplied by 9), the proper injection frequency for a receiver with a 10.7 MHz i-f, for 146.94 MHz. Mixing the 136.24 MHz with 10.7 gives 146.94 MHz, and with 10.1 MHz gives 146.34 MHz. So you get simplex and the -600 kHz offset for 146.94 MHz with just one crystal. Modulation is accomplished by a varactor diode across the 15 MHz crystal, driven by a mike amp, limiter, and filter consisting of a JFET and a 741 op amp. The HT has a separate microphone for the transmitter, reducing the switching requirements and giving better fidelity than if the speaker had been used as a mike.

The nicad pack consists of 10 AA size, 1.2 volt, 450 mAh cells in series with a simple but effective charger. The only charger circuitry external to the HT is the transformer.

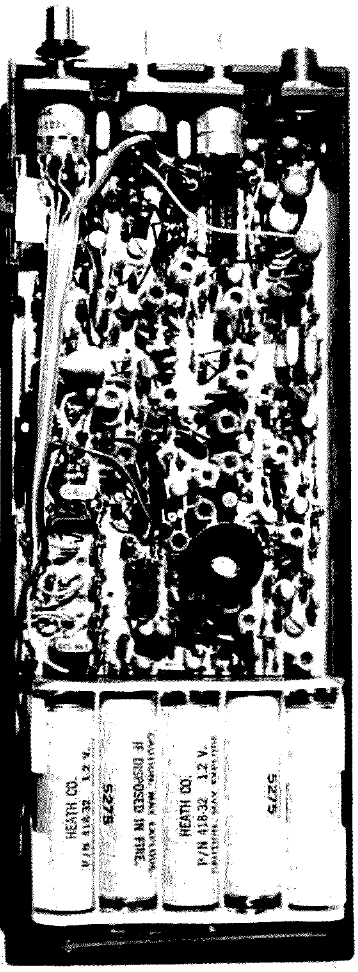
PTT is accomplished by the simple expedient of switching the nicad pack from the receiver circuit to the transmitter circuit. This is done with an SPDT microswitch under a large aluminum bar on the left side of the unit. The rubber duckie is mounted on the top right of the HT in a threaded 5/16 bushing. On the right side of the unit at the top is a standard miniature closed circuit phone jack that is used for external antenna connection. Channel selector, squelch, and volume/power controls are on top. The simplex/offset switch is on the left side of the unit above the PTT bar. The speaker is centered in the grill on the front and the mike is under the top left-hand corner of the grill. The case itself is high quality plastic, sprayed on the inside with a conductive coating. The board is mounted to the case back and the case halves fastened together using threaded inserts and machine screws. No self-tapping screws are used.



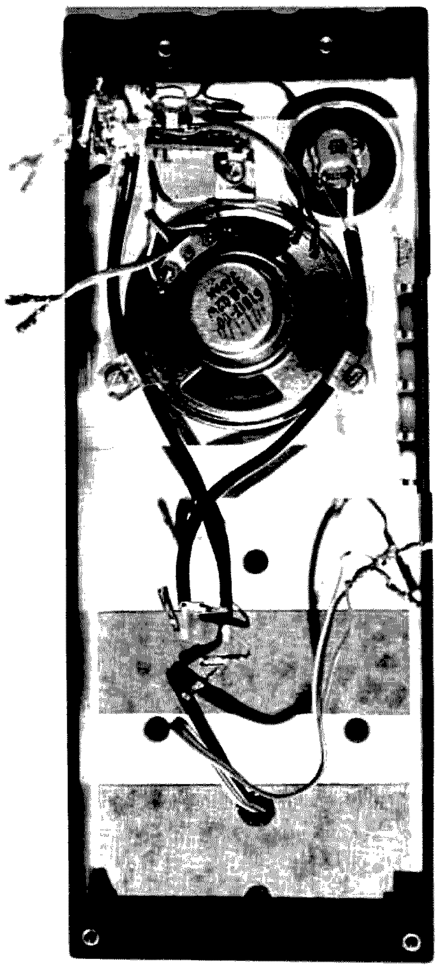
Heath HW-2021 2 meter handie-talkie with HWA-2021-3 autopatch encoder installed. Small slide switch above PTT bar on left side is the simplex/-600 kHz offset switch.

Alignment

Alignment is simple and straightforward. An rf detector and a 51 Ohm dummy load are supplied with the kit. The only test equipment needed is a VOM. The only time exotic equipment should be used is when netting the crystals, which should be done with a frequency counter, although it can be done on the air with a friend. Note: The friend can also talk to you on a repeater if direct



Inside the HW-2021. Frequency controlling crystals are on the left side about 2/3 of the way down. (146.52 crystal is in position 5. Positions 2, 3 and 4 are vacant.) Netting capacitors are just visible under the ribbon cable to the left of the crystals. The offset oscillator crystals are located between the channel switch and the squelch pot. The two crystal-looking things on the right side about 1/3 of the way from the top are the monolithic crystal filters. Note the 2-56 screw in the rubber duckie bushing at the top right — very difficult to get a screwdriver on to connect the rf cable. Transistor with heat sink is rf output.



Inside the front cover of the HW-2021. Small jack at upper left is the external antenna connection. Three wire ribbon cable coming through the bottom is from the HWA-2021-3 autopatch encoder.

is used with the HT. No problems were encountered in alignment.

Performance

The published specs on the HW-2021 are not earth-shattering: one Watt output and receiver sensitivity of 0.5 uV SINAD or 0.75 uV for 20 dB quieting. This is across a ±1 MHz range from the alignment frequency. My unit has only been used between 146.16 MHz and 146.94 MHz, but I found the performance quite a bit better. My output power was 1½ Watts across the measured range and the sensitivity measured on a Singer FM 10 CS meter was 0.25 uV for 20 dB of quieting. The squelch operated well below 0.2 uV. The receiver is quite immune to intermod and adjacent channel rejection is adequate. I can copy the 76 machine in Pensacola, 50 miles away, while the local 79 repeater is operating. It does suffer from desensitization and plain front end overload when operating in the immediate vicinity (100 meters or so) of an off-frequency source of a few Watts. The squelch circuit leaves a little to be desired. Since it is an amplitude squelch, it is more sensitive to external conditions, such as noise levels and hand capacity, than a noise squelch. The setting of the squelch is relatively critical, there being a narrow range between keeping the squelch closed and having it open with a weak but copyable signal.

The audio output is rated at ½ Watt. There is sufficient audio to hear a station in an open car (my wife's VW Thing) at 55 mph. The audio can be run all the way open without objectionable distortion.

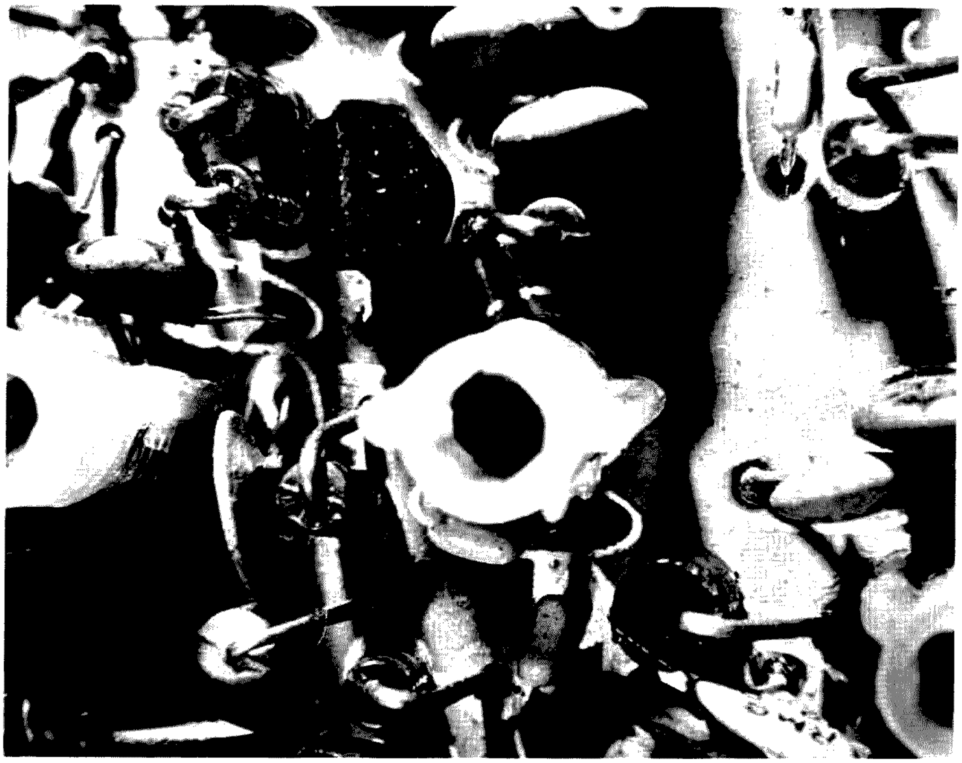
The transmitter has only two problems. The modulation is nonsymmetrical. My unit had an upward deviation of 7 kHz while downward was only 3.5 kHz. The other problem is the PTT sensitivity. It is, for me, much too light. Even with the optional installation to increase the pressure necessary to actuate the PTT, it is much too easy to activate the transmitter accidentally.

Opinions

I felt several improvements could have been made in the kit. I don't like using the phone jack for an rf connection. A BNC jack on top instead of the 5/16 threaded bushing with a BNC rubber duckie would eliminate the

phone jack for external rf connection and clean up some of the internal wiring. It would also allow the phone jack to be used as an external mike or earphone jack, neither of which are provided for. This is a change I am seriously considering for my unit. Also, there is no provision for operating from external power while protecting the nicad pack from possible excessive charging current. This means that all operation must be done off the nicad pack. The nicad pack snaps in place easily, but is not particularly easy to replace since the unit must be opened up and several leads disconnected to get to the pack.

The coax cable used for rf is not to my liking. It's the stuff that has foil instead of braid with a wire running down the foil. This shield wire is rather brittle. I would rather have seen a good high quality subminiature coax used.



Close-up of one section of the main board. Not a helluva lot of spare room. Note ferrite bead rf choke at bottom right.

With the +600 offset activity increasing above 147 MHz, a third offset position would have been nice. As it is now, I would have to sacrifice simplex or -600 offset to get the +600 offset.

There were three areas in construction of the kit that bothered me. First, whenever I cut a cable to the specified length, it seemed that when I installed it, it could have been another ¼ inch longer to make final assembly easier. Secondly, the builder is required to build up a solder bead around a mounting hole to get proper board clearance. Why not a washer? Third, a 2-56 screw is used to attach the rf line to the rubber duckie bushing. It is quite difficult to get to this screw without bending board components this way and that, and you still have to bring the screwdriver in at an angle.

Conclusion

For 170 bucks, the kit is a bargain. It went together, aligned properly, and exceeded spec. The quality is excellent, as is the manual – the kind of equipment we have come to expect from Heath. It's a little larger than most HTs (23.5 cm x 4.8 cm x 8.3 cm) but I would not have cared to build it had it been any smaller. It is sturdy, but not indestructible. I have dropped my unit three times and it broke twice. Once one of the crystal filters broke and the other time one of my crystals broke. Maybe I shouldn't have been so cheap; I should have bought the optional carrying case.

It's not perfect, but its virtues far outweigh its deficiencies and I would highly recommend it for anyone with kit building experience.

THE HWA-2021-3

After my positive conclusions on the Heath HT, I wish I could be as positive about the matching autopatch encoder – however, I can't. It's bulky, technologically obsolete, uses some rather questionable construction techniques, and does not meet the published 1½% accuracy spec. Much better pads can be obtained for the $40 the HWA-2021-3 costs.

Circuit Description

The circuitry is rather straightforward and old-fashioned. Two NE555s are used as separate high and low group oscillators. Precision (1%) resistors are switched by a miniature 12 button keyboard to generate the proper frequencies. The charging voltage waveforms across the timing capacitors are mixed in an LM301A which also filters the waveforms to make them approximate sine waves. There is also a PNP transistor driven by the square wave output of the low tone oscillator which in turn drives an LED. A rather useless circuit that lights the LED when the low group oscillator is running.

Alignment

Alignment is simple. A trimpot for each group is set at the highest tone of each group. The other tones supposedly will then be within the ±1.5% spec. The pots are mounted on the bottom of the board with the adjustment screws *facing each*

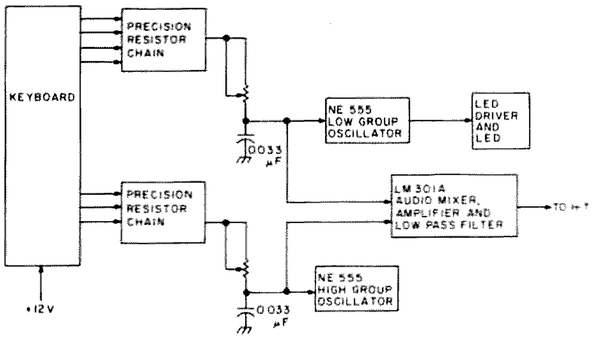
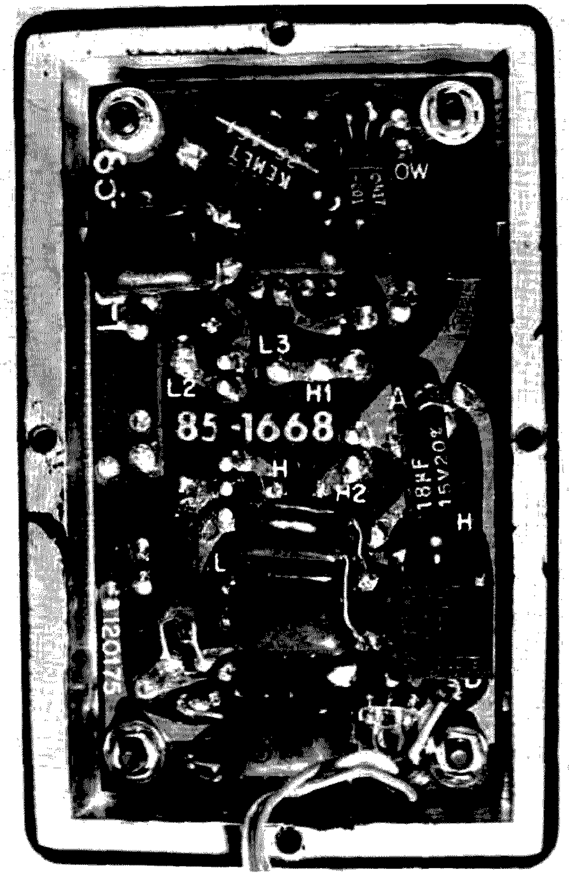


Fig. 2. HWA-2021-3 block diagram.



Rear shot of HWA-2021-3 demonstrates most of its faults. The two tubular 18 uF capacitors, one at the top and one at the right, are tack soldered in place. The ridiculous arrangement of the tone alignment trimpots at the right is obvious. The .01/.02 parallel capacitors necessary to make the whole unit work within spec are located at the top left and bottom center. The transistor at the top right drives the useless LED. Small pot at bottom right sets the output level.

other! Very difficult to adjust and impossible with the pad mounted on the HT. Had they turned the pots 90° and drilled holes in the side of the case, alignment would have been much easier.

Performance

To make a long story short, it didn't meet the 1.5% spec by quite a bit. It was close enough for the phone company as long as the low tone of each group wasn't used. That eliminated 1, 2, 3, 4, 7, and *. The tone decoder on the local repeater is more critical than the phone company and since the 1 and * are used in the autopatch access sequence, I might as well have not had the pad. I tried aligning in the middle of the ranges and ended up with both the high and low tones of each group out of tolerance. I checked and rechecked the circuit and had friends recheck it and could find no assembly error. I checked the resistor chain with a Fluke 8125A digital multimeter and they were within tolerance. I tried several different 555s and .033 timing capacitors and the results were always the same. I then decided to check the design. Running the circuit values backwards through the design equations, I found that the pad was operating as expected given the components supplied with the kit. Well, I had $40 into this thing, and wanted to make it work. My options were either to change the precision resistor chains or the timing capacitors. I worked under the assumption that the resistor chains were correct (two mylar capacitors are cheaper than 7 precision resistors), and resolved the equations for new timing capacitors. Both capacitors computed out to 0.03 within 1%. I couldn't find any 0.03s, but 0.01s, and 0.02s were plentiful. So I paralleled a 0.01 and an 0.02 and substituted the pair for the 0.033s in each of the oscillators. A quick alignment by the instruction book and everything worked as advertised. Even our supercritical autopatch access decoder on WR4ABZ accepted it. I have communicated with Heath and sent them all of my lab results as well as all of my calculations. My latest correspondence from Heath reads in part: "... the chief engineer assured me that as soon as time permits, he will rerun your calculations and reply to you directly. He has also assured me that if the .03 capacitor works in your case, he sees nothing wrong with installing it ..." That letter was dated 24 June 1976.

Opinions

My pad is in use with the .03 capacitors and works well. The parts are of good quality and the manual is excellent. The board is double-clad glass with plated-through holes. However, there are two filter capacitors which are tack soldered on the back side of the board, a practice I consider poor. I have already mentioned the absurd mounting arrangement of the alignment pots and the useless LED circuit.

Conclusion

For 40 bucks, forget it! You can get a smaller, better pad cheaper. ■

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The First Step

-- mystery and adventure

My boss once had a plaque on his wall which read, "To hell with finding a solution, let's fix the blame." Last night, while sitting in my own private Valhalla of wires, lights, and humming equipment, far from all but the most piercing of screams from the kids, I found my thoughts weaving backward looking for my initial step into ham radio.

I can't blame my brother for this one. He had been interested in radio a few years before, but I never cared a rap for what he liked. On the other hand, it was through him that I joined the Bunker Hill Boys Club, and that institution must take most of the blame.

If you're the kind who likes solitude, stay away from a boys club. Every major city has one or more of those diabolical institutions, complete with wall to wall kids of every shape, size, and color, and even the executive office isn't immune to visits from the diminutive membership, especially when a fight has to be settled.

Now we're getting closer to the center of the problem. I mean when we mention a fight. Sure, I'd joined the radio group at the club, but after fidgeting for a while with the code practice oscillator and watching the pattern on the screen of an old oscillograph, I'd gotten my fill of electronics – or so I thought. That was when Bob entered the picture.

Bob and I were natural for thoughts of mutual homicide. We were pretty close to the same age and on opposite sides of the nation's oldest high school rivalry. Now, giving him the benefit of the doubt (in addition to the concession of not revealing his first name which he no longer uses in public), I will say, in all fairness, that I really don't know who started it, nor did I know at the time, nor did he, but fight we did, as kids will often do, and it was a lulu.

We invited each other to step outside into the hallway, and had at it for an hour or more while Jim (he was in charge of the radio room and was the only adult to figure into all this nonsense) remained discreetly on the other side of the door. Bob was a much better scrapper than I, but I was too stupid to give in. We had at it till we both were exhausted, called a truce to rest (during which period Bob offered some constructive criticism to my lousy pugilistic techniques), and then had at it again. Bob's pointers were helpful, but not helpful enough. I still got the worst of it.

The other members of the radio group had long since gone home, and Jim, tired of sitting there by himself, called us in to cool off. I sat wearily down on one end of the bench by the code practice table, feeling very sorry for myself and hoping the world would share the sentiment. Bob, feeling brisk after his pleasant exercise, chatted for a while with Jim and then switched on the old Hallicrafters HT-9 transmitter and started calling CQ.

As I watched that very despicable person, at that moment the world's meanest bully, operating the radio station by himself, I could feel the hairs on the back of my neck bristle with resentment. I hadn't even known there was a transmitting station in that room, let alone that there was anybody able to operate one. I had heard of radio amateurs. My brother (who never exaggerated or told a lie) had said you needed a license to use one of those things. And to get that license you had to know Morse code (at least 750 words per minute) and take an exam consisting of eight million questions made up by Dr. Einstein, while the FCC examiner stood behind you with a bullwhip waiting for you to make just one little mistake. Surely such a thing was out of the question for me. Yet here was that terrible, horrible, rotten, no good, very bad person, and he'd made it.

I don't know of anybody in the amateur radio hobby that began without the assistance of another ham. But, however much help is offered from another, there is a moment when an individual has to act on his own if the thing is ever to happen. When that moment comes you often don't realize it or ponder on the possible far-reaching consequences. When I turned around in my seat, donned a pair of headphones and picked the card containing Group I of radiotelegraph code characters, I took the first halting step on a road that hasn't come to an end after 25 years. There was no thought of a license – just blind rage and a reckless vow to match anything that guy could do or die trying.

Strangely enough, the enemy proved to be a friend, although I didn't really appreciate it at the time. Half helping, half mocking, Bob kept me mad enough to keep at it. He would sit down at the key, betting that I couldn't copy whatever insult he could think to translate into dots and dashes. For the time, Jim kept an eye on the progress, but otherwise stayed out of it. Once in a while he would sit down at the key himself and give me some real practice.

The more I stuck with it, the more Bob seemed ready to encourage. Bit by bit the resentment died away to be replaced by a growing friendship. (Besides, I had reached the conclusion that, as a friend, this guy would be far less hazardous to the health.) Jim entered the scene more and more until I had the code pretty well memorized. Then he saw to it that practice continued every time I showed up. I don't know how many hours I spent there with the phones on, copying code through the din and racket that is a way of life in a boys club. But one day, out of a clear blue sky, Jim casually asked me, "When're you going up for your ticket, Willie?"

That was the first time anybody had even so much as implied that such a thing could so much as be within reach. I pondered for a moment on my brother's sadistic description of the exam, then answered, "I dunno, maybe some day if I ever get good enough at the code . . . "

"What the hell are you talking about? You only have to copy five words a minute, and you're doing better than that now!"

Well, now, this put things into an entirely different light. I pondered on Jim's remark for a while, and then timidly asked about the written exam. That, according to Jim, was nowhere near the torture session I thought it was. In fact, Jim (who by then had had a fair amount of time to estimate my learning ability) felt I could be ready for the exam in a month or so. That did it. I strode over to the calendar, pointed to a date now long since forgotten, and announced that that was when I'd go up for a ticket. I left that night feeling ten feet tall.

Back in 1951, the Novice class license was comparatively new. You had to take the exam at the FCC office. Nowadays, you can take it by mail. It was good for only a year, and after that you had to have a higher grade license or forget it.

Well, I began cramming. Jim had one of the boys in the typing class type out a copy of the questions and answers from the club's only copy of the license manual, and I was on my way. Bob, in his half-friendly, half-antagonistic way, kept prodding me on the questions until I had the answers memorized verbatim. Most of the members of the group would leave by 8:30 or so, and then Bob, Jim, and I would remain until the club was ready to close at 9:30. Sometimes we'd chat about the various operating techniques and the ins and outs of ham radio in general. Sometimes, and it was bending the rules just slightly, Jim would let me try calling an occasional CQ, which occasionally was gratified with a QSO. All in all, W1MOS (the boys club station callsign) got quite a workout.

The big day finally came. I went, completely solo, to the Customs House in Boston, feeling very adventuresome, and requested a Novice exam. The application in those days was four pages long, and it had to be notarized. Luckily, I had some change in my pocket, and the notary in a nearby bank only charged fifty cents for his service. The test itself was uneventful. Jim and Bob had done their work well. The examiner quietly announced that I'd passed and would have a license in about eight weeks.

Now, getting a license is one thing; getting on the air is quite another. This is especially so when you're fifteen years old, live in an apartment house in the inner city, and your parents are struggling to recover from financial disaster. In Massachusetts nobody will hire a kid under sixteen, and you can't earn enough money to outfit an amateur radio station delivering newspapers. However, the club was there, and I got enough operating satisfaction operating W1MOS.

Then came the end of an era. We moved from the Charlestown area, which we had universally despised, to another neighborhood considerably removed from the boys club. I was then wholly on my own to either sink or swim. Now, there was no way in sight to buy a rig, so my only alternative was to build one. Somewhere along the way I'd formed the notion that a radio amateur had to be able to build all his equipment, if necessary, without following some one else's circuit.

The public library now became my retreat. I must have read every elementary book on radio communication they had from cover to cover. I had accumulated a few junk parts and with these began experimenting. An old wood base with a tube socket mounted on it became my classroom, as circuit after circuit was tried out with no direction, rhyme or reason behind my experiments. We moved a second time and, wonder of wonders, there was an old radio in the attic with a shortwave band on it. It had no CW oscillator, but a nearby U.S. Navy station was on the air every night sending out code groups at about fifteen words a minute.

Well, after an unbelievably long time, and after two tries, I finally had my General class license, but no operating station. The attic was a saving grace here because I had a place to tinker. Jim was still available. We had countless conversations by telephone, no question being too much for him to answer. I built a receiver, and began exploring the shortwave bands myself.

That receiver, incidentally, was a sight to behold. It was built in an old wood box that the attic had coughed up, with a type 27 tube in the detector stage, a 957 acorn tube amplifier, and a 6F6 output stage. It was enough to make any engineer vomit, but I'd built it, and it worked.

For a transmitter I hatched up a two tube oscillator with a home brew power supply, which gave out an unknown number of Watts. Our yard was just big enough to squeeze in a quarter wavelength of wire (with the consent of a neighbor who let me anchor one end on his roof). I fed it with a length of twisted pair and a series tuned circuit. Had I then known what I know today, I might not have even tried to get on 80 meters. But I was blissfully ignorant and, with much patient advice from Jim over the phone, I finally made my first two-way contact over a full mile distance with W1YOR.

That was a long time ago. An awful lot of water has gone over Niagara since then. I suppose I could go on and mention the nine-year-old through whose relatives I landed my first job in the field, but I think this is the place to stop. Maybe some Novice struggling to get on the air can take heart and realize that sometimes the impossible can be accomplished if you try hard enough. Amateur radio has been good to me – it has led me into a profession that has been my bread and butter for over 20 years, and has provided an endless challenge to do the near impossible.

Jim W1MCR has long gone. Bob W1TUH lives in Connecticut, and I've only heard from him once in the past decade. But I very often find my thoughts turning to that room in the old boys club where a kindly old man, a spirited rival, and countless peoples' donations to the Community Fund all came together. I owe Jim a debt I can never repay, except possibly by steering some other smart alecky kid into the hobby. Somehow, though, I don't think I'll ever recapture that sense of mystery and adventure that accompanied my taking that first step. ■

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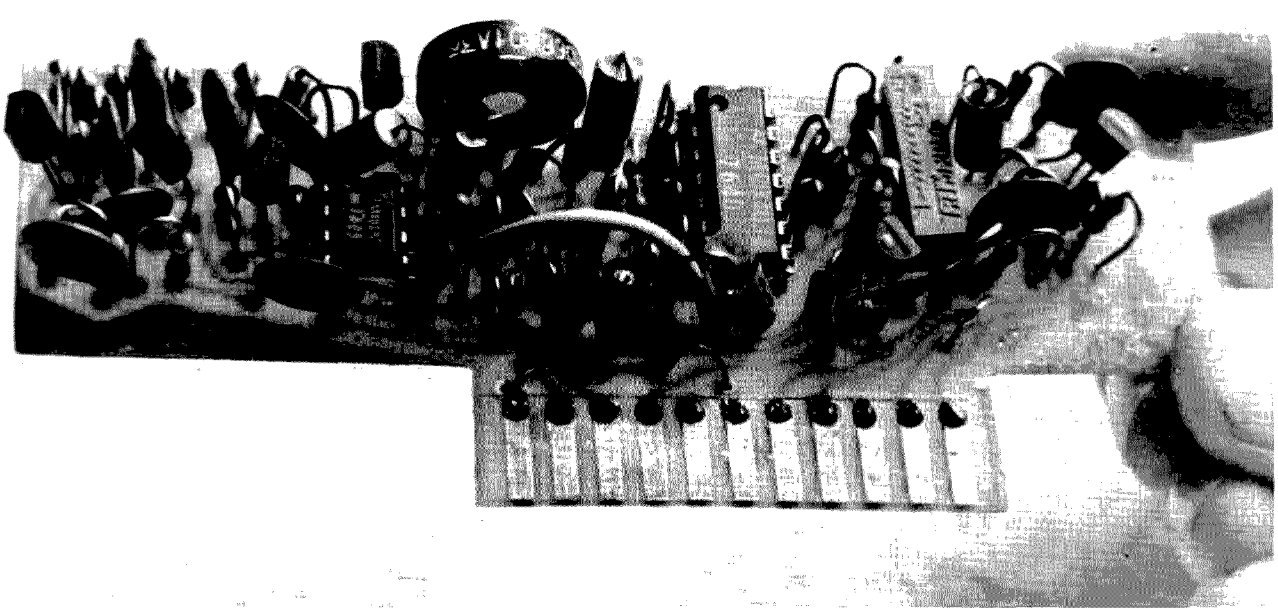
All About SCTS

-- subaudible continuous tone squelch

Subaudible continuous tone squelch has been used for years in commercial two-way radio systems to allow multiple users on a single radio channel or repeater. Most of these units use either mechanical reeds or a crystal or ceramic resonator which must be changed if a change in subaudible tone is necessary. A new resonator can cost all the way from three dollars to twenty dollars, depending on the type used.

The development of multiple op amps in one IC package has made construction of high Q active filters in a small space an easy project. A high Q active filter is the heart of this CTSS encoder-decoder.

Audio is taken from the discriminator or high side of the volume control. The high input impedance will not load the discriminator, so it is not necessary to modify the receiver circuitry. The low pass filter consisting of Q1 and Q2 passes only the audio below about 240 cycles to IC2A.



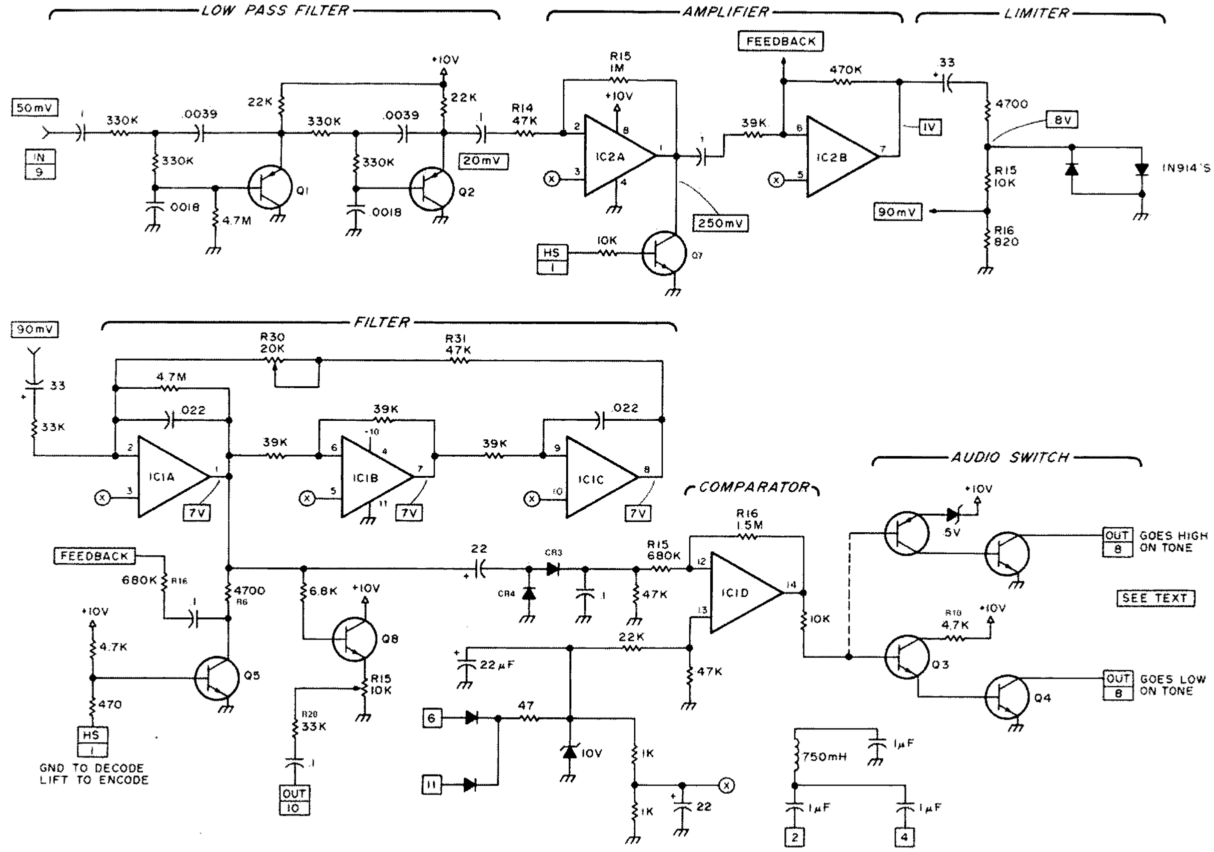


Fig. 1. All NPN — 2N3904. All PNP — 2N3906. IC1 — MC 3403 quad 741. IC2 — 1558 dual 741.

This amplifies the low frequencies and feeds amplifier IC2B, which in turn feeds a dual diode limiter. With all low frequencies being limited to .7 volts peak-to-peak, a voltage divider consisting of R15 and R16 feeds a small amount of this low frequency audio to the input of the active filter. It is most important that only enough audio be fed to the active filter so it will not limit on anything except the frequency to which it is tuned.

The active filter, which is of the "Biquad"[1] type, consists of three op amps, IC1A, IC1B and IC1C. Tuning is done using the twenty turn trimpot R30, and the course range is determined by R31. The active filter amplifies only the frequency to which it is tuned, plus or minus about one half cycle. The output of the filter is rectified by diodes CR3 and CR4. Any time the proper tone is received, the dc developed across these diodes will operate comparator IC1D. When the comparator sees sufficient voltage from the diodes it will cause Q4 to be turned on via Q3. Therefore, when the proper tone is received, the collector of Q4 will be pulled to ground. The comparator has some built-in hysteresis,[2] consisting of R15 and R16. This hysteresis will cause the transistor, Q4, to be turned on only when the output of the active filter is about six volts peak-to-peak. Once turned on, Q4 will not turn off until the output of the filter is down to about three volts peak-to-peak. This prevents the decoder from chattering on an incoming signal, thus turning the receiver audio on and off, which can be very annoying.

To cause the unit to encode, or oscillate, audio must be fed from the output of the filter back to the input. In the "mike hung up" position, Q5 is conducting hard because it is forward biased and shorts the output of R6 to ground, thus not allowing any output from the filter to be fed back to pin 6 of IC2B. Also, transistor Q7 is reverse biased, allowing incoming audio to be fed to pin 6 of IC2B. When the mike is picked up, Q7 is forward biased, shorting incoming audio to ground, and Q5 is reverse biased allowing output from the filter to reach pin 6 of IC2B. R16 is critical in value so that just the right amount of feedback will occur. This is important so the unit will oscillate on the same frequency it decodes. If IC2B is saturated too much, the frequency will be different due to the amount of time it takes the op amp to come out of saturation. The output of the active filter is also fed to transistor Q8, which serves as isolation for the audio output to the transmitter. The output level is controlled by R15, which is the emitter resistor for Q8. If the output is going to be fed into a high impedance modulator, it might be wise to increase the value of R20 so the transmitter circuit will not be loaded. Try to avoid feeding a low frequency tone such as this one into a microphone input as it is possible the microphone amplifiers will not pass such a low frequency. If possible, feed this audio directly into the modulator after the mike amplifier.

The printed circuit layout is for a Johnson 550 or 557 radio. The unit, of course, can be used with almost any radio, and has been used successfully with the General Electric Progress Line 450 units, GE Master and the new Johnson 558. When used on the 558, it is necessary to reverse the operation of the decoder as the 558 requires the ground to be released on incoming tone to unmute the receiver, whereas the 557 requires a ground to be made. This is easily done by substituting a five volt zener diode for R10, and using a 2N3906

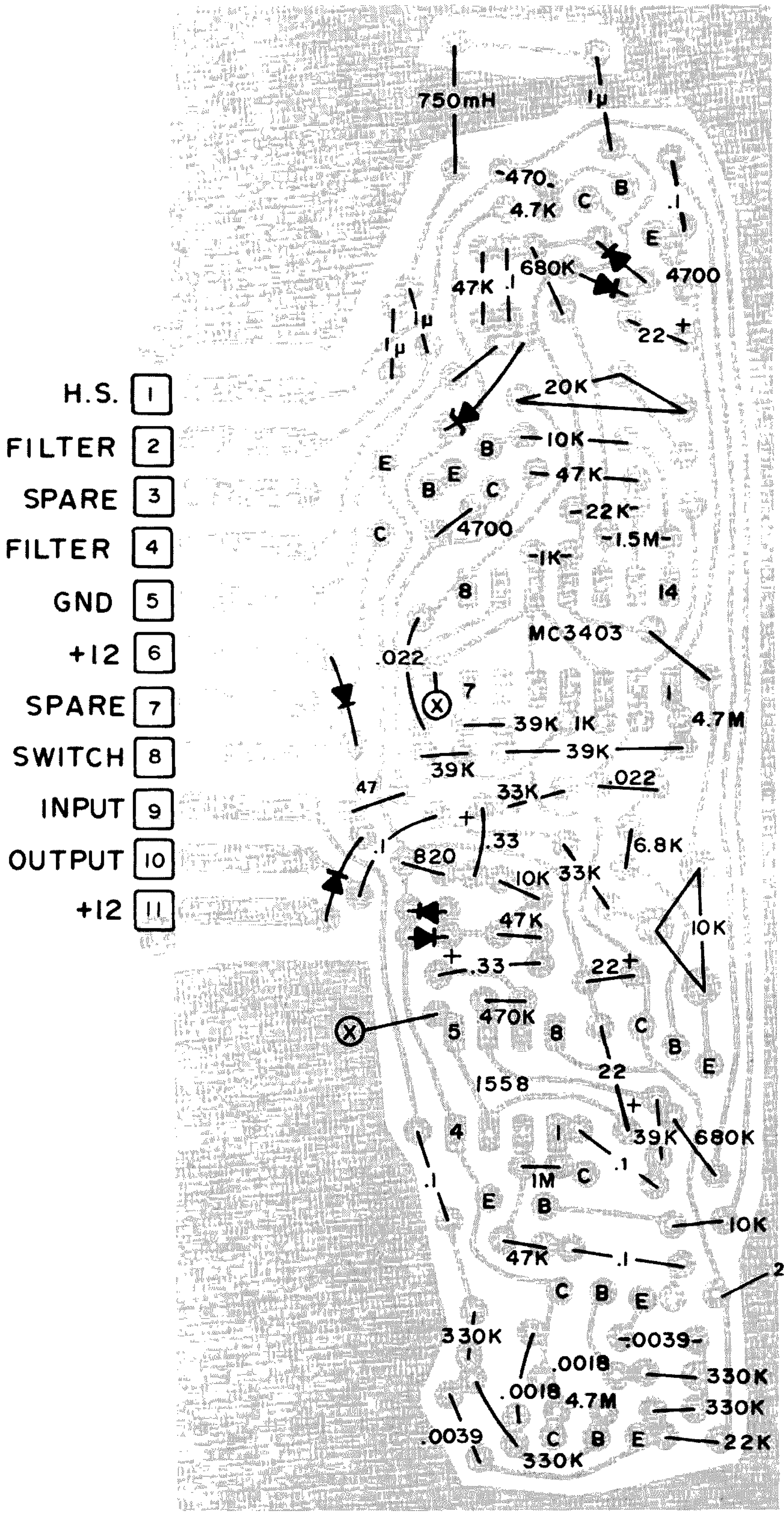


Fig. 2. PC layout.

in place of Q3. Also, when using the unit with a high input level, such as on the 558, it is sometimes necessary to put a resistor in series with the input. Depending on the peak-to-peak level of the input audio, the resistor value can be determined by experimentation. On the 558, a good value would be about 1 megohm. An alternative would be to increase R14 or decrease R15 in the feedback circuit of IC2A.

A low pass filter is included on the layout which can be used in the receiver section of the 550 or 557 to filter audio. If a filter is not wanted, then it will be necessary to install a jumper in place of the filter to provide a path for the audio in the receiver. For most applications, the encoder-decoder can be built on a single-sided board, but if it is to be installed in a 550 or 557, then a double-sided board should be made to provide pins on the plug on the component side of the unit. Wires should be soldered through as the spring connections on the plug in the Johnson won't make good contact if only the plug pins on the transmitter side are used.

It is important to use the most stable capacitors that can be found in the active filter section. The .022 uF capacitors used in this unit are Cornell Dubilier WMF1S22. The same precaution should be observed with the resistors in the active filter section. If the unit is to be used to lock up a repeater, it might be wise to increase R16 somewhat to decrease the Q of the filter so it can be activated by encoders that may be slightly off frequency. A number of these units have been constructed and are presently in use in some commercial radio systems, and they have performed quite well. There are many uses for this unit other than locking up radios. The active filter itself can be very handy for picking tones out of noise. The unit makes a stable single tone oscillator, and, by changing the capacitor values, the frequency range of the unit can be increased greatly. The low pass filter can also be used separately, as can the limiter. ■

References

[1] *Active Filter Cookbook*, Don Lancaster.
[2] *IC Op Amp Cookbook*, Walter Jung.

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Rotary Autopatch Dialer

-- interface repeaters and old phones

Many repeaters use touchtone* pads for control functions and autopatch dialing. Some telephone exchanges, however, still use the rotary dialing technique. With rotary dialing, the telephone circuit is broken a number of times corresponding to the number being dialed by a mechanical switch in the telephone dial. If you dial a "4", for example, the circuit is broken four times. Fig. 1 shows the timing involved in dialing a phone number. The advent of touchtone dialing makes the rotary system a bit archaic, but it is sure to be with us for some time to come, especially in the more rural areas.

To remain compatible with touchtone-oriented systems, repeaters in areas where touchtone dialing is not available may convert the incoming tone pairs to a series of pulses in order to dial the autopatch. To be convenient, the converter should be fully automatic; that is, the mobile operator should be able to access the patch, dial the number (as fast as he or she wishes), and make the call without having to go through any special procedures just because a touchtone-to-rotary conversion is involved.

The design of a *good* touchtone-to-rotary converter can be quite time-consuming. The dialer should begin dialing as soon as the first digit is entered. Since the operator can punch in the digits much faster than the rotary system can dial them, some type of FIFO, or First-In, First-Out memory must be included. The decoded tones must be stable and glitchfree before being presented to the dialer, or a misdial will occur. The point here is that designing the thing can get somewhat messy, if not expensive. A commercial touchtone-to-rotary decoder sells for about $200.

Recently, Motorola announced the MC14409 binary-to-phone pulse converter subsystem shown in Fig. 2. This chip is part of a two-chip system which is designed to replace a telephone dial with a touchtone-like keyboard. This chip is just what the doctor ordered for a rotary autopatch. The one CMOS integrated circuit will accept a four-bit BCD number and convert it to dial pulses compatible with the Bell System. The 14409 has its own onboard clock and will dial up to a 16-digit number. The numbers may be input at rates over 1000 digits/sec.

I got one of these chips as soon as I heard about it, and breadboarded the circuit shown in Fig. 3. The circuit has the following features:

1) Only 9 ICs excluding the PLL tone decoders;

2) Access patch with * for one second, clear with # for one second;

3) Automatic timeout and hangup if patch left on for more than five minutes;

4) Will take touchtone input as fast as any human can punch it in.

Circuit Description

Since this is not meant to be a construction article, the PLL tone decoder circuit is not shown. Two very good articles on touchtone decoders have appeared recently, and those who are interested may refer to them.[1,2]

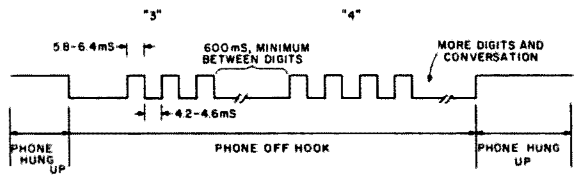


Fig. 1. Rotary dial system timing.

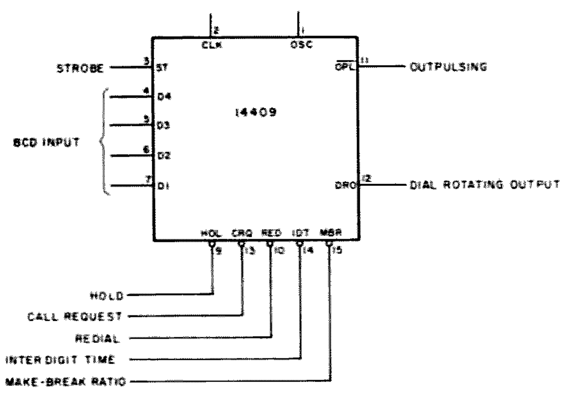


Fig. 2. MC14409 binary-to-phone pulse converter.

*AT&T trademark.

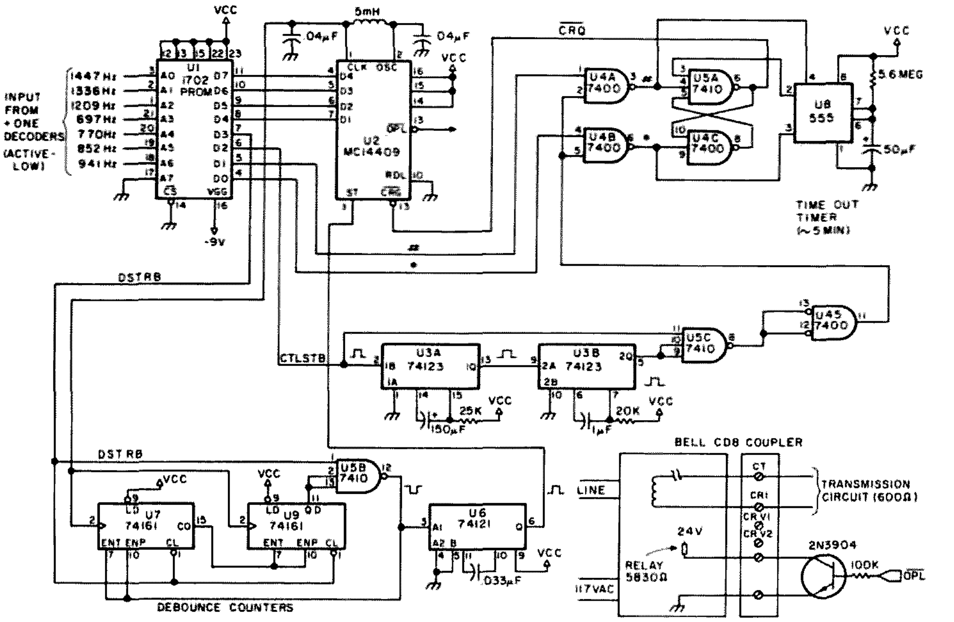


Fig. 3. Rotary autopatch. U4, U5, U6: Vcc = pin 14, gnd = pin 7. U2, U3, U7, U9: Vcc = pin 16, gnd = pin 8.

I decided to use a 1702A erasable PROM to encode the PLL outputs. Although this was a bit more expensive, I did it for two reasons – the 1702A and programmer were available, and it eliminated three or four ICs. In my opinion, every IC eliminated from a circuit eliminates 14 or 16 chances for a wiring error. Fig. 4 shows the data I programmed into the ROM. Data bits D7-D4 form the BCD output to the 14409 dialer chip. Bit D3 is the data strobe, DSTRB. It is high when any of the bits D7-D4 are high, so actually it's the logical OR of these bits. This is an example of the implementation of a bit of combinational logic (gating) with firmware (a PROM program). Bit D1 is the touchtone # and D0 is the *. Bit D2 is the control strobe, CTLSTB, the logical OR of bits 0 and 1.

The patch works like this: When a touchtone * is input (1209 and 941 Hz), PROM bit D0 and CTLSTB both go high. The 0-1 transition of CTLSTB fires one-shot U3A. After about one second, U3B fires. If CTLSTB is still present, gates U4A and U4B are enabled. Pin 6 of U6A goes low, bringing dialer chip input CRQ (call request) low. Output OPL goes high, effectively "taking the phone off the hook." The 555 timeout timer is also triggered at this time. Note that if CTLSTB doesn't remain high for at least one second, none of the above will happen and the patch will remain in the standby mode.

After the patch has been accessed and the operator hears a dial tone, he or she begins punching in the digits. Say, for example, a "7" is dialed. This causes PROM outputs D6, D5, D4 and DSTRB to go high. Whenever DSTRB is high, the debounce counters U6 and U7 begin to count. They are driven by the 16 kHz clock output of the MC14409. If at any time DSTRB goes low, the counters are cleared. This would happen, for example, if the decoders glitched on a noise spike. When DSTRB goes high and remains high, the counters count up to a count of 128, corresponding to a time interval of about 4 ms. When the count of 128 is reached, U5B and U6 generate a strobe signal to the MC14409, which causes it to input the data present in its input data lines and begin dialing. The counters are disabled on the clock pulse after the strobe is generated. (The 74161s have an *asynchronous* clear, but the enable inputs are *synchronous*. This means that if the CLR input is brought low, the outputs go to 0000 *immediately*, but disabling the counter by bringing ENT and ENP low does not halt the count until the *next* clock pulse.)

What this all boils down to is that the two counters debounce the data from the PROM and require it to be stable for 4 ms before strobing it into the dialer chip.

After the call is completed, the operator presses # to clear the patch. It, too, must be held for one second. If the mobile op is long-winded or the patch gets hung up somehow, the 555 timeout timer will hang up the patch after about five minutes by clearing the latch formed by U5A and U4C.

Doing It Legit

The dialer may be legally installed at the repeater by having the telephone company install a Bell type CD8 coupler at the repeater site. The dialer connects to the CD8 as shown in Fig. 3. A conventional audio hybrid phone patch connects to the terminals marked "transmission circuit."

I would certainly be interested in hearing from anyone who has or builds an MC14409-based rotary dialer. Best of luck with this slick chip! ■

References

[1] C.W. Andreasen WA6JMM, "Autocall '76," *73 Magazine*, June, 1976, p. 52.

[2] J.H. Everhart WA3VXH, "Toward A More Perfect Touchtone Decoder," *73 Magazine*, November, 1976, P. 178.

Address	Data	Touchtone Digit
00111101	00001000	0
01110011	00011000	1
01110101	00101000	2
01110110	00111000	3
01101011	01001000	4
01101101	01011000	5
01101110	01101000	6
01011011	01111000	7
01011101	10001000	8
01011110	10011000	9
00111011	00000101	*
00111110	00000110	#

A7	grounded	D7	BCD 8
A6	941 Hz	D6	BCD 4
A5	852 Hz	D5	BCD 2
A4	770 Hz	D4	BCD 1
A3	697 Hz	D3	DSTRB
A2	1209 Hz	D2	CTLSTB
A1	1336 Hz	D1	#
A0	1447	D0	*

Fig. 4. ROM program (data in all addresses not shown is 00000000).

Social Events

MACS INN ID
AUG 5-7

The 45th Annual WIMU (Wyoming, Idaho, Montana, and Utah) Hamfeast is scheduled to be held at Macs Inn, Idaho, just south of West Yellowstone (about 25 miles). This is one of the Rocky Mountain Northwest's largest hamfeasts. The registration fee for the 45th Annual WIMU Hamfeast will be S7 at the door. For further information, please contact Ronald Conley, General Chairman, WIMU Hamfeast, PO Box 30756, Billings, Montana 59107.

NEWBURGH NY
AUG 6

The Mt. Beacon Amateur Radio Club will hold their 4th Annual Hamfest on Saturday, August 6th, 9 am to 5 pm, at Stewart Field, Newburgh NY, inside hangar. Flea market and auction. Talk-in on 37/97 and 16/76. Rain or shine. Plenty of free parking. Admission $1, tailgating S1, under 12 free.

OKLAHOMA CITY OK
AUG 6-7

The 1977 Oklahoma Ham-Holiday will be held August 6 and 7, 1977 at the Southgate Inn Best Western, 5245 South Interstate 35, Oklahoma City, (405) 672-5561. Pre-registration $3.00, at the door S4.00.

JACKSONVILLE FL
AUG 6-7

The Bold City Hamfest sponsored by the Jacksonville Range Association will be held at the Jacksonville Beach Auditorium August 6-7. Vacation at our Hamfest — Florida's Friendliest. Visit our special "Solar" and "QRPp" forums. Send request for information and tables to Hamfest Coordinator, Jacksonville Range Association, PO Box 10623, Jacksonville FL 32207. For motel reservations call Ramada Inn toll free (800) 228-2828.

WASHINGTON MO
AUG 7

The Zero-Beaters ARC will hold their annual Hamfest on Sunday, August 7, 1977 at Washington, Missouri city park. Free parking, bingo, and many prizes. No admission fee or fee for parking in the trader's row. For info or tickets contact Marvin Holdmeyer WBØVPF, or Zero-Beaters ARC WAØFYA, Box 24, Dutzow MO 63342.

BERRYVILLE VA
AUG 7

The Shenandoah Valley Amateur Radio Club of Winchester, Virginia, will hold its annual Hamfest on August 7, 1977, at the Ruritan Fairgrounds, one mile west of Berryville, Virginia, on Business Rt. 7. Admission $1.50, tailgating or table $5.00. Free bingo, lots of great prizes, craft displays for the ladies and manufacturers' exhibits, refreshment stands and famous Ruritan chicken barbecue dinners. Grounds open at 8 am. The annual banquet will be held on August 6 beginning at 6:30 pm in the Pagoda Room of Duffs Rebel Restaurant on Millwood Avenue across from the National Guard Armory in Winchester VA. Admission $7 at door or write SVARC, P.O. Box 139, Winchester VA 22601.

FORT WAYNE IN
AUG 7

The Original FM Hamfest will be held Sunday, August 7, 1977, rain or shine, at the Allen County Police Reserve Center, 3022 Easterday Road, Fort Wayne, Indiana. 5400 square feet of air conditioned exhibit area, hot food and refreshments and prizes. Sponsored by Fort Wayne Repeater Association, Inc. Advanced registration $1.50 — call in to WA9EAU on 146.16/146.76, WR9ADI 146.52 or 52.525 MHz. Tickets at door S2.00. Taped route information available on 146.91 MHz. For more information and advance tickets please write: Fort Wayne Repeater Association, Inc., PO Box 6022, Fort Wayne IN 46806.

PITTSBURGH PA
AUG 7

The 40th Annual Hamfest of the South Hills Brass Pounders and Modulators will be held on August 7, 1977 from noon until dusk at St. Clair Beach, Upper St. Clair Township, 5 miles south of Mt. Lebanon, on Rte 19. Swap and shop, picnic space and swimming for the family. Mobile check-in on 29.0 and 146.52. Information and pre-registration at $1.50 per ticket ($2 at door) from Rich Eckenrode, 1410 Bellaire Pl., Pittsburgh PA 15226. Vendors must register.

LEVELLAND TX
AUG 7

The 12th annual West Texas Emergency Net Picnic and Swapfest will be held in the city park, Levelland, Texas on Sunday, August 7. Bring your own picnic basket. Registration begins at 8 am. Lunch at 12:30. Swapping all day. Tables are provided. This family event is jointly sponsored by the Hockley County Amateur Radio Club and the West Texas Emergency Net. Mobile talk-in frequency is on 2 meters only, on 28/88, the Levelland Repeater (WR5AFX). Prizes will be given this year and a $2 donation will be appreciated, but is not required for registration.

EWING TOWNSHIP NJ
AUG 7

The East Coast VHF Society and the Trenton State College Radio Club will be sponsoring a hamfest on August 7, 1977, at 10:00 am, at Trenton State College, Ewing Township NJ. Featured at 11:00 am will be the eleventh annual antenna measuring contest, on 432, 1296, and 2304. For further information, write Paul Wade WA2ZZF, 153 Woods Rd., Somerville NJ 08876, or Allen Katz, Dept. of Engineering Technology, Trenton State College, Trenton NJ 08625.

ANGOLA IN
AUG 7

The Steuben County Radio Amateurs presents the 19th Annual FM Picnic and Hamfest to be held on Sunday, August 7, 1977, at the Steuben County 4-H Park, approximately 2 mi. west and 2 mi. north of Angola, Indiana. Hamfest includes picnic-style B.B.Q. chicken and refreshments, inside tables for exhibitors and vendors, overnight camping permitted in park for those desiring to arrive Saturday, movies Saturday night, as usual. Tickets $1.00 by donation, advance registration not necessary. Talk-in frequencies 52.525, 146.52, 223.5, 446.0.

CANTON OH
AUG 7

The Canton, Ohio, Hall of Fame Hamfest (an official ARRL hamfest) will be held at the Stark County Fairgrounds on Sunday, August 7, 1977. Hamfest includes ARRL, Amateur Electronic Supply, Ken-Mar Industries, Omar Electronics, flea market, YL activities including games and drawings. Admission $3 at gate, S2.50 advanced. Under 13 years of age free. For advanced reservations contact: Butch Lebold WA8SHP, Box 3, Sandyville OH 44671. Advanced deadline July 30, 1977. For directions and information call: W8ZX on 146.19/79 (WR8ADE) or W8AL on 146.52/52. Mobile check-in prize!

AMARILLO TX
AUG 12-14

The Panhandle Amateur Radio Club of Amarillo, Texas, is sponsoring the 1977 Edition of the Golden Spread Hamfest at the Holiday Inn West, Amarillo, Texas, August 12, 13 and 14. A grand prize and pre-registration prize worth over $800 will be given away. Activities include six big tech and info sessions, commercial exhibitors, flea market, free bingo for all, two hospitality hours, live entertainment, special activities for the ladies, and demonstrations. Pre-registration $3, at the door $4. Write Golden Spread Hamfest, PO Box 10221, Amarillo, Texas 79106 for pre-registration packet.

POLSON MT
AUG 13

Western Montana amateurs will sponsor an annual Mini-Hamfest on Flathead Lake, near Polson, Montana, on August 13, 1977.

RENO NV
AUG 13

The 1977 Sierra Hamfest will be held on Saturday, August 13, 1977. Program includes: guest speakers, prizes, luncheon buffet, swap tables, QSL design contest, ladies' prizes, new equipment displays, WCARS station, swimming pool, kids' playground, rag chewing, oldest and youngest ham. Adult tickets $11 ($12 after Aug 1), ages 7 through 16 $4 ($5 after Aug 1), 6 and under free. For information or assistance, talk-in on 7255 or 146.94 simplex.

BRISTOL TN-VA
AUG 13-14

The Bristol Amateur Radio Club, Inc., will hold the Bristol Hamfest August 13-14 at the Beacon Drive-In Theatre on Blountville Hwy., 9 am to 5 pm, Saturday, 9 am to 3 pm Sunday. Tickets $1, flea market space $2. Talk-in on 01-61, 28-88 and 3980. Contact Bristol Amateur Radio Club, Paul E. Booher WA4KAS, 1221 Jonesboro Road, Bristol VA 24201.

CHARLOTTE VT
AUG 13-14

Burlington A.R.C. International Field Day will be held on August 13 and 14, 1977, at Charlotte, Vermont. Flea market both days 7 am Saturday to 5 pm Sunday. S3.00 early bird registration. $3.50 at door — write P.O. Box 312, Burlington, Vermont. Talk-in .01-.61.

FLOURTOWN PA
AUG 14

The Mt. Airy VHF Radio Club, Inc. (the Pack-Rats) will hold their annual picnic and family day on August 14, 1977, at the Ft. Washington State Park in Flourtown, Pennsylvania. Come renew friendships and talk to the hams of the Colombian Moonbounce Expedition. Time: 9 am to 4 pm. Registration $2 per family. Talk-in 146.52 and 52.525 simplex and 16/76.

PLAIN CITY OH
AUG 14

Union County Amateur Radio Club proudly presents Hamfest 77 to be held on Sunday, August 14, 1977 at Plain City Fairground near Columbus OH on St. Rt. 42, 4 miles south of 33. Hamfest includes large flea market, indoor tables for dealers, food available, free parking, and free overnight camping. Admission $1.50 advance, $2.00 at gate. Talk-in on 146.16/76. Check in (for prize) on 146.52. For more information write: Union County Amateur Radio Club, 13613 U.S. 36, Marysville OH 43040.

LEXINGTON KY
AUG 14

The Bluegrass Hamfest will be held August 14, 1977 at the Lexington National Guard Armory adjacent to the Bluegrass Field on Airport Road, Lexington, Kentucky. Grand prizes and door prizes will be given away. There will also be an indoor/outdoor flea market. Talk-in 146.16-76. Admission is S2.50 advance, S3.00 at door (includes grand prize stub). Doors open at 8 am. For more information and advance tickets write: Bluegrass Hamfest, Box 4411, Lexington, Kentucky 40504.

WILLOW SPRINGS IL
AUG 14

The Hamfesters' 43rd Annual Picnic and Hamfest will be held Sunday, August 14, 1977, at Santa Fe Park,

91st and Wolf Road, Willow Springs, Illinois, Southwest of Chicago. Exhibits for OMs and XYLs, famous Swappers Row. Ticket donation at gate $2.00, advance $1.50. For advance tickets send check or money order to Bob Hayes W9KXW, 18931 Cedar Ave., Country Club Hills IL 60477.

RIPLEY WV
AUG 14

The Jackson County Amateur Radio Club is pleased to announce the Cedar Lakes Hamfest on August 14, 1977. There will be a flea market as well as space for commercial displays available inside. The hamfest is located 3 miles off 177 at Ripley WV, at the site of the Arts and Crafts Fair. Talk-in on 146.52 as well as 31/91. The call is WD8JNU. For more information contact WB8TJA, PO Box 631, Ravenswood WV 26164 or call (304) 273-3190.

ST. CLOUD MN
AUG 14

The Saint Cloud Radio Club Annual Hamfest will be held on Sunday, August 14, 1977 from 10:00 am till closing, at the Sauk Rapids Municipal Park. Free parking and overnite parking, hot dogs and pop and chile available. Swapfest and ham gear sale. Talk in on 34/94 and 3925. For further information, contact Bill Zins WA0OTO, R.R. #4, St. Cloud MN 56301.

STURGIS SD
AUG 20

The Signal Hill Amateur Radio Club of the Northern Black Hills area will hold a Ham Flea Market from 10 am to 6 pm on August 20, 1977, at the South Sturgis Church of Christ, Sturgis SD. Talk-in on 52/52. For more information contact Dennis Painter WB0FYG, Box 759, Sturgis SD 57785, phone (605) 347-3087.

WHITNEYVILLE PA
AUG 20

The 1st Annual Tioga County, Pennsylvania, Hamfest will be held on Saturday, August 20, 1977, at the Tioga County Fairgrounds in Whitneyville, Route 6, 6 miles west of Mansfield PA, 5 miles east of Wellsboro PA. Programs include: Novice and beginner interest, space communications, FM and repeater forum, flea market area — free and large, open and covered. Admission $2 — unlicensed XYLs and harmonics free — CBers welcomed. Talk-in WR3AHN 146.19/79 . . . CB channel 5 simplex .52. Sponsored by the Tioga County Amateur Radio Club. For more information contact Denny Voorhees WA3FWQ, RD 2, Box 117A, Millerton PA 16936.

EL PASO TX
AUG 20-21

The El Paso Hamfest and Swapmeet will be held on Saturday, August 20 and Sunday, August 21 at the Mesa Inn Motel (take Interstate 10 to Executive Center exit). Saturday will feature registration, seminars, ladies' activities and banquet with a guest speaker. Sunday will feature an all day swapmeet. There will be door prizes as well as a pre-registration prize. Registration fees are: hamfest/swapmeet only — $8/head, $14/couple; swapmeet only — $2/head; total package (hamfest, banquet, swapmeet) $15/head, $25/couple. No registration necessary for children under 15. For more information write El Paso Hamfest, PO Box 4573, El Paso TX 79914.

STANTON DE
AUG 21

The 1977 Delmarva Hamfest will be held August 21, 8 am to 4 pm, rain or shine, at the Delaware Technical Community College in Stanton, Delaware. Take the Stanton-Delaware Park Exit off 1-95. Tickets $2 advance, $2.50 at gate. Tailgating and tables $2.50. Door prizes and refreshments. Talk-in on 13/73, 146.52, and 3905. Contact John Low K3YHR, 11 Scotsfield Drive, Newark DE 19713.

DECATUR AL
AUG 21

The North Alabama Hamfest will be held Sunday, August 21 at Calhoun Community College in Decatur, Alabama. For information write North Alabama Hamfest Association, PO Box 9, Decatur, Alabama 35602.

WARREN OH
AUG 21

The Warren Amateur Radio Association will hold their hamfest on August 21, 1977 at the Trumbull KSU Branch, Route 45 at Warren Outerbelt. Best site ever. Bigger flea market, all closed-in parking; parks, lakes nearby. $2 registration. Details? QSL: Hamfest, Box 809, Warren OH 44482.

LAFAYETTE IN
AUG 21

The Seventh Annual Lafayette, Indiana Hamfest sponsored by the Tippecanoe Amateur Radio Association will be held Sunday, August 21, 1977 at the Tippecanoe County Fairgrounds, 18th Street and Teal Road (Indiana Highway 25), Lafayette IN. Tickets are $2 either by mail or at gate. You must purchase tickets by mail to be eligible for pre-registration prize. Send check or money order with SASE to Bill Bayley WA9ZDI, 1021 Beck Lane, Lafayette IN 47905 for tickets by mail. Last date for mail order purchase is August 12. The Indiana Radio Club Council meeting and presentation of awards will be in the afternoon. An Emergency Forum with Bruce W9UMH will be held from 10 am until noon. Bingo for XYLs. Free coffee and donuts early Sunday morning. No additional charges for flea market operators other than regular entrance ticket. Talk-in on repeater 146.13-146.73 and simplex 146.94. Club call is W9REG.

DESOTO IL
AUG 22

The SARS Hamfest will be held on August 22, 1977, in Desoto, Illinois. Program includes prizes, food, auction. No charge for flea merchants. For more information write Nick Koeningstein, 2009 Gray Dr., Carbondale IL 62901.

MARSHALLTOWN IA
AUG 28

The Iowa 75 Meter Phone Net will hold its Annual Ham Feast and Picnic Sunday, August 28, 1977, in Riverside Park in Marshalltown, Iowa. A pot luck meal will be held at noon with a short program and a few small prizes to be given away.

O'FALLON MO
AUG 28

The St. Charles Hamfest will be held August 28, 1977 at Diermanns Lake, 4 miles south of O'Fallon MO on Hiway K. This annual event will be bigger and better with improved facilities. Prizes, flea market, dealers, refreshments and plenty of parking. Tickets still $1.00. For advance info or tickets send SASE to: Dan Corbin, 1512 Sundowner, St. Charles MO 63301.

OAKLAND NJ
AUG 28

The 550 Amateur Radio Club Fleamarket will be held Sunday, August 28, 1977, 9 to 5 pm at the Oakland American Legion Hall, Oak Street, Oakland, New Jersey, rain or shine. Admission $1, tables $3, tailgate $2. Dealers invited. Beverages available. Talk-in WR2AHD, 146.49-147.49, 146.52. For further information contact 550 A.R.C., PO Box 364, Oakland NJ 07436 or call Rick Anderson WB2QOQ (201) 684-8569.

SPRINGFIELD MO
AUG 28

The Southwest Amateur Radio Club is having its annual Hamfest and picnic at Lake Springfield, just south of Springfield, Missouri on August 28, 1977. For more info write Southwest Missouri Amateur Radio Club, Inc., Drawer B, Glenstone Station, Springfield MO 65804.

LAPORTE IN
AUG 28

The LaPorte County Summer Electronic Swapfest will be held on Sunday, August 28th, at the County Fairgrounds in LaPorte, Indiana, 50 miles southeast of Chicago. Paved midway and indoor booths available at no charge. Good food and cold drinks available. Talk-in 37-97, 01-61, or 52 simplex. Tickets $2 at gate. More information from PO Box 30, LaPorte IN 46350.

ROLLAG MN
SEPT 2-5

The Western Minnesota Steam Threshers reunion will be held in Rollag, Minnesota, Sept. 2-5, 1977. Featured will be amateur special events station WM0STR. Plans are being made for operation of CW and SSB on 80 through 10 meters, and possibly on 6 meters. QSL certificate will be sent upon verification of the log and receipt of an SASE. Send to: W8ØLRK, PO Box 596, Fertile MN 56540.

OAKWOOD GA
SEPT 18

Lanierland ARC will hold its fourth annual "Hamnic" at the Lanier Islands Dogwood Pavilion on September 18, 1977. Two large covered pavilions and large parking area for swap shop and exhibits. Food available. No entry fee for Hamnic; however, Lanier Islands charges $2.00 entry fee per car. Picnic, hiking, and swimming for the kids. First prize IC-22S. Many other prizes. Talk-in on W4IKR/4 on 3975 and .07/.67. For further information, write Terry Jones WB4FMJ, Route 1, Box 298, Oakwood, Georgia 30566.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	7	7	7	7	7	7	7A	14
ARGENTINA	14	14	7	7	7	7	7A	14	14	14	14A	14A
AUSTRALIA	14	14	7B	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	7A	7	7	7	7	7A	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	3A	14	14	14	14	14
HAWAII	14	14	7B	7	7	7	7	7A	14	14	14	14
INDIA	7	7	7B	7B	7B	7B	7A	14	14	14	7A	7
JAPAN	14	7A	7	7	7	7	7	7	7	7A	14	14
MEXICO	14	7A	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	7A	7B	7B	7B	7B	7B	7	7	7	7A	14
PUERTO RICO	7A	7	7	7	7	7	7	7A	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	14	14	14	14	14	14	7
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	7
WEST COAST	14	14	7	7	7	7	7	7A	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	7	14	14	14	14	14A
AUSTRALIA	14	14	7A	7B	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7	7A	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7A	7	7B	7B	7B	7B	7B	7B	14	14	14	7A
JAPAN	14	14	7A	7	7	7	7	7	7	7	14	14
MEXICO	14	7	7	7	3A	3A	7	7	7	7	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	7	7	7	7A	14
PUERTO RICO	14	7A	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	14	14	14	14	14	7
U. S. S. R.	7	7	7	7	7	7	7	7	7A	14	14	7

WESTERN UNITED STATES TO:

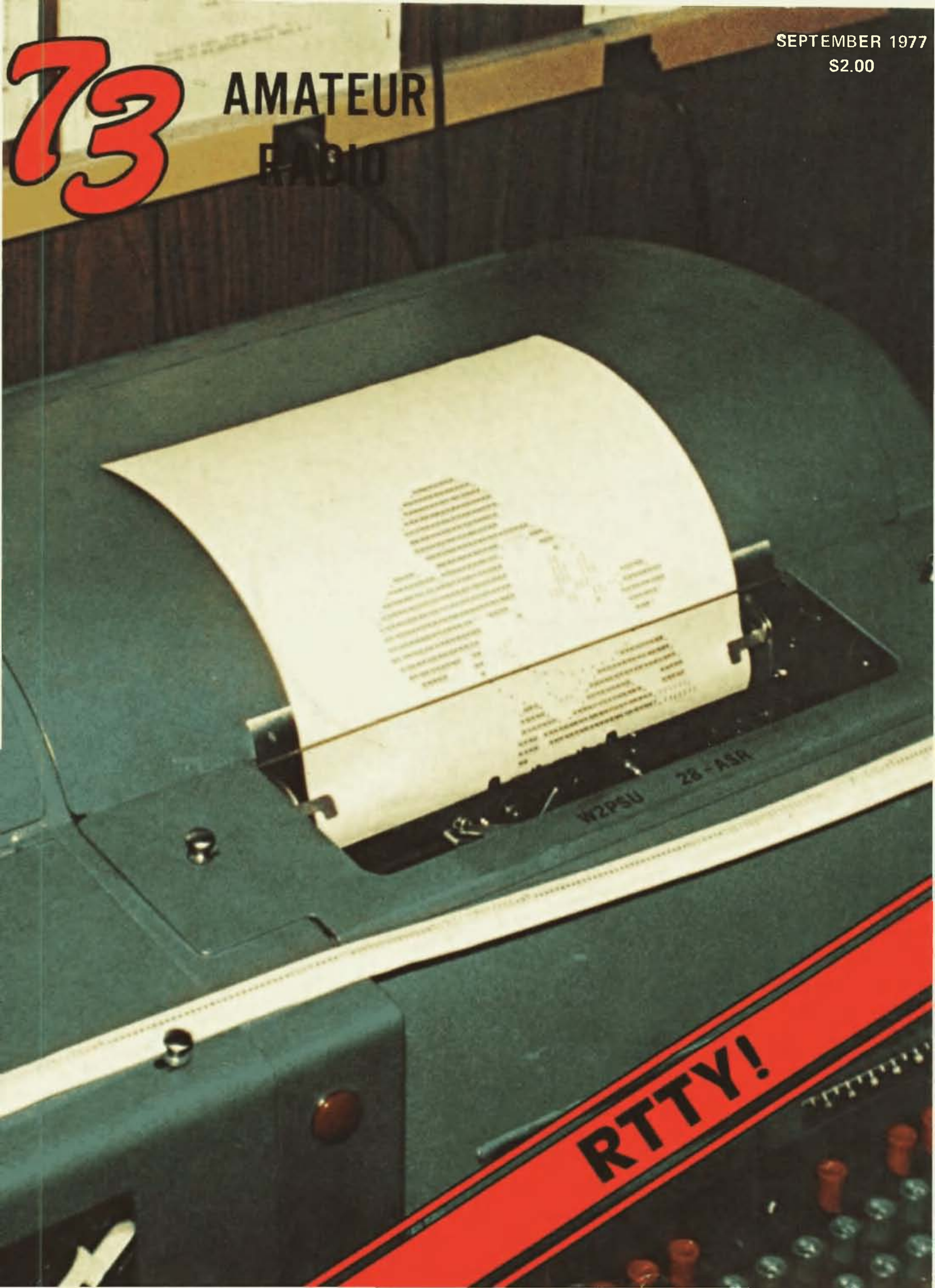
GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	14	7A	7	7	7	7	7	7	7	7	7A
ARGENTINA	14	14	7A	7	7	7	7	14	14	14	14	14A
AUSTRALIA	14	14A	14	14	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	14	14
ENGLAND	7A	7	7	7	7	7	7	7	7A	14	14	14
HAWAII	14	14A	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7B	7A	7A	14	14
JAPAN	14	14	14	7A	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7	7	7	7A	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	3A	7	7B	7B	7B	7B	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	7A	7
EAST COAST	14	14	7	7	7	7	7	7A	14	14	14	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

1977			AUGUST			1977
SUN	MON	TUE	WED	THU	FRI	SAT
	1 G	2 G	3 F	4 F	5 G	6 G
7 G	8 F	9 F	10 F	11 F	12 P	13 P
14 F	15 G	16 G	17 F	18 P	19 P	20 F
21 F	22 G	23 G	24 G	25 G	26 G	27 F
28 F	29 F	30 P	31 P			

73 AMATEUR RADIO

SEPTEMBER 1977
$2.00



RTTY!

REVIEW OF FLESHER RTTY

board. The DM-170 employs six-pole

tors. The entire tune-up procedure took about an hour.

Operating the DM-170 is as easy as building the kit. The TU does not have an internal 60 mA loop supply, so this must be provided, as well as a

All in all, I was very pleased with the performance of the Flesher DM-170. The tiny size of the unit allows it to be built into a small enclosure with power supply and loop supply with considerable size-saving

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 4

whatever problem they were having (and I hadn't been able to get them to admit to what it was) by first stating the problem and then seeing if the mere statement of the real problem wouldn't suggest some solutions.

If the HFers are the big problem, even though the FCC doesn't want to admit it, then there are several possible ways of tackling the problem. One would be to use the historic FCC approach to solving difficult problems . . . legalize the illegal activity. This worked fine with CB. Another approach would be to try and close down HFers with FCC monitoring agents, but since the FCC is outnumbered about 500 to one, and even the most determined efforts at stopping HFers haven't achieved anything significant, this doesn't seem a reasonable way to go.

If there were any justifications for closing down the HFers, I suspect that the FCC might be able to get the enthusiastic aid of amateurs and CBers. But, with the situation of their being illegal, yet not doing any great harm, it is difficult to work up much of a program. Not a few hams may take a good look at the HF band and wonder if the time might not be coming when this will be the *only* high frequency band left for using ham gear . . . unless there is some major change in the prognosis of the coming disaster at Geneva. Do we really want to participate in helping to shut down a band we ourselves may desperately need someday?

Next I wanted to know if CB TVI complaints were tied in with illegal amplifiers. It seems that there is some agreement on this. Since the amplifiers have been made illegal, manufacturers have been making them as cheap and dirty as possible, with the end result that the linear ban has greatly increased TVI problems. The FCC answer to this is to make the laws even stronger banning amplifiers — a typical government approach to a problem.

Several manufacturers at the meeting testified that prohibition had rather conclusively proven that laws are not going to stop people making something that is wanted by the public. I suggested a try at getting the public not to want amplifiers . . . some education which would encourage CB groups to move against any local CBers using amplifiers. After all, the chap with 4 Watts output and a lousy receiver which collapses when an thin over 4 Watts comes on the

Another approach to the linear amplifier problem on CB is to change the rules and allow 1000 Watts. If that gets out of hand, raise it to 5000 Watts. The cost of 5 kW amplifiers is such that this could be a limiting factor for a while. With the coming sunspots and the more constant opening of the CB channels for skip, a bunch of kW signals should be most interesting. Remember that the FCC has no mandate whatever to provide interference-free bands for CB.

Legalized amplifiers would make it easier for the FCC to make sure that the moonshine linears we are seeing these days would be killed off. Making something illegal doesn't stop it — it just makes it attractive and forces people to buy junk instead of goods which have withstood the test of the marketplace.

If the FCC stopped licensing CBers, they could cut the staff at Gettysburg in less than half. I realize that this is contrary to every law laid down by Parkinson and thus can't happen . . . but I like to dream. Just because it is serving no useful purpose is no reason to stop it.

Let's take this even further. While I accept that we do have to have licenses and license exams for amateurs, I don't agree that the tests have to be given by the FCC. The ARRL would dearly love to take over giving the license exams, and I'm sure this would work out as it has in several countries where the national club issues the licenses . . . no membership in the club, no license. And to a club whose main source of income is advertising from a magazine, government-enforced subscribing to their magazine is most attractive.

Even though the FCC found what amateurs had long known, that the Conditional class license was being cheapened by cheating, that doesn't mean that there is no possible way for hams to self-administer the exams. I'd like to see ham clubs with enough interest to run classes be permitted to give exams and issue licenses. With any exam supervised by a minimum of three licensed amateurs of an equal or higher grade than the examinee, we should have little trouble with cheating. A club's reputation would be on the line.

The FCC could require a fairly tough training course and make the clubs toe the line. It would still take far fewer people than they are using today to examine tens of thousands of applicants. The FCC could then take some of the people released from examining us and [illegible]

De WA3ETD

John Molnar WA3ETD
Executive Editor

RTTY

This issue of *73* is dedicated to amateur radio teletype, or RTTY. Even if you are not a RTTY enthusiast, the special articles should be of interest to the technically inclined. The winner of the Call For Papers competition of a few months ago is in this issue. The article, "So You Want To Get Into RTTY?", by Richard Parry, contains information for beginners and experienced operators alike. A fine article, "Design An Active RTTY Filter," by Pete Stark, is also presented. This article is not only for RTTY operators, as it describes basic design techniques for active filters — also used by CW operators and audio enthusiasts. Enjoy!

There is always some trepidation about starting out on a new mode, such as SSTV, RTTY, or OSCAR. In the case of RTTY, it's not really that hard, and the advantages are many. Believe it or not, many hams have mike fright, and conversations over the air often degenerate into a tiresome routine of signal strength reports and local weather information. Typing on a teletype machine is slower paced than talking — it gives you time to organize your thoughts, just like writing a letter to a friend. And, of course, there are always those pictures (pix) to exchange. RTTY art is enjoyed by many operators; just tune in on 20 meters on Saturday morning about 14.09 MHz and see. Some of the pix are masterpieces and take over an hour to print!

I was introduced to RTTY by a friend and fellow ham, Ken W2PSU. He said that "there is always something to do" when operating teletype. Think about it; on phone, most operators just sit and listen during a QSO, having tuned up and organized before answering a call. Could get boring, unless you're locked in a pileup. There is always something to fiddle with while "printing" a QSO. You can pretype your response to questions on paper tape with most systems, prepare picture tapes, adjust your printer, or whatever! Never a dull moment — just watching the QSO type out in front of you is better than listening, in my opinion.

It really does not take a roomful of gear to gain an introduction to the world of RTTY. If you already have a transceiver (HF or VHF), it can be done for less than $100. First you will need a page printer and keyboard. There are a multitude of these available; a common device is the Teletype Corporation Model 15. The larger Model 19 stations with paper tape equipment are based on the ubiquitous Model 15.

Printers are available for under $50. I picked up a classic Model 15 with answerback and internal loop supply for $35 at a flea market this summer — they can be had for less. Check flea markets, or ask a ham who is into RTTY, as he may have a second, unused printer around.

After obtaining and converting the printer, a terminal unit, or TU, is required. The TU converts the received frequency-shift tones into dc pulses that drive the printer. TUs can be very simple. A good one is not all that expensive. This month, almost by accident, I obtained a TU kit from the Flesher Corporation in Topeka KS. Dubbed the DM-170, this $39 kit outperforms much more expensive devices. It takes an hour to build, and is on a 3" x 5" PC board! (Check my review in this issue.) So let's see, we're up to about $80 for a TU and printer — add a loop supply to drive the printer (definitely a junk box project) and you are ready to copy RTTY signals off the air! In order to transmit, a method for keying the transmitter from the keyboard is required. The practice today is to use audio frequency shift keying, or AFSK. This technique involves generating two tones which, when shifted back and forth, provide a means of coding the keyboard characters. In most cases, the audio tones can be fed directly into the microphone input of an SSB transceiver. A suitable AFSK generator can be built with one 88 mH toroid and about $5 of new parts. That's it! A basic RTTY station is guaranteed to produce hours of operating pleasure, and may be expanded as time and money permit. RTTY lends itself to computerization like no other aspect of hamming, and there are loads of digital operating aids that can be added. Some of these special projects are described in this issue.

NOTE TO CORRESPONDENTS

I have been receiving volumes of mail lately, requesting everything from writers' guides to conversion information on 1934 receivers. As I have said, we do our best to answer all correspondence, especially from authors. A problem exists, however. Many of the requests for information come with no return postage or SASE. Most publishing houses immediately file such correspondence in the circular out basket. In the future, I will not respond to unsolicited requests for information unless an SASE is provided. Manuscripts rejected with no return postage will be saved, but not returned unless postage is provided by the author. I don't think you would bear such expense as postal rates spiral; why ask your friendly amateur publication to do it? Thanks!

NEW TRENDS

My experiments on 10 GHz with the Gunnplexers slowed down this month for several reasons. I am refining my system with the VHF Engineering receivers, and ran into a parts bind. The mail advertisers in *73* are fast, but not that fast! The details of my experiments will be along soon, however. Who knows, RTTY on 10 GHz? I did construct a set of active filters for my RTTY station, using Pete Stark's design guidelines. Some type of filter is needed before the discriminator in a RTTY TU, and active filters are the way to go. Most older designs use 88 mH toroids, which require careful and tedious tuning. With an active filter, a variable trim control can be used to set each stage in a matter of minutes. It was a fun project — the filter is now embedded in my terminal unit. I usually get a chance to operate on weekday evenings, especially when 20 is open. Look for me between 14.090 and 14.1. I'd like to print you!

Oscar Orbits

Oscar 6 Orbital Information				Oscar 7 Orbital Information			
Orbit	Date (Sept)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Sept)	Time (GMT)	Longitude of Eq. Crossing °W
N 22307	1	0132:03	86.0	12783 B	1	0122:33	74.8
NA 22319 BTN	2	0031:59	71.0	12795 A	2	0021:53	59.7
N 22332	3	0126:54	84.8	12808 B	3	0116:11	73.3
NA 22344 BTN	4	0026:50	69.8	12820 A	4	0015:31	58.1
N 22357	5	0121:46	83.5	12833 BQ	5	0109:48	71.7
NA 22389 BTN	6	0021:42	68.5	12845 A	6	0009:09	56.5
NA 22382 BTN	7	0116:37	82.3	12858 X	7	0103:26	70.1
N 22394	8	0018:33	67.3	12870 A	8	0002:47	55.0
NA 22407 BTN	9	0111:29	81.0	12883 B	9	0057:04	68.6
N 22419	10	0011:25	66.0	12896 A	10	0151:21	82.1
NA 22432 BTN	11	0106:21	79.8	12908 B	11	0050:42	67.0
N 22444	12	0008:17	84.8	12921 A	12	0144:59	80.6
NA 22457 BTN	13	0101:12	78.5	12933 B	13	0044:19	65.4
NA 22469 BTN	14	0001:08	63.5	12946 AX	14	0138:37	79.0
N 22482	15	0056:04	77.3	12958 B	15	0037:57	83.8
NA 22495 BTN	16	0105:00	91.0	12971 A	16	0132:14	77.4
N 22507	17	0050:55	76.1	12983 B	17	0031:35	62.3
NA 22520 BTN	18	0145:51	89.8	12996 A	18	0125:52	75.9
N 22532	19	0045:47	74.8	13008 BQ	19	0025:13	60.7
NA 22545 BTN	20	0140:43	88 6	13021 A	20	0119:30	74.3
NA 22557 BTN	21	0040:39	73.6	13033 BX	21	0018:50	59.1
N 22570	22	0135:34	87.3	13046 A	22	0113:08	72.7
NA 22582 BTN	23	0035:30	72.3	13058 B	23	0012:28	57.6
N 22595	24	0130:26	86.1	13071 A	24	0106:45	71.1
NA 22607 BTN	25	0030:22	71.1	13083 B	25	0006:06	56.0
N 22620	26	0125:18	84.8	13096 A	26	0100:23	69.6
NA 22632 BTN	27	0025:13	69.8	13109 B	27	0154:40	83.2
NA 22645 BTN	28	0120:09	83.6	13121 AX	28	0054:01	68.0
N 22657	29	0020:06	68.6	13134 B	29	0148:18	81.6
NA 22670 BTN	30	0115:01	82.3	13146 A	30	0047:38	66.4

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.
OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.
Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

CARF

Canadian Amateur Radio Federation, Inc.

CARF NEWS SERVICE BULLETIN

In reply to a CARF request for a special callsign prefix to commemorate Queen Elizabeth's Jubilee year (25th year of her reign), DOC has announced that Canadian amateurs may use the prefix "CY" for VE and "CK" for VO station calls for the balance of this year.

DOC announced third party traffic agreement and reciprocal operating privilege agreement between Canada and Columbia, effective May 25, 1977.

LETTERS

TRANSIENT SWR

I read with interest and disappointment a recent article by J.A. Murphy, "Transmission Line Primer," *73*, June, 1977.

It is unfortunate that instead of enlightening your readership, the author has simply succeeded in muddying the transmission line waters even further. After reading a dreary succession of articles which attempted to explain transmission line theory, standing waves, and reflective power, I have concluded that one of the reasons that nothing definitive has appeared in the amateur literature is that a detailed understanding of the physical mechanism involved simply does not matter.

That is, most hams know that a high vswr is undesirable, and that efforts should be made to match antenna to transmission line. By following these simple rules, in most instances, a satisfactory amateur solution can be obtained without knowing much more.

Nevertheless, Mr. Murphy, apparently a professional engineer, should know better. In substance, he has simply confused the transient solution with the steady state solution. His simple analysis is correct as far as it went, but he incorrectly generalized his result.

Mr. Murphy makes use of a dc step function to describe what antenna engineers would call a pre-cursor wave front. Initially, the transmitter supplies a certain amount of extra energy to the transmission line until the first reflection makes the transit from antenna load back to transmitter. Until that time, of course, the transmitter does not "see" any change in loading due to antenna/transmission line mismatch. A first reflection does represent real power, and that real power is used to establish a standing wave. The presence of the standing wave alters the input line impedance so that the transmitter now "sees" a different load condition, and *thereafter* delivers less power to the line.

Standing waves, by and large, represent a steady-state condition, but standing waves do not represent a continuous back and forth reflection of real power. The phase relation between current and voltage in a standing wave pattern is indeed 90°, with a consequent zero power factor. You can see that this must be so if you consider the case of a shorted line. At the shorted end, current is at a maximum while voltage is at a minimum. If you plot current and voltage as sine waves, and superimpose a minimum point on one curve with a maximum on the other, you will appreciate that a 90° phase shift has occurred at the load. The same reasoning, of course, applies to the case of the open line – maximum voltage with minimum current at the load. The equations derived by Mr. Murphy do not account for these conditions, resulting only in trivial solutions when the line is open or shorted.

The transient effect described in the article is rarely observed in practice by amateurs. It would take an almost lossless and relatively long transmission line to produce noticeable transient effects on transmitter loading. However, when discussing fast rise-time digital pulses in computer circuits, distortion of the leading pulse edge (caused by reflection) can be most important. But this example merely serves to confuse the issue. It is too bad indeed that the article didn't develop the steady-state solution and avoid the usual mumbo-jumbo about effects of loss, phase and group velocity, and other relatively arcane considerations which add little to an understanding of standing waves and reflected power.

I suppose what is really needed here is a definitive article by a recognized expert in the field who will, once and for all, put some of this nonsense to bed.

Martin R. Kramer K2KGF
New York NY

Comments, engineers? – J.M.

APPRECIATION

Kudos to Craig Anderton for his fine article concerning mail order in the July issue of *73*. As someone in that business, I can empathize with the entire story. If everyone who shops by mail would only read Craig's story, it would save many people time and effort, not to mention money.

Al Smith WA2TAQ/WA4LDW
Merrick NY

HOW FAR WEST?

Most cases I don't like to complain too strongly, but after waiting such a long period of time, I can't hold off any longer.

I have been a subscriber to *73* for a few years now, and during that time I have been reading a column entitled "Looking West" by Bill Pasternak WA6ITF. According to my definition of the term, "West" should include many states in the western portion of the country. I don't believe the amateurs in New Hampshire would consider their state as the only state in the "East." Therefore, by the same token, it seems a bit unfair to classify California as the only state in the "West." According to my qualifications, I would say all the states in the "West" would be those in the 6th and 7th call areas.

To the best of my knowledge, since I have been a *73* reader, I have yet to see any coverage of amateur activities in any area other than California in the "Looking West" column. In fact, within the past 8 to 10 months, we have sent Arizona news to Bill. Before I recently acquired my new trifocals, I sure hope I haven't missed any western ham news in "Looking West" (wherever that is) in your magazine.

Wm. Oliver Grieve W7WGW
Phoenix AZ

What say, Bill? – J.M.

SERVICE NETWORK

This is to inform you about the activities and the existence of the Guatemalan net, "TG Amigos del Mundo" (TG Friends of the World).

It was created in June 1976, on the 17th, to be precise, and this day was the first day of labors. It's already been over a year since it was initiated, and on June 17, 1977, we had a party at the American Club of Guatemala, to celebrate our first anniversary.

The net was created to thank the many friendly countries in the world that sent help and assistance to Guatemala during the past earthquake (Feb. 3, 1976), and also to correspond with other countries which have nets that have so many times helped Guatemalan ham radio operators.

Until that date of June 17, 1976, you had to try luck on the different bands to be able to catch a TG station, but now you know that on 7.085 MHz, from 02:30 to 03:30 GMT, Monday through Friday, and from 16:30 to 17:30 GMT, Saturdays and Sundays, you will be able to find TG stations.

Since the initiation of the net, we have handled about one hundred emergency traffic messages. In January 1977, there was a need for medicine in a hospital in Nicaragua, and through the net we coordinated to get the medicine. After approximately two hours, such medicine was taken on a private plane from Guatemala to Nicaragua.

There was another time, unfortunately I don't *remember* the date, when there were floods in Honduras. For 30 hours the Guatemalan net stayed QAP, working on different shifts of one hour each, until we were able to give the necessary help to the Honduran people.

The founders of the net are: TG9LN Mrs. Ana Maldonado, TG9VD Mr. Rafael Maldonado, TG9QV Mr. Ricardo de la Vega, TG9RL Mr. Rony E. Liang, TG9RC Mr. Rodolfo Casas, and TG9LX Mr. Luis Stolz.

TG Amigos del Mundo
Rony E. Liang TG9RL
Guatemala, C.A.

QUALITY OR QUANTITY?

Am I an old-fashioned snob? I never thought so, but apparently, according to Mr. Magness' letter (July '77, "More Tech Debate"), I must be.

I have nothing against Technicians, and certainly not Novices. I had as much, if not more, fun as a Novice as now. *But come on!*

I'm a 16 year old kid who sweated my brains out to get my General ticket. I got my Novice in Oct. of '75, and after failing the General theory in Dec. '75, I finally passed it (second try) in Jan. '76. When I failed, did I beg for an easier test? *No!* I just went home and studied a whole lot more.

At the present, I've failed the Advanced twice, but am I yelping for an easier test? *No!* I'm a DXer, and I see that the Advanced ticket is quite a point in your favor for DXing. Someday, I'll pass my Advanced, and earn new frequencies to use, *but I sure don't want them given to me!*

In explaining to my friends at school some of the differences between CB and amateur radio (besides power, frequencies, etc.), I tell them how you get a CB license by filling out an application and sending it in to the FCC. However, in order to get a ham ticket, you must pass an exam, consisting of being able to copy the International Morse Code, and then you must pass a test on electronic theory. They understand that ham tickets aren't given away, but do we?

OK. Say that the 13 wpm test is too high. Has this stopped thousands of *determined* persons from getting their General tickets yearly? And again, OK. So what if there is a high rate of Novice and Tech dropouts? If they don't want to work for their tickets, should we take it on ourselves to give them to them? Do we want quantity or quality of amateurs? If (and when) they drop out, *have we lost anything?*

I spent a lot of money on my equipment, too. Out of my own pocket (by my parents' decision). I know that since I had to shell out the cash for my rig and antennas, I'm not as likely to abuse it as someone who had it given to them (because I know what it's going to take to replace it). But do I fuss because I can't use frequencies allocated to Advanced or Extra class licensees? *No!*

When I got my Novice ticket, I knew exactly what I wanted to shoot for (General and above), so I buckled down and put out some effort. I expected nothing to be given to me, *and it wasn't!* I had to pass the 13 wpm code test like any other guy who went in for the test.

If we're going to start easing the requirements on exams to encourage CBers (and the public) to become hams, then why not just give 'em all their Extra, and be done with it (and amateur radio) in one big step.

Maybe nobody listens to kids, but after all, I'm a ham just like you, and we kids are the ones who are going to have to live with the laws you grown-ups make.

I'm sure, and I think you'll agree,

that if CBers had to pass an exam to get their licenses, there wouldn't be the problem that there is today with them. The ones who studied and passed their tests in order to *earn* their privileges would respect their right to operate, and wouldn't abuse it (or allow anyone else to).

But look at us! *We're hams!* We're really above the problems caused (and endured) by CBers. And what are we doing? We're lessening the requirements for our licenses so that more people can be hams!

I'm just as willing to welcome newcomers into ham radio as anyone, but if I had my choice, I'd rather be welcoming hams who have earned their new privileges.

Mark A. Clark WB4CSK
Fayetteville TN

WR7AFC

The idea was born over three years ago, and on Father's Day of this year, a group of fathers made this reality become true, when WR7AFC, Arizona's Finest Channel, began operating from Mingus mountain near Prescott and Cottonwood, Arizona. Operated by the Mingus Mountain Repeater Group on 147.600 input and 147.000 MHz output, coverage promises to be excellent from Phoenix to Flagstaff and almost all areas of Northern Arizona.

In fact, California repeater operators take note — many of the mountaintop (not bumps) repeaters are being operated at elevations in excess of 7000, 8000, and even 9000. Attention, Jack Anderson: Come out to Arizona and see some of our high-rise mountains, but don't look down.

Wm. Oliver Grieve W7WGW
Phoenix AZ

TRIAL SUB

Your comments about the ARRL are particularly disturbing. Apparently you do not have very good access to the facts, since many of your comments are out in left field. I realize that you are trying to sell magazines, but you would do better to stop knocking the competition and join with them to really do something for amateur radio. Split factions never do any good for the overall good. I criticize the ARRL in letters to them all the time, but I don't go around saying things bad to other folks.

Your conflicting comments regarding *CQ* in your last editorial make it readily apparent that you are using them to sell magazines. I have a number of friends that do not subscribe to *73* simply because of your lousy editorials. I think you would do much better to join a common cause to help promote amateur radio instead of trying to sell *73* through your editorials, especially when you don't know the facts. (And how about giving the new administration at ARRL a break and stop bringing up this old stuff from years ago?) They make mistakes, but a look at the annual report shows just how much they are really doing for amateur radio.

This subscription will be a trial one for me.

D. Paul Gagnon N6MA
Camarillo CA

Thanks for the chance, Paul! — J.M.

PUBLIC FIRE

The other night while talking over beer and crackers with some amateur friends of mine, we came to a horrible prediction for amateur radio: Amateur radio may no longer be a hobby in the year 2000, due to public opinion.

One of the fellows (an Extra) mentioned the fact that amateurs take hundreds of frequencies for granted. VHF and UHF channels have very sparce activity, while only a few kilohertz away commercial channels are becoming overcrowded.

Think about this: You're watching the six o'clock news and up comes a story on the overcrowded conditions with commercial two-way radio. A telephone company rep tells how four or five megahertz of space isn't even being used by "hams" or "amateurs." He goes on to say how many hundreds of calls should be handled by their microwave links. He finishes, saying, "Amateurs are a stumbling block for the advancement of the radio art."

We may laugh now, but this could happen. Several co-workers are expressing displeasure in my hobby that used to excite them. After the Jack Anderson article, a few would say, "Is it true you hams have thousands of frequencies while CBers have a fraction of that?" One comment really hurt me: "What gives you guys the right?"

About a year ago, the ARRL made a big noise on how they would provide Public Service Announcements to broadcasters, new exciting movies, and code kits.

Where are these magical materials from the League when we need them? The radio station I work for broadcasted the PSAs five or six times, hardly enough for any listener to be convinced amateur radio is the "in" hobby. I still have not seen any PSAs on local TV.

Here's my point. Hams are coming under public fire. A few citizens have realized we do provide a public service, autopatching traffic accidents, or passing traffic. But, the general public can be turned against us, and so can legislators.

Why can't the League buy some prime time commercials during a television special? Why can't local clubs purchase commercials telling of the upcoming hamfest? Why don't hams get off their asses and show the public how exciting this space-age hobby can be?

Now is the time to get a club president of the local ham group to speak to the Chamber of Commerce. Insist on becoming a recognized community organization. How about an OSCAR setup at the shopping mall for two days? Tell how local amateurs have put the town on the map with their contests, QSL cards, and hamfests. Enlist the support of the mayor, the police chief, the City or Town Council.

Recently at a club meeting, the local group was having a field day on Jack Anderson. "He's a clown," "What a joker," were the comments in the meeting hall. Then I mentioned how amateurs should send letters to the Office of Telecommunications, White House, protesting comments made about our hobby. Then follow up with another letter to Congressmen and the President. The bunch of people didn't even hear me. They just went on complaining about the raw deal hams got in a newspaper article.

I know that my next-door neighbor doesn't consider Jack Anderson as a clown. I think most of the nation would agree. I respect him as a reporter. So what's the public supposed to think when this man tells us hams are getting special favors from the FCC?

I love ham radio, enough to write six letters to Washington, D.C., and one that was printed in the local paper about ham radio. I am handling more traffic for reluctant neighbors, and explaining my HT and autopatch to anyone who wants to know.

Hams have to do a "sell" job in preparation for the WARC in '79. Now is the time to become a community leader and show off your station to your neighborhood, to your kids, your kids' friends, to everyone. Once they get a glimpse at your QSLs, CB will seem like a toy.

If I have gotten the reader all fired up, great! Grab some paper and ask our President why an advisory agency that is supposed to coordinate military radio frequencies is hinting at the FCC for more CB frequencies. President Jimmy Carter or Office of Telecommunications, The White House, Washington, D.C. 20030.

You might want to send a radiogram to your Congressman, and good luck with the Chamber of Commerce. Unlike most hobbies, ours is regulated by the people, and for the people.

Dave Sweigert WB9VKO
Fort Wayne IN

You might drop Mr. Baldwin at the ARRL a note endorsing Dave's suggestions. I wonder what the effect of 100,000 letters would be? — J.M.

BELIEVER

I purchased your 13 wpm tape approximately 1 month ago and spent 1½ hours/day 7 days a week and received my General ticket 6/17/77.

I have used 3 different makes of code tapes besides yours, but they always brought me to the mental barrier of 10 wpm. I could not go beyond this until I used your tape.

You made a believer out of me. Keep plugging your method. It works!

Ed Hegyera WB9VZU
Kenosha WI

HERE SHE COMES

Please be advised that amateur radio station K2BR ("Boardwalk Radio") will be operating from the Miss America Pageant in Atlantic City, N.J., from September 1 to 10, 1977. Frequencies: CW — 3560, 7060, 14060, 21060 kHz; phone — 3960, 7260, 14290, 21390 kHz; Novice — 3720, 7120, 2112 kHz.

The station is under the sponsorship of the Southern Counties Amateur Radio Association (SCARA). Please QSL to N2NJ (ex-K2JOX).

Henry G. Rainville WB2QXX
SCARA/Miss America Pageant Coordinator
Ventnor NJ

QRP

Hurrah for K6JQD! I just received the June issue of *73* and am very impressed with the letter from K6JQD concerning power levels. I certainly do agree with his views, but for other reasons than those stated. I have been living in Germany for several years and am aware of how high-powered American ham stations are affecting the overseas ham community, and it does not look good. I also am in about the same position as many of the European hams, in that I am not able to run high power or a very efficient antenna. I am afraid that not many American hams appreciate what is available to them at very reasonable cost. They are also giving American hams a black eye, although it may not be obvious that this is so.

Like many other hams in Europe, I am only able to run 200 Watts or so, and an inefficient antenna, and of course this limits to some extent the number of contacts I can make. This situation is not really that disturbing to me, except for the fact that when the receiver is turned on, about the only stations I can hear are lots of high-powered stateside stations with 1000 Watts and a big multi-element beam punching through with extremely strong signals which override many of the other stations I might like to work. Oddly enough, it is very difficult to work those strong stations; I suspect they only listen for loud stations and won't come back to anyone who does not have at least an S7 or S8 signal. It is very frustrating to call CQ

for hours and not receive a contact due to the stateside QRM or to hear a desirable station but not be able to work it due to the frequency being overloaded with super-powered stations. Then, of course, in the back of one's mind is the fact that you know you don't have a chance with low power (200 Watts) and a vertical antenna. For me, this is merely frustrating, but for a native European (or any other native for that matter), it must be even worse, considering that his knowledge of English is probably limited (along with his understanding of the American ham scene), and then he's limited in power and antenna and hears nothing but strong stateside stations on frequency. I speak German fluently and have had many nice eyeball QSOs and 2 meter QSOs, during which various opinions have been expressed, concerning the mess on 20 meters primarily. Many hams in my area hold a rather low opinion of the American ham and simply do not work HF anymore, or as little as possible due to this situation. One must realize that most foreign hams have had to struggle for a long time to scrape up the cash for a 200 Watt rig and have done a lot of fighting to put up any kind of antenna in the limited space most of them have available. It is then no wonder that many foreign hams are resentful when so many American hams on the air state, as if it were nothing, that they are running 1000 Watts with a multi-element beam high on a tower; such things are only wild dreams to most hams over here. I believe that the image of the American ham is tarnished enough without all of the high-powered stations rattling the ears of other hams all over the world. I would not want to introduce a blanket low power limit; however, after all, as you stated, there are cases where high power is needed, but in most cases it is not necessary.

I am afraid that many hams these days are using high power to cover up poor operating practices or laziness. After all, it does take more effort to dig a little for the weaker stations and that is a shame, for many of those weaker stations could carry on a good QSO, too, if others would put forth a little more effort. Those weak stations out there are hams, too, although some operators seems to think they are little more than sources of QRM. I believe that most of the hams running high power could make do with less power if they would put on their headphones and sharpen up their operating skills.

I believe with WARC coming up we American hams cannot afford to give other countries a bad impression of ham radio in the US, but I am afraid that is just exactly what we are doing. We can do all the goodwill work there is to do and still come up on the short end of the stick if we do not watch our manners on the air.

In closing, I hope that others will respond on this subject and I am very pleased that you offered to open the letter forum to comment. This letter will no doubt stir up a hornets' nest, but I believe that there are many hams out there who will agree with me and K6JQD.

Richard J. Molby WB7NZG/DA1DB
HHB 3rd BN 84th Arty
APO NY 09176

I agree, Richard! It's a shame that the kilowatt signal appears to be the norm on the HF bands, at least in the phone section. Why run 1000 Watts when 100 will do the job? Not only is this practice discourteous to our foreign neighbors, but it cuts the moderately powered stateside stations "out of the action." Most of my low frequency operating is on 20m RTTY. Very few stations run over 200 Watts, and get out just fine. I run 75 Watts out of necessity, and work everything I hear. Now, I'm sure that there are those who will point out that the RTTY section of 20 is not as crowded as the phone areas. True, but how much more usable space would be available on phone if much of the power-induced QRM was eliminated? Think about it. — J.M.

ENJOY

I enjoy *73 Magazine* immensely. Pity that due to my lack of knowledge of the technical end of it, I cannot really absorb it all.

I did manage to pass the Novice exam, due in part to the excellent code tapes, and a great amount of study.

Electronics really did not interest me until the advent of CB SSB. Then I decided there had to be a choice of remaining or advancing. I will truthfully state that the knowledge does not come easily, as first I had to overcome my dislike of the electronics bit, but in the very near future, I intend to pass the Element III exam. I was extremely interested in the articles on conversion of 11 meter rigs to 10 meters, as I had a suspicion it could be done. Keep up the good work and fine articles.

Leon S. Greenwood WB3HEV
Philadelphia PA

Stay tuned for additional conversions, Leon! — J.M.

MORE MAIL

The mail-order article by Craig Anderton (*73*, July 77) was unusually warm to read. It was upbeat, informative, with empathy for both the seller and the buyer. I hope that enough readers paid the due that it so richly deserved, and will benefit by the insight Mr. Anderton provided to enhance understanding in the cold, detached world of consumer economics.

Bob Grove WA4PYQ
Davie FL

WHO CAN LISTEN?

Have you noticed the item in the Happenings column of the July *QST* (p. 67) which states that hams in Indiana have "won" something by being exempted through legislation from the prohibition in bill SB454 against the ownership of receivers capable of copying the police bands for mobile or portable use?

I have always understood that the civil rights of American citizens included the reception of any radio transmission which is within the ability of an individual to receive it. Transmitted signals are within the public domain, and it is the obligation of the transmitting party to achieve security of information through codes, ciphers, cryptography, or whatever means are available. From this perspective, it concerns me greatly that a state agency can include legislation and criminal punishment as means of ensuring the security of its radio communications.

What have hams in Indiana won if they do not have the right of all citizens to listen to any signal which causes current to flow in their antennas? Is tnis a police state? What do the authorities have to hide? Can this be done at the state level?

I am writing to both the ARRL and the Governor of Indiana. I hope that the ARRL and you can come down hard on Indiana, because this activity is clearly out of the authority of state government and is clearly discriminatory if not applicable to all citizens.

Ted Edwards W1AJS
Sugarloaf PA

Ham Help

This is to request your readers to help us with our "Project Lifesaver" radio effort. We need parts and advice to enable us to adapt an ARN-6 system for finding people caught in blizzards.

We are solid stating the following tubes: 2050, 0D3, 6L6, 6V6, 6SJ7, 12SK7, 12SY7, 12SW7, 6SA7, 6SG7, 6AC7, 6J5, 26A7 — and we need a manual or at the least a schematic for ARN-6. Also, we need a 3-stack carbon pot (60k, 10k, 33k).

Ellis County Volunteer
Emergency Services
Box 522
Hays KS 67601

I have a vibroplex key with which I would like to become proficient (prior to on-the-air use). However, after scrupulously cleaning the contacts on the key and installing new batteries in the Heath transistorized code practice oscillator, I'm still getting "dits" that are different in frequency (pitch) than the "dahs" on a straight key. Anyone have a "fix" for this?

James R. Theby WB0HZX
4912 Brockwood Drive
St. Louis MO 63128

I am in need of a tube layout or a schematic for a Jackson Model CRO 25" oscilloscope. It is manufactured by the Jackson Electrical Instrument Company of Dayton, Ohio, which is now out of business. I am missing two tubes which have 8 pin sockets — they control the intensity. Any help would be greatly appreciated.

John M. Matz
741 Schuylkill Ave.
Pottsville PA 17901

Many would-be hams don't know where to turn for classes to help them obtain their Novice tickets. Therefore, we are compiling a list of people or clubs conducting Novice classes throughout the country. We would appreciate it if these people or clubs would send us the following information about their classes: club or person sponsoring the class (if club, specific person who should be contacted); address; telephone number; whether classes are held year-round or at specific times of the year; any additional information.

Please keep us informed of any changes in your classes, so our list will be as current as possible. We ask anyone asking about information concerning classes near them to please enclose an SASE.

Bob Billson WA2TXY
837 Summit Ave.
Westfield NJ 07090

Bob Toegel WA2EGP
1775 Watchung Ave.
Plainfield NJ 07060

I would appreciate hearing from hams who might have improved the AVC in the Galaxy V Mk. II, to cure the popping on the receiver's incoming signals' audio, as well as the attack time of the AVC.

R.R. King
9025 N. Division
Spokane WA 99218

I am at the mercy of a U.S. Govt. OS-4B/AP oscilloscope (No. N383-46496A) whose power supply has ceased to function. I need a schematic and any operating instructions for this model. Any information will be greatly welcomed.

Carl G. Kramer WB3CYL
2525 Midpine Drive
York PA 17404

I was wondering if anyone in the Hamilton-Burlington area could help me with my code and theory. I am an avid SWL and am also very interested in amateur radio. I have been interested in amateur radio about 2 years. I am 13 years old, and I am willing to learn.

Keir Garber
75 Sharon Avenue
Hamilton, Ontario
Canada L8T 1E4

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

This month we will discuss the connections required to interface a Model 15 or 19 machine to a RTTY loop. Once this has been accomplished, the machine can be used with a terminal unit to receive and print RTTY signals.

I will assume you have acquired a Model 15 page printer or its big brother, the Model 19. This is a useful assumption for several reasons. First, it gives me a chance to talk about something I know. Second, the Models 15 and 19 constitute the foundation of ham RTTY. Setup of other machines can be based on what we cover here. Third, if you are rich enough to afford an ASR-32, you don't need *my* help!

The Model 15 machine consists of two major parts, a keyboard and a printer. Separate electrical circuits are provided for both devices; however, they are driven by a common motor. Some Model 15 machines have optional goodies, such as built-in loop supply, answerback, and assorted control relays. In any case, all the electrical connections are terminated on a terminal block on the right side of the machine, when viewed from the front. The terminals are available when connecting the keyboard and printer. Normally, the selector magnets in the printer are connected in series with the keyboard contacts; thus everything typed will be printed locally.

There are three connections which must be made to the Model 15 to get it running: (1) 115 V ac for the motor; (2) loop current for the selector magnets; and (3) keying circuit for the keyboard. We will cover each of these in turn.

To begin with, take a look at the motor in your RTTY machine. If there is a wheel with black and white stripes on one end, with levers protruding, you have a governor motor. The first thing you will have to do, after applying power, is set the speed of the motor. Good luck! You need a tuning fork and lots of patience. Most motors are synchronous, and remain accurate through the good graces of the electric company. To get the juice to the motor, connect the ac line to terminals 21 and 23 on the terminal strip located on the right side of the machine. See Fig. 1. You should use three-wire cable, and ground the chassis of the machine. Now, when you turn on the line switch, the motor should start, and all kinds of levers and gears should clatter. This is called "running open." Now — turn off the machine and unplug it.

Take an ohmmeter and lay it across terminals 45 and 46. There are two selector magnets, each with a resistance of 105 Ohms. If they are connected in series, total resistance is 210 Ohms and operation is for 20-30 mA of current. Parallel connection, with a resistance of 52 Ohms, is designed for 60 mA loops. If your magnets are in series, change them; see Fig. 2. A loop supply capable of delivering 150 volts at 60 mA is needed. Fig. 3 shows a typical circuit. Notice the series resistor. If it was omitted, the current in the loop would be:

$$I = \frac{E}{R} = \frac{150}{52} = \text{about 3 Amps!}$$

Don't forget that resistor! Without it, the selector magnets will burn themselves up. By the way, required wattage for the resistor:

$$W = E \times I = 150 \times 0.06 = 9 \text{ Watts}$$

Don't skimp on size, either!

Now, take this power supply, which we will call the "loop supply," and connect it to terminals 45 and 46 (see Fig. 1 again). Plug the machine back in and turn it and the supply on. Things should run quietly now, without all that clatter. This is not running "closed"; it's just working as it should.

One more hookup and you will have yourself an electric typewriter. Connect some leads onto terminals 32 and 34 (start to wear out Fig. 1). Connect these keyboard leads in series with the loop. Fig. 4 illustrates the point. Now turn everything back on (I hope you turned it off while your fingers were in there), and everything you type on the keyboard should print on the page. Not exactly a Selectric, but still neat, right?

Next month we will discuss how to use the machine to receive signals. Familiarize yourself with the keyboard and special functions. It might be advisable to lubricate the mechanical parts, paying special attention to the oil cups on the motor and main drive shaft. Under no circumstances allow oil to contaminate the printer contacts. To do so will result in erratic transmission. See you next month!

I hope you are enjoying the RTTY Loop. As you can see, this issue of 73 *features RTTY operations, so if you are into RTTY, keep reading! At this point, a little pitch for the* 73 RTTY Handbook, *edited by the 73 staff, is in order. This book has information for beginners and seasoned operators alike, and is a must for all RTTY enthusiasts. This reference is up-to-date, featuring circuits based on op amps, FIFOs, and UARTs. For $5.95 you can't pass it — order from the 73 Radio Bookshop. Another publication will be of interest to RTTY enthusiasts: The* RTTY Journal, *published about ten times a year, is exclusively RTTY oriented. It features a classified section loaded with teletype gear. Subscription price is $3.50 (amazing) a year, and subscriptions may be obtained by writing* RTTY Journal, *P.O. Box RY, Cardiff-by-the-Sea CA 97002. (This is not a paid commercial — just a helpful tip from one RTTY afficionado to another!) — J.M.*

Nice to read that you are finally going to have some RTTY coverage in your publication — it is about time. I first got hooked on that mode many years ago when Wayne Green ran his series of articles in *CQ*.

Now that the *RTTY Journal* is moving back to the West Coast, we could use some coverage for the East and Middle West.

Incidentally, I had always been informed that RATT stood for Radio Amateur Teletype. However, it is no longer used in Navy MARS, although it was ten years ago or so, when I first joined.

Herb Draeger WB5HVE
Mountain Home AR

I'm looking forward to the new column. The timing couldn't be better. I just was handed a Model 15 which is geared for 65 wpm.

I have an SB-303 receiver and an SB-401 exciter. My receiver is already set for FSK of the transmitter via shifting of the vfo in the transceive mode.

So, as you say, John, "Let's get started."

Jack Gott WA6KGI
Pleasant Hill CA

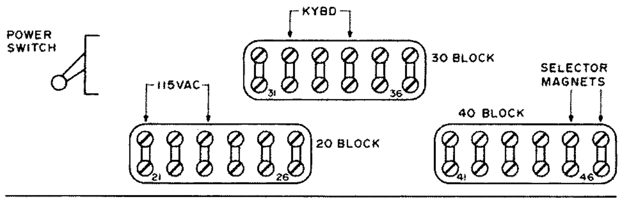


Fig. 1.

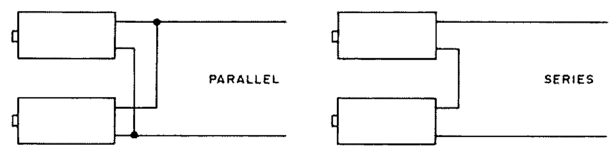


Fig. 2.

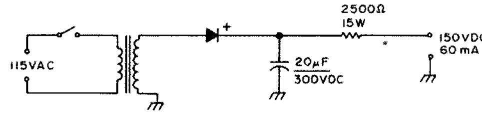


Fig. 3.

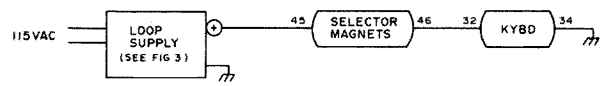


Fig. 4.

Tracking the Hamburglar

PURLOINED: Standard SRC 826M 2 meter FM transceiver, SN: 104207. Stolen on June 27, 1977 from Bill Myers WBØMCS, 942 E. Mississippi, Denver CO 80210, 303-777-3353. Has the following frequencies installed: 146.94-94, 52-52, 16-76, 34-94, 28-88, 88-88, 31-91, 148.01-01, 37-97, 19-79, 25-85, and 91-31. Has KØKGA scribed on receiver board. Receiver crystal board has been rebuilt. Channel 12 — 91-31 transmit is 450 cps. high in frequency; transmit trimmer for this channel is different from others.

RIPPED OFF: Icom IC-22A, s/n 9900 with 12 sets of crystals. Call and SS No. etched on back. Pete Jordan WA1AXK, 832 Temple Street, Whitman MA 02382.

STOLEN: Clegg Mark III, 2 meter transceiver, serial 750,187 with .52-.52 from Dick Haskin W6KEC, 149 Mauna Loa Dr., Monrovia CA 91016.

STOLEN: Drake TR-4 SSB transceiver #16491, AC-3 power supply #18572, L-4B linear amplifier #1102, L-4PS power supply #1124, Hallicrafters SX-100 receiver #151257. These items were stolen in a break-in on April 27, 1977, at a local radio store in Louisville KY, where they were held on consignment for EV Ballard WA4ACJ. Any information would be appreciated. Contact him collect at 502-451-8923 or 812-294-4819, or write 2438 Longest Av., Louisville KY. (Also: Jefferson County Police Department, 502-588-2111.)

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

FOUR LAND QSO PARTY

Starts: 1800 GMT Saturday, September 3;
Ends: 0200 GMT Monday, September 5

Sponsored by the Fourth Call District Amateur Radio Association of the IARS, Inc. The same station may be worked again on each band and/or mode fixed, and repeated again if operated portable or mobile and from each different county.

EXCHANGE:

RS(T), county, and state for 4th call district; state, province, or country for others.

SCORING:

4th call district stations score 1 point for W/VE QSOs and 3 points per DX contact (including KH6 and KL7). Final score is total points times states and provinces; states and provinces count only once, regardless of band/mode. All others score 2 points per QSO and multiply by the number of 4th district states and counties; count each state and county only once.

FREQUENCIES:

CW — 3575, 7060, 14070, 21090, 28090 (±10 kHz); phone — 3940, 7260, 14340, 21360, 28600; Novices — 3710, 7110, 21110, 28110 (±10 kHz).

ENTRIES AND AWARDS:

Certificates to top scorers in each state, province, and country. Second and third place when scores warrant. Other awards to each 4th district county, Novices, SWLs, etc. Logs must be mailed with score within 30 days to Fourth Call District ARA, Attn: Bob Knapp W4OMW/W4NP, 105 Dupont Circle, Greenville NC 27834. Include an SASE for results.

WASHINGTON STATE QSO PARTY

Operating Periods:
0100 to 0700 GMT September 10;
1300 GMT September 10 to 0700 GMT September 11;
1300 GMT September 11 to 0100 GMT September 12

Sponsored by the Boeing Employees' ARC (BEARS), the contest is open to all amateurs. All bands and modes may be used. Stations may be worked once per band and mode, and may be worked again if they are a new multiplier.

EXCHANGE:

WA stations send QSO number, RST, and county; others send QSO number, RST, and state, province, or country.

FREQUENCIES:

CW — 1805, 3560, 7060, 21060, 28160; phone — 1815, 3935, 7260, 14310, 21380, 28660; Novice — 3735, 7125, 21150, 28160.

SCORING:

Score 2 points per QSO. WA stations multiply QSO points by total number of states, provinces, and other countries worked. All others score 2 points per WA QSO and multiply by number of WA counties worked (39 max.). For non-WA stations only, there is an extra multiplier of one for each group of 8 contacts with the same WA county.

Washington county checkoff list for non-Washington State entries: Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Wahkiakum, Walla Walla, Whatcom, Whitman, Yakima.

ENTRIES AND AWARDS:

Certificates to high scores in both single and multi-operator classes. Five BEARS awards are also available to anyone working 5 club members. All contest entries will be screened by the contest committee for possible Worked Five BEARS Awards. The Worked 3 BEAR Cubs Award is also available for working 3 Novice members. Logs are available from the contest committee upon request. Logs must show dates/times in GMT, stations worked, exchanges, bands and modes, and scores claimed. Include a check sheet for entries with more than 100 QSOs. Each entry must include a signed statement that the decision of the Contest Committee will be accepted as final. Logs will *not be returned*. Results of the QSO Party will be mailed to all entrants; an SASE is *not* required. Logs and scores must be postmarked no later than October 10th and sent to: Boeing Employees' ARC, c/o Contest Committee, Willis D. Propst K7RS, 18415 38th Ave. S., Seattle WA 98188.

PENNSYLVANIA QSO PARTY

Starts: 1700 GMT Saturday, September 10;
Ends: 2359 GMT Sunday, September 11

Sponsored by the Nittany ARC; all amateurs are invited to participate. PA stations may work both PA and non-PA stations. Each station may be worked once per band and mode.

EXCHANGE:

QSO number, RS(T), county or ARRL section.

FREQUENCIES:

CW — 1810, 3550, 7050, 14050, 21050, 28050; SSB — 1815, 3980, 7280, 14315, 21380, 28560; Novice — 3715, 7160, 21115, 28115.

SCORING:

PA stations score 3 points per out-of-state QSO and 1 point per PA QSO. Multiplier is number of ARRL sections, including EPA and WPA. One additional multiplier may be counted for DX QSO (limit: one). Out-of-state stations score 1 point per PA QSO times the number of PA counties worked (67 max.).

ENTRIES AND AWARDS:

Logs must include dates/times in GMT, stations worked, RST sent/rcvd., band, mode, and number of new section or county as worked (multipliers). Summary sheet required, showing number of QSOs, QSO points, total multiplier, and claimed score. Also, include a checklist of counties worked. Mail logs, summary sheets, check sheets, and any comments by Oct 15th to: Douglas R. Maddox W3HDH, 1187 S. Garner Street, State College PA 16801. SASE appreciated. Certificates to section winners and outstanding PA entries with minimum of 10 QSOs required for awards.

NORTH AMERICAN SPRINT CONTEST

0200 to 0600 GMT Sunday, September 11

Sponsored by the National Contest Journal, this contest is open to all amateurs. Entry classes include: single op (no helpers, one active xmtr, multiple rcvrs, no spotting net assistance); multi-single (multiple operators, one active xmtr, multiple active rcvrs, no spotting net assistance); multi-multi (multiple operators, multiple active xmtrs, one signal per band). All contacts must be made on CW only on any band from 160 to 20 meters. Stations may be worked once per band. North American stations are defined by the rules for CQ WW contests.

EXCHANGE:

You must make sure the entire exchange includes his call, your call, serial number (starting from 001), your nickname, state, province, or country. Example: W6OAT DE WB2GFE NR 27 BOB NJ K.

FREQUENCIES:

1800-1820, 3530-3550, 7030-7050, 14030-14050. Try 160m during the last half hour of the contest.

SPECIAL RULES FOR NA STATIONS:

If a station calling CQ NA is called by another station and makes a valid exchange with him, he cannot call CQ again on that frequency, nor can he solicit contacts by calling QRZ, etc. He must move a minimum of 5 kHz away from the frequency before calling CQ NA again, or he may answer a CQ NA on the frequency and, following a valid exchange, call CQ NA on that frequency.

CLUB COMPETITION:

Club competition is limited to a maximum of 15 operators as a single club entry unit. Clubs with more than 15 members may submit more than one entry unit. In this case, members of each unit must be drawn by lottery from the pool of members who will compete. To qualify as a club entry

CALENDAR

Sept 3-5	Four Land QSO Party
Sept 10-11	Washington State QSO Party
Sept 10-11	Pennsylvania QSO Party
Sept 10-11	ARRL VHF QSO Party
Sept 10-11*	European DX Contest — Phone
Sept 11	North American Sprint Contest
Sept 17-18	Scandinavian Phone Contest
Sept 24-25	Delta QSO Party
Sept 24-25	Scandinavian Phone Contest
Sept 25-26	Fall Classic Radio Exchange
Oct 1	Open CD Party — CW
Oct 1-2	California QSO Party
Oct 1-2	VK/ZL/Oceania — Phone
Oct 8-9	VK/ZL/Oceania — CW
Oct 15-16	Open CD Party — Phone
Oct 15-17	Manitoba QSO Party
Oct 22-23	CQWE Contest
Oct 22-23	CARTG RTTY Sweepstakes
Oct 29-30	CQ WW DX Phone Contest
Nov 5-6	ARRL Sweepstakes — CW
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest — RTTY
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes — Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Nov 26-27	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

*Described in last issue.

unit, the name and call of each operator in the unit must be registered with the Contest Coordinator (W6OAT) before 6:30 PDT, Sept. 10th. Changes may be made in the unit members up to that deadline. This rule limits multi-multi entries to a maximum of 15 operators if they are a club entry. Multi-multi's, multi-singles, and singles can be combined in a single unit, but the total number of operators cannot exceed 15.

SCORING:

NA stations multiply total valid contacts by the sum of states, VE multipliers, and countries to get final score. Non-NA stations multiply total valid contacts by the sum of states, VE multipliers, and NA countries. KH6 is not counted as a state and is not an NA country. VE multipliers are: maritime (VE1, VO1, VO2, etc.), and each VE call district (VE2 to VE8).

ENTRIES:

Logging is to be done on separate sheets for each band. Regardless of the number of licensed callsigns issued to a given operator entering, one and only one callsign shall be used during the contest period by that operator. Logs should include GMT time as well as complete exchange information.

Entries must be sent to Rusty Epps W6OAT, 35 Belcher Street, San Francisco CA 94114, and be received by Oct. 10th to be eligible for trophies and awards. Each entry should include a summary sheet showing valid contacts by band, total multipliers, total score, name and call of operator(s), station callsign, location, and declaration statement ("I declare, on my honor, that I operated in understanding and compliance with the NCJ Contest rules as well as all regulations for amateur radio in my country, and that my summary and log sheets are correct and true to fact."), followed by the signature(s) of the operators. Also required are a complete, legible log of all contacts (by band, with indication by numbered sequence of each multiplier claimed) and a separate check sheet for each band.

RESULTS

RESULTS OF THE 1977 FLORIDA QSO PARTY

Top 10 FLA Phone Stations		Top 10 FLA CW Stations	
WA4LZR	94,135 points	WA4NFF	27,900 points
WA4UFW	55,057	K4BV	10,560
WB4PQB	34,713	W4OO	10,098
WB4IIN	32,067	K4KQ	9,180
WB4INC	29,040	K4DAS	9,030
W4ZTW	20,586	K4IEX	7,896
W4WKQ	19,400	W4WJ	7,524
WA4EYR	18,069	WB4BMR	6,644
W4KEB	15,041	K4PB	5,740
N4EF	11,136	WB4ZHU	3,600

The top FLA club score was attained by NOFARS, with 126,860 points.

Top 10 Out-of-State Phone Scores		Top 10 Out-of-State CW Scores	
K9DX	6,063 points	WB4HYN/9	1,680 points
WB5STD	2,072	W8YL	1,550
W7KWC	1,512	W2RPZ	1,100
WB4HYN/9	756	K9DX	1,058
K2HLC	700	WBØLFY	1,012
WAØQIT	642	VE3EJK	940
VE3RN	495	W5KLB	798
K9KKX	455	WA2ZQB	765
K5RPC	312	W1GYV	684
K9GTQ	240	W2WSS	630

DELTA QSO PARTY

Starts: 1800 GMT September 24;
Ends: 2400 GMT September 25

Sponsored by the Delta Division of the ARRL; all amateurs are invited to participate. No time or power restrictions. Amateurs outside of the Delta Division will attempt to contact as many amateurs inside the Delta Division (consisting of Ark., La., Miss., and Tenn.) as possible. Stations may be worked once per band/mode. Portables/mobiles may be reworked on the same band/mode if they change counties.

EXCHANGE:

QSO number, RST, and QTH — ARRL section for non-Delta Division; county and state for Delta Division.

FREQUENCIES:

CW — 3550, 7050, 14050, 21050, 28050; SSB — 3990, 7290, 14290, 21390, 28590; Novice — 3725, 7125, 21125, 28125.

SCORING:

Delta Divisions take number of QSOs times number of ARRL sections (75 max.). Outside the division, take number of QSOs times number of counties worked (316 max.). DX stations may be worked, but do not count as multipliers.

ENTRIES AND AWARDS:

Logs must include date/time, call, exchange, band, emission, and multiplier. Logs must be postmarked no later than Oct 21st to be eligible for awards. The Delta Achievement Award is issued to all amateurs contacting 5 different stations in each of the 4 states in the Delta Division.

RESULTS

RESULTS OF THE 1977 BARTG RTTY CONTEST

Top 10 Single Operator Stations (107 Entries)

CT1EQ	488,160 points with 336 contacts
9H1EL	409,464 points
I5WT	281,160
I5KPK	270,560
G3YYD	258,560
K5ARH	235,056
SM6GVA	230,838
PJ3AR	229,600
W3FV	219,186
W2NZ	218,988

The top multi-operator entry was from I1PYS, with 388,448 points. W1MX finished third in the multi-op category. The top SWL entry was from Cech Luhos (OK2-5350), with 278,820 points.

RESULTS

RESULTS OF THE 1977 COUNTY HUNTERS SSB CONTEST

Mobile/Portable		
WAØRJJ	336,868 points	(625 QSOs)
W6ANB	315,768	
WBØELJ	101,376	
WBØICP	69,300	
WB2GFE	42,688	
W5AWT	24,540	
WA7KKN	11,520	
WB9RCY	10,530	
W1EXZ	5,338	
W1DIT	4,865	
Fixed — DX		
CT1UA	43,775 points	
Fixed — W/VE		
W7KWC	3,940,942 points	(1,503 QSOs)
K1GSK	1,683,314	(1,263 QSOs)
WB4OGW	865,358	
W7SUY	365,472	
W8WT	249,678	
VE1RQ	204,200	
W7GHT	156,520	
W7KOI	103,360	
WA8ASV	70,713	
W1LQQ	66,783	

Other certificates and plaques for high scores. Logs will be returned if requested. Send logs to Malcolm P. Keown W5RUB, 213 Moonmist, Vicksburg MS 39180.

FALL CLASSIC RADIO EXCHANGE

Starts: 1800 GMT Sunday, September 25;
Ends: 0100 GMT Monday, September 26

Sponsored by the Southeast ARC (K8EMY) of Cleveland, Ohio, the contest is open to all. The object is to restore, operate, and enjoy older equipment with like-minded hams. A "classic radio" is any equipment built since 1945 but at least 10 years old — an advantage, but not required in the exchange.

EXCHANGE:

Name, RST, state, province, or country, receiver and transmitter type (if home brew, send PA tube, e.g., "6L6").

MISCELLANEOUS:

The same station may be worked with different equipment combinations, and on each mode on each band. No AM phone below 21 MHz. CW call is "CQ CX"; phone call is "CQ EXCHANGE". Non-contestants may be worked for credit.

FREQUENCIES:

CW — up 60 kHz from low end of band edges; phone — 3910, 7280, 14280, 21380, 28580; Novice/Tech — 3720, 7120, 21120, 28120.

SCORING (NOTE CHANGES FROM LAST YEAR):

Add the numbers of different transmitters and receivers, states/provinces/countries contacted for each band. Multiply by total number of QSOs. Multiply that total by class multiplier, the total years old of all transmitters and receivers (three QSOs minimum per unit). For transceivers, multiply years old by two.

ENTRIES AND AWARDS:

Awards for highest scores, longest DX, most equipment combinations, oldest equipment, and "unusual achievements." Send logs, comments, pictures, etc., to Stu Stephens K8SJ, 2386 Queenston Road, Cleveland Heights OH 44118. Include an SASE for a copy of the *Classic Radio Newsletter*.

CALIFORNIA QSO PARTY

Starts: 1800 GMT Saturday, October 1;
Ends: 2400 GMT Sunday, October 2

Sponsored by the Northern California Contest Club. Of the 30 hour period, the maximum operating time shall not exceed 24 hours. Times on and off must be clearly marked in the log, and each time off shall not be less than 15 minutes. All amateur bands may be used, and stations may be worked once per band and mode. Mobile or portable CA stations may be worked in each new county on each band and mode. CA stations may work other CA stations.

EXCHANGE:

CA stations send consecutive QSO numbers and county; others send QSO number and state, province, or country.

FREQUENCIES:

CW — 1805, 3560, 7060, 14060, 21060, 28060; SSB — 1815, 3895, 7230, 14280, 21355, 28560; Novice — 3725, 7125, 21125, 28125. Try 10 meters on the hour and 15 meters on the half hour between 1800 and 2200 GMT.

SCORING:

Each QSO counts 2 points. CA stations multiply QSO points by number of states (including CA) plus Canadian districts (8 max.). DX may be worked for QSO points, but does not count for multipliers. Non-CA stations multiply QSO points by number of CA counties worked (58 max.).

ENTRIES AND AWARDS:

Log information should include date/time, band, mode, callsigns worked, and exchanges sent/received. Number each new multiplier as worked. A summary sheet should be included, showing your callsign, name, address, number of QSOs per band, total number of QSOs, total multiplier, claimed score, and indication of whether single or multi-operator entry. Summary sheets are available from the NCCC. Certificates are awarded to the highest scoring station in each CA county, state, province, and country. Portable stations must make 20 QSOs minimum for county certificate. There will be second and third place awards if justified, as well as special high score awards and a club award for highest aggregate score. All entries must be sent to the NCCC, c/o Lew Jenkins N6VV, 1750 Eucalyptus Ct., Concord CA 94521, and must be postmarked not later than Oct. 31st. Please include a large business-size SASE with each entry.

ZONE 29 AWARD

Issued by the West Australian Division of the Wireless Institute of Australia to amateurs and SWLs worldwide for contacts with 25 stations located within zone 29. Contacts may be on any amateur band or mode, but must have been made after January, 1952. The following endorsements are available when the award is issued as confirmation of following special conditions:

(a) All 25 stations on one band only;
(b) All 25 stations on phone (SSB, AM, FM, etc.);
(c) All 25 stations on CW;
(d) All 25 stations on one band and all on phone;
(e) All 25 stations on one band and all on CW;
(f) 25 stations heard by SWL listener, in (a) to (e) above.

Confirmation in writing of all contacts must be submitted to: The Secretary, WIA (WA Division), Box N. 1002, GPO, Perth, W.A. 6001, Australia. Include S1 or 5 IRCs for postage and handling.

Corrections

There is an error in the article "The Morse Clock," July, 1977. The table in Fig. 7, page 57, has an incorrect value. The ROM contents for digit 1 should be "11110", not "10000" as indicated.

John Molnar WA3ETD
Executive Editor

There are several corrections to "Super DVM," starting on page 108 in the August, 1977, issue. The zener diodes in Fig. 4 are incorrectly designated. The two diodes marked "1NT63" should be 6.2 V 1N753 diodes. In Fig. 3, the op amp is shown with incorrect pinouts. The 100 pF capacitor should be connected between pins 8 and 1, not between 8 and 7 as shown. The power should be connected to pin 7. This pin is not numbered in the figure. The photographs in "Super DVM" were taken by Bert Mau.

John Molnar WA3ETD
Executive Editor

There's an error in my article, "Build A Multiplying Prescaler," in the July issue. Fig. 9(b) on p. 136 should show IC2 pins 5 and 8 grounded, as in Fig. 8.

J. H. Everhart K3JE/2
Lancaster PA

The balun transformer illustrated in Fig. 4 of "Satellite Zapper," on page 83 of our May issue, is in error. The RG-58 coax cable indicated should in reality be RG-59 or RG-11 cable. The balun transformer requires 72 Ohm cable to properly match the 300 Ohm twinlead.

John Molnar WA3ETD
Executive Editor

The article "Inside The Bird," by Robert Bloom, July, 1977, made several references to the term THRU-LINE™ on page 44. This term is a registered trademark of Bird Electronic Corporation, Solon, Ohio, and was incorrectly used without the identifying trademark symbol.

There are also three errors in the article: The resistor in Figs. 2 and 3 has to be on opposite sides of the loop, not in the left leg. On page 45, column one, the formula for I_r is missing a minus sign, and in column two, I^2R is printed as "1^2R". The correct formulas are: $I_r = -E_r/Z_0$ and $I^2R = IE$.

John Molnar WA3ETD
Executive Editor

My letter to you dated 19 May concerning the conversion of certain SSB CB rigs to 10 meters contains a rather foolish statement which I wish to correct. I had said that using a 12.6685 MHz crystal in place of the X4 value given in the table would yield six additional frequencies between 28.6 and 28.8 MHz. This is obviously erroneous: The suggested change would indeed produce six frequencies different from the original crystal frequency, but no more of them would be between 28.6 and 28.8 MHz with either crystal. My apologies — this was an admittedly stupid error which I made due to trying to do the math involved in the conversion at 0230 hours.

Those who are involved in the Ten-Ten activities, and have no particular desire to operate in the DSB full carrier mode, may be interested in the following set of crystal frequencies. When substituted for the high oscillator crystals in the Cobra 138A/138, Midland 13-895, or Pace 1000 CB transceivers, they will produce 23 operating frequencies between 28.510 and 28.800 MHz. X1 — 12.5485 MHz; X2 — 12.5585 MHz; X3 — 12.5685 MHz; X4 — 12.5885 MHz.

If you calculate the operating frequencies obtained with the above, you will note that all of them fall on frequencies which are evenly divisible by 10 kHz. Since approximately one third of the existing Ten-Ten local nets meet on frequencies which are not evenly divisible by 10 kHz, you may want to change one or more of the crystal frequencies by a few kHz to accommodate your local net.

I will repeat my earlier caution that the "delta tune" controls on most SSB CB radios swing both the transmit and receive frequencies. This is accomplished in the abovementioned radios by a varactor diode which operates in the high oscillator circuit. My experience has been that the maximum frequency swing with the original components is on the order of one kHz plus and minus. It may be possible to increase this range by using a different varactor, but I don't know of anyone who has tried it.

Finally, a brief comment on WA4MFT's 10 meter bandplan — fooey! As far as I'm concerned, we already have enough bandplans on the VHF and UHF bands without encumbering the HF bands with them. Some cooperation among 10 meter AM ops is indeed necessary, but Ray's plan is just too structured for my taste.

Stan Modjesky WB3CJI
Woodlawn MD

Alan Christian WA6YOB
PO Box 5314
San Jose CA 95150

A FAAR-OUT DXpedition

-- airborne VHF and OSCAR!

On Saturday, September 17, 1977, the FAAR-OUT Airborne DXpedition will take to the skies over California and Nevada. FAAR-OUT (*F*ive *A*irborne *A*mateurs *R*eaching *OUT*) will provide a unique opportunity for VHF/UHF/microwave amateur operators to participate in a unique experimental DXpedition. We will fly a 1085 statute mile route over a period of nearly eight hours, operating on 4 bands and using several modes of communications. We will be seeking a maximum number of contacts on all bands and modes, and will be looking for real DX stations, as well.

We expect to make contacts with stations in high locations, with good antennas, and with other airborne stations. For pilots who would like to know our exact flight plan, here 'tis: San Jose V334 Sacramento V6N Reno V105 Las Vegas. Lunch and refuel at Las Vegas, then via V21 Hector VOR, V12 Palmdale, V137 Priest VOR, V485 San Jose. We plan to fly the San Jose to Las Vegas leg between 1600 GMT and 2000 GMT, and the Las Vegas to San Jose return leg between 2100 GMT and 0100 GMT. This timing may vary up to an hour each, or either way, and the exact times will depend on the weather and upon OSCAR orbits. The San Jose-Las Vegas leg will be flown at 11,500 feet, and the return leg will be flown at 12,500 feet.

We will be operating on the following bands and modes: 146.52 MHz FM, 145.1 MHz SSB, 223.50 MHz FM, 432.0 USB, 446.0 FM, 437.25 ATV, OSCAR Mode B, and 1296.010 USB. At present, the inclusion of ATV equipment is contingent on getting the equipment working in time, and the OSCAR shot will be made if mode, orbit, and antenna installations on the aircraft permit.

The following operators will be operating the following bands, etc.: 146.52 MHz FM – Dave WB6KHP, 40 Watts ERP; 145.1 MHz SSB – Ray WA6VAB, 40 Watts PEP; 223.50 MHz FM – Brad WA6REE, 10 Watts ERP; 437.25 ATV (if aboard) – Ray WA6VAB, 40 Watts peak video; 432.0 USB – Paul WA6UAM, 40 Watts PEP; 446.0 FM – Alan WA6YOB, 10 Watts ERP; 1296.010 USB – Paul WA6UAM, power not specified; OSCAR Mode B – Paul WA6UAM, 40 Watts PEP.

In addition, if other airborne amateurs wish to contact us and find the QRM a bit much, call Cessna N1522Q on 122.90. We'll fit you in. Please call the operator listed above for the particular band/mode you will be using. We are not planning to use a single call for the DXpedition.

In order to provide an opportunity for as many amateurs as possible to contact us, we request that when you call us, give your callsign and wait for an acknowledgement. Keep trying. There will be QRM and our own self-generated intermod for us to contend with, so if we seem a bit abrupt in acknowledging your contact, please be patient. Be sure to log it, too, and we will QSL 100% of verified contacts with a specially-printed photo QSL card for the expedition. We will also QSL all SWL reports that indicate that you have copied our transmissions.

If conditions permit, we are also going to try some propagation experiments within the California coastal duct. If the duct appears to be forming, or present during the latter part of our flight, we will be flying up and down inside it, in an effort to discover what atmospheric phenomena may be related to various modes of propagation within it. If we locate the duct, we will be operating primarily on 145.1 and 432.0 SSB.

Anyone wishing to schedule a contact or contacts with us can send a note requesting the desired schedule time and frequency(ies) to: Alan Christian WA6YOB, PO Box 5314, San Jose CA 95150. We will reply by mail and will make every effort to keep the schedule.

The SSB and ATV antennas will be horizontally polarized, and the FM antennas will be vertically polarized in an effort to maximize contacts.

If inclement weather on the West Coast causes postponement of the flight on the 17th, we will fly the expedition one week later on September 24.

If you have any questions about the DXpedition, please feel free to write. We would appreciate an enclosed SASE, but we will answer all queries. It seems advisable for stations near our proposed coverage limits to write and schedule their contacts in advance. ■

Richard R. Parry W9IF
38W255 Deerpath Road
Batavia IL 60510

So You Want To Get Into RTTY?

-- "Call For Papers" winner

So you want to get into radioteletype? Congratulations, you made the right decision. Radioteletype (abbreviated RTTY) is the most interesting, fascinating and rewarding mode of communication around today.

The burgeoning of integrated circuits over the last decade and the rapid decrease in the cost of these circuits have made it easier than ever before to get into RTTY at a minimum cost. It is this proliferation that has also aided the development of RTTY systems that were heretofore impossible or impractical. For example, how would you like to be able to turn your friend's teleprinter on and leave a message for him when he gets home? You can do it; it's called a selective calling system. Or how would you like to turn on a transmitter thousands of miles away to get an idea of current propagation conditions? No problem. If the other station has an answer-back system, all you need do is type the station's access code. The transmitter is then automatically turned on and a short message is broadcast. If you are of an artistic bent, exchanging RTTY pictures should fulfill your desires. If you enjoy music, composing songs to be played on the teleprinter will prove fascinating. If building is your bag, you have come to the right place. While commercial equipment is available, building your own equipment should prove rewarding, not to mention the pecuniary savings. If contests are your main interest, RTTY has many throughout the year. You say collecting award certificates is your thing? Then try working all states or all continents on RTTY for a challenge. If you like to rag chew, you have come to the right place.

Photo 1. The author and friends. The basic RTTY equipment includes a Model 15 teleprinter, an ST-6 demodulator, and an AFSK modulator. The amenities include an electronic keyboard; a CRT RTTY tuning indicator; a UT-4 for signal regeneration and electronic speed conversion; a digital date, time, and message generator for the Selcal and W-R-U system; and a cassette tape recorder for storing and transmitting data. (Photo by Anthony R. Donaldson.)

RTTY is a very relaxing way to communicate. Since the conversation is printed on paper, you can go get that cup of coffee or glass of soda pop while the other fellow is talking without missing any of the conversation. It is also possible to start answering the other fellow while he is still talking by punching your message into paper tape. When the other fellow is finished transmitting, you can send your prepared message back.

If you want to keep informed on different aspects of ham radio, W1AW broadcasts RTTY bulletins daily. Information on OSCAR crossings, propagation, and general comments about ham radio are given. You say you like to keep abreast of the news and weather? No problem. Many commercial stations such as the Associated Press broadcast news bulletins throughout the day. Other commercial stations broadcast weather conditions. This type of information could be most useful during

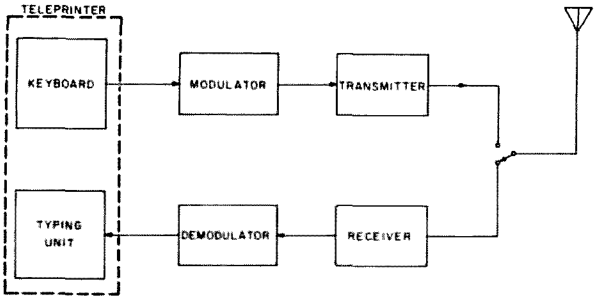


Fig. 1. Typical RTTY station block diagram.

the tornado or hurricane season.

If you are technically oriented, the flexibility of RTTY should interest you. Many amateurs are connecting microcomputers to their stations. With one of these, you are only limited by your imagination. You say you don't like the dampened roar of a teleprinter? Then an elegant video display is just what the doctor ordered. If any of these facets of RTTY intrigues you, then read on, and welcome to the wonderful world of RTTY.

While the history of teleprinters goes back to as early as 1906, when the first American teletypewriter was invented, amateur use of teletypewriters is relatively new. Amateurs were involved in radioteletype as early as 1946. But it was not until 1953, when the FCC removed certain restrictions on amateur radioteletype, that the field of amateur RTTY really began to grow.

The amenities of RTTY are indeed myriad, but let's get down to basics. There are actually only three components necessary to get a RTTY station on the air – a teleprinter, a modulator, and a demodulator. Fig. 1 shows these three basic components and their interconnection in a typical RTTY station.

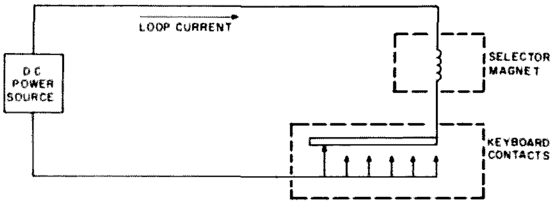


Fig. 2. The Local loop.

PART I
THE BASICS

The Teleprinter

Before getting involved in the technical aspects of teleprinters, a clarification of the word teleprinter is in order. A teleprinter is often wrongly referred to as a "Teletype." Teletype is a registered trademark of the Teletype Corporation. As such, it should always be capitalized and used as an adjective rather than a noun. The name Teletype has come to be used erroneously due to the popularity of the Teletype Corporation products. There are, however, other manufacturers of teleprinters including Kleinschmidt, Lorenz, Mite, and ITT Creed. Therefore, to be correct, I will use the word teleprinter to describe this family of machines.

At the heart of every amateur RTTY station is the teleprinter. The teleprinter is quite similar to a typewriter.

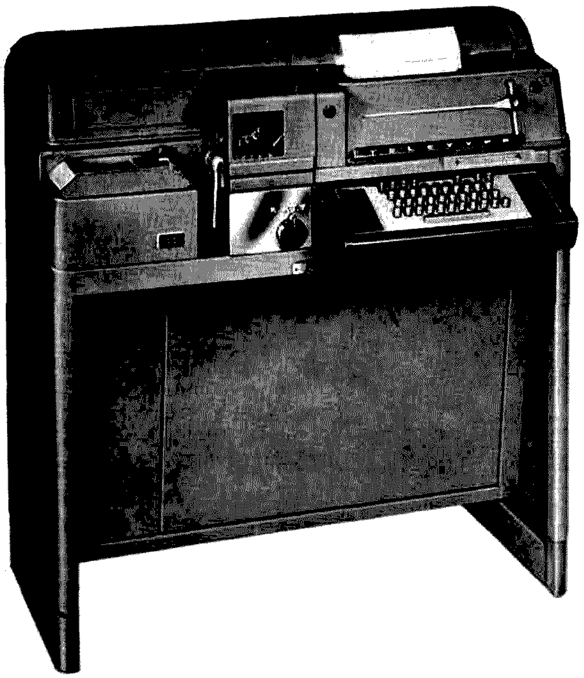


Photo 2. The Teletype Model 28 ASR shown here is a highly respected and sought-after machine. The unit includes a keyboard, a page printer, tape reader, tape punch, and a stunt box for adding special control functions. The Model 28 is built for heavy duty, 24 hour per day operation and easily operates at 100 wpm. Unlike the Model 15, the Model 28 is still manufactured by the Teletype Corporation. (Photo courtesy of the Teletype Corporation.)

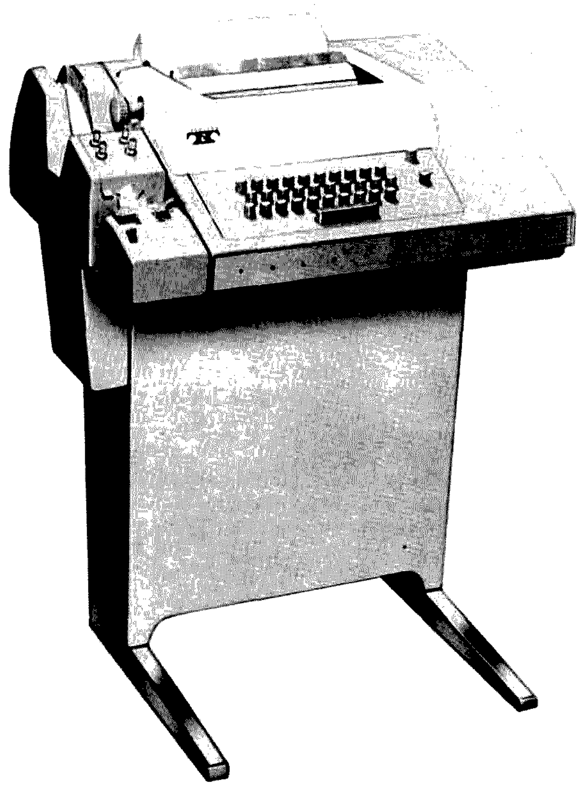


Photo 3. The Model 32 ASR, shown here, is the newest model teleprinter using the Baudot code manufactured by the Teletype Corporation. The machine includes a paper tape reader and punch shown on the upper left side in the photo. (Photo courtesy of the Teletype Corporation.)

Lower Case	Upper Case	Start	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Stop
A	–	S	M	M	S	S	S	M
B	?	S	M	S	S	M	M	M
C	:	S	S	M	M	M	S	M
D	$	S	M	S	S	M	S	M
E	3	S	M	S	S	S	S	M
F	!	S	M	S	M	M	S	M
G	&	S	S	M	S	M	M	M
H	#	S	S	S	M	S	M	M
I	8	S	S	M	M	S	S	M
J	'	S	M	M	S	M	S	M
K	(	S	M	M	M	M	S	M
L	)	S	S	M	S	S	M	M
M	.	S	S	S	M	M	M	M
N	,	S	S	S	M	M	S	M
O	9	S	S	S	S	M	M	M
P	Ø	S	S	M	M	S	M	M
Q	1	S	M	M	M	S	M	M
R	4	S	S	M	S	M	S	M
S	bell	S	M	S	M	S	S	M
T	5	S	S	S	S	S	M	M
U	7	S	M	M	M	S	S	M
V	;	S	S	M	M	M	M	M
W	2	S	M	M	S	S	M	M
X	/	S	M	S	M	M	M	M
Y	6	S	M	S	M	S	M	M
Z	"	S	M	S	S	S	M	M
blank		S	S	S	S	S	S	M
car. ret.		S	S	S	S	M	S	M
line feed		S	S	M	S	S	S	M
space		S	S	S	M	S	S	M
letters		S	M	M	M	M	M	M
figures		S	M	M	S	M	M	M

Table 1. The Baudot code. M = mark, S = space.

However, in a typewriter there is a mechanical linkage between the key the typist depresses and the arm that comes up and strikes the paper. This is not the case in the teleprinter. The teleprinter consists of two virtually separate units – the typing unit, and the keyboard. When one depresses a character on the keyboard, the keyboard encodes the character as a stream of pulses. The exact coding will be discussed later in greater detail, but at this time it should be noted that each character has a particular code much like the Morse code.

The purpose of the typing unit is to convert the stream of pulses back into a mechanical motion. Typically, the keyboard is also wired to the typing unit so that in addition to sending pulses to another machine, the pulses are received and printed locally.

Fig. 2 shows what is referred to as a local loop. With this circuit configuration, it is possible to type on the keyboard and obtain local copy. Current is flowing in the circuit until broken by the operation of the keyboard. The selector magnet senses the current pulses and prints the requested character.

The condition in which current is flowing in the loop is referred to as the "mark" state. The "space" state is characterized by the absence of current flowing in the loop. With these marks and spaces (current and no current), it is possible to make a code in which a particular combination of marks and spaces represents a particular character. We will discuss this code in greater detail later. The important concept to grasp at this point is that the keyboard and the typing unit are separate and not mechanically attached. In fact, some teleprinters do not have a keyboard at all, such as the Model 28RO. The RO indicates Receive Only. These machines are used where only one-way communication is desired, such as in a commercial newsroom.

While new teleprinters are available from the Teletype Corporation, the price is rather high for the average amateur. For this reason, most amateurs use teleprinters that have been retired from commercial use. A teleprinter may be obtained for as little as $30. Hamfests or advertisements in the amateur radio magazines are good sources for machines.

There are several models of teleprinters that are currently used in amateur applications. However, Models 15 and 28 are the most popular. These models are called page printers. This means the message is printed on a continuous roll of paper rather than a narrow paper strip. The paper tape printer is virtually gone from amateur use.

The Code

Before we get into the two remaining basic units of the RTTY station, the modulator and the demodulator, we must discuss the code used for radioteletype communication.

The code used by the teleprinter is similar in nature to the Morse code. However, where the Morse code uses dots and dashes, the teleprinter code uses marks and spaces. One important difference between the teleprinter code and the Morse code is the length of each basic element or bit of information. For example, the length of a dot or dash is determined exclusively by the operator.

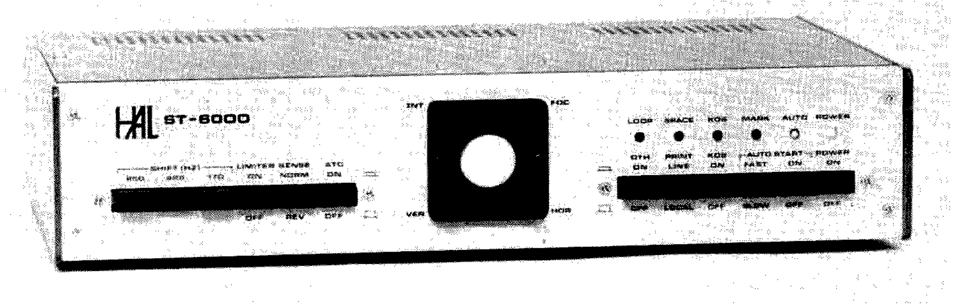


Photo 4. The Hal Communications Corporation is the most popular manufacturer of amateur RTTY equipment. Shown here is the ST-6000. Other demodulators manufactured by Hal include the ST-5000, the ST-6, and the ST-5. Of particular note is that most of the Hal products can be purchased already assembled or in kit form, or, for those with a well-stocked junk box, individual components such as printed circuit boards are available. For more information write Hal Communications Corporation, Box 365, Urbana, Illinois 61801 or call 217-367-7373. (Photo courtesy of Hal Communications Corporation.)

It would be difficult to design equipment that would have to copy correctly at all typing speeds. Therefore, a special teleprinter code, referred to as the Baudot code, is used. This code was designed so that each character contains the same number of elements or bits, and each element is of a fixed duration. One other important characteristic is required of our teleprinter code. When transmitting the code, the receiving teleprinter must be synchronized with the transmitting teleprinter, even though they may be thousands of miles apart. To accomplish this end, a start pulse is added at the beginning of the character, and a stop pulse is added at the end. These pulses are used to insure synchronization of the machines.

Table 1 shows the Baudot code that is used by teleprinters to communicate. All elements of the code are 22 ms (22/1000 seconds) except the stop pulse, which is 31 ms. Fig. 3 represents graphically a teleprinter character. The entire 7 bit word for this character may be written as SSMSMSM. Since the first and last bits are the start and stop bits respectively, the character is reduced to the following 5 bit code, SMSMS. Referring to Table 1, we see the character is the letter "R", or the number "4". Why are there two possibilities you ask? For those of a mathmatical bent, you will notice with a 5 bit code that the maximum number of combinations is 32 (2^5=2 x 2 x 2 x 2 x 2=32). The alphabet and ten digits require 36 (26+10) combinations by themselves, and we still haven't allowed for punctuation and other special functions. To obviate this problem, the teleprinter is equipped with a lower and upper case character set. This is analogous to the upper and lower case of a modern electric typewriter. However, where the typewriter uses "shift" and "unshift" to control the case, the teleprinter uses the "figures" and "letters" command. The upper case is attained by depressing the figures key. The teleprinter moves to the lower case when the letters key is depressed. Going back to our example, if the teleprinter is in the lower case (letters), it will print the letter "R". If a figures key has been depressed previously, the teleprinter will be in the upper case (figures) and print the number "4".

Since each character is of a finite duration, there must be an upper limit to the number of words that can be printed in one minute. Adding the duration of the 7 elements of the code, we arrive at a total time of 163 ms for each character (see Fig. 3). Since each character is 163 ms, the number of characters that can be printed in one minute is 368 (60 seconds/.163 seconds). One word is typically considered to be 5 letters plus 1 space. Thus, the number of words per minute is equal to 61.3 (368/6). This is then rounded off to 60. It would be nice to use machines that operate at higher speeds, but one should remember that teleprinters use mechanical parts that are limited to relatively slow speeds. Video display units are obviously not mechanical and hence are not limited to such low speeds. Speeds of several thousand words per minute are not uncommon. The 163 ms character length sets the upper typing limit at 60 wpm (actually 61.3). Since few amateurs are speed typists, this does not usually limit one's typing speed. While it is true that other speeds are used, such as 67, 75, and 100 wpm, amateurs use 60 wpm almost exclusively.

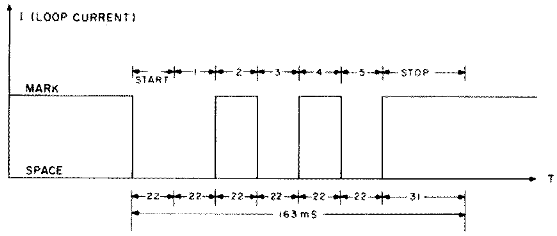


Fig. 3. Graphic representation of the letter "R" or the number "4".

It is important to note that each and every character is 163 ms no matter who is typing or how fast. Contrasting this with CW, even if all operators sent CW at a specific speed, each character is of a different duration. This is a characteristic inherent in the Morse code.

We now know the code that we must use to talk to the teleprinter. Our next task is to put these marks and spaces in a form that can be transmitted over the air. This is the purpose of the modulator.

The Modulator

Modulation refers to the process of transmitting the RTTY signal. Let's return once again to our analogy between CW and RTTY. CW is transmitted by opening and closing a telegraph key. Since a telegraph key is nothing more than a switch, and a teleprinter's keyboard is also a switch, why don't we substitute the keyboard contacts for the telegraph key? With this technique, the mark may be thought of as the transmitter's "on" condition, and the space the transmitter's "off" condition. This is called make-and-break keying and is sometimes used. However, a problem arises using this method. It occurs while the transmitter is off. Suppose a static crash occurs during the space condition (transmitter off); chances are the static crash may be misconstrued by the equipment as a mark, when it is really a space. The net outcome under this method is poor reliability, and thus a wrong character may be printed. We don't have this problem with CW because the incredible machine, the brain, can discriminate between a static crash and a signal.

So now what do we do? The answer is use frequency shift keying (FSK). With this method, the transmitter is on during both the mark and space states. If the transmitter

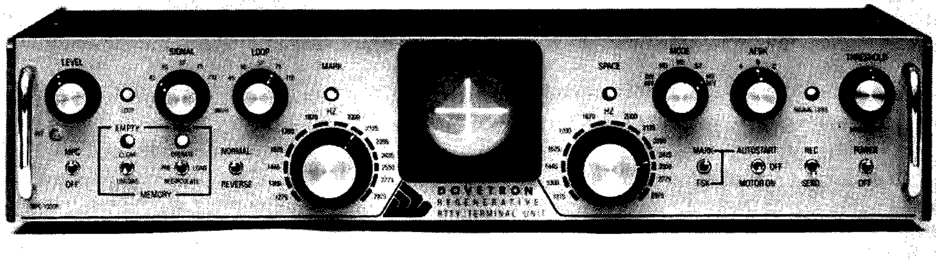


Photo 5. The Dovetron MPC-1000R is the Rolls Royce of terminal units. Some of the special features of the unit are electronic speed conversion, signal regeneration, a character memory up to 200 characters, error correction to erase misspelled words, Tee Dee inhibit, and variable character rate. Front panel controls permit "signal" and "loop" speed selections of 60, 67, 75, 100 wpm Baudot and 110 baud ASCII. (Photo courtesy of Dovetron.)

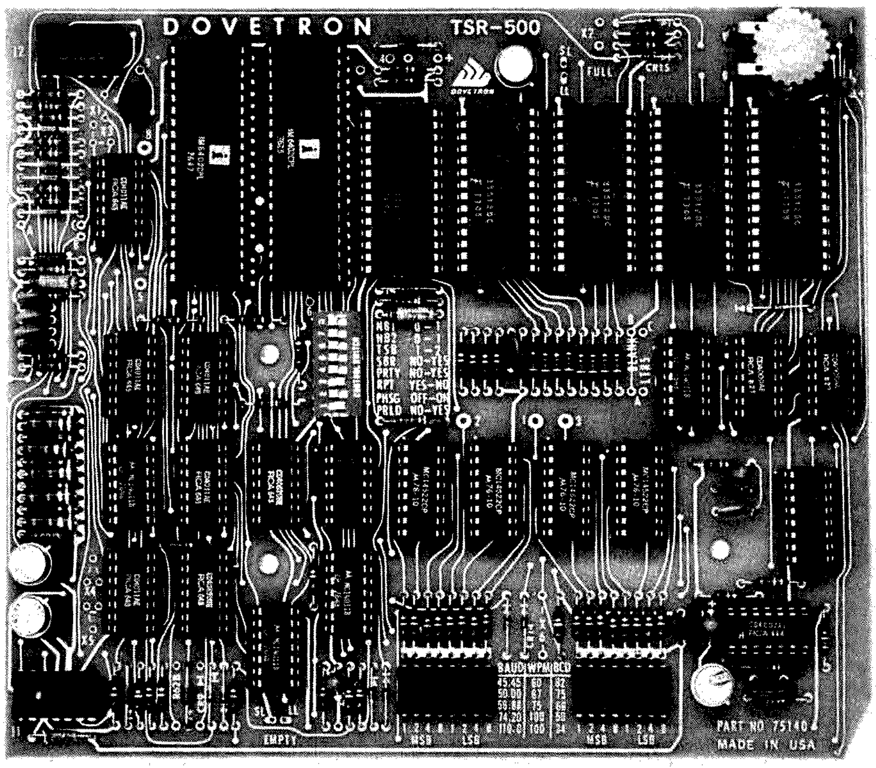


Photo 6. The TSR-500 is at the heart of all the special features of the Dovetron MPC-1000R and may be purchased separately. The error correction circuit allows one to erase the last word put in the memory by depressing a "blank" key. Information on this and other Dovetron products may be obtained from Dovetron, 627 Fremont Ave., South Pasadena, California 91030 or phone 213-682-3705. (Photo courtesy of Dovetron.)

is on during both states, how do we differentiate between the two? Simple, we let the transmitter transmit one frequency during the mark condition and transmit another frequency during the space condition. Thus, we are shifting between two frequencies, and hence the name, frequency shift keying. The difference between the two frequencies is referred to as the shift. While amateurs are allowed to transmit RTTY using any shift less than 900 Hz, the amateur fraternity has settled down to two standards, 170 and 850 Hz shifts. The 170 Hz shift is used almost exclusively on the low bands, while 850 Hz shift is typically used on the VHF bands.

Two methods are used to shift the transmitter's frequency – carrier frequency shift keying (FSK), and audio frequency shift keying (AFSK). With the first technique, the carrier frequency is shifted by placing a capacitor across the transmitter's oscillator tank circuit. This capacitor is connected by the contacts of the keyboard. With the capacitor disconnected, the transmitter is transmitting a mark signal. When the capacitor is connected by depressing a key on the keyboard, the transmitter's frequency is lowered, and this represents the space condition. Typically, the keyboard is buffered from the tank circuit because the keyboard's contacts cannot efficiently control these radio frequency signals, but the idea of connecting a small capacitor for space and disconnecting it for mark remains unchanged.

With the second method, audio frequency shift keying, audio tones are generated and fed directly into the microphone jack of the transmitter. For narrow shift, the AFSK unit generates 2125 and 2295 Hz signals (2295 - 2125 = 170 Hz shift). The 2125 Hz signal denotes the mark signal and the 2295 Hz signal represents the space signal. When the keyboard contacts are closed, a 2125 Hz signal is fed into the microphone jack. The 2295 Hz signal is generated when the contacts are open. Note that with this method, the space frequency is higher than the mark frequency. When using carrier FSK, the opposite is true; the mark frequency is higher than the space frequency. This apparent contradiction can be explained by noting that the heterodyne system of generating a lower sideband signal has the effect of flipping the frequencies over. Therefore, the final space frequency generated by the transmitter is indeed lower than the mark frequency when using AFSK as it is when FSK is used.

The AFSK method of generating a RTTY signal requires a stable audio generator. Its main advantage lies in the ease of interfacing the keyboard with the transmitter. One need simply plug the output of the generator directly into the microphone jack of the transmitter.

The Demodulator

At the receiving end, our job is to decipher the tones and reconstruct the information in a form the teleprinter can handle. There are basically two methods that are used to differentiate between the two tones. The old technique, and still the most widely used, involves demodulation via two separate resonant LC (inductor and capacitor) circuits. In the case of 170 Hz shift, one LC resonant circuit is tuned to pass the 2125 Hz mark signal, and the other is tuned to pass the 2295 Hz space signal. These filter circuits, called discriminators, pass only their respective tones, mark or space, and drastically attenuate all other frequencies. Fig. 4 shows a simplified diagram of this type of demodulator. After the two tones have been segregated through the filtering process, they are fed to a stage called a slicer, which drives the keying transistor. When a mark signal is received, the slicer turns the transistor on, and we have a closed loop. With a space signal received, the slicer turns the keying transistor off, and we have an open loop. Thus the keying transistor acts as a switch. However, more to the point, it is simulating the keyboard switch contacts of the station transmitting.

A modernization of this method employs active filters to replace the passive LC filters. The main advantage of this technique comes from the fact that fairly large inductors (typically 88 mH) are not required. Tuning the

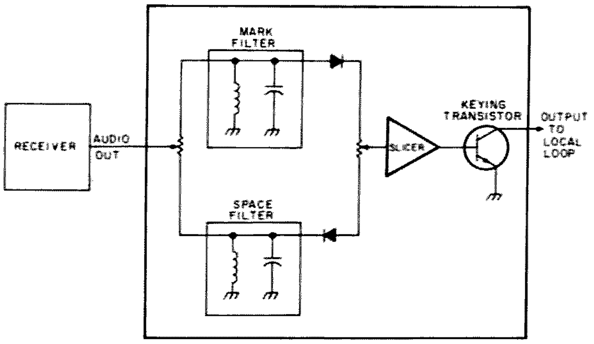


Fig. 4. Simplified circuit diagram of a RTTY demodulator using passive filters.

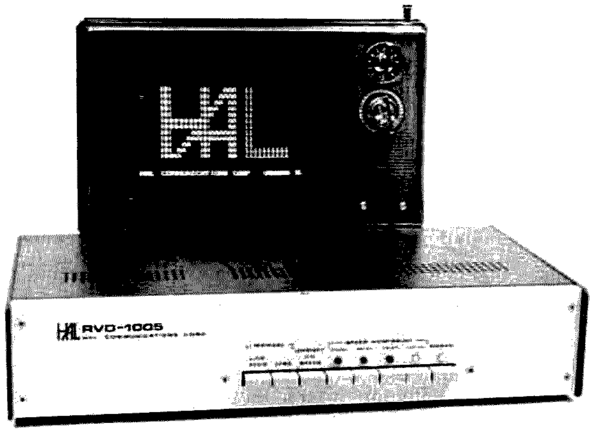


Photo 7. The RVD-1005 visual display unit is the modern answer to the teleprinter. The unit accepts demodulated Baudot signals at 60, 66, 75, and 100 wpm and displays the information on 25 lines with 40 characters per line. (Photo courtesy of Hal Communications Corporation.)

active filters for the exact frequency during calibration is also simpler, since it typically requires an adjustment of a resistor rather than the trial and error technique used in trimming an LC filter to the exact frequency.

The second method that is used to demodulate a RTTY signal uses a phase locked loop (PLL) integrated circuit. Despite its inferiority to the method described above, it is cheap and easy to build. As such, it makes a great demodulator to build to get on the air in a hurry.

PART 2
THE AMENITIES

As previously stated, all that one needs to get a RTTY station on the air is a teleprinter, a modulator, and a demodulator. However, several accessories may be added to a station to really increase the joy of RTTY and operating ease. Amenities available to the RTTY aficionado include an electronic keyboard, a vidio display, tape distributor, tape reperforator, magnetic tape recorder, a CRT RTTY tuning indicator, a Selcal, and a W-R-U answer-back system.

The Electronic Keyboard

Typing on a typical teleprinter keyboard will require some practice and patience, especially if you are accustomed to typing on a modern electric typewriter.

Refering back to Table 1, you can see that the alphabet is printed if the typing unit is in the lower case, and punctuations and numbers are printed if the typing unit is in the upper case. Thus, typing a station call or an address, which contains both numbers and letters, would require extra operations to put the teleprinter into the upper or lower case as desired. An electronic keyboard, designed for the Baudot code, automatically inserts upper and lower case commands to insure the proper character is printed without the operator directly requesting the upper or lower case.

An electronic keyboard has other, more subtle, advantages. In addition to being attractive and quiet, the action of the keys is much smoother than a conventional teleprinter keyboard. These features decrease operator fatigue and increase the ease of operation.

The Video Display

For those who don't like the noise and maintenance of a teleprinter, state of the art technology has made video displays possible. An old black and white TV, coupled with a video display interface module, makes an attractive display.

Two notes of caution. Except for the Hal Corporation unit (see Photo 7), these video display units require a special code called ASCII. ASCII is the acronym for USA Standard Code for Information Interchange. Therefore a unit capable of translating the Baudot code to ASCII is required.

The second shortcoming of a video display deals with the maximum amount of information that can be displayed on the screen. While the format of characters on the screen varies from manufacturer to manufacturer, 1000 characters is typical. This 1000 characters may seem like a lot, but it really isn't. A typical QSO consists of several thousand characters. This means that you cannot look back at the content of a previous transmission or leave the ham shack for more than a few minutes. Both are only slight disadvantages, but, nonetheless, something to consider before purchasing a video display.

The Reperforator

If one wished to record a message to be played back at some later date, he would use a reperforator. The reperforator records a message by punching holes in a narrow strip of paper tape. Messages may be recorded either locally, by typing on the local keyboard, or straight off the air. The Teletype Corporation Model 14RO is a reperforator typically used by amateurs. Of particular importance is that once the paper tape has been made, it may be transmitted at full machine speed (60 wpm), thus expediting the transmission of information. A tape reperforator is used most often by amateurs to make and record RTTY pictures. More on this exciting facet of RTTY later.

The Tape Distributor

The tape distributor is used to read the punched paper tape made on the tape reperforator. The unit translates the holes in the tape into pulses so that they may be printed locally or sent to another station. The Teletype Corporation Model 14TD is a popular tape distributor used extensively on the ham bands.

The Magnetic Tape Recorder

Since the RTTY signals sent to the demodulator are in the audio range (2125 and 2295 Hz), why not record the information on a magnetic tape rather than on paper tape? After all, a cassette player is quieter, cheaper, and more convenient than a mechanical paper tape reperforator. The answer is that we can do just that. In fact, this technique is used extensively by computer hobbyists to record data. However, some problems can arise. For example, when using a narrow shift (170 Hz), this method becomes very sensitive to fluctuations in

Photo 8. Shown here is a small sampling of some of the RTTY pictures that are exchanged on the ham bands. The small uncomplicated pictures require approximately 10 minutes to reproduce at 60 wpm, while some of the large pictures with overlining can require an hour or more. The RTTY Journal *sponsors an annual RTTY art contest for those interested in this facet of RTTY. The pictures were stored on the cassettes shown in the photo. (Photo by Anthony R. Donaldson.)*

the tape speed. The mark and space tones will change frequency as the tape player changes speed. This problem can be remedied by using a high quality tape player with a low wow and flutter specification. There is still one additional complication, though. It would be difficult to find two machines that turn at exactly the same speed. Therefore, the cassettes could not be interchanged between machines. Both problems are solved by using a wider shift (850 Hz). For a mark tone of 2125 Hz to be misconstrued as a space tone of 2975 Hz, the tape player would have to be in very poor shape indeed. Photo 8 shows several RTTY pictures, all of which have been recorded on the cassette tapes shown.

The CRT Tuning Indicator

Several methods for tuning in a RTTY signal have been tried over the years. However, one of the oldest, and perhaps the best, makes use of a cathode ray tube (CRT). The mark and space signals are depicted on the screen of a small CRT (see Photos 4 and 5). The mark is typically a line displayed horizontally, and the space signal is a line shown vertically. With such a unit, the operator tunes the receiver until the horizontal and vertical lines are of maximum length.

The Selcal

The station equipped with a selective calling (Selcal) system can be turned on and off by typing a predetermined access code. While a station may be programmed for any access code, the standard has become the use of the last three letters of the station's call. For example, if your friend's call were W9IUV, typing the last three characters of his call, IUV, at your station would turn on the teleprinter at the station of W9IUV. You can now leave a message. When you are finished, typing four Ns will shut your friend's teleprinter off. The four Ns at the end of the message are a universally accepted shutdown code. Such a system is a great way to keep in touch with friends. Of particular importance is that there is no need for a person to be on the premises. Therefore, the equipment may be left running continuously. I still get a kick out of getting home to a few notes sent by friends. The distinct advantage of this system is that only notes addressed to you are received. In an all-call system, you would receive everyone's notes.

The W-R-U

A W-R-U (who are you) answer-back system is one step beyond a Selcal system. Leaving a note for a friend can be a hit or miss affair unless you are sure his equipment is on. A W-R-U system allows one to ascertain just that. By typing a predetermined access code, one can in essence interrogate the condition of the equipment. Adding the three characters figures, blank, and H after the last three letters of the station's call has become the customary code used to gain access to the equipment. For example, suppose you want to leave a note for W9YPS, but you are not sure if his equipment is up and running. To ascertain the condition of the equipment, you would type the six characters Y, P, S, figures, blank, H. Typically, the message sent after the W-R-U is tripped has been punched on paper tape and is played back on a tape distributor. Having tripped the W-R-U and, thus, confirmed the status of the equipment, you can now proceed as with a Selcal system and leave a note with the assurance the note has been received.

PART 3
SOME UNIQUE ASPECTS OF RTTY

For those of you who are connoisseurs of art, you should enjoy designing, making, receiving, and sending RTTY pictures. The number and kinds are truly prodigious, ranging from angels to nudes. Making a RTTY picture requires a reperforator (paper tape puncher) and a tape distributor (paper tape reader). For those wishing more information on this fascinating aspect of amateur RTTY, consult any of the RTTY handbooks listed in the annotated bibliography.

RTTY Music

I got home late one night during the Christmas season and thought I would listen to a RTTY QSO or two before retiring. Instead of hearing the customary clatter of old faithful (my Model 15), my ears were treated to a chorus of Jingle Bells followed by Noel and other Christmas favorites. This aspect of RTTY makes use of a tape distributor and tape reperforator. Instead of printing a character, the bell of the teleprinter is actuated in time to the melody.

Conclusion

It has been the purpose of this article to give the reader

an introduction to the fascinating world of RTTY and to whet his appitite. For those wishing to pursue this mode of communication further, I have accumulated an annotated bibliography listing books and articles to read for further information on this subject. Good luck and MMSMM MMMSS MSSSS. ■

ANNOTATED BIBLIOGRAPHY

Periodicals and Books Devoted to Radioteletype

American Radio Relay League. *Specialized Communications Techniques for the Radio Amateur.* Newington, Conn., The American Radio Relay League, 1975.

Only a portion of this book is devoted to radioteletype. Other topics include slow scan television, facsimile, and space communication. However, the approximately 70 pages that are devoted to radioteletype are well filled with useful information. I recommend this book highly.

RTTY Journal. *Beginners RTTY Handbook.* RTTY Journal, 1975.

If you want the most for the least, this is it. As the title indicates, the handbook is designed specifically for the beginner. I find it an excellent reference book and recommend it highly. Send $2.50 to RTTY Journal, PO Box RY, Cardiff-by-the-Sea CA 92007.

RTTY Journal

This short but useful periodical is devoted exclusively to

GLOSSARY

AFSK — Abbreviation for audio frequency shift keying. With this method of modulation, two tones (mark = 2125 Hz, space = 2295 Hz) are fed directly into the microphone jack of the transmitter.

Answer-Back (W-R-U) System — A system capable of being remotely controlled by another station. When tripped by a unique access code, a short predetermined message is broadcast.

Autostart (All-Call) System — An autostart circuit may be thought of as a squelch circuit. If an authentic RTTY signal is detected, the teleprinter motor is turned on and the message is printed. Unlike a selective calling system that turns the teleprinter on only when a particular access code is received, autostart circuits act as an all-call system and, thus, print any RTTY signal. The cessation of the RTTY signal causes the teleprinter motor to turn off.

ASCII — Acronym for the USA Standard Code for Information Interchange. At present, this code cannot be used on the amateur bands without special FCC permission. Unlike the 5 level Baudot code, this is a 7 level code used extensively in the electronics industry.

Baud — The basic unit of speed derived from the duration of the shortest code element. For 60 wpm operation, the baud rate is 45.45 (1/22 ms).

Baudot — The code used by amateur RTTY stations to exchange information. It is a 5 level code plus one start and one stop bit.

Discriminator — A discriminator, as used in RTTY circuits, consists of a filter, either passive or active, to pass one frequency and discriminate against all others.

FIFO — Acronym for first-in/first-out. A special integrated circuit memory device that will accept parallel data and retransmit it on a first-in, first-out basis.

FSK — Abbreviation for frequency shift keying. With this method of modulation, the frequency of the transmitter's crystal or vfo is shifted.

KB — Abbreviation for keyboard.

KOX — Acronym for keyboard operated transmission. A station equipped with a KOX system can turn on the transmitter and turn off the receiver simply by typing on the station's keyboard. When the operator ceases typing, the transmitter automatically turns off, and the receiver turns on after some preset delay.

Local Loop — The circuit containing a power source, the selector magnets and a keyboard. This connection allows local copy on the teleprinter (see Fig. 2).

Mark — In RTTY applications, the mark is one of two states. The mark condition is characterized by a closed circuit. The space, the other state, is characterized by an open circuit condition.

Modem — Acronym for modulator, demodulator. A modem is typically used in a system where tones are transmitted and received over telephone lines. It may be thought of as the equivalent to a RTTY station's terminal unit.

PLL — Abbreviation for a phase locked loop. A PLL integrated circuit can be employed in a RTTY demodulator to discriminate between the mark and space tones.

RTTY — Abbreviation for radioteletype. Often pronounced "ritty."

Selcal — Acronym for selective calling system. This system allows the teleprinter to be remotely controlled by a unique code.

Selector Magnet — An electromagnet that senses current flowing in the local loop and picks a character to be printed in response to the current pulses.

Shift — The difference between the mark and space frequencies. For example, if the mark frequency is 2125 Hz and the space frequency is 2295 Hz, the difference of 170 Hz is referred to as the shift. The 170 and 850 Hz shifts have become two widely used standards.

Space — One of two states describing the condition of a teleprinter's loop. The space is characterized by an open loop condition. The mark state indicates a closed loop.

Stunt Box — A mechanical unit that allows the operator to add control features to the teleprinter; for example, an automatic "non-overline" control which prevents printing over a message already typed. Controlling a remote device is another use for the stunt box.

Tape Distributor — A machine that reads prerecorded paper tape.

Tape Reperforator — A device that records data by punching holes in a paper tape.

TU — Abbreviation for terminal unit. This is the RTTY equivalent to a modem. It contains a modulator, demodulator, and loop power supply.

UART — Acronym for universal asynchronous receiver transmitter. A sophisticated integrated circuit that accepts serial data and retransmits it as parallel data and vice versa.

W-R-U — Abbreviation for who are you. See Answer-Back system.

amateur radioteletype. To subscribe send $3.50 to RTTY Journal, P.O. Box RY, Cardiff-by-the-Sea CA 92007. Price differs outside the U.S., Canada, and Mexico.

73 RTTY Handbook

There are two RTTY handbooks, both of which are, or have been, distributed by *73*. The old RTTY handbook, while probably a fine book several years ago, is currently outdated. Being aware of this shortcoming, *73* has recently released a new handbook called, appropriately enough, *The New RTTY Handbook*.

Teleprinters

McNatt, M.S. "A Guide to Baudot Machines: Part 1, Description of Available Devices," *Byte*, April 1977, p. 12.

An excellent, interesting, and succinct article describing many of the Teletype Corporation machines (i.e., Models 11, 12, 14, 15, 19, 20, 26, 28, 29, 31, 32, 33, 35, 37, 38, and 40). On page 158 of this article is a list of sources for Baudot equipment.

Modulators

Roos, J.C. "Universal AFSK Generator," *73*, July 1974, p. 37.

This article describes a RTTY modulator using the AFSK method of modulation. The unit is somewhat advanced for the beginner, but it does a very nice job. This is the modulator I have been using for several years, and I can speak highly of its effectiveness and reliability.

Demodulators

Grossman, B., and John S. Reid. "Building the Safari RTTY Terminal," *73*, August 1976, p. 122.

Unlike most demodulators that use passive filters (inductor and capacitor) to discriminate between the mark and space frequencies, this unit uses active filters. Inherent in active filters is their ease of calibration. A resistor is used to trim the filter to the exact frequency, rather than the iterative method used in LC filters.

Hoff, I. M. "The Mainline ST-6 RTTY Demodulator," *Ham Radio*, January 1971, p. 6.

The author, Irvin Hoff, has probably done more for RTTY within the last 15 years than any other RTTY aficionado. He is responsible for many demodulators, of which this article describes the most advanced. This unit has become a standard of excellence in the RTTY community. For the amateur who is earnest about RTTY, this is the demodulator to get.

Joffe, A.S. "Ridiculously Simple RTTY System," *73*, September 1976, p. 70. For those who want to get on RTTY in a hurry, this is the article you want. The demodulator, while lacking sophistication, works, and you can't argue with success.

Stinnette, N. "Phase Locked Loop RTTY Terminal Unit," *Ham Radio*, February 1975, p. 36.

This article describes a simple demodulator using the phase locked loop principle. This is probably the best demodulator for the neophyte to RTTY since it is cheap and simple.

Selcal, Answer-Back, and Related Equipment

Kelly, B. "Monitor Receiver for RTTY Autostart," *Ham Radio*, December 1972, p. 27. This article describes a fixed frequency receiver for the RTTY aficionado interested in autostart operation. Unattended autostart operation requires more than just a receiver with good sensitivity and selectivity. It requires the receiver to be ultrastable since, as previously stated, the station is unattended. For this reason, the receiver described in this article is crystal controlled.

Lichtenwalner, B.D. "The Computer QSO Machine," *73*, January 1976, p. 80.

This unit is capable of sending the time (hours and minutes), the date (year, month, and day), a preprogrammed message, and a CW ID. This unit is typically used in an answer-back system. When tripped by an access code, the time, date, message, and CW ID are broadcast, indicating the equipment is up and running.

Sanders, L.W. "RTTY Autocall — the Digital Way," *73*, February 1976, p. 76.

This article describes a selective calling unit (Selcal). Of particular note is that the unit uses integrated circuits rather than a mechanical stunt box.

Advanced Projects

Guthrie, R.D. "ASCII/Baudot with a PROM," *73*, June 1976, p. 114.

There are many commercial video display units on the market for those who don't like the clatter of a teleprinter. Unfortunately, these commercial units are geared for the computer hobbyist and, as such, accept only the ASCII code. This article describes a circuit that will convert the Baudot code to ASCII, so an amateur RTTY station can use one of the commercially manufactured video display units.

Hoff, I.M. "The Mainline UT-4," *RTTY Journal*, February, March, April, May 1974.

This series of articles describes the UT-4 which is a UART/FIFO combination capable of regenerating the received signal and electronic speed conversion. It's an advanced project but most worthwhile to the serious RTTY aficionado.

Hutton, L.I. "Build This Exciting New TVT," *73*, March 1976, p. 76.

This article describes two projects. The first is a home brew electronic keyboard that generates the Baudot code. The second portion of the article describes a Baudot to ASCII converter and a TVT character generator.

Levy, S.P. "A Morse to RTTY Converter," *73*, June 1976, p. 106.

If you like sending CW but not receiving, this article is for you. The circuit makes use of a microprocessor to convert CW to ASCII or Baudot. It sure would be nice to have the next time you have to take a code test at the FCC.

Mooring, E.E. "Phase-Shift RTTY Monitor Scope," *Ham Radio*, August 1972, p. 36.

There are many different methods that one can use to tune in a RTTY signal properly. This unit uses the phase shift method and a CRT display. This technique is superior to most other methods, since the CRT display gives a great deal of information. It is possible to tell at a glance if the other station is transmitting wide or narrow shift, if the mark and space signals are reversed, and much, much more. This is a nice amenity to add once you have a station running.

Miscellaneous

Alexander, D. "The First Computer-Controlled Ham Station," *73*, August 1976, p. 82.

This very interesting article describes the amateur RTTY station of the grand prize winner at the 1976 Altair Computer Convention. If you want to get some idea of the flexibility of a computer-controlled amateur RTTY station, this article is for you.

Brehm, R.C. "RTTY Goes Modern," *73*, February 1977, p. 82.

This article is a must for the beginner who wants to know the history of amateur RTTY. The author concludes with a prognosis for RTTY and its ever increasing comradeship with microprocessors.

Green, W. "Thirty Years of Ham RTTY," *73*, November 1976, p. 110.

An interesting article describing the history of amateur RTTY and is by one who was around during its infancy. Also included are pictures of antique RTTY gear.

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Design An Active RTTY Filter

-- eliminate CW QRM and noise

This project started several months ago when I became interested in RTTY and bought a copy of the ARRL's *Specialized Communications Techniques* to learn something about RTTY demodulators. But I couldn't quite see why, in this day and age, anyone in his right mind would want to build RTTY equipment with *tubes*. It seemed antediluvian.

The next thought was that perhaps the LC filters used in most current demodulators could be replaced by *active filters*. An active filter is made with an operational amplifier IC such as the popular 741, plus a few resistors and capacitors. Though it has no inductor, it can be tuned just like an LC filter can. It's used in the same way and does the same job. Aside from lacking an inductance, the active filter has one big advantage — its resonant frequency and its Q can easily be adjusted with potentiometers. A conventional LC filter requires removing turns from a toroid and/or hand-picking capacitors to find one with just the right value.

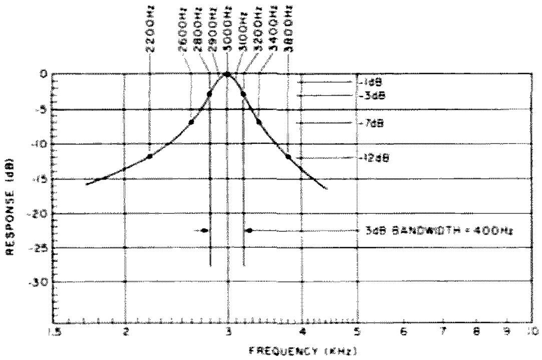

Fig. 1. Simple bandpass filter response curve.

In this article you will find not only several filters useful for RTTY, but also a complete description of how they were designed. Following these simple steps you could design other useful filters as well.

This description will concentrate on bandpass filters. In a good RTTY demodulator, a bandpass filter is used at the input to separate the desired RTTY tones from noise and QRM. This filter has to have fairly constant gain throughout the middle of its passband so that all needed RTTY information can pass through without distortion. But to reject the most QRM its response should drop quite fast to either side of the desired frequency range. This is a fairly tall order for a filter and usually requires the use of three 88 mH toroids and a batch of capacitors which are *very* carefully chosen. With active filters the three toroid filter stages are replaced instead with three op amp filter stages. Separate filters are used for receiving 170 Hz shift and 850 Hz shift RTTY signals.

In case your knowledge of filters needs a little brushing up, the following discussion will help bring you up to date and also explain why three stages of filtering are needed.

Single-Stage Filters

The frequency response of a one stage bandpass filter is shown in Fig. 1. This particular filter is resonant at 3000 Hz and has a bandwidth of 400 Hz. This means that the peak in the response curve is at 3000 Hz. This is the frequency where the filter has a maximum gain.

The bandwidth is measured by noting those frequencies where the gain drops to 70% of its maximum value. In terms of decibels, this is equivalent to a loss of 3 dB gain from its maximum value at the top. For the sake of simplicity, the gain at the top is usually defined as 0 dB, in which case the gain at the 70% points is -3 dB. The two frequencies where this occurs (see the plot) are 2800 and 3200 Hz. Since the difference between them is 400 Hz, we say that the bandwidth is 400 Hz. Sometimes, just to be precise, we say that "the 3 dB bandwidth is 400 Hz."

The "quality" of a bandpass filter is judged by how narrow the bandpass is in relation to the center frequency. This "quality factor" is called Q, and is defined as Q = resonant frequency/ bandwidth. In this case, the Q is 3000/400 or 7.5, while typical Qs range from 2 or 3 up into the hundreds in some cases.

If you know the resonant frequency and the Q of a filter circuit, it is easy to draw an approximate

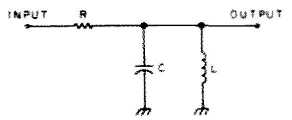

Fig. 2. Simple LC bandpass filter.

100 Hz away	(2900 and 3100)	the response is	-1 dB
200 Hz away	(2800 and 3200)	the response is	-3 dB
400 Hz away	(2600 and 3400)	the response is	-7 dB
800 Hz away	(2200 and 3800)	the response is	-12 dB

Table 1.

response curve. First, you use: bandwidth = resonant frequency/Q to solve for the bandwidth. Then you assume that the bandwidth of the filter is centered evenly around the resonant frequency. (This is usually not true, so you get a slight error when you do it.) If you divide the bandwidth by two, this tells you how far to go each side of the center frequency to find the -3 dB points. In this case the bandwidth is 400 Hz, so you go 200 Hz each side of 3000 to find the -3 dB points.

Other points on the curve can be gotten if you remember that halfway to the -3 dB point the response is at -1 dB, while twice as far away the response is at -7 dB, and four times as far as the -3 dB point the curve is at -12 dB.

In the example of Fig. 1, this works as shown in Table 1, using the center frequency of 3000 Hz as the reference.

Simple filters of this type have a curve which falls off 6 dB for every octave. What that means in this case is that each time you double the distance from the peak the response would drop by another 6 dB. Hence 1600 Hz away the response would be at -18 dB, 3200 Hz away it would be at -24 dB and so on. Most practical filters, however, completely stop dc and very low frequencies. As a result their response curve drops much faster for the low frequencies, and much slower for high frequencies than the above would make you think. Nevertheless, the above calculations are useful for high Q filters as long as we do not get too far away from the center frequency.

Bandpass responses such as Fig. 1 can be approximated by simple LC filters such as the one in Fig. 2. Because this filter has two reactive elements — one inductor and one capacitor — it is called a *two-pole* filter.

Two-pole filters can also be built with op amps as shown in Fig. 3. Many different kinds of op amps can be used with just minor changes in biasing. My favorite happens to be the 741, so that is what is shown here. Because it has two reactive elements — both capacitors — such a filter is also called a two-pole filter. (In many cases there may be more capacitors used for bypassing or coupling. These are not part of the filtering action and don't count toward the number of poles. If in doubt, check whether changing a capacitor's value changes the resonant frequency or the Q. If it does, then the capacitor counts as a pole.)

The circuit of Fig. 3(a) uses only one op amp, and is usable only for Qs less than 10. The component values are easy to find from the following equations. Given the resonant frequency f, the Q, and the desired gain G, choose a convenient value of capacitance C. For typical audio filters C is often 0.01 or 0.1 uF. Then,

$$R1 = \frac{Q}{2\pi fGC}$$

$$R2 = \frac{Q}{(2Q^2 - G)\, 2\pi fC}$$

$$R3 = \frac{2Q}{2\pi fC}$$

$$R4 = R3$$

where π = 3.14. The value for R2 is the exact value assuming all the other components have the exact values calculated. Usually R2 is a pot about twice the calculated value, which is then used to precisely set the resonant frequency. Making R2 twice the calculated size makes the final setting come out about midway in the pot rotation.

To get higher Qs requires two op amps as shown in Fig. 3(b). This circuit works for Qs in the range from 10 up to about 50. Component values for this circuit require a little more work to calculate.

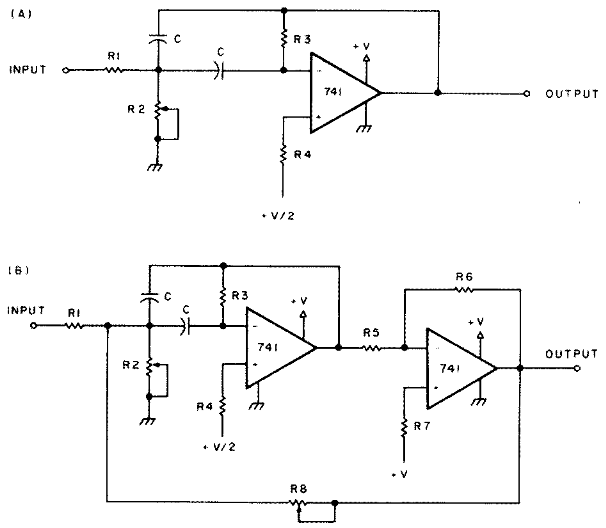

Fig. 3. Two-pole active bandpass filters. (a) Single op amp for Q less than 10. (b) Two op amps for Q between 10 and 50.

This circuit does not work well for low gains. It is at its best when the gain is somewhat greater than the square root of Q. For instance, if the filter is designed for a Q of 16, then the gain should be greater than 4. Usually we design for a gain several times greater than that, perhaps in the range from 8 to 20.

Once you have decided on the values for the resonant frequency f, the Q, the gain G, and the capacitors C, the following equations are used to find the resistor values:

$$R1 = R3 = R4 = R5 = \frac{Q}{2\pi f C}$$

$$R2 = \frac{R1}{Q^2 - 1 - \frac{2\sqrt{Q}}{G} + \frac{1}{G\sqrt{Q}}}$$

$$R6 = \frac{G\,R1}{\sqrt{Q}}$$

$$R7 = \frac{R5\,R6}{R5 + R6}$$

$$R8 = \frac{R1\,G\sqrt{Q}}{(2Q-1)}$$

While these equations look quite complex, any calculator will have them solved in a very short time.

Assuming that the values of the capacitors are exact (which is unlikely), these equations would give exact values for all the resistors. Usually, though, the capacitors will not be exactly the values used in the calculations, and the resistors will probably be the nearest standard values rather than the exact values found from the equations. In this case the circuit has to be adjusted to give just the right center frequency and the right Q. The normal approach is to make R2 and R8 pots of about twice the calculated value. R2 is then used to adjust the center frequency while R8 is used to adjust the Q. There is a slight interaction between the two pots, so you must repeat the adjustment two or three times.

When building active filters you must use good components. Do not use disk capacitors, even for testing! Every time you breathe on them they change value with the change in temperature. Polystyrene or polycarbonate capacitors are best, followed by mylar or mica capacitors. Also use good op amps. 741-type amps (which include the 1458, 5558 and 747) provide good performance up to several kHz. High frequency op amps may be needed for higher frequencies. I have had bad luck using the LM3900. Its gain is too low for reliable operation

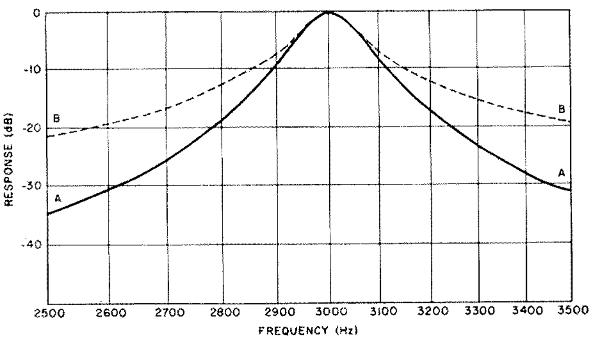

Fig. 4. Comparison of two-pole and four-pole filters.

in these circuits at the frequencies used for RTTY. Moreover, do not use dual or quad op amps such as the 1458 or 5558 in the same filter. Under some conditions the internal coupling between two amps in the same IC will produce strange results. It is best to use single 741 amplifiers.

Filters with Very Narrow Bandpass

There are different ways of building a narrow bandpass filter. You can use one stage of filtering with a high Q or use several stages cascaded (connected one after the other) with lower Q. Both approaches are often used. Cascading LC filters require

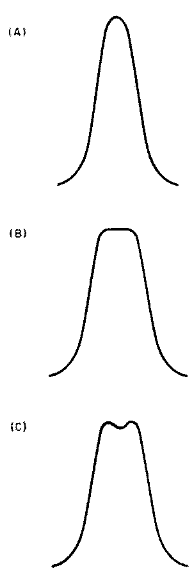

Fig. 5. Effects of coupling (or stagger tuning) on response of bandpass filter. (a) Under coupling. (b) Critical coupling (Butterworth). (c) Over coupling (Chebyshev).

careful mathematical analysis, since connecting LC filters together causes them to load each other down. As a result often the bandwidth gets bigger rather than smaller. Active filters, on the other hand, can be connected together without loading each other because they generally have a high input impedance and a low output impedance. Connecting several low Q stages (wide bandwidth) together really does narrow down the bandwidth.

Although filters with a very narrow bandpass are not generally needed for RTTY, it's useful to examine what happens anyway. Fig. 4 shows the difference between one high Q filter and two low Q filters in cascade. Curve A is for two cascaded filters, both tuned to 3000 Hz and a bandwidth of 150 Hz, while the two together have a bandwidth of only 96 Hz. Curve B is a single filter with a Q of 31.2, which also has a 3 dB bandwidth of 96 Hz.

Although the two sets of filters have almost the same response very close to 3000 Hz, they are very different far away from 3000 Hz. The single filter (Q = 31.2) is a two-pole filter which, as we mentioned earlier, results in the response dropping 6 dB each time we double the distance away from the center frequency. For example, at 3200 Hz the response is about -12 dB, while at 3400 Hz it is about -18 dB.

Combining two filters as in curve A makes this a four-pole filter whose response falls off twice as fast, in this case at 12 dB per octave. For example, at 3200 Hz curve A is at about -17 dB, while at 3400 Hz it is at about -29 dB. We note that 3400 Hz is twice as far from 3000 as 3200 is, and the gain is about 12 dB lower. From this example we see that a four-pole filter can be designed to have the same bandwidth as the two-pole filter, but its response falls off much more quickly to each side of the center frequency. In the same way, a six-pole or eight-pole filter would have even steeper sides to its response curve, decreasing at 18 dB per octave and 24 dB per octave, respectively. When talking about i-f amplifiers, we would say that an eight-pole filter has a better shape factor than a two-pole, meaning that it drops off faster. (You may have noticed eight-pole or ten-pole filters mentioned in ads for 2 meter FM transceivers.)

Wide Bandpass RTTY Filters

A typical RTTY demodulator – or TU for Terminal Unit – needs several filters for separating the RTTY tones from noise and also from each other. Two common sets of frequencies are used. The pair of 2125 and 2295 Hz is separated by 170 Hz and is used with 170 Hz shift, while the pair of 2125 and 2975 Hz is separated by 850 Hz and is used for 850 Hz shift. The first filter in a good TU is used to separate these tones from the rest of the audio coming from the receiver.

For use with 170 Hz shift, the filter used is centered about 2200 Hz, and usually has a bandpass of about 260 Hz, which then extends from about 2070 Hz to about 2330 Hz. This covers more than the 170 Hz difference between the tones, and is necessary to allow reception of some of the audio sidebands produced by keying as well as to allow a small amount of drift.

For use with 850 Hz shift, the filter used is centered around 2550 Hz and usually has a bandpass of about 1100 Hz, which then extends from roughly 2000 Hz to about 3100 Hz.

In either case, we need a filter which will give fairly constant amplification over the bandpass of 260 or 1100 Hz, while at the same time providing a steep rolloff for frequencies outside that range. We find that a two-pole filter could give the wide bandpass, but that its response would not fall steeply enough outside the range to reduce QRM to an acceptable level. What we need is a multiple pole filter which will have steep skirts – response whose sides fall off very fast. Most of the filters used for this purpose are six-pole designs dating back to a series of articles in *QST* and in the *RTTY Journal*, written by Irvin Hoff K8DKC/W6FFC. Each of these filters uses three parallel-tuned LC circuits which are critically coupled to each other. Each of the LC circuits provides two poles, for a total of six.

As shown in Fig. 4, cascading several bandpass filter stages gives steeper response skirts but still results in a rounded top. As it turns out, if a six-pole filter were built out of three two-pole stages all tuned to the same frequency, it would be impossible to get both steep skirts and a wide enough top to pass the entire bandpass without seriously dropping off at the edges. In order to get a good enough response curve, it is necessary to stagger-tune the three filters so that each stage emphasizes a different part of the bandpass. In this way the top of the bandpass curve is spread out and flattened, while the steep skirts are retained.

The original Irv Hoff filters all did this by properly coupling the three LC resonant circuits. As the oldtimers will remember, all the old electronics books discussed what happens when

the tuned primary of an i-f transformer is overcoupled to the tuned secondary. The top of the i-f response curve flattens out and in extreme cases develops a dip in the middle. (You don't read about this much in modern books because modern i-f transformers tend to have only one tuned winding.) Anyway, Irv Hoff's designs did just that – by coupling the three LC circuits he was able to broaden out the response curve so that it had a fairly flat top with steep sides. Fig. 5 shows the effect of coupling on two LC circuits. When they are undercoupled, as at (a), the response is sharp and thin with a smoothly rounded top. With critical coupling (b) the top flattens out, while with overcoupling (c) the top acquires a dip. Many old electronics textbooks had curves just like these.

With active filters, the separate filter stages in cascade are completely independent of each other so there is no such thing as overcoupling. Instead, the same effect can be achieved by stagger-tuning the stages and by carefully adjusting their Qs. When the overall filter is adjusted so that the top is as flat as possible, as in Fig. 5(b), the filter is then called a Butterworth filter. If it has one or more dips in it, as in Fig. 5(c), it is called a Chebyshev filter. While the Chebyshev generally has steeper skirts than the Butterworth, it tends to distort pulses like those of RTTY, and so Butterworth filters are used more commonly. Hoff's filters, as well as those in the popular ST-6 demodulator, are six-pole Butterworth filters.

The correct design of a Butterworth or Chebyshev filter is very hard to do with LC filters, but amazingly easy to do with active filters – once you know how. It's just a matter of knowing how to choose the center frequency and Q of each filter stage. The whole process can be done with graph paper, a compass, and a protractor in a few minutes.

In the following example we will design an input filter for a 170 Hz shift RTTY demodulator. As mentioned earlier, we want a Butterworth filter with a center frequency of 2200 Hz and a bandwidth of 260 Hz.

Start by getting some graph paper with small squares, a compass, and a protractor. Along the bottom of the graph paper, draw a long horizontal line and label it with frequencies so that the center frequency of the filter is somewhere near the center, and the 3 dB bandwidth of the filter is centered around it. Make use of the graph paper's lines to evenly space out the frequency steps, and use graph paper with equal size squares throughout. (Don't use the log graph paper normally used for frequency response diagrams.) See Fig. 6 for an example of how to label the line.

FF	Correction Factor (Degrees)
0 to 0.01	0
0.01 to 0.025	1
0.025 to 0.04	2
0.04 to 0.06	3
0.06 to 0.08	4
0.08 to 0.1	5
0.1 to 0.11	6
0.11 to 0.13	7
0.13 to 0.15	8
0.15 to 0.17	9
0.17 to 0.19	10

Table 2.

Now take your compass and draw half a circle centered on the center frequency of the filter, with a diameter exactly equal to the desired bandwidth. This circle should then touch the line exactly at the lower 3 dB frequency (2070 Hz in our example) and also at the upper 3 dB frequency (2330 Hz in our example). If you were designing a Chebyshev filter, then instead of a circle you would use an ellipse whose height would depend on how large the dips in the response should be.

Now see Fig. 7. Depending on the number of poles needed, look at the appropriate drawing in Fig. 7 to see the location of the dots. In this case we want to duplicate the performance of the Hoff filter in the ST-6 demodulator, so we will use a six-pole filter. (Usually, you would have to decide how many poles to use based on the desired steepness of the bandwidth curve skirts.) As shown in Fig. 7, we want one dot up at the very top of the circle, with two more exactly 30 degrees up from the line. Now go back to your drawing and use the protractor to draw in the dots. For our filter we get the dots shown in Fig. 6, and labeled A, B, and C. (In electrical engineering language, this drawing would be called the s-plane and the dots are the *poles*. A six-pole filter has six poles, of which only three are shown in this drawing. The other three are not used.)

If we were using an ideal filter having only the poles shown, we would use the points A, B, and C which we have drawn. There are, however, those other three poles not shown in the drawing as well as the fact that the filter

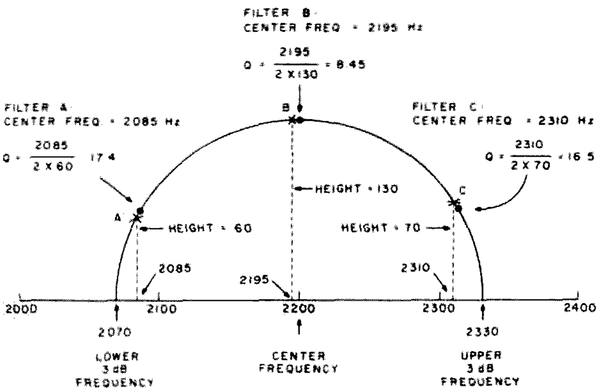

Fig. 6. Designing a Butterworth RTTY input filter for 170 Hz.

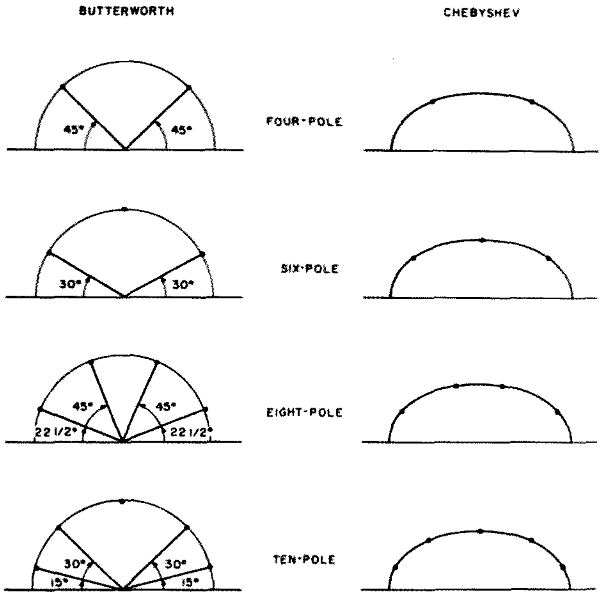

Fig. 7. Pole locations for Butterworth and Chebyshev filters.

Stage	Center Freq.	Q
A	2085 Hz	17.4
B	2195 Hz	8.45
C	2310 Hz	16.5

Table 3.

stages do not pass dc. Although their effect is not very obvious, they do cause a slight error in the final filter which we have to try to remove. And so here we apply a small "Finagle Factor."

Compute the quantity, FF = Desired filter bandwidth/(3 x Center Frequency).

In our sample filter this comes out to (260)/(3 x 2200), which is equal to 0.04. Now look up this FF (Finagle Factor) in Table 2.

Now return to Fig. 6, and move all the poles *left* by a small angle as shown by the above table. In our example the finagle factor is .04, so we move all the poles left about 3 degrees. This puts them at the locations labeled with an X. These three poles determine the actual performance of the whole filter. (Remember, there are three more poles not shown, for a total of six.)

Each of these poles will be produced by one of the three stages of the filter, and each pole determines the center frequency and the Q of that stage. The center frequency is easily read off the graph by drawing a line from the X straight down the horizontal line and reading the frequency off the scale.

To find the Q, carefully measure the height of the X above the horizontal line. Use the frequency scale to judge the height. In the case of the pole labeled A, its height is about 60 cycles (or is it 60 Hertz?). Calculate the Q of each stage from Q = Center frequency of filter/2 x Height above line. For pole A this works out as a center frequency of 2085 Hz and a height of 60, so the Q is 2085/120 = 17.4.

To build the overall bandpass filter with a bandwidth of 260 Hz we need three staggered filter stages with the center frequencies and Qs as shown in Table 3.

Fig. 8 shows the overall circuit for the entire filter. Since filter stages A and C have Qs above 10 we use the double op amp circuit shown in Fig. 3(b). The Q of stage B is below 10 so the circuit of Fig. 3(a) is good enough. As mentioned earlier, the double amplifier circuit works best when the design gain is several times the square root of Q. For Qs around 17, the square root is slightly above 4, so I designed these circuits for a gain about three times higher, or about 13. Stage B was arbitrarily designed for a gain of 2. There is nothing magic about these gains, and the final circuit will have different gains anyway, so there is little you can do here to obtain precise gains. The problem is that the gains would be exactly as specified if all of the components we used were exactly equal to the values calculated from the equations. But, since we have to rely on standard value resistors as well as possibly large tolerance errors, by the time we finish trimming the resonant frequency and the Q with the potentiometers, the gain will wind up considerably different from the assumed values. So the trick is to design for considerably more gain than you really need and use an external potentiometer as a level control to cut it back to the desired value.

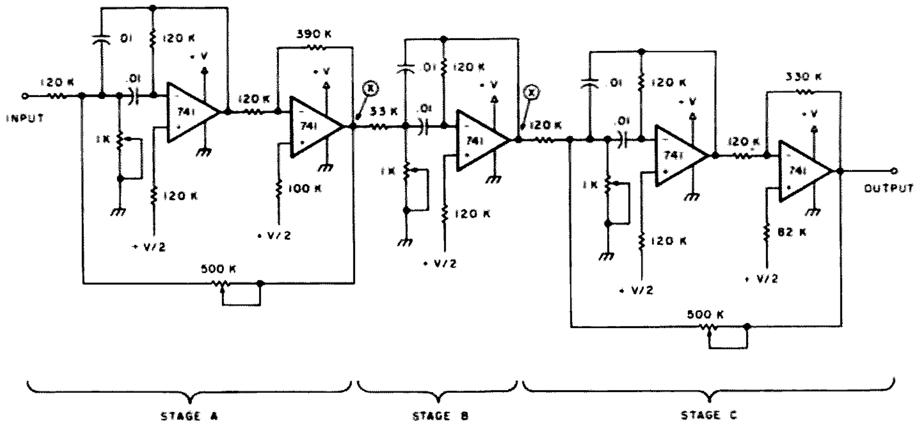

Fig. 8. 170 Hz shift bandpass input filter.

To permit trimming the center frequency of each stage and the Q of the two end stages, five of the resistances calculated are replaced by potentiometers as shown in Fig. 8. (By the way, the three stages could have been connected together in any order.)

Alignment of the filter is easy. The three stages are disconnected from each other at the points marked X, and each stage is aligned separately. First, the 1k pot is adjusted to peak the gain at the center frequency. Then the 500k pot (for the two amplifier circuits) is adjusted to make the bandwidth correct. There is a slight interaction between the two adjustments, so the process is repeated two or three times. Once the three stages are adjusted separately, they are connected together.

Fig. 9 compares the response of this active filter

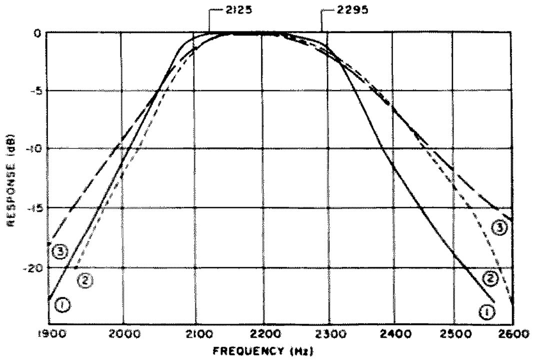

Fig. 9. Response of two LC filters and one active filter.

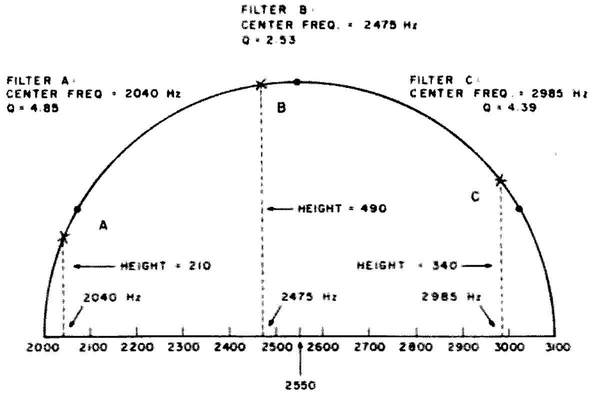

Fig. 10. Designing a Butterworth RTTY input filter for 850 Hz shift.

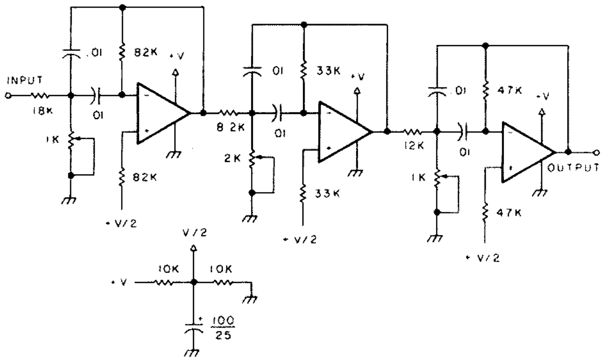

Fig. 11. 850 Hz shift bandpass input filter.

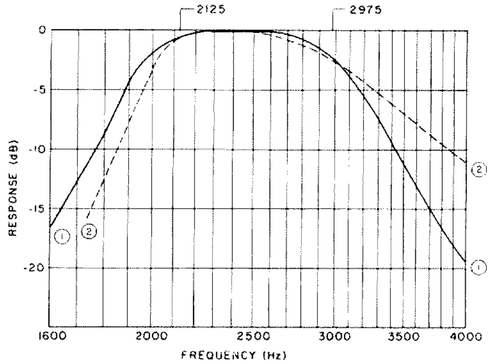

Fig. 12. Frequency response of 850 Hz input bandpass filter.

with two other filters. Curve 1 is the active filter we have just designed. Curve 2 is the curve published by Irv Hoff for his LC filter in *QST* more than ten years ago. Curve 3 is the 170 Hz shift filter in my ST-6 demodulator (built from a HAL kit). As you can see, there is remarkable similarity between the original Hoff design and the active filter we have designed. Both are Butterworth filters with 260 Hz bandwidth, so both should be very similar.

Another filter needed in a RTTY demodulator for 850 Hz shift is a bandpass filter with approximately 1000 or 1100 Hz bandwidth, which will pass the 2125 and 2975 Hz tones plus a little more to allow for modulation sidebands and drift. Though I won't go through the details of this design, it is shown in Figs. 10 and 11. Fig. 11 also shows how the 741 op amp is biased when used with a single power supply. The positive voltage, called +V, is divided with two 10k resistors to give a bias voltage called +V/2, which is then connected to the + inputs on the op amps to provide bias. In this way the inputs and outputs of the op amps are biased to run at half of the supply voltage. For instance, if a 12 volt supply is used, this voltage divider provides +6 volts, so the inputs and outputs of the op amps run at +6 volts. Though not shown in Fig. 8, this voltage divider is needed there also.

Fig. 12 compares the response of this active filter (curve 1) with the similar 1100 Hz filter in my ST-6 (curve 2). (I will have to look at that ST-6 filter to see whether it is properly aligned!)

In conclusion, let me encourage you to design and build your own filters, whether it is for RTTY or other uses. It is fun and, with this graphical approach and the equations presented earlier, even relatively easy. ■

Moving Display RTTY Readout

-- just like Times Square

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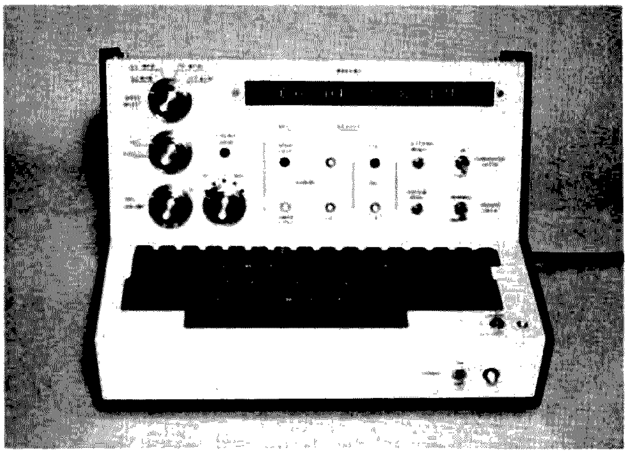
The desire to build an all-electronic RTTY system without incurring the high price tag that usually accompanies video display units in this class is what prompted the construction of this terminal. The unit uses, instead of the CRT normally associated with video systems, a series of 16 alphanumeric type displays, each with the capability of reading out any one of the 64 standard ASCII characters. The readouts are clocked in such a manner that the generated words appear to "walk across" the display screen from right to left. Provision is made for tape recording the incoming signal for playback at a later time. This provision helps offset the potential problem of there being no hard copy available. Also included is a keyboard monitor feature, which allows the operator to see his transmitted copy as it is sent out over the air. The circuit, which uses 6 level ASCII code for internal signal processing, utilizes a series of 3 read only memories (ROMs) to permit compatible operation with the 5 level Baudot code. The system has been designed so that it is only a matter of throwing one switch to realize straight ASCII operation.

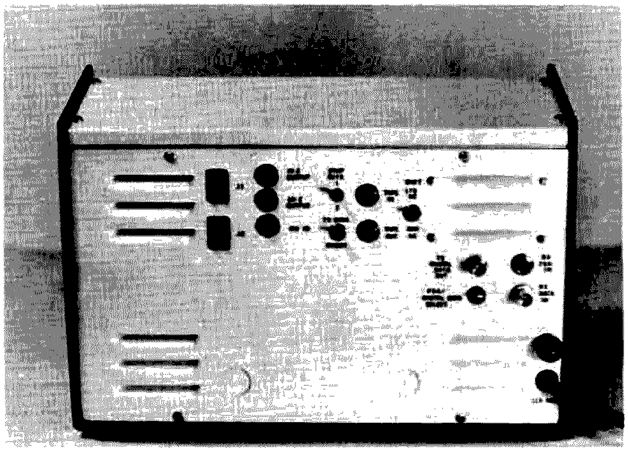
Receive Circuit Description

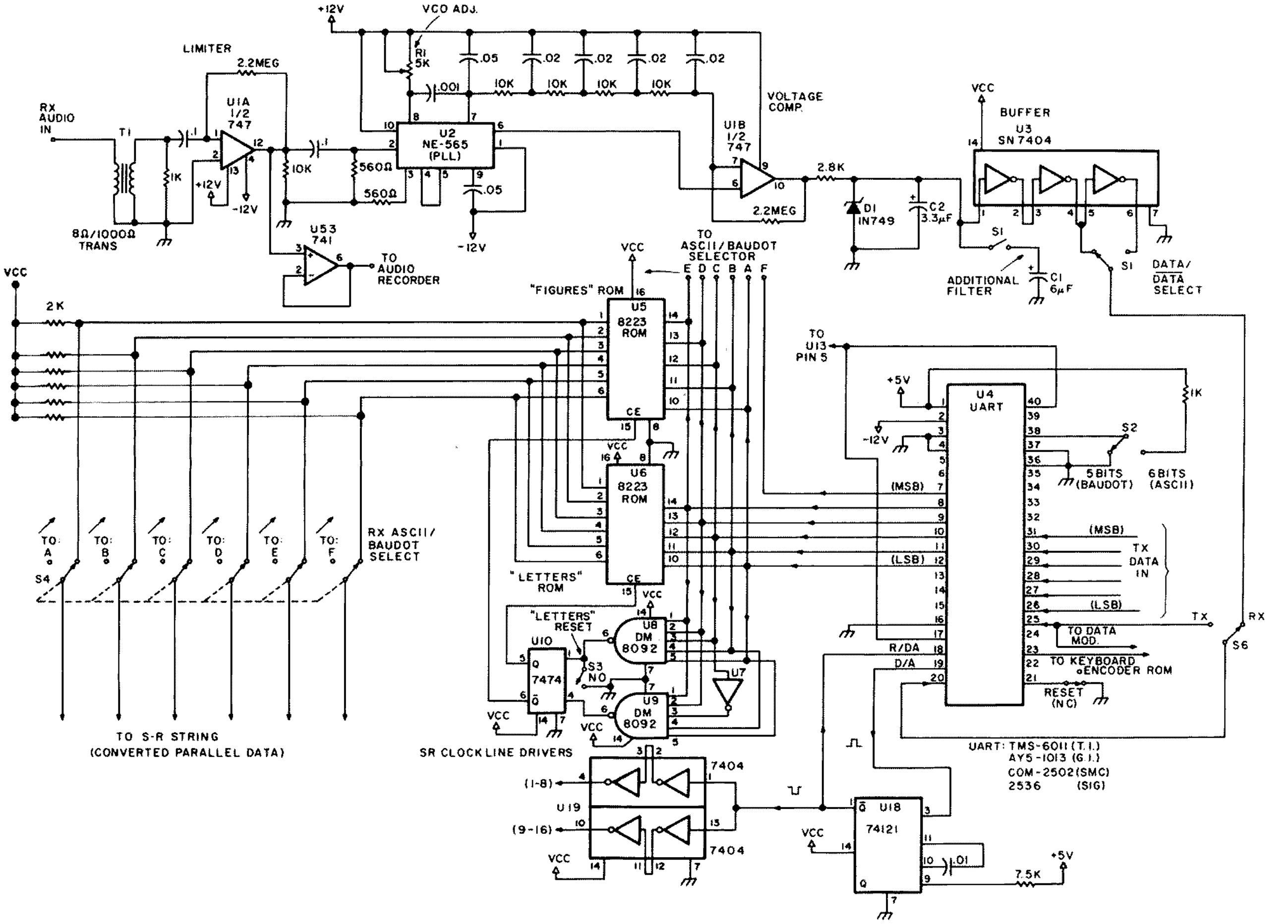
The system starts from scratch, due to there being no RTTY equipment on hand at the onset of the project. Signal demodulation is accomplished by a phase locked loop, U2, with the receive signal first passing through limiter amp U1a. The limiter amp also drives a unity gain isolation amp, U53, and signals for a tape recorder may be taken at its output. The VCO in the NE565 PLL tracks the mark and space tones, and the VCO control voltage drives voltage comparator U1b, causing positive and negative voltages in direct proportion to the transmitted marks and spaces.[1] Zener diode D1 makes the output TTL compatible by cutting off the negative-going portion of the signal and limiting the positive peak to 5 volts. Buffer U3 aids as a signal conditioner by shaping the rising and falling edges. The 6 uF capacitor, C1, serves as additional filtering by slowing the frequency response of the comparator amp, and is very effective in reducing short duration noise. If a suitable terminal unit with a TTL output is available, then the PLL converter can be left out. The converted output is then fed into the serial input of the UART chip, U4. The UART strips off the start and stop bits and outputs the corresponding parallel code, 5 bits for Baudot and 6 bits for ASCII. This word then addresses the two 8223 ROMs (U5 and U6) which convert the Baudot code into ASCII. Should the ASCII mode be selected, then no conversion takes place and the data is switched directly to the display section. Inverter U7 and AND gates U8 and U9 form a character recognition circuit which detects "letters" (lower case) and "figures" (upper case) commands. The output of this circuit sets flip-flop U10, which enables the appropriate ROM and disables the other. ROM outputs are "open collector" and may be tied directly in parallel. They need not be gated. Push-button switch S3 is pro-

Front view of RTTY unit.



View of rear panel.

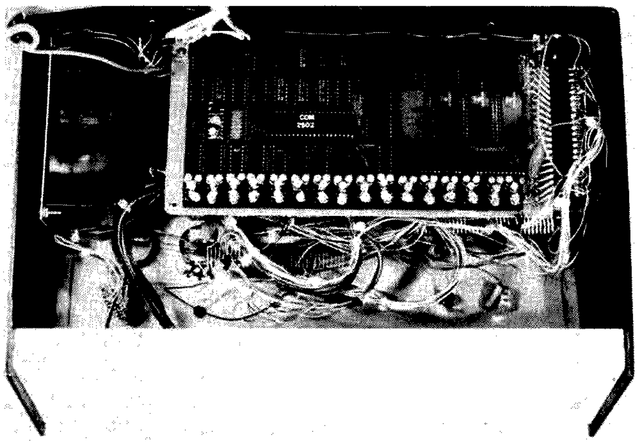




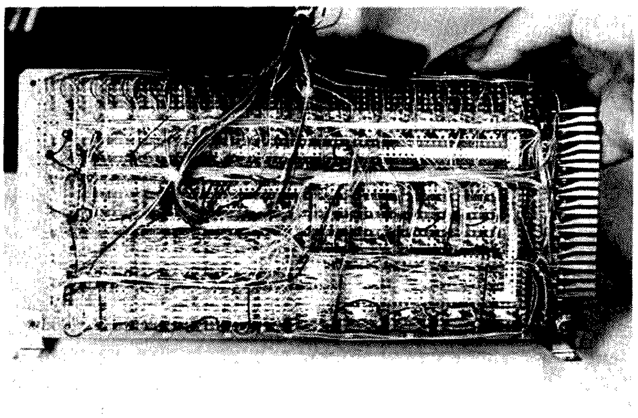
vided to manually reset the "letters" ROM should it miss the automatic command due to noise, QRM, fades, etc.

Display Section

The parallel data is then applied to the input of the shift register chain. Each shift register directly corresponds to a display, and all are clocked simultaneously from the Data Available flag on the UART, through driver U19, to cause the characters to move along from display to display. The output of each shift register is sampled by multiplexers U37-U42, which are all clocked in parallel and, together with U11, form the horizontal scan generator circuit. A multiplex frequency of approximately 4.8 kHz was selected to provide flicker-free operation of the displays. The outputs of the multiplexers are then inverted and fed into the 2513 character generator, U43. The six inputs from the multiplexers constitute an address and a five line dynamic parallel signal is produced at the 2513 output. The signal is again inverted and drives de-multiplexers U45-U49, which are all parallel clocked with the multiplexers. The de-multiplexers distribute the



The RX/driver circuit board. Driver transistor modules are on the top, with the character generator, multiplexers, and de-multiplexers on the left side. The UART is in the center with the character recognition circuit above it; the two RX code converter ROMs are to the right. The shift register string occupies the bottom two rows on the right. The +5 volt power supply is mounted on the right wall.



Rear view of RX/driver board showing density of wiring.

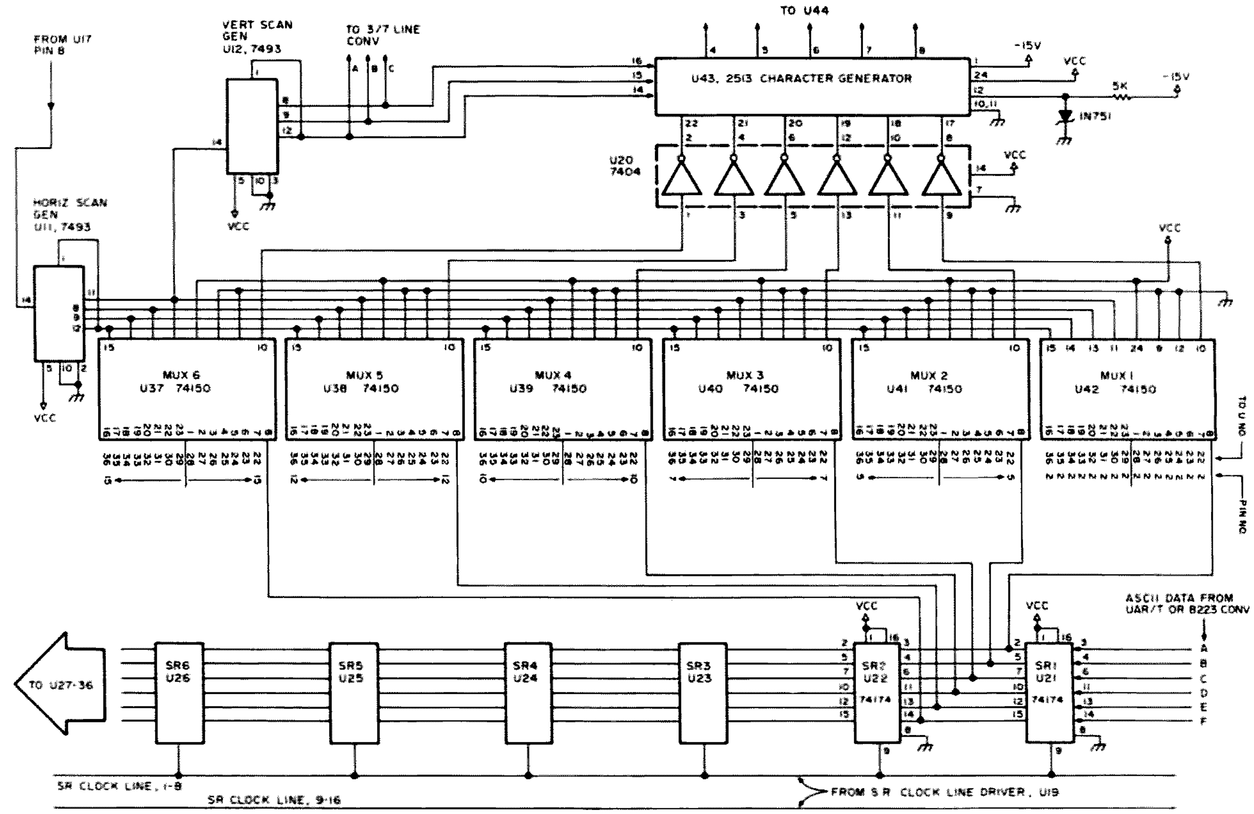
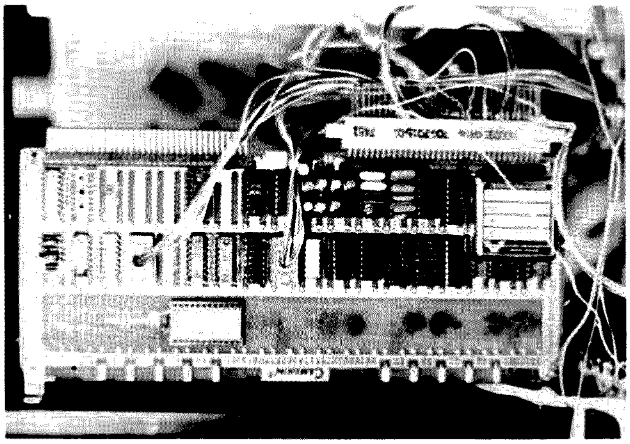


Fig. 2.

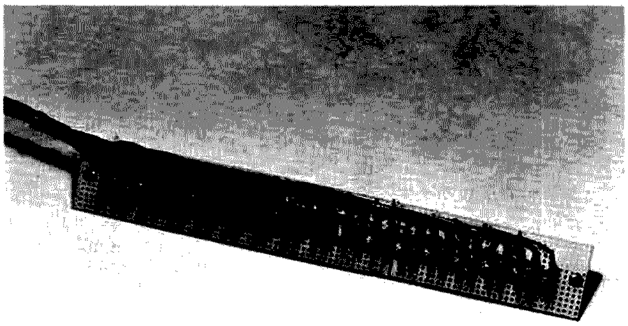
signals to their respective displays through driver transistors Q8-Q87. Multiplex clock U11 drives a second binary counter, U12, which is used to clock both the character generator and the 3-line to 7-line converter. The resulting scan is from right to left and from top to bottom, with the vertical row advancing 1 count downward for every 16 horizontal sweeps.

Baud rate selection and the multiplexer clocks are derived from a master oscillator. 38.4 kHz was used in this model because of the availability of a stable module, but an NE555 oscillator circuit may be used in its place. The UART chip is designed to be clocked at 16 times the desired baud rate for both the transmit and receive functions. One design goal was to make the system operable on the four commonly used speeds of 60, 66, 75, and 100 wpm (45, 50, 57 and 75 baud respectively). The four clocks are generated from the master oscillator using a divide by "N" counter chain (U14 and U15), with "N" being derived by programming a multi-deck wafer switch to produce the binary divisors required. The output of the counter chain is a very narrow pulse at twice the desired frequency. This pulse is applied to flip-flop U13, which halves the frequency and produces a symmetrical waveform. The clock frequency does not have to be exactly 16 times the data rate, incidentally, as the UART is capable of tracking receive signals over a small range (approximately ± 5%), and in most cases this is sufficient to make up for any differences between the transmit and receive clocks. However, the correct speed range

Clock/TX/converter board showing master oscillator unit on the right, PLL converter, row drivers and LED drivers to the left. The transmit converter ROM is the 24 pin package on the bottom.



Rear view of readout board.



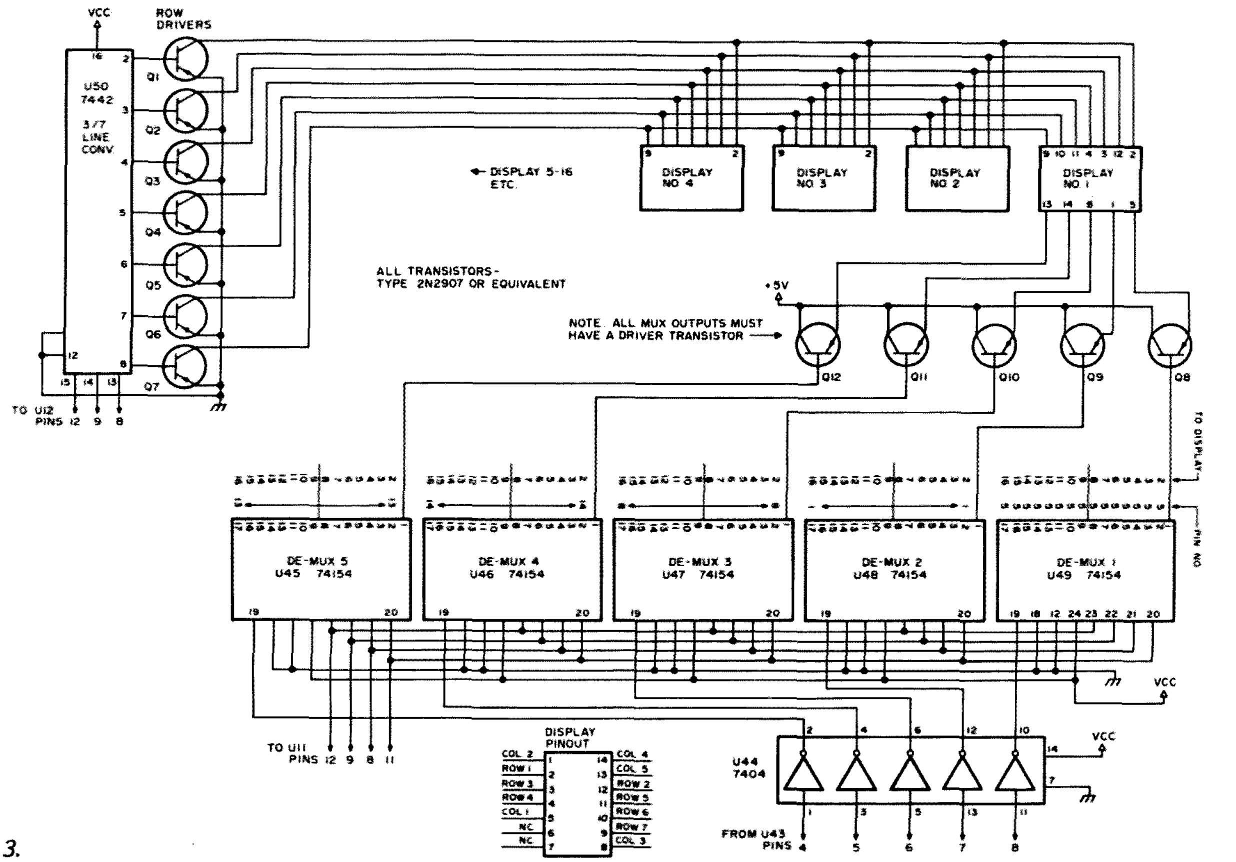


Fig. 3.

must be manually selected.

Transmit System

The transmit system is relatively straighforward. The keyboard addresses an encoder ROM which directly outputs an ASCII word and produces a transmit strobe pulse.[2] The output of the encoder ROM is fed into the code converter ROM which turns the ASCII data into Baudot, or passes it directly through, depending on the mode. Then the output of the converter ROM addresses the data inputs on the transmit side of the UART. The transmit strobe pulse from the encoder ROM is used to "key out" each character, and occurs whenever a key on the board is depressed. The serial digital output from the UART then branches out, with one line going back into the receive side for transmit monitoring, and the other line driving the AFSK modulator. The modulator is then outputted to the audio section of an SSB transmitter.

To facilitate construction, a commercially manufactured unit (HAL AK-1) was used as the AFSK section.

Construction

The two main circuit boards, which contain the digital electronics and the PLL converter, were fabricated using the wire-wrap technique. Utilization of

LETTERS ROM, U6

Baudot Address	ASCII Output	Character
00000-MSB	100000-LSB	null
00001	010100	t
00010	100000	carriage return
00011	001111	o
00100	100000	space
00101	001000	h
00110	001110	n
00111	001101	m
01000	100000	line feed
01001	001100	l
01010	010010	r
01011	000111	g
01100	001001	i
01101	010000	p
01110	000011	c
01111	010110	v
10000	000101	e
10001	011010	z
10010	000100	d
10011	000010	b
10100	010011	s
10101	011001	y
10110	000110	f
10111	011000	x
11000	000001	a
11001	010111	w
11010	001010	j
11011	011111	upper case
11100	010101	u
11101	010001	q
11110	001011	k
11111	011111	lower case

FIGURES ROM, U5

00001-MSB	110101-LSB	5
00011	111001	9
00100	100000	space
00111	101110	.
01010	110100	4
01100	111000	8
01101	110000	0
10000	110011	3
10101	110110	6
10111	101111	/
11001	110010	2
11100	110111	7
11101	110001	1
11000	101101	–
10010	100100	$
10110	100001	!
01011	100110	&
11010	100111	'
11110	101000	(
01001	101001	)
10001	100010	"
01110	111010	:
01111	111011	;
10011	111111	?
00110	101100	,

Any left over addresses should be programmed to: 100000 space

Table 1. 8223 receive converter ROM encoding programs, upper case and lower case.

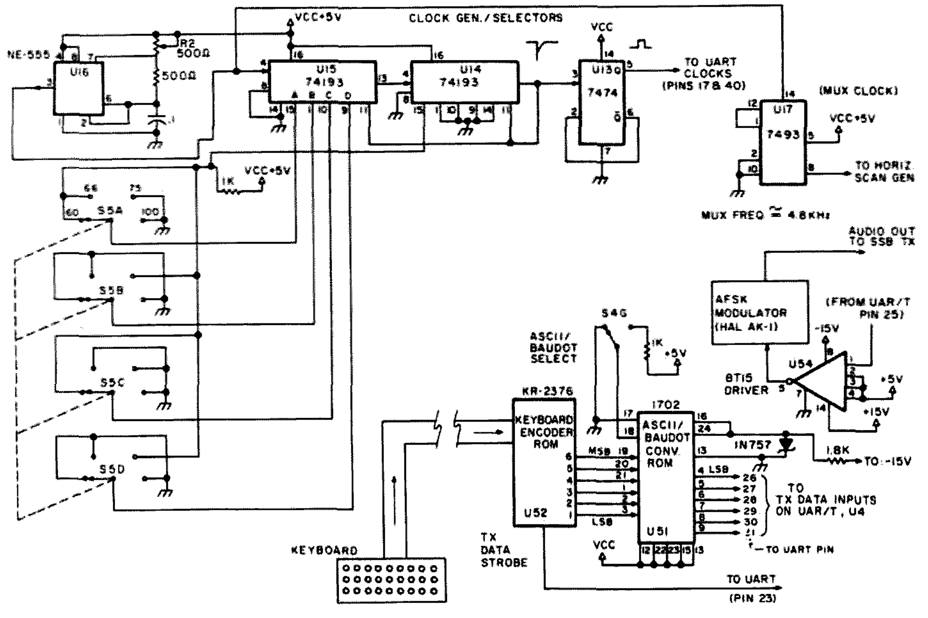


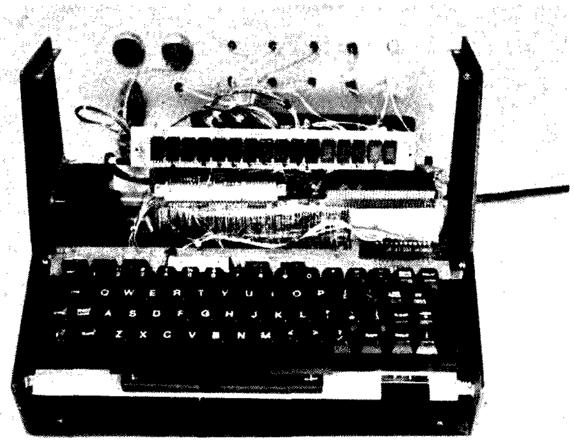
Fig. 4.

other construction techniques is possible, but will most likely result in the finished unit taking up considerably more space than the prototype. The MAN-2 displays were mounted in wire-wrap sockets (which were used extensively throughout the unit) and attached to a section of vectorboard. The wiring harness between the digital and display boards was formed and carefully labeled on the digital board, bundled together, and run out to the displays. There, the wiring was custom fitted to each display. This results in a much neater package than if the lines were run out individually.

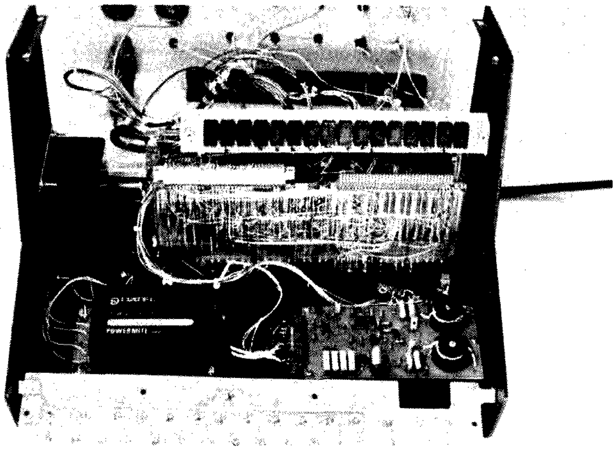
Power supply current is on the order of 1.2 Amps from the 5 volt source and 150 mA and 50 mA from the respective -15 volt and +15 volt supplies, using the type chips specified. If a larger 5 volt supply is available, then the more expensive 74LSXX series chips, which were used

Binary Address	5 Level Output	Baudot Character
00	00100-LSB	space
01	00011	a
02	11001	b
03	01110	c
04	01001	d
05	00001	e
06	01101	f
07	11010	g
08	10100	h
09	00110	j
10	01011	j
11	01111	k
12	10010	l
13	11100	m
14	01100	n
15	11000	o
16	10110	p
17	10111	q
18	01010	r
19	00101	s
20	10000	t
21	00111	u
22	11110	v
23	10011	w
24	11101	x
25	10101	y
26	10001	z
27	11011	upper case
28	not programmed	
29	00010	line feed
30	01000	carriage return
31	11111	lower case
32	00100	space
33	01101	!
34	10001	"
35	not programmed	
36	01001	$
37	not programmed	
38	11010	&
39	01011	'
40	01111	(
41	10010	)
42	not programmed	
43	not programmed	
44	01100	,
45	00011	—
46	11100	.
47	11101	/
48	10110	Ø
49	10111	1
50	10011	2
51	00001	3
52	01010	4
53	10000	5
54	10101-LSB	6
55	00111	7
56	00110	8
57	11000	9
58	01110	:
59	11110	;
60	01101	,
61	not programmed	
62	11100	.
63	11001	?
Binary Address	**6 Level Output**	**ASCII Character**
64	000000	@
65	000001	a
66	000010	b
67	000011	c
68	000100	d
69	000101	e
70	000110	f
71	000111	g
72	001000	h
73	001001	i
74	001010	j
75	001011	k
76	001100	l
77	001101	m
78	001110	n
79	001111	o
80	010000	p
81	010001	q
82	010010	r
83	010011	s
84	010100	t
85	010101	u
86	010110	v
87	010111	w
88	011000	x
89	011001	y
90	011010	z
91	011011	[
92	011100	\
93	011101	]
94	011110	Λ
95	011111	—
96	100000	space
97	100001	!
98	100010	"
99	100011	#
100	100100	$
101	100101	%
102	100110	&
103	100111	'
104	101000	(
105	101001	)
106	101010	*
107	101011-LSB	+
108	101100	,
109	101101	—
110	101110	.
111	101111	/
112	110000	Ø
113	110001	1
114	110010	2
115	110011	3
116	110100	4
117	110101	5
118	110110	6
119	110111	7
120	111000	8
122	111010	:
123	111011	;
124	111100	<
125	111101	=
126	111110	>
127	111111	?
127	111111	?

Table 2. Encoding program for 1702 transmit converter ROM.



RTTY unit with top cover removed.



Interior front view. The keyboard has been pivoted completely forward and over, showing the ±15 volt power supply module, and the AK-1 AFSK unit. Behind these are the clock/TX/converter board and the readout board. The +5 volt power supply module is mounted on the bottom portion of the left wall in this photo.

only to save power, need not be used. Indeed, excellent results were achieved using the standard 74XX series chips. Power supplies are of the modular type, available at reasonable cost from many discount or surplus houses. Again, for the sake of economy, units could be constructed with discrete components.

The use of a metal cabinet for housing the unit is highly recommended, as the digital circuitry (particularly the clocks and multiplexers) tends to produce a good deal of noise (which will be evidenced in your receiver if steps aren't taken to guard against it). The metal cabinet serves well in keeping this noise inside the unit and out of your speaker.

The output transistors were all mounted on 14 pin component holders for ease of installation, and for possible repairs. Should suitable integrated PNP arrays be available, they could be substituted for the 80 column and 7 row drivers.

Conclusions

At first, it was thought that the displayed words would move across the screen too fast to read, but fortunately this was not the case. Even at 100 wpm, text sent out on reperf tape can easily be read. The fact that most RTTYers don't type more than 20 or 30 wpm makes keeping up with the display that much easier.

The keyboard takes a little bit of extra thought to operate. Due to the coding of the transmit converter ROM, it is necessary in the Baudot mode to hit both the upper case and shift keys to produce the symbols for quotation marks, exclamation point, etc. However, only the upper case key need be struck to produce figures Ø through 9 and the question mark.

The ASCII/Baudot selector switch is located on the front panel, as is the adjustment for centering the VFO on the PLL. This allows for easy tuning of both 170 Hz and 850 Hz shift signals.

The only real drawback of the unit at this time is in the phase locked loop converter, which has a tendency to track and lock onto noise. However, a standard type converter of the ST-5 variety with a TTL configured output would most likely improve performance in this area.

The unit is very compact and portable. Total weight is approximately 12 pounds (substantially lighter than mechanical or even CRT type

List of Required Integrated Circuits

Quantity	Type
1	747 op amp
1	741 op amp
1	565 PLL
4	7404 inverter
1	UART, COM 2502, AY-5-1013, Signetics 2536
1	74121 one shot
2	DM8092 5 input AND gate
2	7474 flip-flop
2	8223 programmable ROM
16	74LS174 hex flip-flop (type 74174 is an acceptable substitute)
6	74150 multiplexer
1	2513 character generator
5	74150 de-multiplexer
3	7493 binary
1	NE555 timer/oscillator
2	74193 programmable counter
1	1702 256X8 programmable EROM
16	MAN-2 displays (Texas Instruments TIL-305 is an acceptable substitute)
87	2N2907 driver transistors
1	8T15 TTL/MIL-188 (± 6 volt) driver
The following IC is also required if the keyboard kit specified or a suitable substitute is not used.	
1	KR-2376 keyboard encoder ROM
The following components are required if the power supply modules specified are not used and discrete units are to be constructed.	
1	7806 integrated regulator
1	7815 integrated regulator
1	7915 integrated regulator
1	2N3055 power transistor
4	50 volt, 3 Amp rectifier diodes
1	2000 uF, 25 volt electrolytic capacitor
1	1000 uF, 25 volt electrolytic capacitor
5	.22 uF bypass capacitor
1	12 volt, 3 Amp filament transformer
1	12 volt, .3 Amp filament transformer

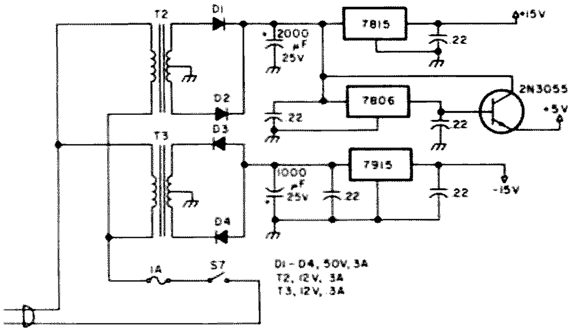


Fig. 5. Schematic diagram of substitute power supply units to be used in place of modular units.

systems), and it may be considered for emergency or field day use. Total cost is on the order of $250-$300, which is quite a bit less than most all-electronic systems.

Since the unit has direct ASCII transmit and asynchronous TTY receive capabilities, its use as a computer terminal should not be overlooked. Indeed, if it were designed specifically for this purpose, all of the Baudot conversion circuitry and AFSK devices could be left out, further reducing costs. ■

Acknowledgements and References

The author wishes to give special thanks to Kenneth E. Ayers and to Robert J. Slightham WB8URN, for their invaluable engineering and technical assistance with this project.

[1] N. Stinnete, "Phase Lock Loop RTTY Terminal Unit," *Ham Radio*, Feb., 1975.

[2] An entire encoded keyboard kit, including ROM and circuit board, is available from Poly Paks, PO Box 942, S. Lynnfield MA 01940, for $59.95 plus shipping charges.

Webb Linzmayer WA2MOT/WT2AAG
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Morris Plains NJ 07950

RTTY SWLing

-- new horizons!

I have been an enthusiastic shortwave listener for years, with a desire to receive everything in the VLF-HF spectrum (10 kHz to 30 MHz). Recently I programmed a Data General Nova mini to give myself a glimpse into an area of SWLing that I had previously left unexplored — radioteletype, or RTTY, for short.

This article will give you a brief introduction to the technical aspects of RTTY, a survey of many types of signals heard, and not heard, and two lists of actual off-the-air RTTY frequencies.

I first learned about the existence of RTTY years ago as a high school student attending an Armed Forces Day open house. While I was tuning around with a system on display there, I came upon a Spanish language RTTY transmission, and I was hooked. Imagine a radio typing at 60 wpm and in a foreign language to boot!

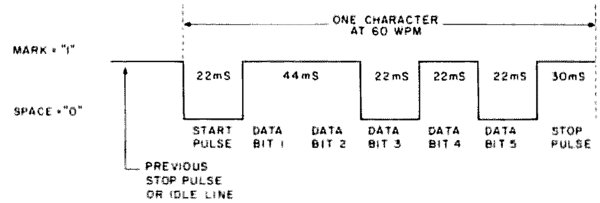

Fig. 1. Typical Baudot 60 wpm RTTY character.

Somewhere along the way I heard that radioteletype was sent at several different "standard" speeds and codes. Not knowing what speeds or codes were in common use was enough to delay my attacking the problem until recently, when I realized what a natural application RTTY SWLing is for a home computer.

RTTY characters are sent as binary data with a series of pulses representing each character. The classical code used for RTTY is commonly called Baudot code. A good deal of what is heard on the air today, including all present US amateur transmissions, is sent in Baudot code.

What the computer hobbyist calls "1" and "0" are called "mark" and "space," respectively, in RTTYese. Mark and space are transmitted by shifting the carrier a small amount to either side of an imaginary center frequency. This is called frequency shift keying, or FSK, for short.

To receive RTTY we need a way to distinguish between mark and space. The most common way is to use the receiver in either CW or SSB mode, with the bfo set above the FSK signal, to produce an audio tone of 2125 Hz for mark and a higher frequency tone for space.

What the computer hobbyist calls a demodulator, the RTTY devotee calls a TU (terminal unit), and it's into this device that the audio tones are sent. The demodulator changes the tones into what the old time RTTY man views as an on/off 60 mA loop current, to drive the selector magnets of his Model 19 machine. Modern demodulators, such as the Dovetron used in my system, provide an additional logic output which is a more welcome input to a computer.

Each character sent in Baudot code is composed of a start pulse, five data bits, and a stop pulse. See Fig. 1. The start and stop pulses are used for synchronization; the data bits define the character. A standard Baudot teleprinter has a set of 52 characters and 5 functions. This is accomplished with only 5 data bits by defining one combination of bits as a "figures shift" function and a second as "letters shift." The Baudot character set is shown in Table 1.

What Frequency Is That RTTY Signal On?

If you are interested in RTTY SWLing, you'll more than likely want to start keeping a log of stations heard. Your log would probably include frequency, shift, speed, sense (upright or inverted), times heard, and maybe a hard copy sample of

SIGNAL NR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
FIGURES	—	?	:	✚	3	□	⊟	⧄	8	BELL	(	)	.	,	5	0	1	4	'	5	7	:	2	/	6	+	CARRIAGE RETURN	LINE FEED	LETTERS	FIGURES	SPACE	BLANK
LETTERS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z						
1	1	1		1	*1	1				1	1						1		1		1		1	1	1	1			1	1		
2	2		2				2		2	2	2	2				2	2	2			2	2	2					2	2	2		
FEED HOLE	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
3			3			3		3	3		3		3	3		3	3		3		3	3		3	3				3		3	
4		4	4	4		4	4			4	4		4	4	4			4				4		4			4		4	4		
5		5					5	5				5	3		5	5	5			5		5	5	5	5	5			5	5		
	SOME D KEYTOPS READ "WHO ARE YOU" IN U.C., OTHERS ARE BLANK. F,S,H KEYTOPS ARE BLANK IN U.C.																															

Table 1. Baudot 5-unit code.

some received text. You could exchange this information with other RTTY freaks, go back and listen to favorite stations with a minimum of fuss, etc. Incidentally, one thing you probably shouldn't do is ever let anyone see any of the hard copy text. Unless it's an amateur transmission or clearly of broadcast character (RTTY weather?), it would seem that its disclosure is prohibited by the Communications Act of 1934.

Having decided to start a log, your first problem is what to write down for frequency. What's the standard way of documenting the frequency of a RTTY transmission? The answer, unfortunately, is that there are several "standards" encompassing almost any reasonable method you might devise.

Dyed in the Wool RTTY Ham Method

This method, used by a number of amateurs, is to simply log the frequency of the mark signal. After all, mark is the frequency you're on more often than not, especially if you aren't a hotshot typist. One of the original ways of generating an FSK signal was to shift the transmitter down from mark to space by switching capacitance into the vfo circuit. Logging the mark frequency is natural for anyone using this method. There's a complication when this method is used on foreign news transmissions or other commercial signals which frequently send "upside-down," i.e., with mark being the lower frequency rf signal. In this case, one logs the higher rf signal (the space signal) and notes that the transmission is inverted.

Method	Frequency Logged
Mark	14800.2125 inverted
Lsb	14802.3375 inverted
Average	14800.000 inverted

Table 2. Examples of three of the methods commonly used to document RTTY frequencies. Taken from ADN, the East German News Agency, sending inverted, 66 wpm, 425 Hz shift, mark = 14799.788, space = 14800.2125.

This method, which we'll call the mark method for short, is the one I use when logging with an R390A. All frequencies mentioned in this article are mark frequencies.

The ARRL Lsb Method

If you use a sideband receiver to receive RTTY, this method should appeal to you. Simply set the receiver to lsb, tune for a mark tone of 2125 Hz, and log the frequency indicated on the receiver's dial. The RTTY frequencies listed in *QST* under "Operating Events" conform to this convention. This type of signal can be generated at the transmitter simply by driving the microphone input with clean audio tones of the same frequency meant to be recovered at the receiver.

The Imaginary Method

It makes sense to average folk to talk about RTTY being sent on the frequency halfway between the transmitted mark and space frequencies, i.e., on a frequency which is never actually sent. RTTY weather transmissions and news agencies are among the stations I've found to be using this method. With your receiver in CW mode, use the S-meter to tune for the strongest signal, then read the frequency from your dial. You'll have to set your bfo at different spots depending on the shift being used. This method can be inconvenient if the shift is unknown, if your bfo is uncalibrated, or if a sharp peak on the S-meter cannot be obtained due to a weak signal.

Examples of the three methods described are presented in Table 2. Formulas for converting from one method to another are given in Table 3.

What's To Be Printed?

Imagine that you have the ability to receive and print RTTY sent at any speed. (How this can be done with the help of a computer will be discussed.) You're ready to tune around the HF bands. What signals will you be able to print? See Table 4 for a representative list of signals heard during the last 18 months at my New Jersey QTH. Note that this list is just a sample of what's on the air. For those interested in obtaining a more comprehensive list, I strongly recommend Robert Grove's *Confidential Frequency List* (Gilfer Associates, Inc., Box 239, Park Ridge NJ 0765).

Unusual FSK Signals Heard

Roughly half of the FSK signals to be heard on the HF bands cannot be printed intelligibly on a straight Baudot teleprinter, no matter how you fiddle with the adjustments for wpm, shift, upright/inverted. The characteristics of a number of these signals are described in the following paragraphs. Sample frequencies are listed in Table 5.

Cyrillic

Cyrillic alphabet traffic is transmitted using a Baudot-like code. The transmissions in Table 5 listed as "Russian telegrams" are examples of this. On a normal Baudot machine, Cyrillic transmissions print as orderly lines of numbers and punctuation with an occasional "word" or two mixed in. Unlike western Baudot machines, which have two cases (letters and figures), Cyrillic machines have three cases – Latin, Russian, and figures – which are selected by the letters, blank, and figures functions, respectively. If you can cause

Mark = lsb - 2.125
Mark = avg. + ½ shift

Lsb = mark + 2.125
Lsb = avg. + ½ shift + 2.125

Avg. = mark - ½ shift
Avg. = lsb - ½ shift - 2.125

Table 3. Formulas for converting between the various methods of logging RTTY signals.

Freq. kHz	Time GMT	Date GMT	Speed wpm	Upright/ Inverted	Shift Hz	Notes
2429.8	0330	01-31-77	66	I	850	News in Spanish
2682	0430	01-20-76	100	I	170	USCG news relay
3344.4	0350	02-02-77	60	U	800	Station "WAR" testing with RYs
3562.2	0130	02-01-77	67	U	360	OEJD calling OKBK
3600	OFTN	1976-77	60	U	170	Ham RTTY autostart net
3608	0100	02-06-77	60	U	170	Ham RTTY
3622.9	2230	M-F	60	U	170	ARRL bulletins
3622.9	0400	TU-SU	60	U	170	ARRL bulletins
3622.9	2200	SU	60	U	170	OSCAR schedules for week
4003.1	0145	01-16-76	60	I	425	Mexican news in Spanish
4062.4	0155	01-16-76	100	U	850	WX (weather)
4160	2033	10-11-75	67	U		German ship traffic
4232	0100	09-24-75	100	I		USCG news relay
4235.4	0100	03-05-76	67	U	850	News in Portuguese
4535.4	0255	02-17-76	67	U	425	6VU in Senegal testing
4874.4	0030	03-05-76	60	I	825	MARS traffic
5463.2	0330	02-15-77	60	U	425	News in English, strong signal
5940.4	0315	01-18-76	60	U	850	WX
7406.0	0030	01-22-76	67	I	425	Cuban telegrams
7535.3	0225	03-04-76	67	U	425	Spanish lang. news from France
7954.8	0310	01-06-77	67	I	425	News in Spanish
8140.0	0210	08-25-76	100	U	850	WX
9081.7	0020	08-25-76	67	I	425	CLN244 Havana testing
10176.5	0030		67	I		Spanish lang. telegrams
10972.2	0215	02-18-77	60	U	425	English lang. news
11016.3	2315	03-06-76	67	U	425	Spanish lang. news
11545.8	2130	01-30-77	67	U	425	WX
13479.7	1830	03-06-76	67	U	675	9HA Malta testing
13487.8	1830	03-06-76	67	U	425	News in French
13624.3	1750	01-18-76	100	U	850	WX
13843.1	1910	03-06-76	67	I	425	News in Spanish
13977.4	1945	01-01-76	100	I	170	US naval traffic
14088.0	1330	02-05-77	60	U	170	Hams
14089.6	1840	02-06-77	60	U	170	CO2FRC Havana
14530.4	1915	01-01-76	60	I	850	Telegrams in English
14901.4	1350	04-18-76	67	U	425	News in Spanish
15913.8	1815	11-30-75	67	I	445	News in English
15955.4	1540	10-31-75	67	U		News in French from Morocco
15994.0	1405	10-31-75	100	I		Canadian govt. telegrams
16372.7	1450	05-21-76	60	U	425	News in English
16440.3	1700	12-21-75	100	I	850	WX
16443.1	1500	02-28-76	67	U	425	News in Spanish
18040.8	1340	04-18-76	67	I	850	News in Turkish
18984.2	1620	01-04-76	67	U	425	News in English from Prague
19070.0	1550	10-31-76	67	U	425	News in French from Morocco
19805.5	1415	11-23-75	67	I		News in English
20078.0	1515	12-24-75	67	U	425	News in French
20907.4	1505	02-27-76	60	U	850	WX

Table 4. Normal RTTY signals copied in New Jersey.

a letters shift on receipt of a blank, the garbage lines of figures case characters will be transformed into something almost resembling Slavic language words. I say almost because occasional words will have imbedded figures characters leading to words like BO4EK and HORO&EGO. Cyrillic machines need three cases to take care of the abundance of characters in the Cyrillic alphabet. The "4" in BO4EK is the best a normal machine can do for one of these third case characters.

Baudot Crypto

Encrypted Baudot, where code characters are substituted on an essentially random basis for plaintext characters and then transmitted, prints as garbage and, as such, is difficult to identify. Unless you have a way of qualifying the speed, sense (upright/inverted), and asynchronous nature of a signal, encrypted Baudot will look like any other garbage, although it will sound better than wrong-speed garbage while being printed.

Encrypted Baudot does not lend itself to being easily decoded. The transmitted characters do not have a one-to-one correspondence to the plaintext characters they represent. Each time a particular plaintext character is sent, it is encrypted as a different character selected on a random basis or on a pseudo-random basis derived from a complex mathematical formula known only to the receiving end. A string of test characters such as RYRYRYRY might be encrypted and sent as QAANFGRM, for example.

Some signals in Table 5 are listed as Baudot crypto. They were categorized as Baudot crypto because they exhibited the following attributes: 1) The received characters are individually all valid Baudot characters; that is, each has a start pulse, five data pulses and a stop pulse. 2) Each character received in a row exhibits these characteristics. 3) There are 32 possible individual characters in the 5-unit Baudot code.

Using the computer, a large sample of characters (e.g., 800) is received, and the occurrence of each of the possible 32 is counted. The counts are then examined. When analyzed this way, Baudot crypto exhibits an essentially flat character distribution, i.e., just about as many of any one character as of any other. Plaintext or text encoded by simple bit inversion or bit transposition (described later on) show relatively large counts on the characters corresponding to frequently sent characters (space, T, E) and low counts for infrequently sent characters.

Bit Inversion (Funny Cryptic Carrier)

A simple means of preventing the casual listener from reading one's traffic is to invert (mark becomes space and space becomes mark) one or more of the data bits in each character. When received on a normal machine, this type of transmission resembles Baudot crypto, but, upon inspection, it will not show the random character distribution of a highly encrypted code. The characters equivalent to the frequent spaces, Es, and Ts aren't hard to find, if a little elementary cryptanalysis is performed.

The result of bit inversion is the creation of a simple substitution cipher, which ought to appeal to amateur code breakers. The technically inclined code breaker need only get the five data bits of each character in parallel and experiment with inverting them in various combinations (only 32 possible) until he's printing plaintext. The bit inversion frequencies listed in Table 5 provide a 24 hour ready source which should be easy to copy anywhere in the USA. When text isn't being sent, a mark carrier is on the air. Hint: The number of bits

Freq. kHz	Time GMT	Date GMT	Speed wpm	U/I	Shift Hz	Ms/Bit	Notes
2426.4	0330	01-31-77	-	-	850	13	Synchronous
2590.4	0400	01-31-77	100	I	850	-	Baudot crypto, strong signal
2648.2	0410	01-31-77	100	I	170	-	Baudot crypto
2745.6	0330	01-31-77	100	I	850	-	Baudot crypto, strong signal
4015.6	0415	01-31-77	-	-	850	20	Synchronous, clear signal
4042.4	0255	02-08-77	67	I	850	-	Baudot crypto
4144.6	0030	03-05-76	100	U	425	-	Baudot crypto
4295.6	0425	01-31-77	-	-	850	13	Synchronous, strong signal
4348.6	0055	03-03-76	-	-	425	13	Synchronous, strong signal
4714.6	0305	01-18-76	100	I	850	-	Baudot crypto
5070.4	0350	02-15-77	-	-	850	11	Moore, duplex, both channels idle beta
5133.3	0500	03-16-76	60	U	425	-	Bit inversion privacy cipher, heard often
5158.0	0055	02-21-77	-	-	-	-	FDM, strong, buzz saw, 4 chan?
5254.1	0120	02-14-77	-	-	400	11	Moore, strong signal
5857.8	0215	02-14-77	-	-	700	11	Moore, 2 channels, strong signal
5903.6	0040	02-21-77	67	U	850	-	Baudot crypto
6252.4	0230	02-23-76	67	U	425	-	Russian telegrams
6256.4	0230	02-23-76	67	U	425	-	Russian telegrams
6284.5	0230	02-23-76	67	U	425	-	Russian telegrams
7603.8	0230	03-04-76	60	U	425	-	Bit inversion, on all the time
7617.2	0105	02-15-77	-	-	300	11	Moore, idling
7790.0	0135	03-06-76	60	U	425	-	Bit inversion, carrier with sporadic text
7900.2	0115	02-15-77	-	-	400	11	Moore twinplex, TDM/FDM
8216.4	0250	02-26-76	-	-	230	13	Synchronous, strong signal
8312.3	0216	02-07-77	67	U	425	-	Russian telegrams
8336.4	0140	02-18-77	67	U	500	-	Russian telegrams
8344.4	0300	02-26-76	67	U	425+	-	Russian service messages
10245.9	0210	02-10-77	-	-	400	11	Moore idling
11045.3	2250	05-19-76	-	-	850	13	Synchronous
11106.4	2315	05-19-76	-	-	850	16	Synchronous
11610.8	2330	03-06-76	-	-	425	16	Synchronous
12149.8	2030	02-20-77	-	-	-	-	FDM, buzz saw
12256.5	2025	02-20-77	-	-	-	-	FDM, buzz saw, strong signal
12476.3	2000	02-20-77	67	U	425	-	Russian telegrams
12850.4	0005	03-07-76	-	-	850	20	Synchronous, clean signal
12939.6	1445	02-28-76	100	I	850	-	Baudot crypto
13592.3	1245	02-22-77	-	-	850	11	Moore idling, clean signal
13830.3	1600	03-06-76	60	U	425	-	Bit inversion, always on air
13942.2	1745	03-03-76	60	U	425	-	Bit inversion
16220.4	1620	02-20-77	-	-	400	11	Moore twinplex, TDM/FDM
17397.6	1550	02-20-77	-	-	280	11	Moore idling
18045.0	1515	02-20-77	-	-	-	-	FDM, 8 channel?
18583.6	1700	02-12-77	-	-	-	11	Moore idling, strong signal

Table 5. Unusual RTTY signals heard in NJ.

inverted is always 2 or 3 (never 0, 1, 4 or 5), and the key is changed at 0000 hours GMT.

Here's an example: For the sake of discussion, let's number the data bits of the Baudot code 12345 (as in Table 1) and represent characters by binary numbers with mark represented by "1" and space by "0". The letter "E" is represented by 10000, "R" is 01010, etc. If bit inversion is being used on, let's say, bits 4 and 5, 10000 (E) becomes 10011 (B), 01010 (R) becomes 01001 (L), and 00010 (carriage return) becomes 00001 (T). Thus, if bits 4 and 5 are being inverted on a particular day, E will always print as B, R as L, carriage return as T, etc.

Synchronous Codes

We've talked about Baudot being an *asynchronous* code. By this we mean that, due to the presence of a start and stop pulse for every character, each character is self-synchronizing, and there is no other need for the transmitting and receiving ends to stay in synchronization.

There are numerous examples of signals on the air which show no evidence of start and stop pulses. In Table 5, examples of these signals are labeled as *synchronous.*

A study of various methods used for data communication between computers shows that there are many methods of synchronizing the transmitting and receiving ends of a synchronous communications line. In general, these methods have in common the presence of an accurate and stable timebase reference at each end, as well as some means of achieving initial synchronization and periodic resynchronization based on the content of the received signal. A normal Baudot machine will see random false start pulses in a synchronous signal and print garbage.

Other than Moore code, which is described further on, I haven't broken, or even identified, any of the synchronous codes listed in Table 5. The characteristics by which they are classified are simply frequency, shift, and bit size in ms. Computer analysis has shown that they do not have regularly occurring start and stop pulses for any size code, from a 6-unit code through a 14-unit code.

I would welcome information from readers having definite knowledge about any of these so-called synchronous codes.

Twinplex

Twinplex is a method of transmission in which the carrier is shifted among four discrete, closely spaced frequencies, allowing two distinct (but synchronized) RTTY channels to be simultaneously sent using one transmitter. It is designed such that reception of one of the channels is possible using a fairly standard TU.

Frequency	Notes
8899.970 kHz	Channel 1 space
8900.030 kHz	Channel 1 mark
8900.090 kHz	Channel 2 space
8900.150 kHz	Channel 2 mark
8900.210 kHz	Channel 3 space
8900.270 kHz	Channel 3 mark
8900.330 kHz	Channel 4 space
8900.390 kHz	Channel 4 mark

Table 6. Four channel FDM.

As an example, let's call the four frequencies A, B, C and D as follows:

A 8900.000 kHz;
B 8900.200 kHz;
C 8900.600 kHz;
D 8900.800 kHz.

We'd like to use these four frequencies, only one at a time, to send two synchronized TTY channels simultaneously. We design our transmitting scheme as follows:

1) At any point in time when channels 1 and 2 are both mark, send frequency A.
2) When channel 1 is mark and channel 2 is space, send frequency B.
3) When channel 1 is space and channel 2 is mark, send frequency C.
4) When channels 1 and 2 are both space, send frequency D.

This same relationship between the TTY channels and the transmitted frequency can be shown in tabular form:

Channel 1	M	M	S	S
Channel 2	M	S	M	S
Frequency Transmitted	A	B	C	D

If a twinplex signal is recognized as such (a good panadaptor is a help here), it should be possible to print channel 1 on a standard setup, provided the filters in the TU are not too sharp. You will have to tune so that your TU thinks it is seeing mark when either frequency A or frequency B is being transmitted, and seeing space when either frequency C or frequency D is being transmitted. Reference to the table above will show that setting up in this way will recover channel 1.

Commercial equipment, designed to receive twinplex, separates and recovers both channels simultaneously.

Frequency Division Multiplex (FDM)

Signals exist which are comprised of 4, 8, 16 or more separate RTTY channels sent simultaneously by the same transmitter. The available literature describes both amplitude modulated (pulsed CW) and frequency modulated (FSK) subcarriers with shifts of 30, 35, 42.5, 60 and 85 Hz. The equipment used commercially to separate such a signal into its constituent channels consists of a large, impressive rack of precision narrow band filters.

An example of a 4-channel FDM system using 120 Hz channel separation and FSK with 60 Hz shift per channel is shown in Table 6.

The twinplex signals described earlier can be considered as a special example of FDM. In a twinplex system, at any one instant in time, all the power is in only one of the four subcarriers. This advantage is counterbalanced by the requirement that the two channels of information be synchronized. The channels of a more conventional FDM system need not be synchronized, but the power is shared among the subcarriers, i.e., one subcarrier per channel is transmitted at any instant in time.

It's not unusual to receive signals which sound like a buzz saw gone berserk, and it's these that are allocated to the frequency division multiplex category in Table 5. Since I haven't yet printed clean copy on most of these signals or verified them in some other way, the FDM listings should not be considered 100% accurate.

Time Division Multiplex (TDM)

If two or more channels of information are separated in time by alternating the transmission of characters from each of the channels, time division multiplex results. Diplex transmission of Moore code, described further on, is an example of TDM.

For example, a 2 channel TDM system would alternate characters from each of two channels. Consider two messages punched on tapes: Channel 1, "READ KILOBAUD" and Channel 2, "ABCDEFGHIJKLM". The transmitter would alternately select a character from channel 1, then channel 2, then channel 1, resulting in a transmission of: "RAEBACDD EKFIGLHOIBJ AKULDM".

TDM/FDM

Time and frequency division multiplex techniques are sometimes combined into a single transmission. I've identified several examples of this to date – two channel FDM transmissions, each channel of which is sending diplex Moore code (TDM).

As an example, consider four TTY channels – A, B, C and D. Each, for simplicity's sake, is sending a message comprised of the channel's name repeated over and over, e.g., channel A's traffic is AAAAAA ..., channel B's traffic is BBBBBB.

This could be combined into a 2-channel (4-frequency) FDM system, the first channel of which is sending alternate characters from A and B (TDM), the second channel of which is sending characters from C and D (also TDM). See Table 7.

Frequency	Notes	Sending
8899.970	Channel AB space	ABABABAB
8900.030	Channel AB mark	
8900.090	Channel CD space	CDCDCDCD
8900.150	Channel CD mark	

Table 7. Four channels, TDM/FDM.

Moore (ARQ) Code

In 1963, the International Telecommunication Union published a unanimous recommendation that an automatic repetition on request (ARQ) code be used in situations where the use of a five-unit code would otherwise produce an intolerable error rate. The code recommended, called Moore code after its inventor, is an error-detecting synchronous code which represents each character in seven bits. For any character, three of the seven bits are always mark; the other four are space. This provides an error-detecting function, as well as the means of synchronization. The utility of the code is in full duplex (simultaneous two-way) situations. When one end detects a mutilated character, it momentarily interrupts its transmission of traffic and transmits a special character which initiates an ARQ cycle, that is, the retransmission of the last few characters from the other end.

Thirty-two of the 35 possible Moore code characters have a one-to-one correspondence to Baudot. Figures and letters case characters are paired the same in both codes. Indeed, standard 5-unit teleprinters are used in Moore systems, after appropriate code conversion, to create and print the traffic sent and received. See Tables 1 and 7 for the complete Baudot and Moore codes.

The three special Moore characters without Baudot equivalents are *idle alpha*, *idle beta*, and *signal I*. The idle characters are used as fillers; signal I is the special character used to request a

FIGURES	—	?	:	✙	3	□	⊟	⧄	8	BELL	(	)	.	,	9	0	1	4	'	3	7	=	2	/	6	+	CARRIAGE RETURN	LINE FEED	LETTERS	FIGURES	SPACE	BLANK	SIGNAL I	IDLE α	IDLE β
LETTERS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z									
1			1				1	1	1			1	1	1	1	1		1		1		1					1	1			1				
2					2		2		2	2		2						2	2		2		2			2				2	2		2	2	2
3	3	3		3	3	3		3	3				3	3							3			3	3	3		3					3		
FEED HOLE	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
4	4	4	4	4	4						4					4	4		4			4						4	4		4			4	4
5			5	3										5	5		5	5		5			5	5	5				5	5		5	5		5
6	6					6		6		6	6	6			6	6			6		6			6			6		6	6		6			
7		7				7	7			7	7		7				7			7		7	7		7	7	7					7		7	

Table 8. Moore 7-unit code.

retransmission when a mutilated character has been received. The Moore signals I've received are comprised of two separate channels of information. Two different Baudot signals are translated to Moore and alternately sampled to produce a single FSK transmission. This is called diplex and results in a bit length of 11.67 ms or 163.38 ms per character pair. Characters from the two channels, called the A and B channels, are sent in alternate time slots, one A character, one B character, etc. To further complicate things (actually to help synchronize and to distinguish between the A and B channels), certain character positions are sent inverted, that is, 4 bits of mark and 3 of space. The pattern of inverted and uninverted characters repeats in cycles of 8 characters, 4 from channel A, 4 from channel B. Using upper case to represent uninverted characters, the two channels are combined in the following repetitive pattern: abaBABaB. This pattern repeats over and over, providing the method of distinguishing between channels and aiding in synchronization.

RUMORED SIGNALS

This section will present the characteristics of various signals which I've never heard on the air. I almost believe they're out there just waiting for the sunspots to come back. My faith is due to the number of people I've talked to who are convinced that they have received them, plus what I've been able to find in the literature.

Correspondence from readers who can provide actual time and frequencies of nonstandard RTTY signals, based on their personal listening or commercial experience, would be welcome.

ASCII

A popular nonsignal among hams is ASCII. Some are even convinced that most of the FSK they can't print is ASCII. I wish that were so. It's not. At least not where my antenna's been pointing. Using the computer, as will be described, I've analyzed hundreds of non-Baudot signals. I've never found any non-Baudot asynchronous code, let alone ASCII. They tell me Canadian amateurs are using it and North African news agencies, too. I'll keep looking.

Six-Unit Typesetter Code

Some South American countries are said to use a six-unit typesetter code on the air. This code is said to have a start pulse, five data bits, and that's it — no stop pulse.

High Speed Morse Code

High speed Morse code (around 300 wpm) is used in tactical situations to prevent interception and direction-finding by the enemy. Advantages are that simple equipment can be used at both ends. An operator records a message at normal speed, it is sent at high speed, recorded at high speed at the receiving end, played back at greatly reduced speed, and reduced to writing by a trained Morse operator. Despite the current disagreements between New Jersey and New York with respect to state income taxes, no high speed Morse has been received at my QTH.

Bit Transposition Baudot Cipher

Bit transposition is said to be used in private systems, similar in application to the bit inversion system described earlier. As with bit inversion, bit transposition requires that the five data bits of the Baudot character be obtained in parallel at both ends of the circuit. At the sending end, using a switchboard type arrangement, two to five of the data bits of the character are scrambled, according to a prearranged pattern, by moving them to a different position. At the receiving end, after obtaining the data bits of the character in parallel, the bits are unscrambled, utilizing a similar switchboard, then the character is printed.

Here's an example: As in the discussion of bit inversion presented earlier, let's number the data bits of the character 12345. A simple example of bit transposition would be for the sending end to transpose bits 1 and 5. Then 10000 (E) becomes 00001 (T), 01010 (R) remains unchanged, 01001 (L) becomes 11000 (A), and 01111 (V) becomes 11110 (K).

Character frequency distribution analysis of a bit transposition cipher would indicate a simple character substitution code. To date, computer analysis of scores of strange Baudot signals has not resulted in the identification of any bit transposition transmissions.

Bit transposition and bit inversion can be combined in a single system simply by the application of both techniques simultaneously. For our example, we'll invert bits 4 and 5 of each character and then, after inversion, we'll transpose bits 1 and 5.

Plaintext:
10000 (E)
01010 (R)
10011 (B)

Bits 4 and 5 inverted:
10011 (B)
01001 (L)
10000 (E)

Bits 1 and 5 transposed:
10011 (B)
11000 (A)
00001 (T)

If the procedures are reversed, that is, transposition first, then inversion, the results are entirely different.

Plaintext:
10000 (E)
01010 (R)
10011 (B)

Bits 1 and 5 transposed:
00001 (T)
01010 (R)
10011 (B)

Bits 4 and 5 inverted:
00010 (car. ret.)
01001 (L)
10000 (E)

Note that bit inversion, bit transposition, bit inversion followed by transposition, and bit transposition followed by inversion all have one thing in common – their use results in the creation of a simple character substitution cipher. As long as the key remains unchanged, each plaintext character will result in the same encoded character every time it is sent.

Although several sources have indicated that simultaneous bit transposition and inversion was in common use just several years ago, I haven't found any of it on the air since I've been listening.

I developed a computer program over the last two years to help in the reception and analysis of the many hundreds of RTTY signals I have found on the air. Without this computer program, the preceding article could not have been written. The computer provided the versatility necessary to quickly identify and print a variety of normal RTTY signals, as well as to analyze and classify the unusual signals.

This combination of the radio and computer hobbies is still in its infancy and would seem ready for growth. The number of RTTY signals on the air is increasing all the time; there are codes yet to be discovered, as well as a variety of codes already discovered, which need further analysis. Attacking this with a home computer is a computer game of sorts, a real time, real world computer game, which is at once very challenging and very satisfying. ■

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RTTY Local Loop

-- perfect for beginners

About two years ago I saw an amateur radio teletype (RTTY) station on the air. That one look was all it took to fix in my mind that one day I would communicate from a keyboard instead of a mike.

Finally after several months of searching, I found my machine, a Model 15. It had been used in amateur service before and was in practically new condition.

Once I was home with the 15, the big job started – convincing the XYL that there was room in the spare bedroom I call a ham shack for this thing that it took two people to carry in. Fortunately, I have an understanding XYL, and, after some moving around of furniture, the 15 was set in position next to my operating table.

I plugged it in and turned the switch on. The motor came to life, and I was ready to see if this thing would really type. It wouldn't. I didn't know much about RTTY at that point, but I took a guess that it might have something to do with the two wires that were dangling down from the machine with phono plugs on the end.

It seemed that now was the time to pull out the back issues of *73*, which make up a large part of my reference library, and find out a little more about the 15 – like how do I make it type. After a few hours, I finally had it figured out. What I needed was a thing called a loop supply. It seemed that the RTTY needed dc as well as ac to run on.

I did more reading and looking for a loop supply that I could build and finally reached a conclusion. I would design and build the supply to fit my needs. My requirements were:

1. Ability to run the page printer from the keyboard (to make sure it will work).
2. Ability to run the page printer from a paper tape reader (T.D.). I was lucky to acquire one of these with the 15.
3. Ability to run a paper tape punch and the page printer at the same time. (What good is a tape reader without a tape punch?)
4. Use as few parts as possible. (I have a small junk box.)
5. All parts to be readily available. (Someone else might like to build one.)
6. Keep cost at a reasonable level. (My extra money is smaller than my junk box.)

A schematic diagram of the local loop supply that meets my requirements is shown in Fig. 1.

Unfortunately, the only parts I found in the parts box were the pilot lamp and the fuse holder, which is not much to start with. One of the requirements was that all parts be readily available, and a trip to the local Radio Shack found all the parts in stock. (The part numbers I used are listed in this article.)

The phono plug should not be grounded in this circuit. To overcome this problem, I first used one of the black Bakelite boxes that are so handy for small projects. This was a mistake. I found the mistake after about 10 minutes of test operation as the box slowly started melting around the resistors.

I made a second trip to town and back for a new box, this time a metal one with vents. I had no more problem with heat buildup. I insulated the jacks from the metal cabinet by using vinyl grommets.

If you do not run a type punch and T.D., you could leave out phono jacks J-3 and J-4. R-1 is a 2.5k Ohm, 10 W resistor, which gives the 60 mA required by my 15. (Since the required resistor wasn't available, I used my vast knowledge of electronics and came up with two 1k Ohm and one 500 Ohm resistors in series.)

So, I've got my 15 typing, and it's doing a good job. Now all I have to do is find out how to get it on the air. I believe it takes something called a converter and an AFSK oscillator. I have some ideas for the oscillator, and maybe I can tell you how it turns out later. ■

Parts List

Quantity	Description	Radio Shack Part Number
1	ac power cord	278-1255
1	fuse holder	270-739
1	fuse (1 Amp)	270-1273
1	pilot lamp	272-703
1	metal cabinet 4" x 2½" x 6"	270-252
1	push/on—push/off switch	275-1551
1	full-wave bridge rectifier (4 Amp, 450 volt)	276-1172
1	electrolytic capacitor (20 uF, 450 volt)	272-103
2	10 Watt power resistors (1000 Ohm)	271-140
1	10 Watt power resistor (500 Ohm)	271-138
4	phone jacks 2 conductor (closed circuit type)	274-255

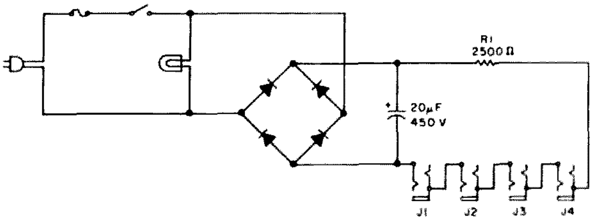

Fig. 1.

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Try the RTTY Reader

-- computer display goes ham!

Only a handful of area RTTY enthusiasts could be convinced to come up to two meters from the HF bands. That was until the Central Pennsylvania Repeater Association (CPRA) established its WR3ACO RTTY machine*. Now, with autostart a must, a Model 15 printer has become a "paper hungry monster," with the machine running continuously from early afternoon until well after midnight. In the Harrisburg PA area, your only defense against a daily reading load approaching the *New York Times* is to turn the thing off, and miss all the good stuff, or record everything on cassette tape.

In my search for noiseless RTTY, I came upon a truly unique subassembly, designed and built by Micon Industries in Oakland CA.[1] The unit is an extra bright alphanumeric display module designated as the #932. The module is the heart of their personal computer terminal called the Pocket-term. The display consists of a single line of text with 32 alphanumeric character positions. The letters are the size of a display on a typical hand-held calculator, but the display is 6.4 inches in length. The LED module can be set up to display parallel ASCII or Baudot information simply by grounding one pin of its 16 pin minidip interface plug. Further, information may be shown in a variety of ways — typewriter mode with cursor reset, clear, and backspace, or in a walking mode similar to the Times Square news and weather display. Another mode, burst mode, may also be used ... for the more enthusiastic builder.

Therefore, if a mother board were designed into which the display module could be plugged, providing a simple RTTY terminal unit, a UART for converting serial Baudot to parallel, power supplies and some associated interface circuitry so that the #932 module could be used without modification, a desktop RTTY reader would be the result. As an added bonus, the unit, when completed, would be hardly bigger than a carton of cigarettes.

A letter to Micon Industries brought the display to my door in less than two weeks. The associated data sheets left much to be desired, but the basic data furnished was sufficient to continue with the project. Table 1 shows the terminations for the 16 pin male DIP plug which is furnished with the module along with about 8 inches of ribbon cable.

*WR3ACO RTTY rptr (ns). In: 147.975 MHz; out: 147.375 MHz.

Pin #	Function
1	Ground
2	-12 volts dc
3	End of line (positive edge indicates start of new line)
4	Memory clock 4 kHz
5	Read/Write
6	LTRS (low); FIGS (high) . . . also 6th bit in ASCII
7	05
8	04
9	03 DATA IN . . . five bits for Baudot, 6 bits for ASCII
10	02 with pin 11 being the least significant bit.
11	01
12	An LED indicator which needs only +5 volts through a 470 Ohm res.
13	Scan clock . . . connect to pin 4
14	Clock Inhibit "0" enable
15	Baudot (high); ASCII bring low
16	+5 volt logic supply

Table 1. Pin connections for the Micon #932 display module.

Circuit Interface

The scan clock and the memory clock are both driven from the same simple CMOS oscillator. The clock must run anywhere from 3 kHz to 5 kHz and is not critical. The scan clock is interrupted by the use of the clock inhibit (pin 14 for use in the walking mode, in this application). Only one 8-input NAND gate is required to decode the FIGS LTRS input. By recognizing the high condition of Baudot data bits 01, 02, 04, and 05 and pin 19 of the UART, we can then use data bit 03 to tell the display module the shift code for FIGS or LTRS.

This arrangement, when data bits and pin 19 of the UART are in the true state, allows the flip-flop to sample bit 03. Almost as an afterthought, the same logic was applied to decode uppercase "S" or bells . . . you just gotta have bells. One half of the CD4013 D type flip-flop is clocked similarly, but this time detecting a true condition on the 5 data lines (three inverters are required) and, once again, the high condition on pin 19 of the UART. An all conditions true for upper case "S" triggers the other half of the CD4013, which is set up as a one-shot multivibrator. Given that the single Baudot code for a bell is approximately 160 ms, the RC network on the one-shot stretches this pulse length to about 250 ms. This pulse then directly triggers pin 4 of an NE555 timer, set up in an oscillator configuration, which drives a speaker directly from pin 3 through a capacitor. This oscillator is set up to provide a fairly good volume without controls. But volume can be adjusted to suit by shunting the output more than that shown. All unused CMOS inputs must be grounded or

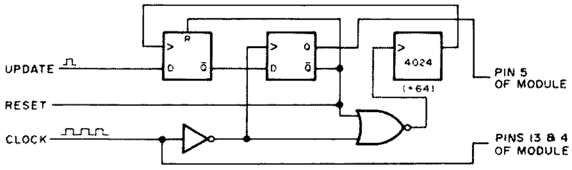


Fig. 1. Typewriter mode.

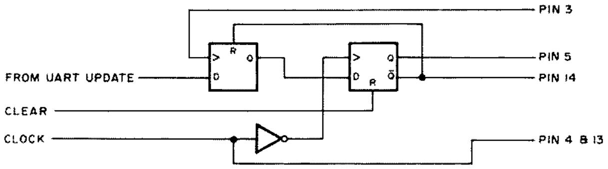


Fig. 2. Walking mode. Data bits must all be low when clear is activated.

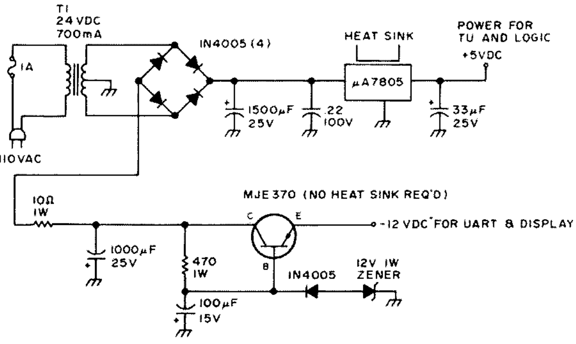


Fig. 3. RTTY reader supply. 5 – 1N4005 diodes; 1 – 1500 uF 25 V; 1 – .22 uF 100 V; 1 – 33 uF 25 V; 1 – UA7805/MC7805; 1 – xfmr 24 V ac 700 mA, Stancur; 1 – MJE370; 1 – 12 volt zener; 1 – 470 Ω 1 W resistor; 1 – 10 Ω 1 W resistor; 1 – 1000 uF 25 V; 1 – 100 uF 15 V.

tied to other inputs to prevent self-oscillation.

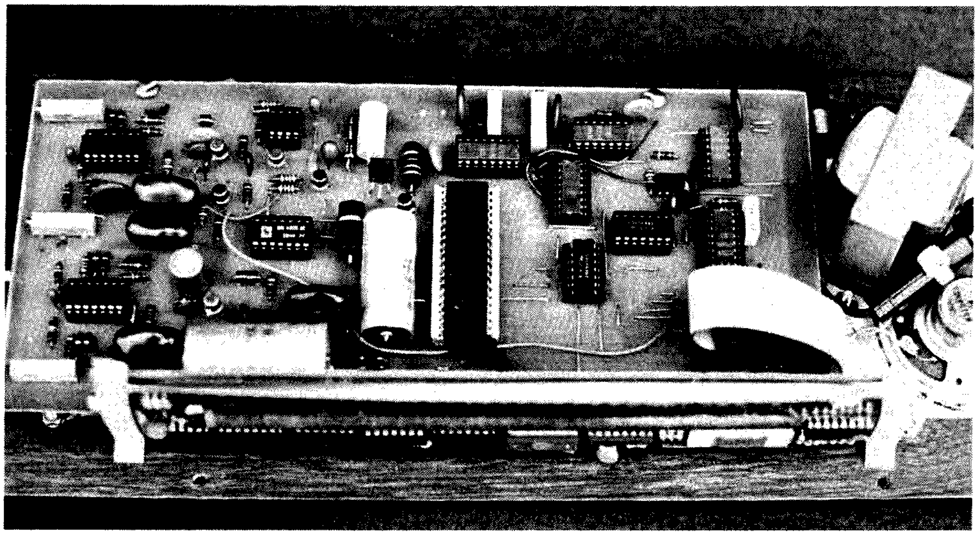
Two clocks are required to operate the display. The UART clock should be set to 727 Hz for 60 wpm operation. The clock speed control will adjust to any speed desired, however. If the fixed resistor is carbon film, then the variable control can be any cheap composition type, while still maintaining greater than 1% frequency tolerance. The capacitor should be mylar or silver mica. The display clock, on the other hand, is not critical and can have a 20% tolerance. Therefore, composition resistors and a disc capacitor may be used. No adjustment of this clock should be necessary. The CD4049 hex inverter is used for both clocks, as the outputs are buffered as necessary.

As a special note, additional information is presented for other applications for the display module. A strapping option on the board allows the use of EBCDIC. The display can accept data rates of up to 250 characters per second – too fast to read but not to photograph. Higher speed versions can be furnished by Micon that will display up to 1000 characters per second. Power requirements for the RTTY reader are +5 volt logic at about 600 mA and a scant 20 mA at -12 volts. Since the display module and the UART both require -12 volts, no other voltages are required. Each character of the multiplexed array emits about 500 microcandles of light. It's almost too bright. Only one character position is being illuminated at any one time, and the display appears to the eye as average. Actually, each LED is being strobed 32 times brighter than its average appearance, but is run on a 1 out of 32 duty cycle. The 4 kHz clock frequency produces a scan frequency of 125 Hz. Any scan frequency below 90 Hz may cause the display to flicker.

The negative edge of the clock applied to pin 13 (see Table 1) will advance the scan logic and character position to the right. On the negative edge of the clock applied to pin 4, the memory will select the segments to be lighted for the next character. If pins 4 and 13 are tied together, as they are in this application, then the display (with no new data entered) will appear static. A positive edge is output from pin 3 every time a scan starts out from the left of the display. This pulse is used to synchronize character positioning for the updates. For example, if, in typewriter mode, you wish to place a new character in position 14 (from the left of the display), wait until you receive a positive edge from pin 3, and then count 13 negative edges of the scan and memory clock. Now the read/write line on pin 5 should be pulled low, and, during the next positive edge of the memory clock, the character on the input pins will be loaded to memory. Pin 5 should be returned high on the next negative edge.

In the project described here, the walking mode is used. Here update occurs coincident with the positive edge of pin 3. This causes the new character to appear in the left-most position. All characters are then shifted to the left, rotating the new character to the right. In order to move characters to the left, the scan clock needs to skip one cycle in relation to the memory clock. Conversely, skipping a memory clock cycle in relation to the scan clock causes all the characters to advance in the other direction. In the walking mode, pins 4 and 13 can still be tied together, and pin 14, the scan clock inhibit, can be used to inhibit scan cycles. See Figs. 1 and 2.

Pin 12 on the module connector controls a bright spot LED on the left end of the display. This may be used as an indicator for anything. Here we use it as a tuning LED for mark (on) and space



(off) for tuning in signals. In my version of the RTTY reader, there are absolutely no external controls – switches or knobs – not because we don't like them, but none were necessary. The TU to be described has such a wide dynamic range with self-limiting that no control was required. No manual reset was required, either, because of the electronic autostart control system included. The only wires coming out of the box, then, are the ac power cord and an audio input phono connector. When using the LED indicator, be sure to current limit the LED with a 470 Ohm resistor, if using a 5 volt supply.

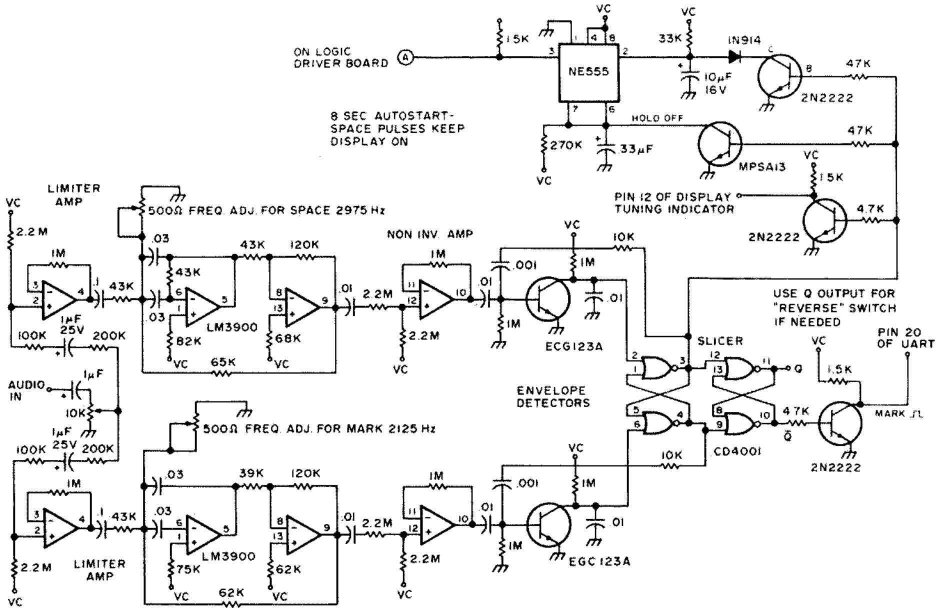


Fig. 4. RTTY reader terminal unit. Vc is +5 V dc. (Pin 14 is Vc, pin 7 is gnd.) 2 – 500 Ω type 43 trimpots, James; 1 – 10k type 43 trimpot, James; all resistors are ¼ Watt 10%/5%.

Construction of the RTTY Reader

Construction of the RTTY reader mother board, which included TU, autostart, power supplies, and UART, is easily accomplished with a single-sided PC board included. Construction is begun with the two power supplies. A single 24 volt power transformer is used with center tap to ground. The resulting plus 12 volt supply is used in the 5 volt logic regulator, and the minus 12 volt supply is regulated for both the UART and the display module. As can be seen, there are many over-board power supply jumpers to provide power up of each individual stage or functional section of the board. This aids stage by stage testing of the unit. Complete stage by stage testing is a must to avoid errors which would destroy costly CMOS components.

The power supply is a straightforward design with an MC7805 or equivalent used for the 5 volt regulator chip. Adequate +5 volt power supply bypassing is provided throughout by the liberal use of .1 uF capacitors at the inputs of the various stages.

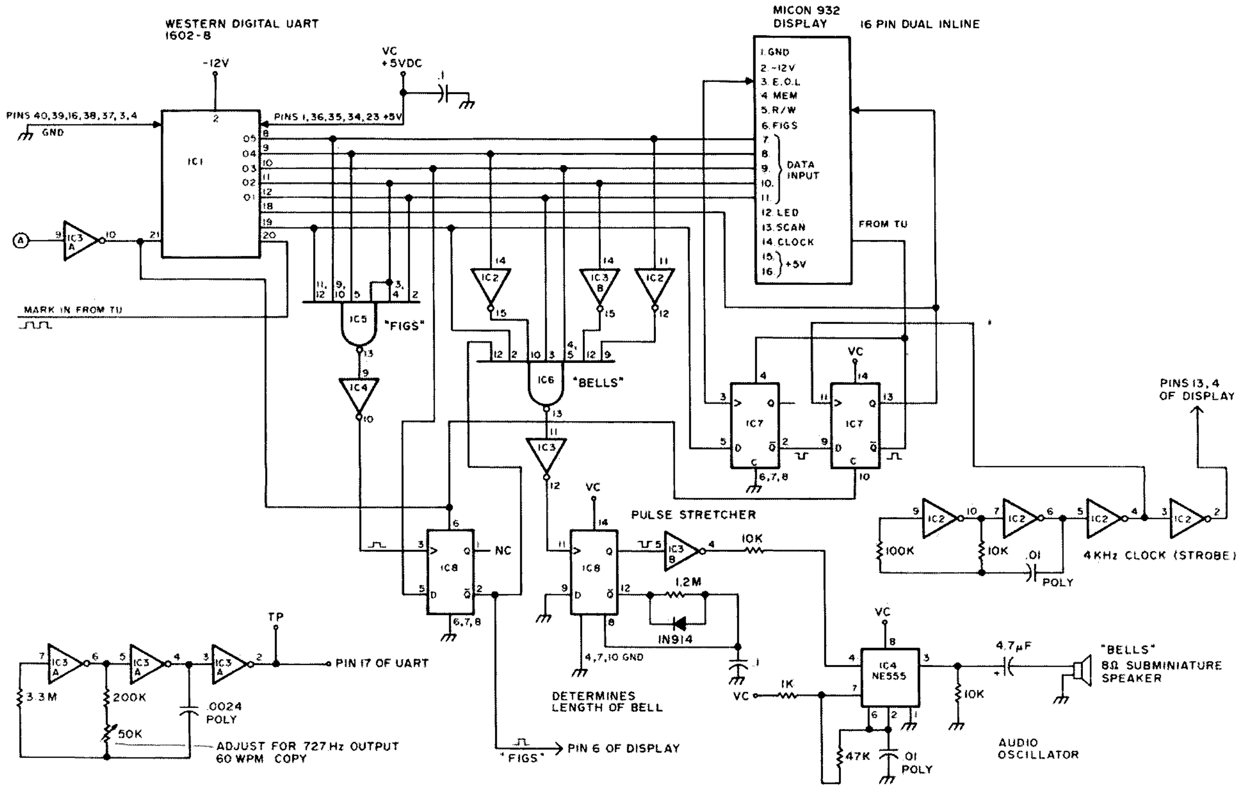


Fig. 5. Logic display driver. 1 – IC1 1602B UART, Tri-Tek; 3 – IC2, 3 CD4049; 1 – IC4 NE555; 2 – IC5, 6 CD4068B; 2 – IC7, 8 CD4013; 1 – 50k type 43 trimpot, James; all resistors ¼ Watt 5%.

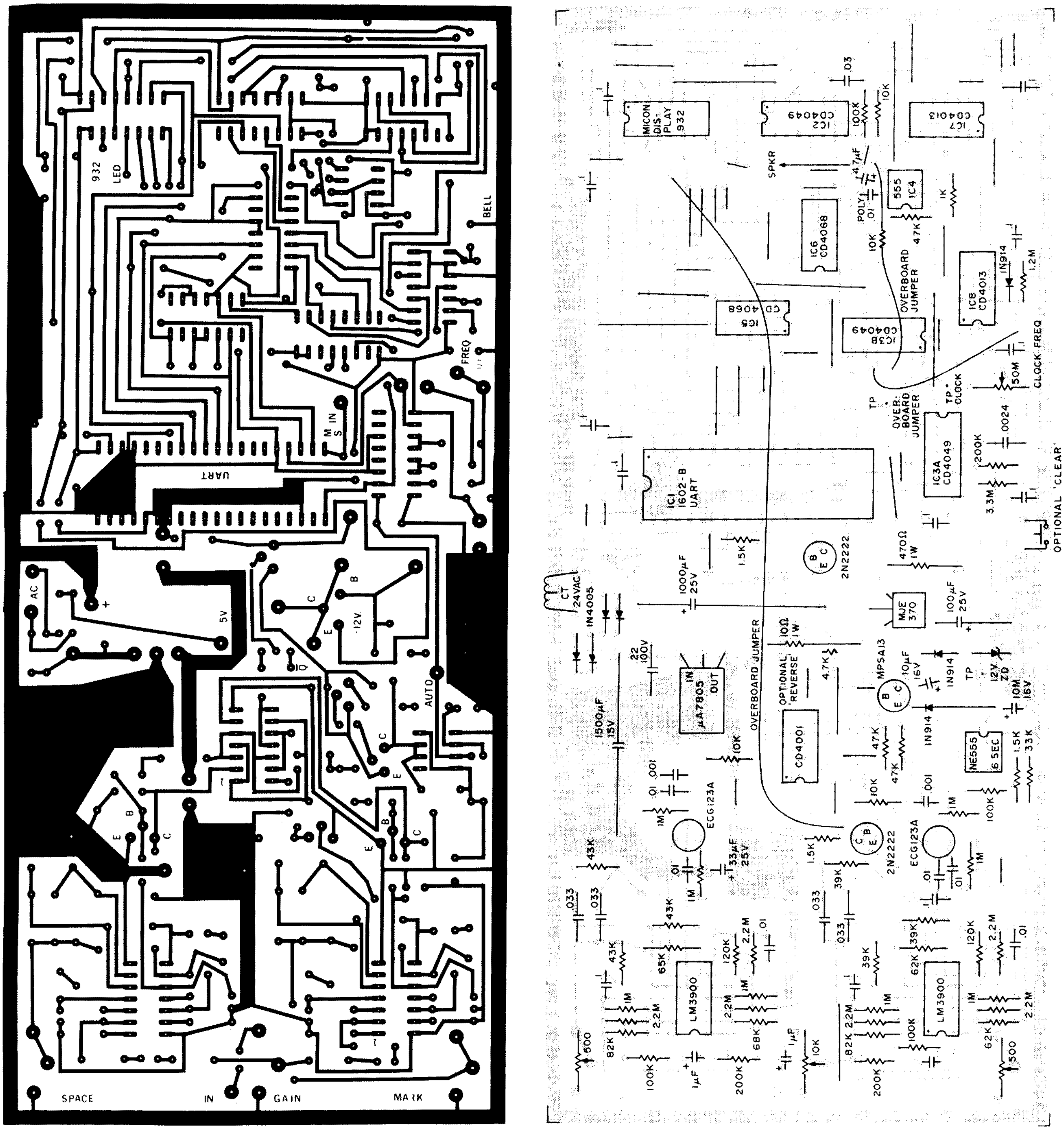


Fig. 6. PC board. Component layout shown from bottom.

The -12 volt supply requires no heat sink because the MJE370 current demand is well under 50 mA. The 5 volt supply will require heat sinking in addition to the large foil on the board for this purpose, because, with all the characters going on the screen, thermal shutdown will occur without sinking. The mother board was mounted on ¼ inch standoff spacers, and the 7805 was bolted directly to the aluminum bottom plate of the chassis. This provided more than enough sinking for cool operation and for continuous duty. Remember, the -12 volt supply is negative and the filter capacitor's polarity must be reversed. See Fig. 3.

RTTY Terminal Unit

The all-purpose mother board also provides a simple, yet very effective, RTTY terminal unit, with many desirable features. Mark and space tones are easily adjusted with a simple pot. The terminal unit described makes use of the LM3900 quad op amp.

This unique component consists of four individual operational amplifiers in a standard 14 pin dual in-line case. The power supplied to this component can be anything between +5 volts up to 18 volts. See Fig. 4. Audio from the receiver is brought to the board through a 1 uF capacitor and volume control. The audio path is divided and directed to two sections of the op amp, which are limiting non-inverting amplifiers. These amplifiers in turn

drive a two stage bandpass filter with a gain of 15 and a Q of about 25. A slight frequency variation of the bandpass is possible by using the 500 Ohm variable resistor employed in the feedback circuit of each bandpass filter. The values shown for each filter were selected for a mark tone of 2125 and a space tone of 2975 Hz, respectively. The resistors shown in the feedback path will provide for optimum gain and Q but are not that critical. Determination of these components was obtained from the *Op Amp Cookbook*[2]. Other space tones, such as 2295, may be substituted and are within the practical range of the given component values. However, not inserting more exacting parts in the feedback circuits causes some gain and some Q loss.

The outputs of both filters are once again amplified in a non-inverting final stage of the LM3900. Tuning the active filters consists of driving the input from an audio source of the proper frequency and turning the 500 Ohm pot on each feedback network for maximum sine wave output at pin 10 of the op amp with a simple ac scope.

The MPS 2925 (ECG 123A) transistors convert the audio peaks to CMOS driving pulses in an envelope detector configuration. The two detectors then drive alternately a basic RS flip-flop, which follows the mark-space transition. The output is buffered again, resulting in a Q and Q-bar output of IC1, which then drives a low power keying transistor used to provide RTTY serial input to the UART. A reverse switch may be installed at this point if desired.

Autostart

The autostart function utilizes a small portion of rectified audio from the output of the 2125 amplifier. This audio delay starts (about 3 seconds) an NE555 timer, which is held from timing out by the use of space tones to bleed off the timing capacitor. Since the output of the NE555 at pin 3 is held high with valid RTTY only, the output is coupled to pin 21 of the UART. This supplies enable high to the UART and supplies a clear to the update flip-flop, causing the recirculate line to go low. This will fill the display with the characters present on the data lines. Since the UART has been reset, the data lines will all be "0", thereby filling the display with blanks. The NE555 also provides a clear pulse to the FIGS/LTRS FF, which always comes up in LTRS. Reset of this line occurs in three ways – autostart call-up, manual pushbutton (if desired), and power up.

A miniature noiseless RTTY terminal, without the rigid design specifications and high cost of a video/CRT system, is the result of this project. Other applications could include an automatic Morse code reader display or a portable "advertising" display using prerecorded information on a tape recorder. Perhaps the more industrious ham gear manufacturers will provide a similar module in their new receiver models, which decode Morse, all speed RTTY, and ASCII at the flick of a panel switch.

We hope you will have as much fun with this project as we did in building and showing it off. Technical questions with regard to the display module should be directed to Mike, and TU interface and mother board questions to W3JJU. Good viewing. ■

References

1. Micon Industries, 252 Oak Street, Oakland CA 94607. ADM #932, $199.00 in quantities of 7 or more.
2. *Op Amp Cookbook,* Walter Jung, Howard Sams, 1975.

EDITORIAL BY WAYNE GREEN

from page 16

FRIVOLOUS PETITIONS

The FCC says on the one hand that it doesn't hear enough from amateurs about the rules they want. On the other, they complain about the many silly petitions being sent in.

The ARRL has caused a lot of this trouble. In order to appear to be the "representative" of amateurs, the League works hard to convince amateurs that they should tell their directors about their reactions to rule changes rather than "bother" the FCC. Amateurs find that this is a sure way to not be heard at all, so they react with apathy . . . what can one person do? . . . etc.

The League would like it best if they were the only group entering amateur rule change petitions to the FCC . . . and the only group commenting on dockets proposed by the FCC. This is the thrust of just about everything you read in *QST* and hear from directors when (and if) they visit your club.

In many cases, rule making petitions are submitted to the FCC as a way of tackling some immediate problem. By the time the FCC has come to grips with the petition, several years later, the whole matter is often irrelevant. Unfortunately, this doesn't deter the FCC from making a big deal out of it and coming forth with some fascinating rule proposals.

Also contributing to amateur apathy in the matter of FCC dockets is the reaction of the ham magazines. *QST* generally provides a dry and boring report in very fine print. *Ham Radio*, in refusing to even mention the subject, indicates that it is of no importance. *CQ* does the same in almost all cases. I try to see that FCC dockets are as well covered and discussed as possible in *73*, but we're only one magazine out of four, so the general attitude is that someone else should worry about these things . . . they are of no real significance.

Perhaps you've noticed that very few of the petitions submitted to the FCC for rule making have been published in any of the ham magazines. They are not generally published in *73* because we haven't been getting copies of them – not even the more interesting ones. If the person submitting the petition doesn't think enough of it to send us a copy, how serious can he be about it? The FCC doesn't have the men or money to make copies of all petitions and send them to the magazines.

One possible way to keep the FCC from wasting a lot of time trying to cope with frivolous petitions would be to have a committee of interested amateurs look them over and recommend action on the valuable changes. This would act somewhat like a congressional committee. I'd be glad to help with such a committee and I'm sure we could get some other fellows to help.

The more amateurs can do for themselves, the freer amateur radio will be to encourage amateurs to do the things our "service" has been designated for: pioneering and inventing, public service, etc.

UNWELCOME VISITORS

There seems to be a lot of fretting going around that the sale of two meter transceivers by Sears, the recent promotion by Ancomm of their two meter set in CB magazines, and NRI ads for a two meter transceiver as part of their educational package might result in a lot of CBers turning up on two.

The thinking is that since little or no license is required for CB operation . . . and since a lot of CBers are used to ignoring the rules . . . and since there are perhaps 200,000 or so CBers operating in the "channels" above number 40, what is to stop them from claim-jumping into two meters and showing up on our repeaters?

Maybe. If this is starting to happen, I'd like to hear about it. I don't doubt that a few CBers with more brass than others will make a try at getting on two without a ham ticket . . . but I think that amateurs will figure out how to put a stop to it in short order. I'd like to hear about any experiences along this line . . . and think this would be of interest to all readers.

This is something we have to come to grips with quickly . . . for the most part, we are on our own. Don't think that the FCC is going to send a van out to track down a pirate for you and put him out of business. The amateur service is billed as self-policing, and this will have to be it for any practical matters. Repeater groups should plan ahead what they would do if a pirate comes aboard, and have the routine worked out ahead of time.

Most fellows who give piracy a try will probably get discouraged quickly if your group is able to respond and convince him that you are not going to put up with any non-licensed operation. I suspect that a "polite, but firm" approach may be the best. If you get abusive, then you may create a challenge for the chap to harass you with kerchunking and bad language. Explain the facts of life to him . . . invite him to come to the club and take a course so he can get his ticket

Continued on page 120

Organize Your RTTY Pix

-- a sweet tooth is desirable

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Fig. 1. The author and two methods of storing paper tape pix. The choice should be obvious!

There are many interesting aspects of amateur radio teletype. Some RTTY operators are into DX, others have computerized stations, and still others collect RTTY art, or "pix." I am a member of the latter category, and can usually be found exchanging pictures with other enthusiasts on Saturday morning.

Some hams may not be familiar with the technique of transmitting pictures with teletype. Let me explain, to provide insight into the associated problems. RTTY pictures are formed by typing standard characters over a "pattern," which is the picture being generated. Shading and detail is produced by using different character groups. It usually takes several attempts to make a good picture, as experimentation is required to form the correct shades. All of this "editing" is performed on the previous attempt until a perfect work of art is produced! In order to work on the previous partial picture, some method of saving it is required. The medium most commonly used is paper tape – yards of paper tape. Most RTTY machines have a paper tape punch incorporated into the keyboard system, so a tape is punched along with the character being printed. This tape can be read at a later date with a "tape distributor" (TD). Thus, the end result of the editing process is a new paper tape with the complete picture. Some detailed pix use overlining to achieve contrast, which requires many feet of tape. I

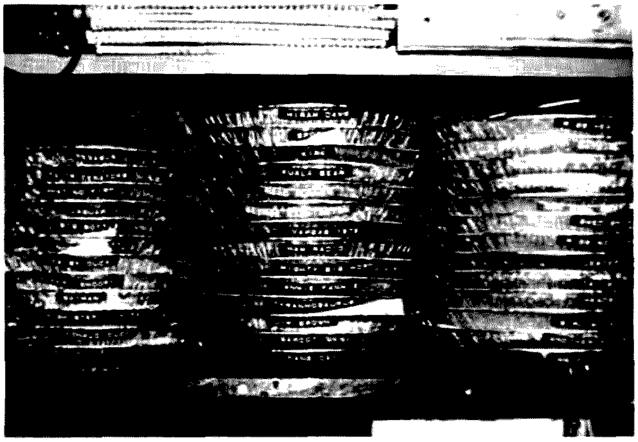
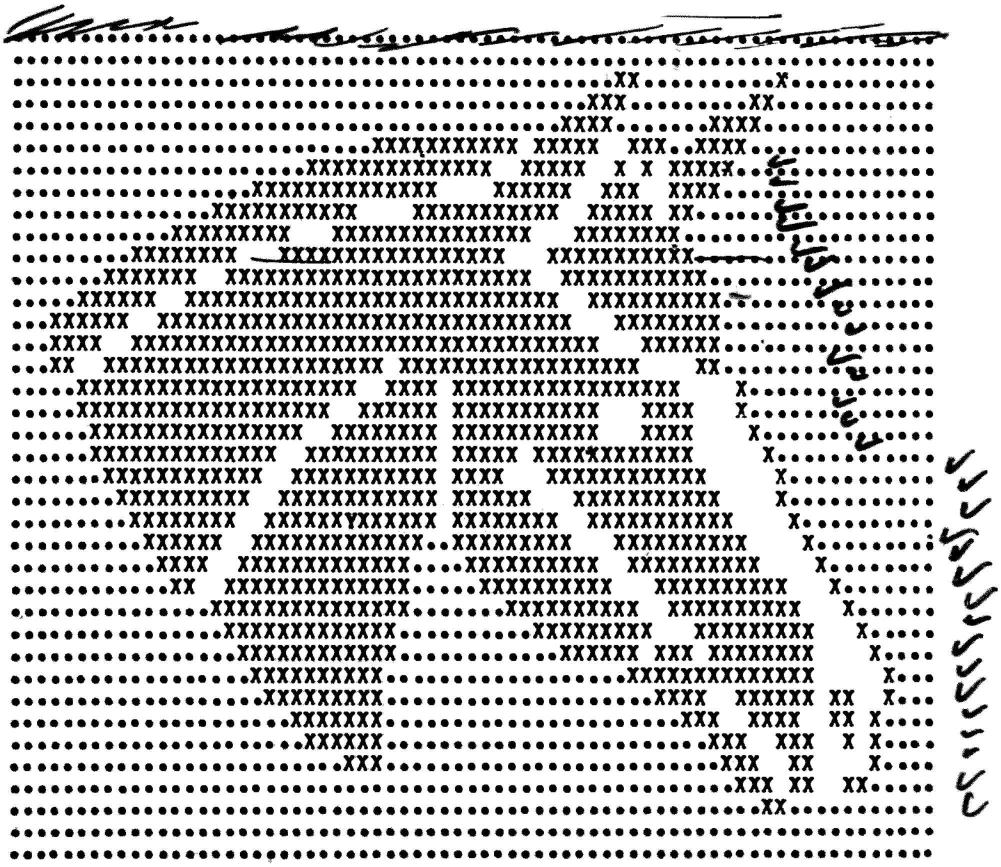


Fig. 2. Paper tape library. The titles of the pix are cemented on the outside of the plates for easy reference. The plates are stacked to conserve space.

have several pictures which are represented by several hundred feet of tape and take over an hour to print! Pictures are received off the air in similar fashion. In order to save the picture for your own collection, it is necessary to use tape or magnetic cassettes. When using paper tape, a device known as a reperforator is employed to punch the tape while the picture is being printed off the air. This tape is usually edited to correct transmission "hits," and then is saved for later use. This is where the problem develops — what does one do with mounds of paper tape as the pix library expands?

Originally, I saved my pix by winding the tapes in the classic military "figure eight," and hung them around the shack. However, this posed two problems: (1) it didn't take long until every available inch of wall space was covered with little rolls of tape, and (2) it was difficult to tell which tape was which. My initial solution involved storing the tapes in shoe boxes, with the "table of contents" on top. Soon, however, my floor began to fill up, and who can afford new shoes every week just to get the boxes? A cure to the tape storage problem was definitely required.



THE DERBY WINNER

Typical RTTY art.

The ultimate cure presented itself one evening as I watched my wife discard a pile of aluminum pie plates. (Her father owns a bakery, and pie plates are a fact of life.) It seemed obvious that a lot of tape could be stored in a flat plate, when the tape was rolled in a cylinder, like film in a 35mm cassette! Sure enough, my longest tape fit neatly in a pie plate when it was rolled up! Never again will those plates end up in the trash.

My method is simple: I simply roll the pix tape into a cylinder, and secure it with a rubber band. The pie plate can be labeled on the outside, eliminating confusion. Another advantage to the plate method is that successive pie plates can be stacked, thus conserving additional space. See Fig. 1 for a before and after example of tape storage. Fig. 2 provides a close look at a shelf holding my pix library.

That's it! I cannot think of any easier method of storing valuable RTTY art in limited space. The only problem with the pie plate method is obtaining a large quantity of plates. Possibly your friends can save them; if not, be prepared to join Weight Watchers, as your diet may become overloaded with cherry pie! So go after those pix, and look for me on 20 meters any Saturday — I'll be ready to copy any new works of art. ■

New Products

from page 15

With the new P(*)M gooseneck plug, mike and gooseneck stem can be quickly, easily disconnected from the stationary receptacle and stored away. The potential of damage or theft of the gooseneck and microphone is eliminated.

Also, the easy connect-disconnect feature permits ready use of microphone and gooseneck in different locations.

The new plug, available in a choice of 3, 4, and 5 pins, has heavy brass housing and satin nickel finish, 5/8-27 external thread on one end for securing plug to bottom of the gooseneck, features exclusive captive design insert screw, and "ground terminal" is electrically integral with plug housing for sure grounding.

P(*)M plugs mate with Switchcraft "Q-G" audio receptacles, new QGP (quick ground professional), and other connectors with compatible contact configurations.

For details, write for New Product Bulletin No. 308, Sales Dept., *Switchcraft, Inc., 5555 No. Elston Ave., Chicago IL 60630.*

*Choice of 3, 4, or 5 pin contacts.

NEW ACCESSORIES FROM YAESU

Yaesu Electronics Corporation of Paramount, California, announces the availability of two accessory items to its product line: a digital LEO readout for the FT-221, FT-221R two meter all mode transceiver, and high quality headphones for all communications requirements, commercial or amateur.

The YC-221 LED frequency readout simply plugs into the FT-221 series. A simple minor modification needs to be made to some of the early transceivers and full instructions are given in the YC-221 manual. The frequency readout is in seven digits, covering 144 to 148 MHz in one half inch LEDs. Amateur net price is $119.

The YH-55 headphones are low impedance types with cushioned type earpads, and frequency response tailored for voice communications. Amateur net price is S15. Both products are now available at all authorized Yaesu dealers. *Yaesu Electronics Corporation, 15954 Downey Ave., P.O. Box 498, Paramount CA 90723.*

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Build A RTTY Message Generator

-- it's programmable!

This project is similar to some of the CW keyers with memory, where a CW message can be put in memory to be recalled later. There is one major difference – this one is for RTTY. It will store as many individual messages as desired, but is limited to 1024 characters. A CQ message could be message 1, and several contest reports might be entered as later messages. All that is necessary to operate the contest is to press RUN, watch your machine send "CQ contest DE WB9XXX," and come to a halt. You then listen for a call, and, if you get one, enter the call on the keyboard and press RUN again. The machine will then send message 2. If message 5 was desired instead of 2, its starting address is selected on 3 rotary switches and loaded. Just press RUN and it will now send message 5.

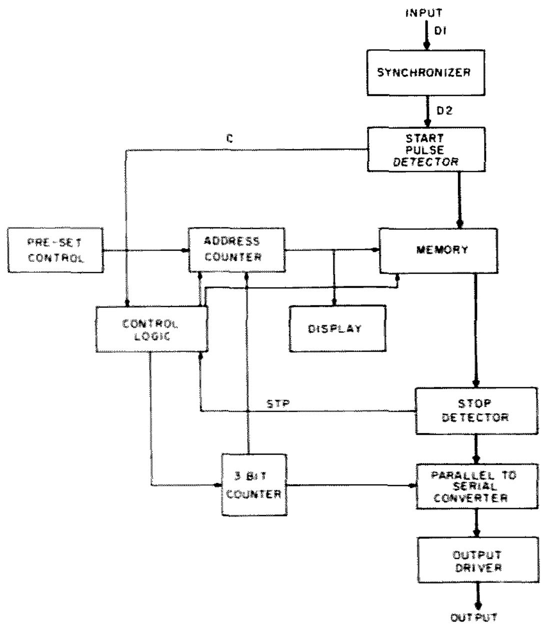

Fig. 1. Block diagram.

The RTTY message generator is intended for the person just getting started in RTTY or one who has been on the air on RTTY without any type of digital control. I do not claim that this system can outperform a computer, but it does not deplete the savings account as much, either. You cannot change its basic function by changing a program, but you can change its message content and output format. What about cost? True, the 8008 micro is under $20 now, but it requires other ICs for support. This project uses standard TTLs and five MOS static RAMs, which, at last check, were selling for $1.05 each. I built the system mostly from junk box parts, but, even if you bought everything new (excluding packaging), it should cost less than $25.

As presented here, the system will do the following: In input mode, and after the RUN button is depressed, the unit will record a serial TTY input which is TTL compatible (mark = 1, space = 0) at any speed up to 100 or 60 wpm. A second message may now be typed in. Note and jot down the address from the 3½ digit LED display first, so, when you want to recall message 2, you will know where it is. This can be continued until memory is full. (There is a limit of 1024 characters for this unit, but that could easily be expanded.)

Let's say you have 5 messages in memory, and they are stored as in Table 1. If the operator wants to send CQ at memory location 0000, he can press RESET, then press RUN. The message will be outputted in serial format at 60 or 100 wpm (as selected) and will stop at location 0136. If the second message is to be transmitted next, all that has to be done is to press RUN. If the operator wishes

Message #	Address (octal)	Content
1	0000	CQ
2	0136	QTH, name
3	0224	Station, ant, rig
4	0506	RTTY art
5	1212	CQ

Table 1.

to skip to message 4, he must change the address to 0506, then press RUN. The address can be changed to any desired value by selecting that value on 3 rotary switches and one toggle switch and then pressing the LOAD button. The address is inputted and read out on the LEDs in base 8. This octal input is converted to a ten bit binary number required by the RAM address inputs by a diode matrix. Octal is used because it would be difficult and confusing to attempt to load in a ten bit binary number with ten toggle switches, not to mention the operator's ability to remember a ten bit binary number. The BLANK key on the Teletype keyboard is used as a stop command when printing data from memory. So any number of separate messages can be started and printed by, first, loading in the address where that particular message is known to start, and second, depressing the RUN button. This message will be typed out at 60 or 100 wpm, and the printer will automatically stop at the end of the message.

How It Works

The signal flow through the unit is represented by the heavy black line in the block diagram in Fig. 1. The input signal from the machine is labeled as D1. It is generated by the keyboard switches shorting pin 2 of latch U18A to ground during a space and opening the path to ground during a mark. See Fig. 2(a). A resistor going from pin 2 to Vcc keeps it a logical 1 during mark. Mark and space are terms used in describing, respectively, whether current is flowing in the selector magnets of the machine, or it is not.

The Baudot code used with most Teletype machines consists of seven bits. These seven bits are sent serially over one line. The first bit is called the start bit and is always a space (logical low in this circuit). The next five are the five data bits of the code and can be high or low depending on which letter is being sent. The last is a stop bit and is always a mark or high. The start bit tells the receiving machine to get ready to receive the data bits. The stop bit is used to allow the machine to come to a rest before the next letter is sent. At 60 wpm all pulses are 22 milliseconds in length, except the stop pulse, which is 31 milliseconds long. Since D1 goes low at the instant a key on the keyboard is depressed, it must be synchronized with the clock of the system. This means the new synchronized signal D2 changes levels only at the same time that the clock goes from a low to a high. Referring to Fig. 2(a), the clock is applied to a monostable multivibrator U16. The timing resistor and capacitor produce a short pulse at pin 6. This is applied to the latch U18A. This latch stores the present state of the incoming data and is updated each clock pulse (every 11 ms).

As can be seen from the block diagram, D2 is now applied to the start pulse detector and to memory. The start pulse detector does just what its name implies – it detects a start pulse coming in, starts a timing sequence to control the counters, and creates write pulses, which are sent to each RAM at the time when its data bit should be on D2. The output of this circuit is called $\overline{C}$. It is normally low when data is coming in and for short times between each letter. When D2 goes low, $\overline{C}$ goes high and remains high for 14 clock pulses. It returns low during the middle of the incoming character's stop pulse.

Referring to Fig. 2(c), this

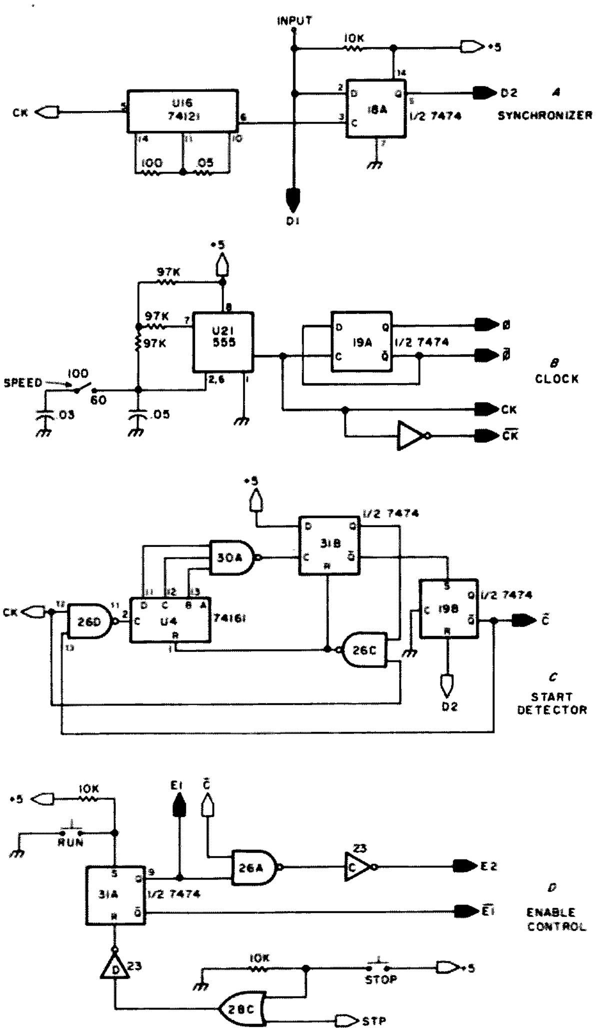

Fig. 2. a) Synchronizer; b) Clock; c) Start detector; d) Enable control.

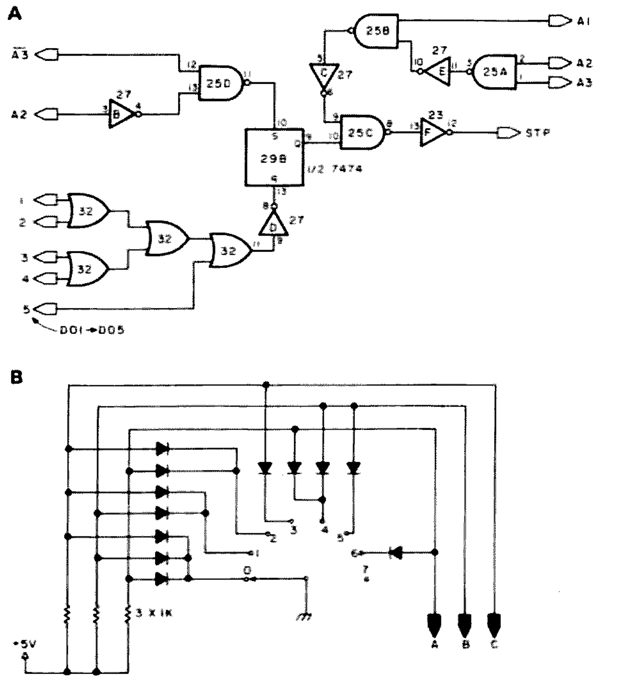

Fig. 3. a) Stop detector; b) Input selector and diode matrix (one of three). Preset controls.

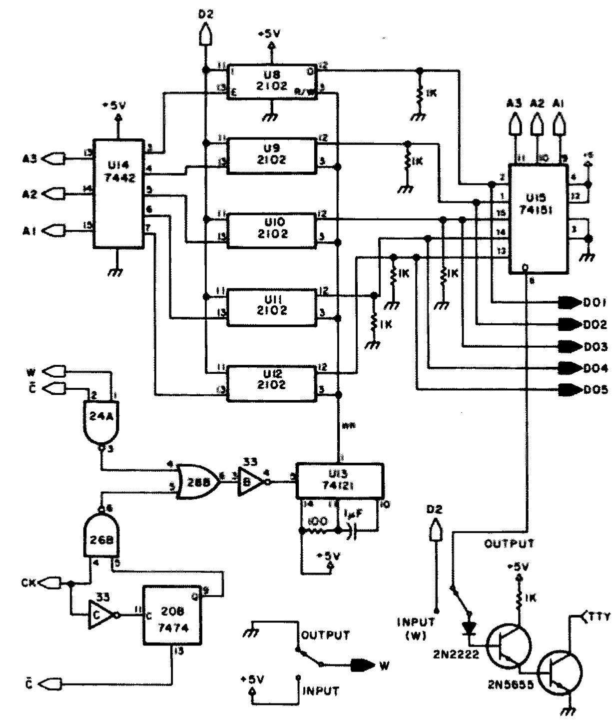

Fig. 4. Memory.

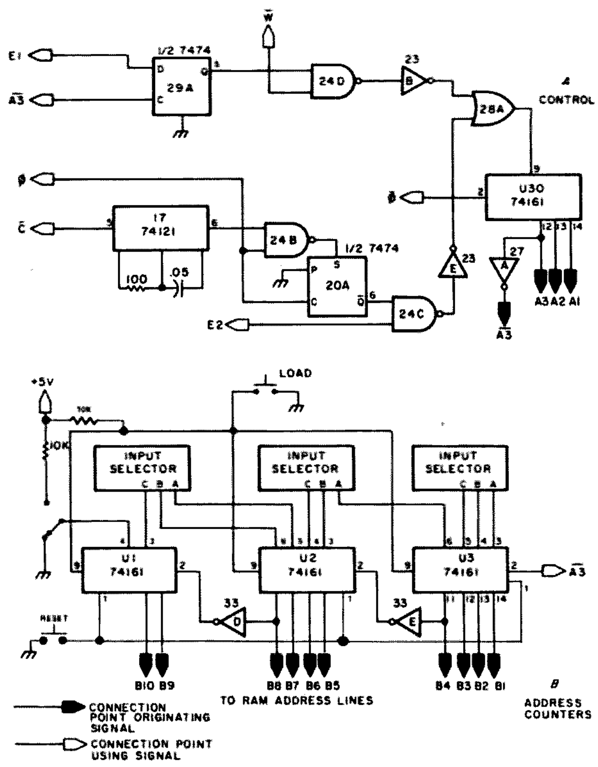

Fig. 5. a) Control. b) Address counters.

function is realized by using D2 to reset flip-flop U19B low. This allows the clock to be applied to the four bit binary counter U4 through gate U26D. After 14 clock pulses, U31B is toggled by the output of the counter through U30A, resetting flip-flop U19B and $\bar{C}$. When the clock then goes high, counter U4 and flip-flop U31B are reset by gate U26C. A duration of 14 clock pulses causes $\bar{C}$ to return high during the stop pulse.

Now, the data bits are being applied to the input of five RAMs. The timing logic must sort out the times when each RAM should individually be enabled and a write pulse applied to write the first data bit into RAM one, the second data bit into RAM two, and so on.

Counter U30 is set up to count the 7 data bits of each letter. See Fig. 5(a). When in output mode, the stop pulse is split into two 22 ms pulses instead of a 31 ms pulse. They are both high, so the end result is to increase the stop pulse at the output of the system to 44 ms. This only slightly decreases the operating speed. Ø is a second clock signal which has twice the period of the clock. As can be seen from the timing diagram, D2 can go low under two possibilities: when Ø is high (lower half of diagram) and when Ø is low (upper half of diagram). If it goes low when Ø is low, it should immediately begin clocking counter U30 with Ø. If it goes low when Ø is high, it should delay counting the first Ø transition and then start counting on the second. This is necessary to ensure that the address 010 lines up in time with data bit one, address 011 lines up with data bit two, and so on. Since a decision is necessary when D2 goes low, C is applied to a monostable U17 to produce a short sampling pulse. Gate U24B uses this pulse to sample Ø. If Ø was low at the time of the pulse, then the output of U24B remains high, and flip-flop U20A remains in a reset state (output pin 6 high). This allows E2 to be applied to the enable pin of U30 through U24C, U23E, and U28A to begin counting. E2 is similar to $\bar{C}$, except it is ANDed with a signal which is only high when the system is in RUN mode and not the STOP mode. Now, if Ø was high during that sampling pulse coming out of monostable U17, a low pulse is applied to the set input of flip-flop U20A through U24B. This sets output pin 6 low, which inhibits enabling of counter U30 until Ø comes along again and toggles the flip-flop back to its original reset state.

Referring to Fig. 4, the three bit output of counter U30 (A1, A2, A3) is applied to the decoder U14. This IC decodes the address and enables the proper RAM.

Now that each RAM is receiving an enable pulse at the proper time at its enable input, sometime during that enable pulse a write pulse must be applied to the read/write input of each RAM. Since no two RAMs are enabled simultaneously, a single write pulse can be applied to all RAMs simultaneously. This signal is developed by the remaining circuitry at the bottom of Fig. 4. W, which is only high when the system should be recording information in RAM, is ANDed with $\bar{C}$, the clock, and a modified version of the clock. The modified clock is produced by flip-flop U20B. This is to produce a write pulse command at every other clock pulse. This combination of signals singles out the times when write pulses are desired plus one extra one. The extra one occurs during the start pulse of the incoming letter and does not do anything because at that time none of the RAMs are enabled (see timing diagram). This command is applied to monostable U13, which produces a negative pulse of the proper duration to write data into the RAM. The output is applied to the read/write terminal of all five RAMs.

The system clock consists of an NE555 timer and one flip-flop, U19A. The .08 μF capacitor charges up through two 97k resistors. When pin 2 sees a voltage of 2/3 Vcc, pin 7 is internally grounded, discharging the capacitor through two 97 Ohm resistors (one different from charging path). When pin 2 gets down

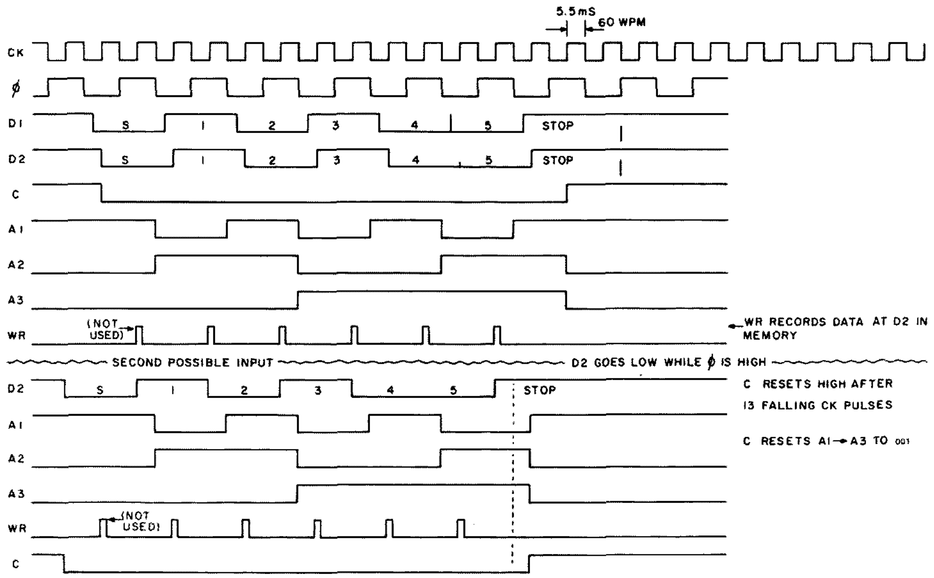

Fig. 6. Timing diagram.

to 1/3 Vcc, the ground at pin 7 is released by the 555, and the capacitor then charges back up to 2/3 Vcc and repeats. This produces a TTL-compatible square wave at pin 3, with the frequency dependent on the capacitor and resistors used (in this design it has a period of 11 milliseconds). Flip-flop U19A divides this clock signal by two to produce ∅.

There are several front panel controls in the unit. The RUN button grounds the set input of flip-flop 31A, which is normally held high by a resistor to Vcc. See Fig. 2(d). This sets output pin 9 high which is enable 1 (E1). E1 ANDed with $\overline{C}$ in U26A and U23C produces E2 mentioned earlier. $\overline{E1}$ is also produced. The flip-flop can be reset by one of two means. A signal (stp) from the stop detector applied to U28C, or the operator depressing the stop button, will cause U23D to lower the reset pin on U31A and lower E1 and E2 immediately. The load pushbutton lowers the voltage on the load input on the 3 memory address counters U1-U3. This causes the memory address (B1-B10) to immediately take on the values of the output to the diode matrix (C1-C10). This is determined by the setting of the address input rotary switches. Finally, the RESET button resets the memory address to all 0s.

If the operator pushes the stop button while the machine is right in the middle of printing a letter, it would be desirable to have the machine stop after it has completed printing of that letter. If the unit stopped in the middle, the Teletype would not print the correct letter. This is taken care of by the upper circuit in Fig. 5(a). E1 goes low when the stop command is received. E1 is applied to the data input of flip-flop U29A. The stop is not transferred to pin 5 until $\overline{A3}$ toggles the flip-flop (A3-low). This happens at the end of each character during the stop pulse. E1 is then ANDed with $\overline{W}$ (used only when printing out data, not when reading data in) and applied to the enable of counter U30 through OR gate U28A. The other circuit applied to U28A has already been described and is used to enable U30 when in the READ mode.

Now we are ready to follow the signal flow from RAM to Teletype machine when the unit is in the OUTPUT mode.

Referring to Fig. 4, when in the OUTPUT mode, the RAM enable selector U14 is receiving a free running count (A1, A2, A3) from U30, enabling each RAM in sequence with three counts between RAM five and RAM one, when none are enabled. These three counts last 22 ms each and are used to insert the start (one count) and stop (two counts) at the output. The data outputs from the five RAMs go to the inputs of an eight-bit data multiplexer U15. U30's count is also applied to U15's selector input. A3, A2, and A1 determine which of the eight inputs is applied to the single output. Since U30 supplies a free running count, U15 "scans" its eight inputs. It is set up so that when U14 enables RAM one, U15 transfers RAM one's data output to its output. During the start pulse, the input to U15 is grounded, and, during the two counts of the stop pulse, the two corresponding inputs to U15 are tied to Vcc. So U15 is a parallel to serial converter for the five data bits from RAM and also inserts the start and stop bits necessary to operate the Teletype machine.

As seen in Fig. 1, the outputs of the RAMs are also tied to the stop detector. This circuit detects when any character has all five bits low when coming out of memory (BLANK key), and, if so, sends a signal (stp) to control the stop.

As seen in Fig. 3(a), U32 is connected to the RAM's outputs (D01-D05), so that pin 11 goes high unless all inputs are low. So, if the character being sent is anything other than a blank, at least one data bit will be high. When a data bit goes high, U32 pin 11 goes high, U27 pin 8 goes low, which resets the output (pin 9) of flip-flop U29B low. U25B, U25A, U27E, U27C decode the condition when A3, A2, and A1 are all high at the same time. This is during the first half of the stop pulse. So, when the stop pulse comes along, U25C samples the condition of flip-flop U29B. If it has been reset (any character except blank), the stp signal remains unchanged (low). If, however, the flip-flop had not been reset during the data bits (BLANK key), U25C will sample the flip-flop and see it is high, and stp will go high, stopping the system. Flip-flop U29B is then set during each space count by $\overline{A3}$, A2, and U25D to have it ready for the next character.

The serial output signal from U15 is then applied to the output driver. A TTL signal must be used to open and close the selector magnets of the Teletype machine. They require about 60 mA of current. The output transistor must be able to handle a collector current of 60 mA, and the CE voltage must be able to handle 150 volts when not conducting. A 2N5655 was chosen for the output transistor. It is rated at 300 volts and over 100 mA. The TTL signal is applied (Fig. 4) through three diodes to ground. Thus 2.1 volts are required to turn on the driver transistor. 2.1 volts is a reasonable switching voltage for TTL logic. The remainder of the TTY loop can be seen in Fig. 7. The TU (terminal unit) converts the audio FSK signal from the receiver into a dc signal to switch the selector magnets. To receive, the generator can be in any mode except outputting. The reed relay senses

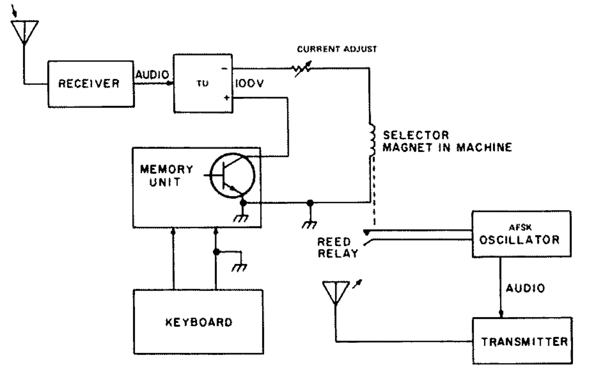

Fig. 7. This shows how the unit is connected in an amateur RTTY station.

Parts List

ICs
74161 – 4
2102 – 5
74121 – 3
7442 – 1
74151 – 1
7474 – 5
7404 – 3
7400 – 3
7432 – 2
7410 – 1
7447 – 3
NE555 – 1

Diodes
1N914 – 37

Resistors (all ¼ Watt)
97k – 3
10k – 4
1k – 16
100 – 3
330 – 22

Capacitors
.05 uF – 2
.03 uF – 1
1 uF – 1

Transistors
2N2222 – 1
2N5655 – 1

Power Supply
transformer 6.3 to 8 V ac 2 A – 1
bridge rectifier 50 V 2 A – 1
filter capacitor 10,000 uF – 1
noise suppression
capacitors (distributed on
+5 V line) .01 uF – 10

Controls
SPST toggle – 1
SPDT toggle – 1
SPST push NO – 3

Miscellaneous
LED seven segment displays
common anode – 3
LED – 1
breadboard
hardware
SP8T rotary switch – 3

changes in TTY loop current from memory or keyboard and drives an AFSK (audio frequency shift keyer) oscillator, which is fed into the transmitter.

The RTTY station can do any of the following functions:

1. Put received message in memory and print.
2. Put message from keyboard into memory and print.
3. Transmit from keyboard and print.
4. Transmit from memory and print.
5. Send received message to printer only.

If it is desired to transmit at 100 wpm, the .03 uF capacitor in the clock circuit is switched out, leaving .05 uF. The speed of the generator must match the running speed of the machine, but you can type into memory as slowly as you want.

I recommend breadboarding of some type over PC boards because of the wiring complexity.

I have not included a power supply diagram because many have appeared in previous articles. Plus 5 V dc regulated is required, and an LM309 on a heat sink will do the job well. The output consists of an NPN transistor with emitter to ground, so it can be inserted directly into a 60 mA TTY loop. Also, provision is made for local copy on the printer (or video display) of data as it is typed into memory.

Good luck, and I would appreciate any comments from builders. ■

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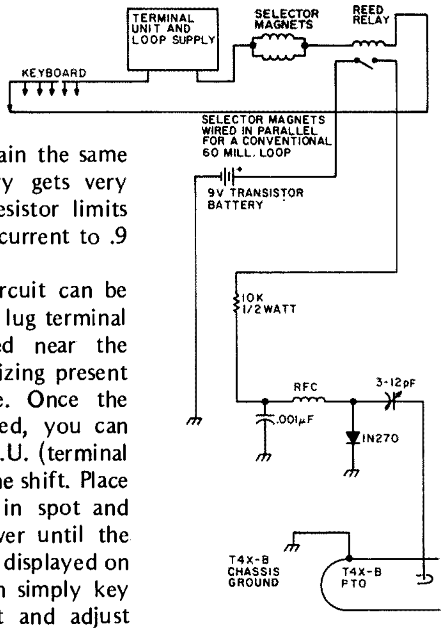
FSK for the Drake -- easy



This circuit is actually a saturated diode keyer right out of the handbook, but instead of using an FSK driver to supply the forward bias needed for the diode, I used a 9 volt transistor battery, which is supplying .9 milliampere to the diode. Since the diode is non-linear, the current does not change in proportion to the voltage across it. At that low current, the battery will last a very long time, and even when it does start to get weak, the current will remain the same until the battery gets very low. The 10k resistor limits the total circuit current to .9 mil.

The whole circuit can be mounted on a 3 lug terminal strip and placed near the T-4XB PTO utilizing present chassis hardware. Once the circuit is installed, you can use your own T.U. (terminal unit) to adjust the shift. Place the transmitter in spot and tune your receiver until the space is properly displayed on your scope, then simply key the shift circuit and adjust the 3-12 pF variable to obtain the proper shift by watching the mark display on your scope.

The reed is shown open, indicating no loop current. When the loop is on, the reed contacts are closed, completing the shift circuit. In this condition, with the keyboard closed, the vfo is downshifted 850 Hz to indicate a mark; when the keyboard is open, the vfo upshifts to indicate a space. To reverse, just wire the reed so its contacts are open when the loop is on. ■

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Baudot to ASCII Converter

-- use it for OSCAR RTTY

Among the current crop of Teletype machines that are being retired from commercial service, there are quite a few ASCII machines, such as Models 33 and 35. If you are just getting into RTTY, or you are looking for more equipment, there are a number of reasons to consider building your station around an ASCII machine. First of all, the newest and most modern machines are the ASCII machines. Indications are that ASCII will be allowed on the air sometime in the near future; in fact, it is legal in Canada right now. The keyboard is very similar to a standard typewriter, which is an advantage if you already know how to type. It is also a good place to start if you don't. Finally, if you eventually get interested in microprocessers, you can use the TTY machine as your terminal.

In order to communicate in Baudot code on the amateur bands, you will need a code converter which converts Baudot to ASCII, when you are receiving, and ASCII to Baudot, when you transmit. This article describes a two-way code converter, built on a single PC board, which will allow you to receive and transmit at all amateur and commercial speeds. A number of these units have been built by amateurs in the Winnipeg area and are in use on the HF and VHF bands. During the design and construction of the converter, I learned about some aspects of digital logic design that do not seem to be very widely known by amateurs. I hope that I can pass some of this information to the reader. Most of the discussion of the operation of the converter will be in terms of logical functions, rather than in terms of currents and voltages, because this is the way I visualize things.

Principles of Code Conversion

The ASCII code is comprised of seven information bits, so there are 128 distinct combinations, or ASCII characters. An eighth bit, the parity bit, is also transmitted, but is generally ignored at the receiving end. The eight bits are framed by start and stop bits during transmission and reception.

The Baudot code has only five information bits, so there are only 32 possible combinations. In order to accommodate all the required letters, numbers, and punctuation marks, two of the Baudot characters are used to select alternate character sets in the printer. These are called the LTRS and FIGS shift characters. Thus the interpretation of Baudot code depends upon which shift character was previously transmitted. The five bits of Baudot are also framed with start and stop bits for transmission.

There is no simple relationship between the bit pattern of a Baudot character and the pattern of the corresponding character in ASCII. This means that there is no way to use a few logic gates to translate Baudot to ASCII. What is required is a translation table. If such a table is coded into a read only memory, all you have to do is to present the five Baudot bits as the address input to the ROM, and the seven ASCII bits for the corresponding character will appear at the data outputs. (See Fig. 1.) Because there are two possible interpretations of the Baudot character, a flip-flop is used to remember the shift status, and the output of the flip-flop is used as a sixth address bit. When this bit is high, figures are generated, and, when it is low, letters are

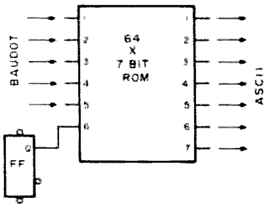


Fig. 1. Baudot to ASCII conversion.

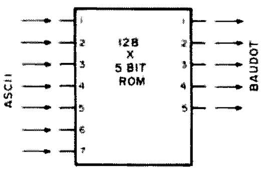


Fig. 2. ASCII to Baudot conversion.

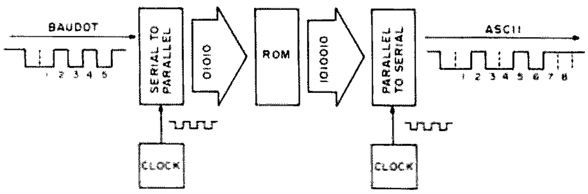


Fig. 3. Conversion of serial TTY data.

generated. The complete conversion table requires 64 seven-bit words in the memory.

Conversion from ASCII to Baudot can be done with a ROM having seven address inputs and five data outputs. (See Fig. 2.) It is also possible to use a smaller ROM and do some of the conversion with external logic, but this approach generally results in a more complex circuit. Again, a flip-flop is used to remember the current shift status. ASCII to Baudot conversion is complicated by the requirement that the FIGS or LTRS characters must be inserted into the data stream, so that the receiving station interprets the data correctly. Whenever the incoming ASCII changes from letters to figures, a FIGS character must be generated, and when the ASCII returns to letters, a LTRS character must be generated.

So far I have been discussing the conversion of parallel data from one code to another. This can be done within a few microseconds, because all the incoming data bits are present simultaneously. However, RTTY signals are transmitted in serial form with start and stop pulses. This means that a serial to parallel conversion must precede the code conversion, and a parallel to serial conversion must follow it. Fig. 3 shows the letter R in Baudot code being converted to serial ASCII. The serial input is controlled by a clock running at a fixed frequency determined by the baud rate of the incoming signal. For example, Baudot code having a maximum speed of 60 wpm has a baud rate of 45.45. Likewise, the serial output is controlled by another fixed frequency clock. In the case of ASCII with a maximum speed of 100 wpm, the baud rate is 110. Thus, a speed conversion is obtained, as well as the code conversion. In the case illustrated, if the Baudot is arriving at maximum speed, the ASCII will be leaving the output side at about half its maximum speed. There will be pauses between the characters, and, during the pauses, the output line will remain in a marking state. This is a result of the upward conversion of speed.

When a downward speed conversion is required (for example, when converting from 100 wpm ASCII to 60 wpm Baudot), the average speed of the incoming data must be restricted to 60 wpm. Otherwise a condition known as overrun will occur, and some characters will be lost. This is no problem when I am typing on my 33ASR because I can only type at 10 wpm or so. However, in the situation when a steady stream of data is arriving at 100 wpm, there is no way on earth to convert it and make it print on a 60 wpm machine. You might think that a memory that would store the excess characters would solve the problem, but eventually the memory would fill up, and the overrun would still occur. The only solution is to limit the speed of the incoming data to a level that the converter can handle.

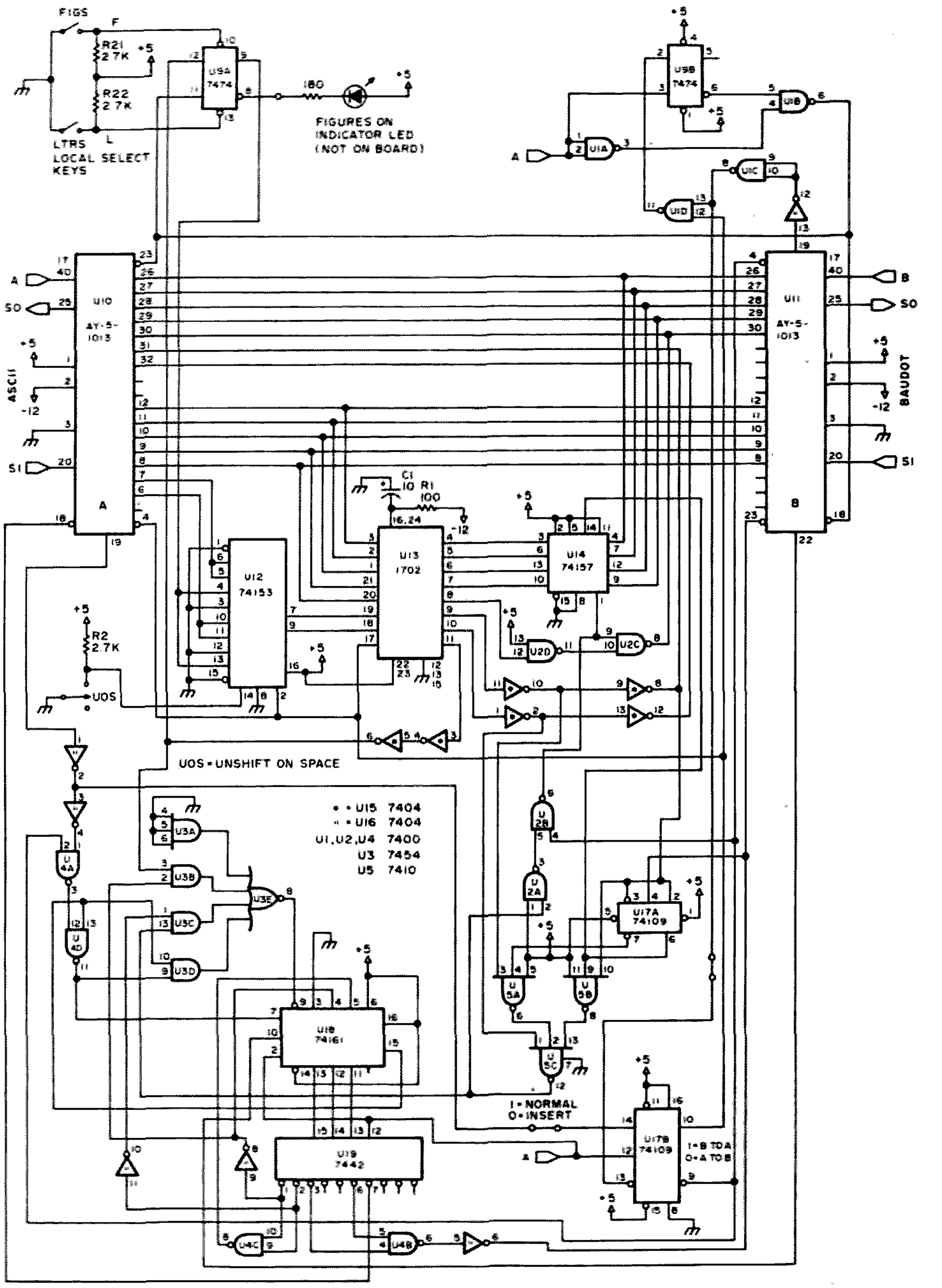


Fig. 4(a). Two-way code converter. Baudot to ASCII and ASCII to Baudot with integral Baudot speed conversion. Main circuit. Design: main circuit — Gary Mills VE4CM; interface — John Delaive VE4YD; board — Bert Franz VE4BF; design box and drawings — Fritz H. Hellmuth VE4XD.

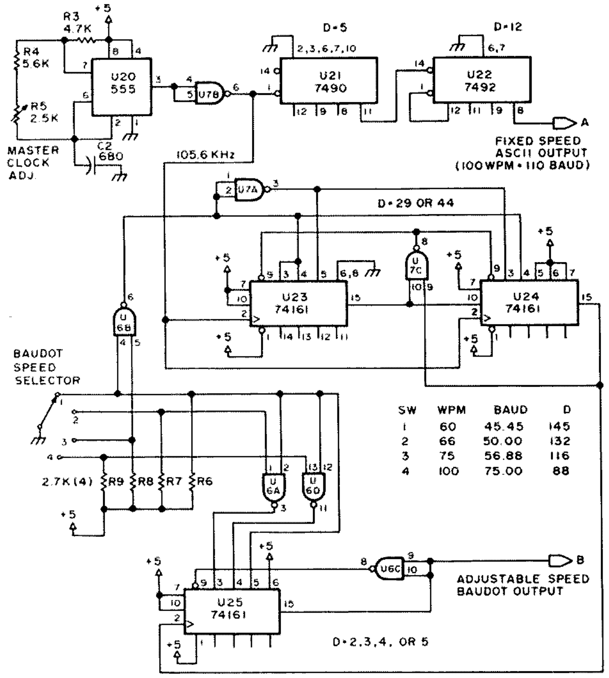


Fig. 4(b). ASCII and Baudot clock.

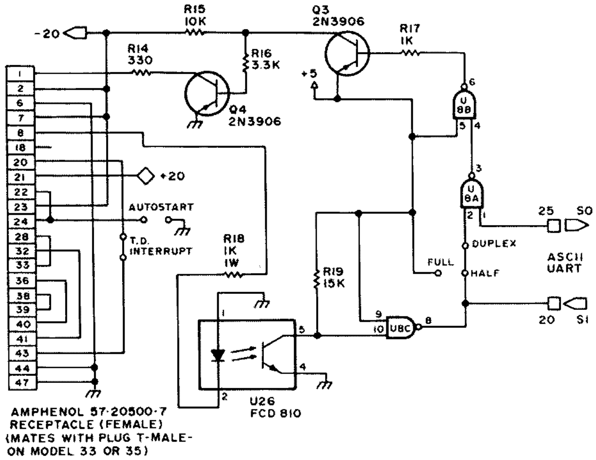


Fig. 5. Teletype Model 33 or 35 interface.

Circuit Description

The translation tables for both conversions are contained in a single 1702 PROM. This device has a capacity of 256 eight-bit words, giving me lots of space to play with. There are eight address inputs and eight data outputs. The way I have partitioned the memory may be seen in Table 1. The desired portion of the memory is selected by the high-order address bits.

For example, when bit 8 is high, the table to convert Baudot to ASCII is selected. The five low-order address bits are the incoming character to be translated. Bits 6 and 7 are used to select portions of the table that convert Baudot letters or figures, as well as a special portion that is designed to provide automatic unshift on space. When address bit 8 is low, the ASCII to Baudot conversion is selected. The seven low-order address bits are the incoming ASCII character. Bits 6 and 7 are changed from data to control information by a 74153 multiplexer, which behaves like a two-pole 4-position switch.

The data contained in the storage locations of the memory consists of a character in the low-order bits and control flags in the high-order bits. In this manner, it is never necessary to decode a character to determine what to do with it. For the Baudot to ASCII conversion, seven data bits are occupied by the ASCII character. Bit 8 contains the current shift status. For the ASCII to Baudot conversion, more control flags are required, but, fortunately, the Baudot character only occupies five bits. Bit 6 is the Baudot shift required for that character. Bit 7 is a flag that, when on, says to inhibit insertion of the shift character. It is used for characters that may be transmitted in any shift. Bit 8 is another flag which causes the entire character to be ignored. It is used for ASCII codes that have no Baudot equivalent.

The insertion of LTRS and FIGS characters in a stream of Baudot is done by a five-bit multiplexer, which is constructed of a 74157 and a pair of NAND gates. A single control line is used to switch from the output of the PROM to the shift character, which is hard-wired except for the middle bit. This bit is obtained from the shift status kept in the 74109 flip-flop. The decision to insert a shift character is produced by a 7410 triple NAND gate, which is connected in an exclusive OR configuration. This device compares the shift status in the flip-flop to the shift information coming from data bit 6 of the PROM.

The serial to parallel and parallel to serial conversions are performed by a pair of AY5-1013 UARTs. Each UART contains a serial receiver and a serial transmitter. The two sections are independent, except for some control information which defines the structure of the serial data. Besides the data inputs and outputs, each section has status lines that are used for communication between the UART and the control circuits. When the UART receiver has a character ready, it sets the DAV (data available) line high. The external circuit should process the character and then indicate that it is no longer needed by strobing the RDAV (reset data available) line. The transmitter section has a TBMT (transmitter buffer empty) line, which goes high when the buffer is empty. The external circuit should wait until TBMT is high and then may load a character into the transmitter by strobing the DS (data strobe) line.

The portions of the circuit I have described so far are all concerned with operations on five- or seven-bit parallel characters. The PROM, multiplexers, and UARTs run under the control of three other portions of the circuit, which I am about to describe. First, there is the ASCII sequence generator, which consists of one flip-flop and two NAND gates. When the DAV from the Baudot UART goes high, the sequencer waits for 1/2 a clock and then puts out a negative pulse for 1/2 a clock. This pulse loads a character into the ASCII UART, clears the data available flag in the Baudot UART, and loads the shift flip-flop.

The Baudot sequence generator consists of a 74161 binary counter, a 7442 decoder, a 7454 AND-OR-INVERT gate and a few NAND gates and inverters. The sequence is initiated when the DAV from the ASCII UART goes high. Table 2 shows the steps that the circuit goes through. The output signals are negative pulses that are used to load characters into the Baudot UART, load the shift flip-flop, and clear the data available flag in the ASCII UART. The 74161 is connected as a 3-bit counter, so it has eight states. Its output is decoded by the 7442. The two count enable inputs of the counter are used to hold the counter in a given state when necessary. The AOI gate controls parallel loading of data into the counter, permitting jumps to

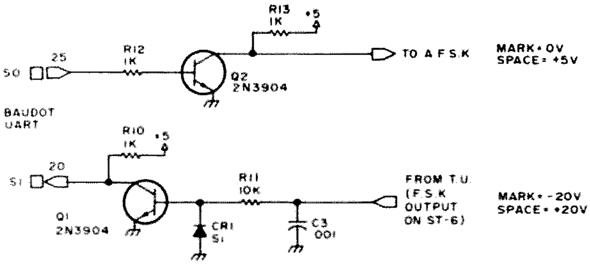


Fig. 6. Baudot interface.

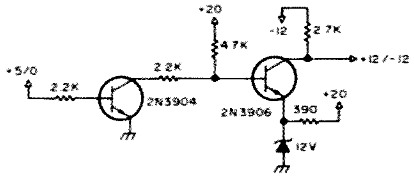


Fig. 7. Driver for FSK diode.

new states.

Finally, there is the mode switching circuit, consisting of one JK flip-flop and a couple of NAND gates. When the flip-flop is in the high state, the Baudot to ASCII conversion is selected by enabling the Baudot UART, addressing the upper half of the PROM, and gating the DAV line to the ASCII sequencer. In a similar manner, the ASCII to Baudot conversion is selected when the flip-flop is in the low state. Input to the mode switching circuit comes from the DAV lines of the two UARTs. With no inputs, the flip-flop toggles. When an input signal appears, the flip-flop holds in the required state until the conversion is completed and the DAV is cleared. It then switches to the other state if the DAV from the other UART has come on, or it just toggles if there is no input. Note that there is plenty of time to interlace the conversions this way because the control circuits are clocked at 16 times the baud rate.

The clock generator consists of a master oscillator and two divider chains. The 555 is connected as a free-running oscillator at .105.6 kHz. This frequency is divided by 60 to produce the ASCII clock. The Baudot divider chain consists of three 74161 binary counters connected as programmable dividers. The first two divide by 29 or 44, and the third divides by 2, 3, 4 or 5 to produce the Baudot clocks for the four speeds ranging from 60 to 100 words per minute. All clock outputs are accurate to better than 0.2%, once the master clock is set. It would be possible to economize there by using separate 555 oscillators for ASCII and for Baudot, particularly if only one Baudot speed were desired.

Design Criteria

In designing the code converter, I generally followed the recommendations of the Fairchild TTL handbook.[1] You will notice that there are no monostable multivibrators or RC coupling elements in the circuit. This allows me to retain the inherent noise immunity of TTL logic. Also, I have used synchronous edge-triggered flip-flops and counters in the control circuitry. These devices are only sensitive to input conditions during the low to high transition of the clock. The use of synchronous logic makes the design very predictable and free of glitches and unexpected states. I also paid attention to the fan-out rating of the devices. Most TTL-compatible MOS devices such as the UARTs and the PROM are able to drive only one standard TTL load. Where more drive was required, I used gates or inverters as buffers. Another solution would be to drive only low-power Schottky TTL from the MOS. In this case, up to four LSTTL inputs could be driven.

Address		Data			
Hex	Binary	Hex	Binary	Character	Purpose
00	00000000	40	01000000	NUL	
01	00000001	FF	11111111		ASCII to Baudot
...					
1B	00011011	5B	01011011	ESC	Cntl and Figs.
...					
30	00110000	36	00110110	0	
31	00110001	37	00110111	1	
3F	00111111	39	00111001	?	
40	01000000	FF	11111111		
41	01000001	03	00000011	A	ASCII to Baudot
42	01000010	19	00011001	B	
...					Letters
61	01100001	03	00000011	a	
62	01100010	19	00011001	b	
...					
7F	01111111	5F	01011111	RO	
80	10000000	00	00000000	BLNK	
81	10000001	45	01000101	E	Baudot to ASCII
...					
9B	10011011	82	10000010	FIGS	Unshifted
9C	10011100	4D	01001101	M	
9D	10011101	58	01011000	X	
9E	10011110	56	01010110	V	
9F	10011111	7F	01111111	LTRS	
A0	10100000	80	10000000	BLNK	
A1	10100001	B3	10110011	3	Baudot to ASCII
...					
BE	10111110	BB	10111011	;	Shifted
BF	10111111	7F	01111111	LTRS	
C0	11000000	80	10000000	BLNK	
...					Auto unshift
DF	11011111	7F	01111111	LTRS	on space
E0	11100000	FF	11111111		
...					Unused
FF	11111111	FF	11111111		

Table 1. Translation tables contained in the PROM. Complete listings of the tables may be obtained from the author.

Interfacing

The logic levels at the serial input and output lines of the two UARTs are TTL-compatible – that is, Mark = 1 = +5 V and Space = 0 = 0 V. These lines may be connected directly to any other TTL logic, but, usually, some interfacing is required for equipment such as a terminal unit or a TTY machine. Considering the ASCII end first, the most common requirement would be connection to a 20 mA current loop. If you are lucky enough to have a Model 33 or 35 Teletype that was formerly used for TWX service (there will be a telephone dial on the right-hand side), the circuit of Fig. 5 is for you. You will find two 50-pin micro ribbon connectors, dangling underneath the machine, that formerly connected to the modem (Bell 101C Dataset). No

State	Function
0	If bit 8 = 1, jump to 6
1	If bit 7 = 1 or shift not changed, jump to 4
2	Strobe DS
3	Wait for TBMT
4	Wait for TBMT
5	Strobe DS
6	Strobe RDAV
7	Wait for TBMT, jump to 0

Table 2. Steps of the ASCII to Baudot sequence.

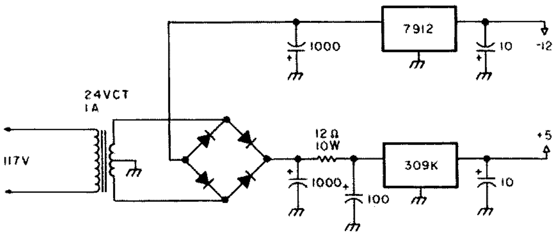


Fig. 8. Power supply.

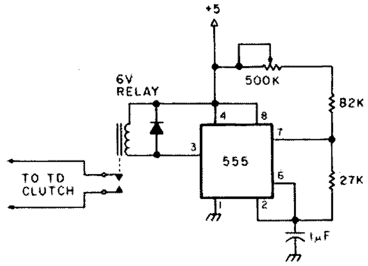


Fig. 9. Tape reader control.

modifications to the machine are required. Just obtain a mating female connector, wire it to the interface and plug it in. You will also require a source of plus and minus 20 volts at 30 mA or so. A Model 33 does not use the +20, so this may be omitted. The connections to pins 1 and 2 are the printer loop, and the connections to pins 7 and 8 are the keyboard loop. If you have a Model 33 without all the telephone stuff, just forget about the connector and wire these lines directly to the machine.

At the Baudot end of the converter, the usual requirements will be connections to a terminal unit (demodulator) and to an AFSK oscillator (modulator). Interfaces for the popular ST-6 and AK-1 are shown in Fig. 6. The ST-6 interface is very tolerant of input levels and may be used with many other sources of Baudot. The AK-1 interface may be modified to an open collector stage or to a higher voltage stage for use with other modulators. If you need both positive and negative levels to drive an FSK diode, use the interface shown in Fig. 7.

Power Supply

The code converter requires a regulated +5.0 volt supply at about 600 mA and a regulated -12 volt supply at about 50 mA. In addition, voltages of -20 and +20 at about 30 mA may be required for the interfaces. Regulation is not necessary here. One design of a suitable power supply is given in Fig. 8. Many other designs would work equally well.

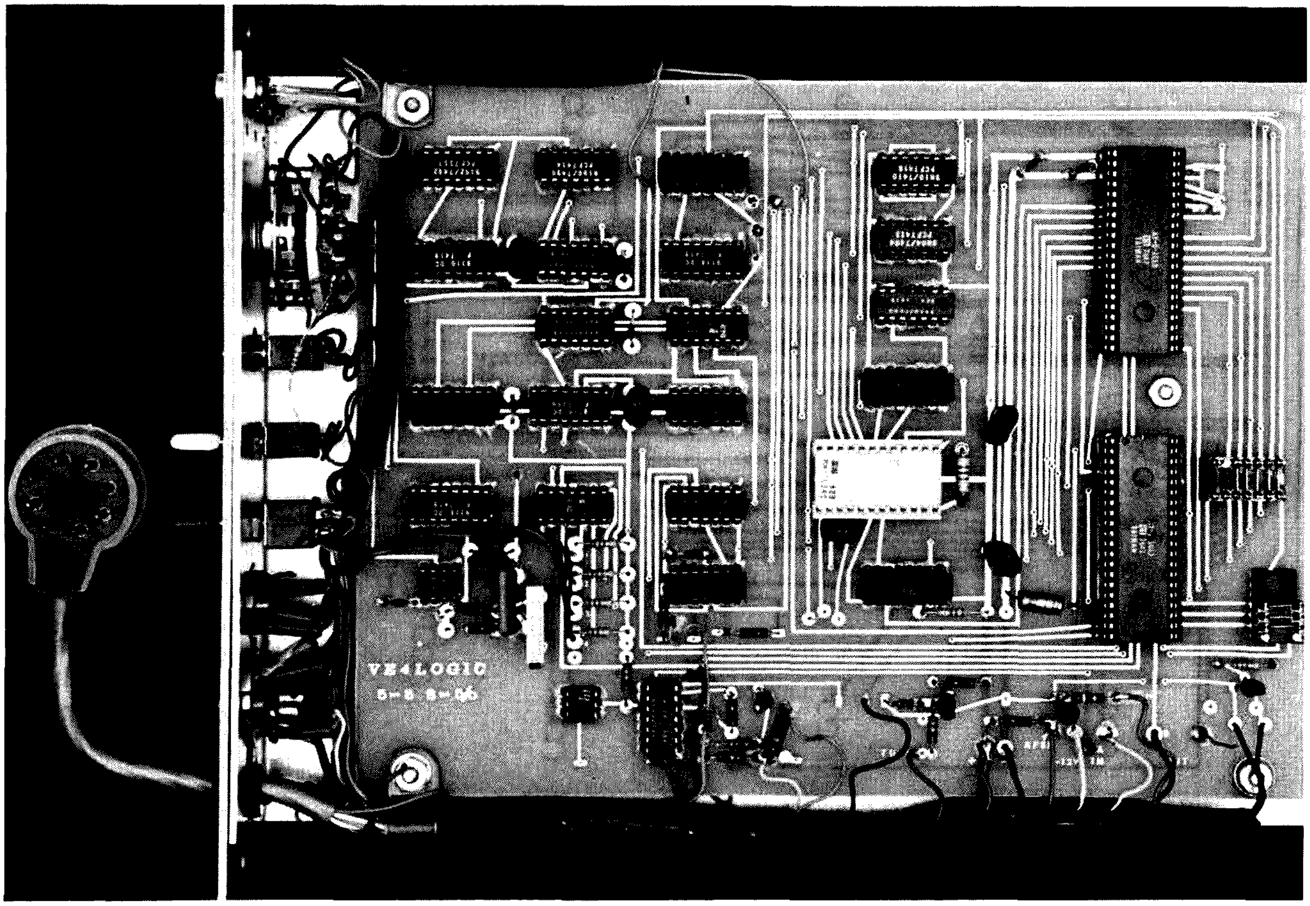
Tape Controller

When I run a tape on my ASR Teletype, I get overruns in the code converter resulting in missing characters in the 60 wpm Baudot output. A simple solution to this problem is shown in Fig. 9. The 555 is connected as a free-running oscillator, with the frequency adjustable from 2 to 10 Hz. The relay

Parts List

C1	10 uF, 25 V electrolytic capacitor
C2	680 pF mica
C3	.001, 50 V ceramic disc
CX1-CX11	.05-.1, 25 V disc ceramic despiking capacitors
CR1	1N914 or similar silicon diode
Q1, Q2,	2N3904 or similar NPN transistor
Q3, Q4	2N3906 or similar PNP transistor
R1	100 Ohm ½ Watt resistor
R2, 6, 7, 9, 21, 22	2.7k Ohm ½ W (1.5-6.8k Ohm acceptable) pullup resistors
R3	4.7k Ohm ½ W
R4	5.6k Ohm ½ W
R5	2.5k Ohm potentiometer, printed circuit style (multi-turn preferred) Master Clock Adj.
R10, 12, 13, 17	1k Ohm ½ W
R11, 15	10k Ohm ½ W
R14	330 Ohm ½ W
R16	3.3k Ohm ½ W
R18	1k Ohm 1 Watt
R19	15k Ohm ½ W
U1, 2, 4, 6, 7, 8	7400 TTL integrated circuit DIP chip
U3	7454
U5	7410
U9	7474
U10, 11	AY5-1013 General Instruments UART
U12	74153
U13	1702 UV erasable PROM
U14	74157
U15, 16	7404
U17	74109
U18, 23, 24, 25	74161
U19	7442
U20	555 timer
U21	7490
U22	7492
U26	FCD 810 optocoupler, Fairchild

A semi-kit, consisting of a double-sided PC board with plated-through holes, a 1702 EPROM programmed and tested, sockets for U10, U11, U13 and complete assembly instructions, is available at a cost of $62.50 from: VE4 LOGIC, 76 St. Clair Blvd., Winnipeg, Manitoba, Canada R2C 0V2.



contacts close once during each oscillator cycle, causing the tape reader (TD) to transmit one character. With this circuit, you can adjust the speed of the tape to a speed that the converter can accept, and everything runs just fine with no missing characters. You can cut a tape from a received Baudot signal and transmit it later, or make a tape locally from the ASCII keyboard and transmit it in Baudot code.

One-way Conversion

The first code converter I built is shown in Fig. 10. It has two UARTs, the same PROM, one 7404 and one 7474. I used separate 555 clocks running at 727 Hz and 1760 Hz. If you want to make a gradual start into code conversion, or if you just want to listen in on amateur and commercial activity, then this circuit is ideal. If you later decide you want to transmit as well, the circuit could easily be expanded to the two-way version.

Construction

I assembled the prototype of the code converter on an IC breadboard and had no particular problems. Everything worked just the way the circuit logic and manufacturer's data sheets predicted it would, the moment I plugged it into the breadboard. A group of local amateurs, VE4BF, VE4CM, VE4XD and VE4YD, was formed to design and produce PC boards for the converter. Because of the circuit complexity, we decided upon a double-sided board with plated-through holes. Several copies have now been built using this board.[2]

If you build the circuit (or part of it) yourself, using your own board or hand-wiring or wrapping, there is nothing critical about the layout. Just follow normal TTL construction practices, keep the interconnections shorter than 18 inches, and bypass the supply buses occasionally. The only adjustment required is the clock trimmer. This can be set with a counter if it is available. If not, do it on received signals by determining the range over which error-free copy is obtained and then setting the trimmer to the midpoint of the range. I can give very few suggestions on troubleshooting, other than to try to localize the trouble to a small portion of the circuit. If you use only first quality ICs, the circuit should work the first time you try it, and no debugging will be required. ■

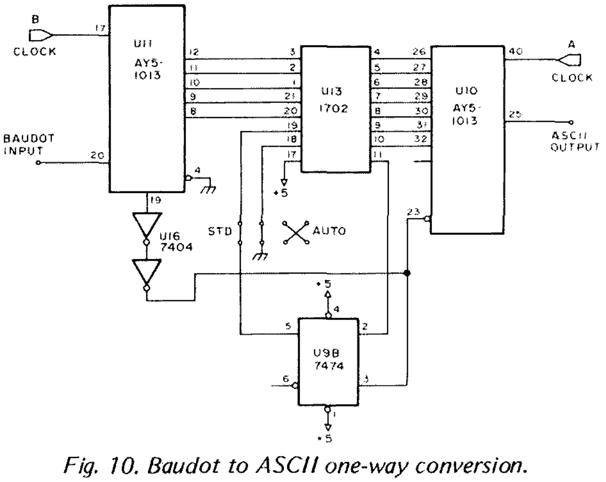


Fig. 10. Baudot to ASCII one-way conversion.

References

1. *The TTL Applications Handbook*, Fairchild Semiconductor, Mountain View CA.
2. Boards, programmed PROMs and some other parts are available from: VE4 LOGIC, 76 St. Claire Blvd., Winnipeg, Manitoba, Canada R2C 0V2.

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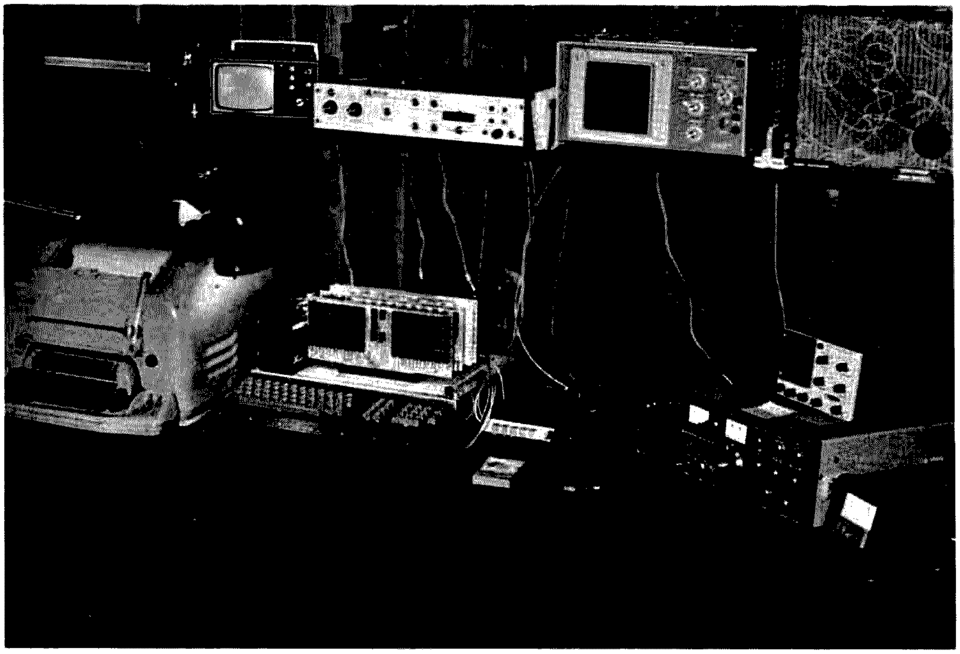
Digital Group RTTY Micro

-- a natural team

Because I was interested in electronics, including amateur radio, I decided to get in on this new thing called microprocessing. I have worked with digital electronics before and have put together some successful hardware projects. I quickly found that there were a few small computer systems available, so some wise decision-making was necessary.

I sent away for literature and paid close attention to magazine advertising. Then, things were pretty well summed up for me at the Spring, 1976, Rochester, N.Y. Hamfest, where they had a computer seminar. Pior to that I seemed to have a choice between MITS, IMSAI, and HAL. But now there was a new one on the scene – the Digital Group. I was planning to get the HAL 8080, but, when I found out that the Digital Group System could actually do something, and that software was only $5 per cassette, I was *sold*. Further discussion with the fellows at the seminar confirmed that the Digital Group was for me. I knew nothing about software or programming, so the best bet had to be a company that would get me started without overcharging.



The author's shack, showing his Digital Group 8080A-4BD system with 10K RAM memory, 4 input/out ports x 8 bits, and 16 line x 32 letter character generator; surplus keyboard; Kleinschmidt 60 wpm Baudot machine; Ampex Micro 9A cassette recorder; Icom IC-22; and Kenwood TS-520.

I took delivery of my system on the July 4th weekend of 1976. I managed to complete the unit inside 3 days – it didn't work. After searching under a magnifying glass and bright light, I found and removed the solder bridge that could have done me in. Sure enough, there it was, telling me via my TV monitor to "Read 8080 Initialize Cassette." I was off in another world, making it play the Star Spangled Banner while printing the flag on the TV. It would also play a number guessing game, send Morse code from the keyboard, and receive RTTY on the TV.

Since I had also ordered an additional 8K of memory with the system, I quickly began construction of the extra memory board. This board, along with the 2K of memory on the processor board, is what makes it a 10K system. Well, this time things didn't go so well. Nothing really seemed to work, including the Tiny BASIC tape and the Ham-1 tape. After some phone conversation with Digital Group and a check of my tapes by the software people (Dianne Howerton is very patient and

understanding), I finally paid attention to the construction instructions. Back *again* to the bright light and the magnifying glass. Sure enough, just as written in the instructions. I had forgotten to solder two socket pins. Two in over a thousand isn't bad, is it? Anyway, the BASIC worked, and the Ham-1 tape worked.

Being inquisitive, I began to "dump storage" and look at what was going on in there. After reading and more reading, I finally was able to start some programs of my own. First I ran a few simple things, and then I began block moving data, studying subroutines, and learning how to change memory addresses. Little by little I worked on making modifications. Before long I was surprised at how many octal instructions I could remember — load, jump, call, return, compare and jump based on flag sets, and so on, throughout the Intel 8080 program card. I found that I could remember octal more easily than hex, and, since the Digital Group 8080 operating system was in octal, I adopted it.

I found that the Digital Group Ham-1 RTTY transmit was not really doing as much as I wanted it to do, and, in fact, the Digital Group instructions encourage making modifications and improvements. One of the more aggravating problems was missing letters when typing too fast, especially during automatic figures-letters shifting, and another problem was no carriage return or line feed. The reed

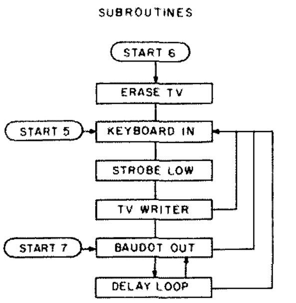


Fig. 1.

switch ASCII keyboard would barrel right along when 60 wpm was the limit. Of course, a mechanical machine like my Klienschmidt would mechanically prevent typing too fast. For a while I was using Tiny BASIC Baudot for amateur RTTY, but it kept giving out automatic error messages. It was for BASIC, not ham use.

At any rate, I wanted to have a RTTY transmit program which would have automatic carriage return after 70 letters, and, after accomplishing that, I went further to add an additional carriage return after 64 letters and a space. I then made a program to act just like punching paper tape, where letters entered at the keyboard were shuffled off to a blank memory area and stored. Executing the read program would then go back to the start and read the memory whenever called and as many times as I wanted.

Next, I put in a program modification to back step (decrement) the pointer, and back spacing for error correction was born. I even made a quick little program to send K2AOU in Morse code on the output and "Here is K2AOU" in RTTY — all at the punch of a number at the keyboard. I have future plans for it to turn the transmitter on and off. You had better not let it control your frequency, though; I heard of one fellow working WWV that way!

My ultimate goal was to build a buffer system. I had a discussion with an associate who had done some FORTRAN and general programming, and I learned about rotary pointers and fullness registers. I also dismantled the CW transmit part of the Ham-1, which works great as is but is scattered throughout memory. From it I learned more about pointers and timing loops, and I cleaned up the CW program's structuring within memory. Mind you, I did all this *before* Digital Group came out with their Dissassembler.

I felt that the operator with only 2K of memory needed a fair deal, so I began work on a 2K FIFO (first in first out) buffer, as outlined here. It is a program which can be useful to any RTTY enthusiast, essentially a sidekick to the amateur RTTY station. Actually it takes only 500 bytes of instruction space and 256 bytes of scratchpad memory. The machine language is for the Intel 8080A. Those of you who have 8080 systems from other manufacturers can probably adapt the program. Be careful to observe Digital Group subroutines for TV output, delay loops, and keyboard input. If you have more memory, of course, you can add RTTY receive, additional buffers, CW ID, here is key, etc.

The Digital Group Operating System is based on the following routines:

1. READ in a new program from audio cassette to memory.
2. WRITE out a program from memory to the audio cassette record input.
3. OCTAL STORAGE DUMP of sequential memory locations.
4. KEYBOARD PROGRAM memory by entering each byte in octal numbers.

5.6.7.8.9.0. User assigned "go to" or "execute" at specified addresses.

How It Works

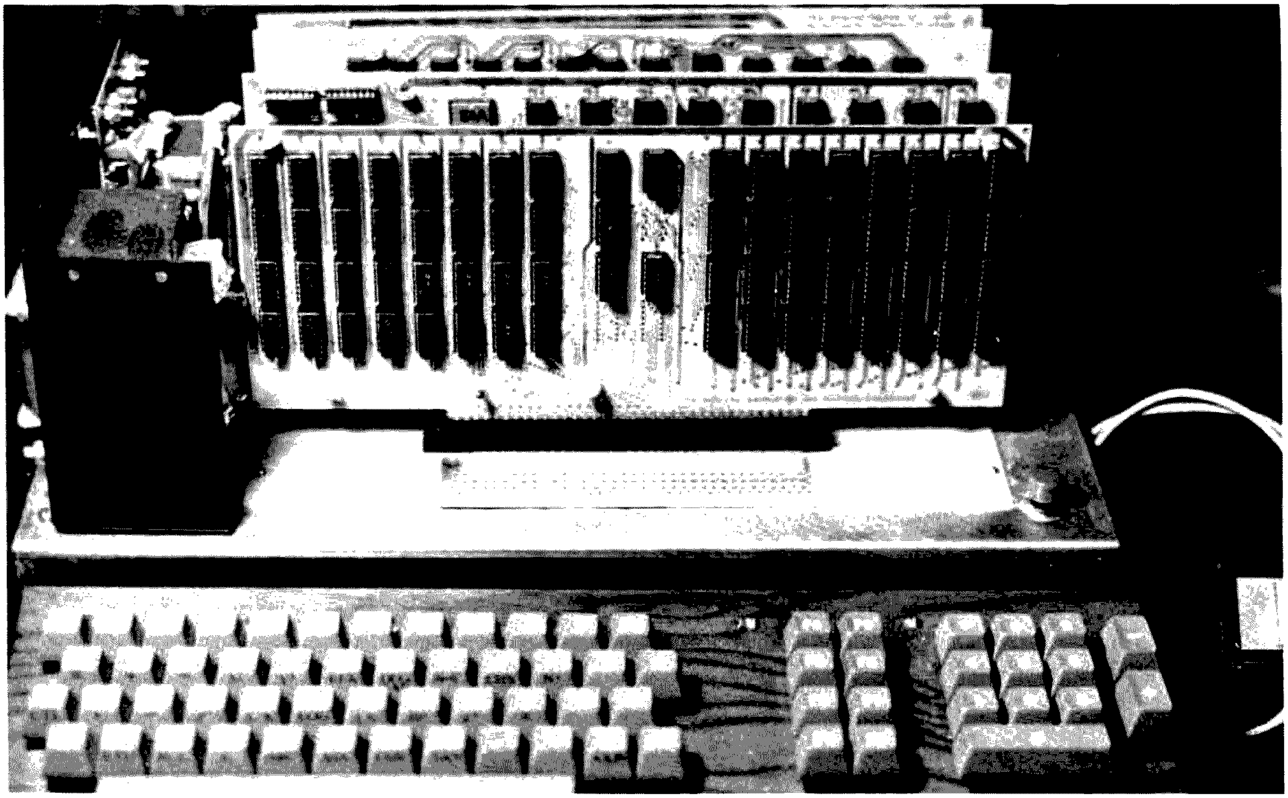
It takes time to output Baudot RTTY, time for the start pulse, time for the five bits and time for the stop pulse. During this time the computer is kept busy, continuously sampling the keyboard input for action. If a key is pressed, it holds the letter, waits for the keyboard strobe to go low again (one letter per keystroke please), and then sweeps the letter off to the proper storage point in the buffer. Write storage point, read storage point, and storage fullness are all kept track of by special pointer bytes, including the location of the last carriage return, whether manual or automatic. This software is set up for 60 wpm output. If you wish to experiment with other speeds, there are three memory locations to work with — 007 304 is 015 for 60 wpm, 010 for 100 wpm. 007 154 is 064 for bit length, and 007 172 is 112 for the stop pulse. This can also be worked on if you have other than a 2 MHz clock speed.

Output Connections

The system output for the

Memory Blocks:	
000 000 TO 000 377	Digital Group PROM
001 000 TO 001 277	Digital Group Operation System
001 300 TO 001 316	Start #5 Buffer Preload
001 317 TO 005 055	Digital Group Operating System
005 056 TO 005 075	Part of Buffer Preload
005 076 TO 005 123	Operating System
005 124 TO 005 136	Part of Buffer Preload
005 140 TO 005 247	Keyboard Subroutine
005 250 TO 005 274	Delay Loop Subroutine
005 277 TO 005 377	Operation Monitor Title Page
006 000 TO 006 377	Buffer Scratchpad (initialize full of 240s)
007 000 TO 007 277	Baudot Output Subroutine
007 300 TO 007 362	Start #6 Buffer load and read
007 363 TO 007 377	Start #7 Buffer Read Only

Table 1. ASCII to Baudot buffer system (FIFO). As you can see, no space is wasted to put this in 2K of memory. For more simplicity, one could eliminate the buffer preload and the buffer read only routines, but these are quite handy. An address is specified by page number and byte number, i.e., 007 000 in octal. When giving the address to the computer, always give it low first and then the high.
303
100 Means jump to page 7, byte 100.
007



serial Baudot is port 002 lsb. I connect from this output through a 1000 Ohm safety resistor to a HAL ST-6 terminal unit. Inside the HAL there is an extra switch position for the optional 425 Hz discriminator. You can add a connector on the cabinet or make use of an extra pin on the back. Position 1 is then 850 shift, position 2 is computer output and position 3 is 170 shift. Because I wanted to be able to output either shift, I removed the AK-1 from this switch and installed a separate one. I also placed a jumper from the autostart bus to an open section of the input switch to turn on the page printer when in the computer position. Other connections to the RTTY loop can be made, but, by all means, use caution! TTL and loop voltages do not survive together. Refer to the article "How to Use Those Old Teletypes," *73*, February, 1977, p. 88. Simpler yet would be to output to port 001, the built-in RTTY oscillator.

Instructions For Use

After reading in your tape to the operations monitor, hit number 6 to use the buffer in real time. The processor will go to 007 300 and loop and wait for your message. You will have to be a good typist to get into the buffer to any depth, but it is very handy during figures to letters shifts and carriage return line feeds. When you hit the keys too fast for the output speed, the buffer remembers everything and puts it out in order. It does automatic carriage returns at the end of 70 letters or after 64 letters at the next space. Figures-letters are automatic in the ASCII conversion, and, whenever you hit a carriage return, it is automatically carriage return, line feed, letters. Hitting a control alpha will exit back to the operations monitor. ASCII % is Baudot bell, and ASCII # is Baudot H (STOP). Hitting a 5 from the operations monitor will cause the processor to go to 001 300, loop, and wait for you to preload the buffer with your next message of up to 250 letters, while the other station is sending to you on your page printer. When it is time to transmit back, hit control L and continue to type into the buffer. The processor will output your message in Baudot while you continue to feed into it with ASCII. If you are slow, it will soon catch up to you. The whole idea here is that you get a 250 letter head start, just as if you were using punched tape. Also, during the preload mode, if a mistake is made, just key in an ASCII delete and the buffer will step back one space at a time. Hitting a 7 from the operations monitor will execute at 007 363 and read the buffer contents from the start at any time.

What Kind of Hardware?

If you only want this one item of software, you could get a single board system going with an 8085, 1K PROM, and 256 bytes of RAM. The board could be mounted underneath your ASCII keyboard and remain dedicated to this one job. If you are the innovative and inquisitive type (and bore easily), then you will want a more flexible system. I am quite pleased with the Digital Group System, as it offers a lot of flexibility. CPU boards can be changed at any time, drawing from 8080A, Z-80, 6800 6502, and others, as they become available. The system comes with 2K of RAM memory on the CPU board 4 parallel input output ports, a TV character generator, and 1100 baud cassette interface. I'm using port 000 in for the ASCII keyboard. Port 000 out drives the TV generator's 512 byte memory, port 001 lsb in and out is for the cassette tape system, and port 002 lsb out is the Baudot serial RTTY output. My total memory at this time is 18K.

Locally, I am working on the air with Bob Hanson WB2DHL, and Ed McNeely K2RQB. We are trying to convince WA2BTG to join us, but, we've had no luck yet. We monitor two meter FM on 147.15 MHz RTTY and carry on at times on 146.25-85 (Oswego Repeater). Shhhh... we've even sent programming at 1100 baud on the air with super results. Hurry up with ASCII, FCC! ■

KEY BOARD IN SUBROUTINE

005 140	333 000	Input Keyboard	
005 142	247	Set Flag	(Key Pressed?)
005 143	360	Return +	(Key not Pressed)
005 144	315 007 002	Call Strobe Low	(Anti Echo)
005 147	041 133 007	Load H&L	
005 152	064	M= M+1	(Incr. Fullness)
005 153	054	L= L+1	
005 154	064	M= M+1	(Increment Write)
005 155	156	L= Write Point	
005 156	046 006	H= Buff Page	
005 160	167	M= Letter	(Store Letter)
005 161	376 215	Set Flag	
005 163	302 176 005	Carriage Return? no	
005 166	041 134 007	Load H&L	
005 171	176	A= M	(Saves Pointer at
005 172	054	L= L+1	last Carriage Rat.
005 173	167	Store A	Manual or Auto.)
005 174	076 215	A= Carriage Rat.	
005 176	376 340	Set Flag	
005 200	365	Save A	
005 201	332 206 005	A> 340? no	(Small Letter?
005 204	326 040	A= A- 040	Make Capital.)
005 206	315 372 000	Call TV Writer	(Put Letter on TV)
005 211	041 134 007	Load H&L	
005 214	176	A= Write Pointer	(Subtract Last
005 215	054	L= L+1	Carriage Return
005 216	226	A= A- Memory	from Write Pointer)
005 217	376 106	Set Flag	
005 221	302 232 005	70 Letters? no	
005 224	361	Pop A	(Reset Stack)
005 225	076 215	A= Carriage Rat.	
005 227	303 147 005	Jump & Store	(Automatic C.R.)
005 232	376 100	Set Flag	
005 234	332 246 005	A> 100? no	(64 Letters?)
005 237	361	Pop A	
005 240	376 240	Set Flag	
005 242	312 225 005	A= Space? yes	
005 245	365	Save A	(Keeps Stack
005 246	361	Pop A	in Order)
005 247	311	Return	

This keyboard routine is called by the Delay Loop routine, which is called by the Baudot Output routine. Even this keyboard routine calls for one more step of nesting for a Keystrobe Low routine and the TV Writer routine, both of which are within the Digital Group operating system.

BAUDOT OUTPUT SUBROUTINE*

007 000	376 215	Set Flag	
007 002	302 030 007	Carriage Ret? no	(Jump to Letters)
007 005	076 010	A= Baudot Ret.	(For every ASCII
007 007	315 142 007	Call Output	Carriage Return,
007 012	076 002	A= Baudot L.F.	This Sequence
007 014	315 142 007	Call Output	Outputs Baudot
007 017	076 037	A= Baudot Lette.	C.R.,L.F.,Lette)
007 021	062 177 007	Store Pointer	
007 024	315 142 007	Call Output	
007 027	311	Return	
007 030	046 007	Load H	(Page # of Look
007 032	376 340	Set Flag	up Table)
007 034	332 041 007	Capital Lett? yes	
007 037	326 040	A= A- 040	
007 041	376 300	Set Flag	
007 043	332 064 007	ASCII Upper? no	
007 046	365	Save A	
007 047	072 177 007	A= Pointer	(Figures Letters)
007 052	376 037	Set Flag	
007 054	312 116 007	Letters? yes	
007 057	076 037	A= Letters	
007 061	303 110 007	Jump	
007 064	376 240	Set Flag	
007 066	302 075 007	Space? no	
007 071	315 140 007	Call Output	
007 074	311	Return	
007 075	365	Save A	
007 076	072 177 007	A= Pointer	
007 101	376 033	Set Flag	
007 103	312 116 007	Figures? yes	
007 106	076 033	A= Figures	
007 110	062 177 007	Store A	
007 113	315 142 007	Call Output	
007 116	361	Pop A	
007 117	376 300	Set Flag	
007 121	332 126 007	ASCII Lower? yes	
007 124	326 100	A= A- 100	(Prepare for look up table)
007 126	315 140 007	Call Output	
007 131	311	Return	
007 132	015	Speed Pointer	
007 133	000	Fullness Pointer	
007 134	000	Write Pointer	
007 135	000	Carriage Return Pointer	
007 136	000	Read Pointer	
007 137	000	No Operation	

BAUDOT OUTPUT SUBROUTINE CONTINUED (OUTPUT PORTION)

007 140	157	L= A	(ASCII code gets Baudot code from look up table)
007 141	176	A= Memory	
007 142	000	No Operation	
007 143	036 006	E= 006	
007 145	000	No Operation	
007 146	067	Set Carry	
007 147	077	Comp. Carry	
007 150	007	Rotate Carry Left	(Clear start bit)
007 151	323 002	Output Port 002	(Can be 001) OUTPUT PORT
007 153	016 064	C= 064	
007 155	315 250 005	Call Delay Loop	(Start Bit Time)
007 160	037	Rotate Right	
007 161	035	E= E- 1	(Five Bits Out)
007 162	302 151 007	E= 0? no	
007 165	076 001	A= 1	(Stop Bit)
007 167	323 002	Output Port 002	(Can be 001)
007 171	016 112	C= 112	
007 173	315 250 005	Call Delay Loop	(Stop Bit Time)
007 176	311	Return	
007 177	XXX (033 or 037)	Letters - Figures	(Pointer)

BAUDOT OUTPUT SUBROUTINE LOOK UP TABLE

007 200	000	@	007 220	026	P	007 240	004	Space	007 260	026	0
007 201	003	A	007 221	027	Q	007 241	015	!	007 261	027	1
007 202	031	B	007 222	012	R	007 242	021	"	007 262	023	2
007 203	016	C	007 223	005	S	007 243	024	# OFF	007 263	001	3
007 204	011	D	007 224	020	T	007 244	011	$	007 264	012	4
007 205	001	E	007 225	007	U	007 245	005	% BELL	007 265	020	5
007 206	015	F	007 226	036	V	007 246	032	&	007 266	025	6
007 207	032	G	007 227	023	W	007 247	013	'	007 267	007	7
007 210	024	H	007 230	035	X	007 250	017	(	007 270	006	8
007 211	006	I	007 231	025	Y	007 251	022	)	007 271	030	9
007 212	013	J	007 232	021	Z	007 252	035	* :	007 272	016	:
007 213	017	K	007 233	000		007 253	032	+ &	007 273	036	;
007 214	022	L	007 234	000		007 254	014	,	007 274	017	(<
007 215	034	M	007 235	000		007 255	003	-	007 275	016	: =
007 216	014	N	007 236	000		007 256	034	.	007 276	022	) >
007 217	030	O	007 237	000		007 257	035	/	007 277	031	?

**Adopted from Digital Group Tiny BASIC and modified for efficiency.*

References

1. *73 Magazine,* Dec., 1976, "A Ham's Computer," Page 78, K7YZZ.
2. *73 Magazine,* Feb., 1977, "How to Use Those Old Teletypes," Page 88, K7YZZ.
3. *73 Magazine,* Apr., 1977, "An Intelligent RTTY Station," Page 72, K7YZZ.

DELAY LOOP SUBROUTINE

Address	Code	Step	Comment
005 250	365	Save A	
005 251	041 132 007	Load H&L	
005 254	106	B= Memory	(Speed Constant)
005 255	005	B= B-1	
005 256	312 267 005	B= 0? — yes	
005 261	315 140 005	Call Key In	(Keyboard Routine)
005 264	303 255 005	Jump	
005 267	015	C= C-1	
005 270	302 251 005	C= 0? — no	
005 273	361	Pop A	
005 274	311	Return	

At 60 words per minute output, the keyboard is checked for a key pressed 5018 times for each Baudot letter printed out (or 30,108 times per second).

BUFFER PRELOAD (OPTIONAL)

Address	Code	Step	Comment
		Start #5	
001 300	041 132 007	Load H&L	
001 303	257	Clear A	
001 304	006 004	B= 004	(Clear all pointers)
001 306	054	L= L+1	
001 307	167	Store A	
001 310	005	B= B-1	
001 311	302 306 001	B= 0? — no	
001 314	303 124 005	Jump	
005 124	315 140 005	Call Key In	(Keyboard Routine)
005 127	376 214	Set Flag	
005 131	302 056 005	Control L? — no	(Exit to Read)
005 134	303 322 007	Jump	
005 056	376 377	Set Flag	
005 060	302 124 005	Delete? — no	(Backspace?)
005 063	041 133 007	Load H&L	
005 066	065	M= M-1	(Fullness Point)
005 067	065	M= M-1	
005 070	054	L= L+1	
005 071	065	M= M-1	(Write Pointer)
005 072	065	M= M-1	
005 073	303 124 005	Jump	

NOTICE:

BUFFER READ ONLY (OPTIONAL)

Address	Code	Step	Comment
		Start #7	
007 363	076 377	A= 377	(Fill fullness pointer)
007 365	041 133 007	Load H&L	
007 370	167	Store A	
007 371	257	Clear A	
007 372	056 136	L= 136	
007 374	167	Store A	(Set read pointer to 0)
007 375	303 322 007	Jump	(Jump into Buffer)

Using Start #5, preload with RYRY, The Quick Brown Fox, CQ DE K2AOU, etc. Then, hit Start #7 as many times as you want the message! Program your Digital Group "GO TO" or "Execute" (Start) locations as follows:

005	112	300	#5	GO
005	113	001		
005	114	300	#6	GO
005	115	007		
005	116	363	#7	GO
005	117	007		

KEYBOARD STROBE LOW ROUTINE (Digital Group Op. Sys.)

Address	Code	Step
002 007	365	Save A
002 010	333 000	Input Keyboard
002 012	376 200	Set Flag
002 014	362 010 002	Strobe High? — yes
002 017	361	Pop A
002 020	311	Return

Note that the TV Erase and TV Writer routines are also part of the Digital Group operating system. The Operations Monitor title page was also moved and condensed to make room for this program. Change the following bytes to move the title page TV editor location:

005 004 041 300 005 Load B&L (With new ASCII message location)

005 300	377	Erase	005 327	033		005 357	266	6
005 301	011	9 Spaces	005 330	263	3	005 360	240	
005 302	310	H	005 331	240		005 361	302	B
005 303	301	A	005 332	323	S	005 362	365	u
005 304	315	M	005 333	364	t	005 363	346	f
005 305	240		005 334	304	D	005 364	346	f
005 306	322	R	005 335	360	p	005 365	345	e
005 307	324	T	005 336	032		005 366	362	r
005 310	324	T	005 337	264	4	005 367	030	
005 311	331	Y	005 340	240		005 370	267	7
005 312	057		005 341	320	P	005 371	240	
005 313	261	1	005 342	347	g	005 372	322	R
005 314	240		005 343	355	m	005 373	345	e
005 315	322	R	005 344	073		005 374	341	a
005 316	345	e	005 345	265	5	005 375	344	d
005 317	341	a	005 346	240		005 376	000	
005 320	344	d	005 347	320	P	005 377	000	
005 321	032		005 350	362	r			
005 322	262	2	005 351	345	e			
005 323	240		005 352	314	L			
005 324	327	W	005 353	357	o			
005 325	362	r	005 354	341	a			
005 326	364	t	005 355	344	d			
			005 356	027				

RTTY Test Station

-- complete pattern generator

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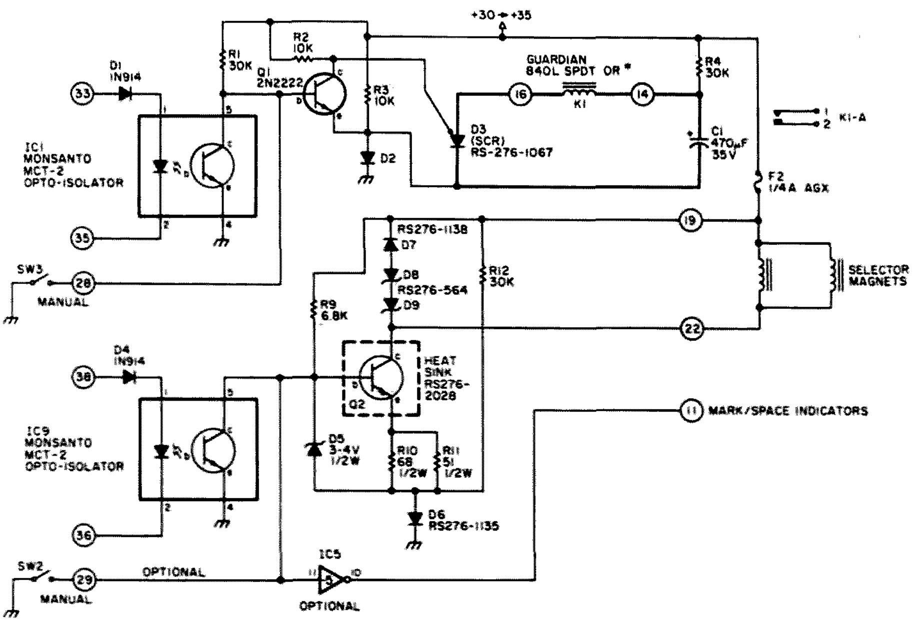


*Fig. 1. Motor control and selector drive. RS = Radio Shack. *Sears, Roebuck garage door opener, model 139.65400, replacement part #160B27.*

This article describes a solid state Teletype control/test system that satisfies the following needs:

For the RTTY amateur:

- A solid state selector magnet driver;
- A low power motor control for standby operation;
- RY test generator for stand alone operation and maintenance.

For the microprocessor enthusiast:

- A solid state selector magnet driver with TTL interface;
- A low power motor control with TTL interface.

The design is modular in that any function can be implemented independently of the others.

Functional Specifications

The "box" satisfies the following needs:

1. Complete electrical isolation between the Teletype and the microprocessor.
2. Computer-controlled on/off motor control.

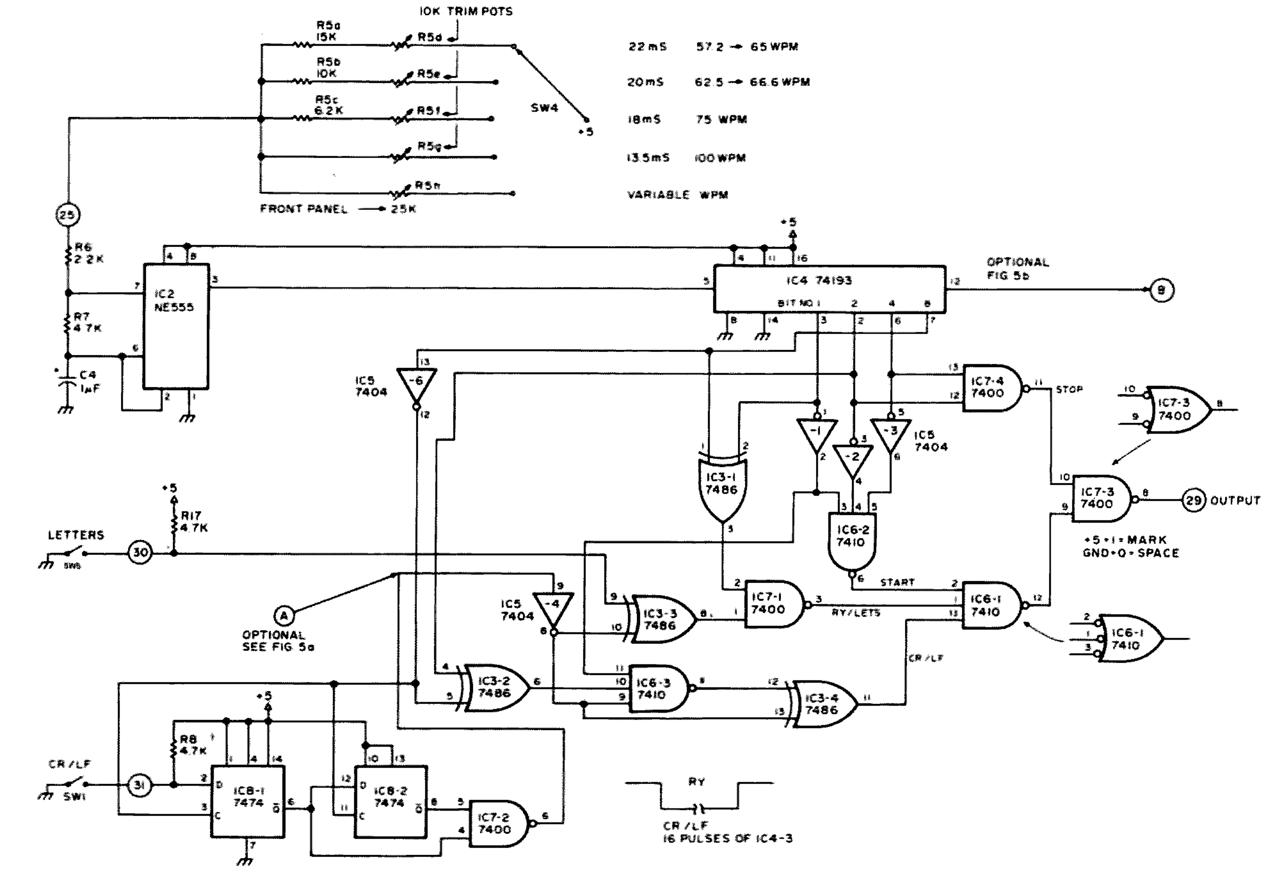


Fig. 2. Test pattern generation.

3. Solid state selector magnet control.
4. Self-contained RY test generator.
5. TTY interface.

Motor Control – Fig. 1

IC1, an optoisolator, is normally in the off state. Q1, normally in the on state, holds D3 (the SCR) in off state. C1, the power storage capacitor, has charged to +30 V via R4; this takes about 15 seconds. The steady state current is about 8 mA.

When 10 mA is applied to IC1 pins 1 and 2, IC1 turns on, driving Q1 off. This permits 3 mA of gate current to flow into D3 via R2. D3 turns on, discharging C1 through the motor control relay K1. K1 is a mechanically latching relay. Each successive pulse changes its state; if it is on, it is turned off; if it is off, it is turned on. The stored charge in C1 is sufficient to energize K1. When the charge on C1 is dissipated in K1, K1 de-energizes and the anode current on D3 drops to 1 mA (via R4), which is insufficient to maintain conduction in D3 and D3 turns off. There is no inductive kick on K1 since no current exists in K1 at the time of turnoff. This condition will last until the 10 mA is removed from IC1.

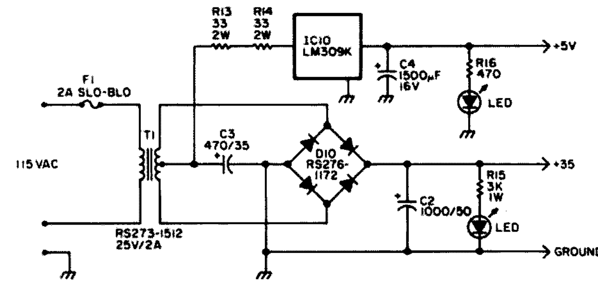


Fig. 3. Power supply. RS = Radio Shack.

A waiting period of 15 or more seconds must be observed before another action can be initiated in order to recharge C1 at a power supply voltage of 35 volts, 25 to 30 seconds at 30 volts.

Note the connection of C1 to D3 must be direct and as short as possible since there are 3 Amperes of pulsed current flow in this loop.

D1 is used to prevent damage to the optoisolator in case the wrong polarity is applied to pins 1 and 2 of IC1.

D2 is used to bias Q1 high enough to insure that IC1 turns off Q1. Manual control is achieved by turning off Q1 via SW1.

Test Pattern Generator – Fig. 2

A test pattern that generates letters R and Y (or numbers 4 or 6) is stimulated by IC2, a free running oscillator. IC2 generates positive transitions at a rate determined by R5a-R5h and SW4. These rates range from one each 22.0 ms (60 wpm) to one each 13.5 ms (100 wpm), or at a variable rate determined by R5h.

The function generation logic is divided into five functional areas: START, STOP, R(4)/Y(6), CR/LF, LETTERS. The START logic IC6-2 provides a down level at the output when the timing generator, IC4, is at 000x (outputs 1, 2, 4, and 8, respectively) START time. Note "x" is a don't-care condition. The STOP logic IC7-4 provides a low pulse at the output when the timing generator, IC4, is at 011x or 111x STOP time. The following explanations are only concerned with the 1-5 Baudot bits; the start and stop bits are common to all test patterns.

Letters

The LETTERS feature

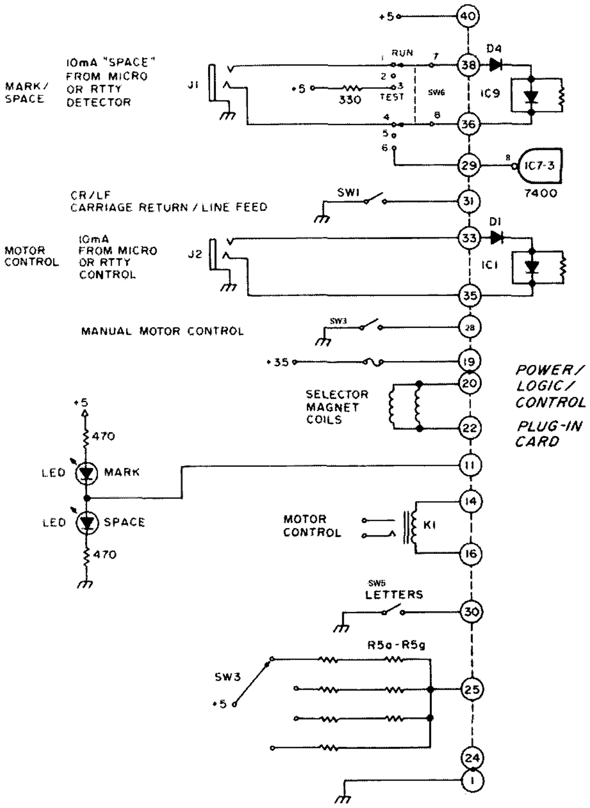
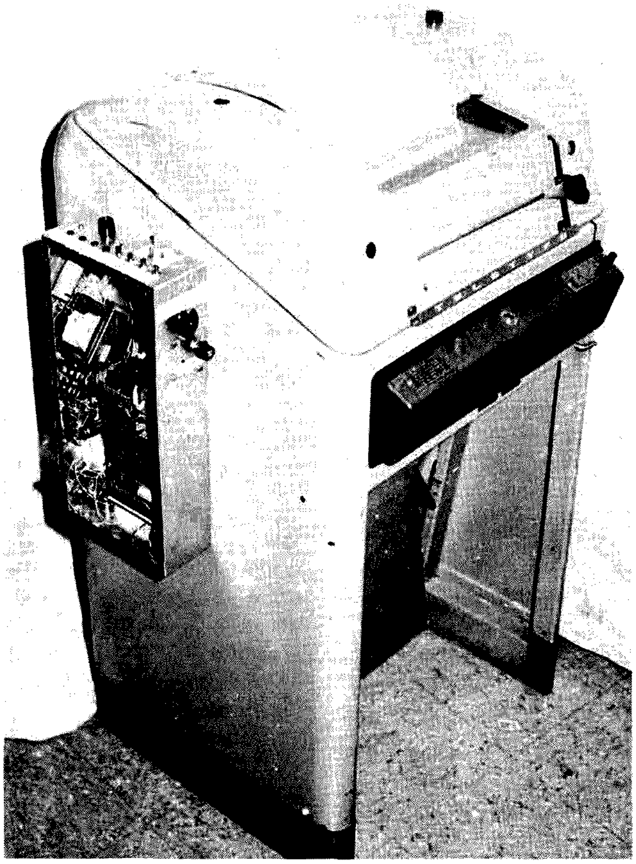


Fig. 4. Interconnections.



Solid state Teletype control/test system.

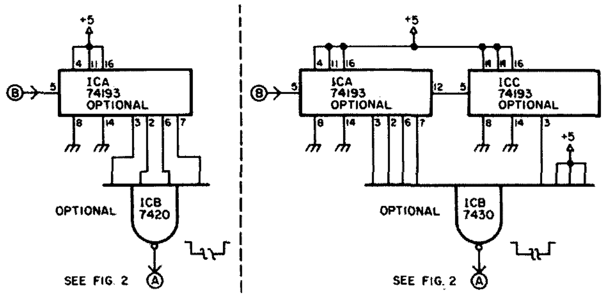


Fig. 5. Optional automatic CR/LF. (a) 30 character line. (b) 62 character line.

came essentially free. Since one section of IC3 was still unused, it was wired in using only an additional pushbutton and a 4.7k pull up resistor. Unfortunately, the FIGURES function would have required more than the simple implementation of that required for LETTERS, and since both LETTERS and FIGURES are "wants" versus "needs," I decided to get along without the FIGURES function.

RY(46)

RY(46) is generated continuously, but is only applied to the output when IC7-1 is high (no CR/LF). "R" is derived from bit 1 being high, and "Y" is derived from bit 1 being low. This is accomplished by exclusive OR logic IC3-1, controlled by bit 8.

CR/LF

Carriage return is executed before line feed to allow the maximum amount of time for the carriage to return before RY printing resumes. CR/LF is generated when IC6-pin 9 is high (CR/LF). As in the RY generation, timing pulses are combined in IC3-4 to provide CR/LF.

Timing bit 8 controls whether CR or LF is generated by inverting timing bit 2 via IC3-2. IC3-4 is required to provide the proper polarity of signals at IC6-pin 3 when generating CR/LF vs RY.

Character/Line Control

IC4 generates 16 timing pulses – 8 for sequence 1 (8 bit low) and 8 for sequence 2 (8 bit high). There are three alternatives that can be used to control the number of characters/line. The manual control is shown in Fig. 2. Two optional automatic controls of 30 and 62 characters/line are shown in Fig. 5.

The common requirement is that the negative CR/LF

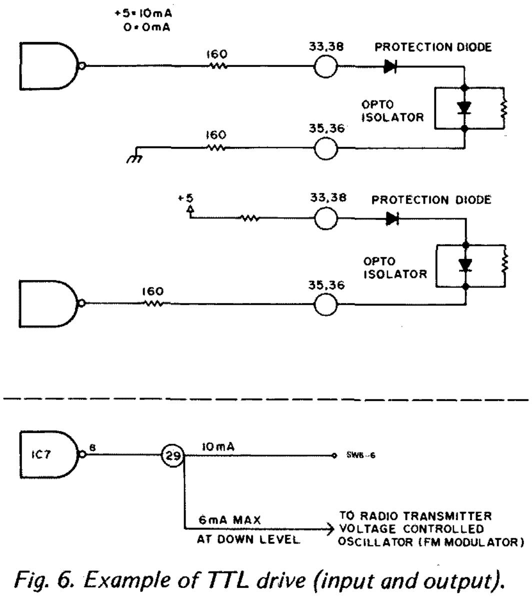
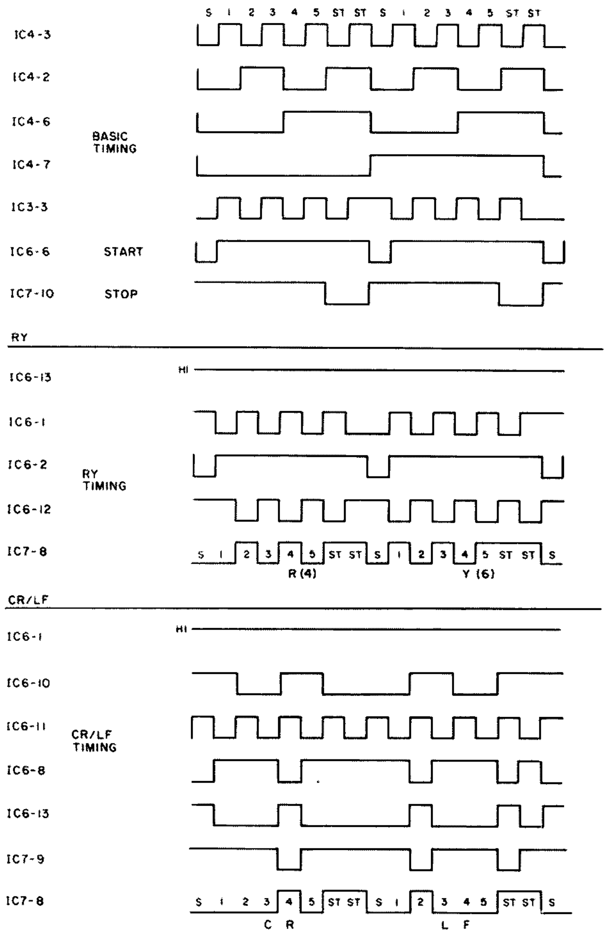


Fig. 6. Example of TTL drive (input and output).



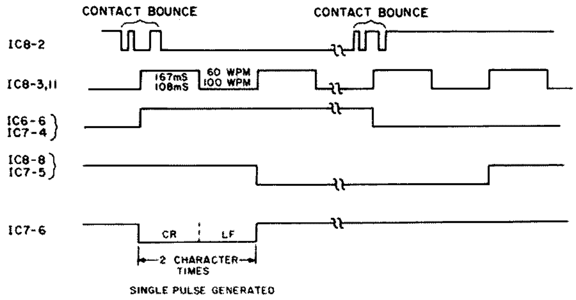


Fig. 7. System timing diagrams.

gating signal start at the beginning of CR and end at the end of LF. This is accomplished in the manual configuration by clocking the pulse generator IC8-3,11 with bit 8 low. It is implied in the automatic generator ICA and ICB (Fig. 5) since ICA is controlled and synchronized by IC4. Since ICA increments one for each 16 bits of IC4, each ICA count equals two printing characters. ICA and ICB provide a count of 16; this results in 30 characters plus CR/LF for a total of 32 characters. ICA, ICB, and ICC provide a count of 32; this results in 62 characters plus CR/LF for a total of 64 characters.

The automatic CR/LF circuits in Fig. 5 can be used by disconnecting at points "A" and "B" in Fig. 2 and connecting in one of the circuits shown in Fig. 5.

The selection of the mode and number of characters/line is strictly an economic and space choice.

Selector Magnet Driver – Fig. 3

IC9, an optoisolator, is normally in the off state. This permits 4.7 mA to flow into D5 and the base of Q2 via R9. The voltage across R10 and R11 is clamped via D5, minus the base to emitter drop of Q2, to about 3 volts. This fixes the voltage across R10 and R11, and thereby the current through Q2, independent of the collector voltage variations of Q2. This value should be trimmed via either R10 or R11 to 60 mA.

The "Pick" current level of the selector magnet coils in the 60 mA configuration is about 35 mA (the "drop level" is about 25 mA). The measured time to reach this value, in this circuit, is about 2.3 ms. This compares favorably to the calculated time of 2 ms in the original high voltage circuit. The driver has operated at a 100 wpm rate with a power supply voltage as low as 20 V.

D4 is used to prevent damage to the optoisolator in case the wrong polarity is applied to pins 1 and 2 of IC9. Note that the selector magnet coils are connected in the 60 mA loop configuration (Fig. 1).

Power Supply

The power supply is a dual voltage configuration supply, +35 volts at up to 1 Ampere and +5 volts regulated at up to 500 milliamperes.

The approximate current loading is about 160 mA at +5 volts and about 80 mA at +35 V. R13 and R14 are used to reduce the power dissipation on IC10.

Adjustment Procedure

1. Preliminary 60 mA Mark Adjustment

Remove F2 and place a milliammeter across the F2 contacts.

Adjust the MARK current to 60 mA by trimming R10 or R11.

Replace F2.

2. Frequency Adjustment

Scientific Method:

Set the range selector to 50.

Place a scope probe on the collector of Q3.

Adjust R5d-R5g until the voltage glitch, caused by the movement of the selector magnet, appears at the trailing edge of each MARK voltage waveform.

Brute Force:

Set the range selector to 50.

Adjust R5d-R5g until Rs (or Ys) are being printed.

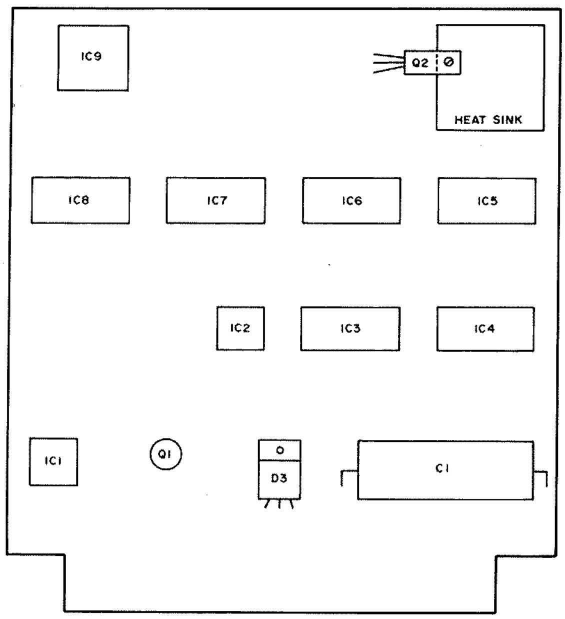


Fig. 8. Board layout used at W2FJT.

Rock R5d-R5g until they are in the center of the range.

Operation

1. Test

Place mode switch in TEST position.

Press SW3 to start motor.

If manual CR/LF is implemented, press SW1 and hold for at least 1/2 second to ensure a CR/LF.

2. Automatic

Plug mark/space signal line into J1.

Plug motor control line into J2.

Provide a current pulse, with at least 10 mA to control each of the functions (Fig. 6).

Construction

I implemented the manual CR/LF configuration, since my Model 28 had automatic CR/LF, together with the selector magnet driver and power control relay driver, on a single card. If I had to construct the whole thing again, I would build the power circuits on one card and the logic on a second card. This would leave sufficient room for the automatic CR/LF circuitry if desired.

The physical layout is arbitrary except to keep the high current motor control relay (K1) loop direct and short.

Both Q2, the selector magnet driver, and IC10, the +5 V regulator, must be heat sinked. Note that the heat sink tab on Q2 is not electrically isolated from the collector and, therefore, the heat sink must be insulated from the chassis.

Conclusion

The low power drain, electrical isolation, reliability, and testing versatility offered by this control/test system makes it a valuable addition to either a computer or a radio-controlled Teletype installation. It has been at W2FJT. ■

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Loves Park IL 61111

The World's Cheapest Calibrator

-- works on 2m!

Having trouble netting your transmit crystals on your 2 meter handie-talkie or transceiver? Can't buy or conveniently borrow a frequency counter to do the job? Then read on about a $10 solution . . .

With today's proliferation of sensitive, narrow band repeaters, it is increasingly important to be right on frequency to obtain maximum range and good audio quality from your own gear when "making the system." Even when operating simplex the tolerant wide band receivers are rapidly disappearing. Most would agree equipment should be within about ± 1 kHz of the nominal channel frequency for optimum results.

I got tired of borrowing a frequency counter every time I put new rocks in my equipment or changed the channel locations of some of them. Couldn't see putting out $100 or more for a frequency counter. One day while tuning my low band receiver with its stable 1 kHz calibration, the idea hit me. Add a 2 meter converter to it! So what if the low band receiver is for SSB-CW and my 2 meter gear is FM? The frequency of the unmodulated FM carrier would be just as recognizable as a continuous CW signal.

In looking around for a 2 meter converter for my Heathkit SB-301 low band receiver, I discovered Heath Company no longer made the Model SBA-300-4 2 meter converter. However, I picked up a used one in the flea market for only $10! The Heath Model SBA-300-4 2 meter converter output is a 28-30 MHz signal that is inputted into the four SB-301 half megahertz 10 meter band increments. With the proper crystal in the converter, any 2 MHz segment of 2 meters is tunable with 1 kHz resolution on the SB-301. Other 2 meter converters are available or you can build one yourself from the literature.

Netting 2 meter crystals is a snap now. First, check the calibration of your receiver and converter. You can verify it by comparing it to the output frequency of one or more of the accurately calibrated repeater stations when keyed by an unmodulated FM carrier with the receiver in the CW position. Use a minimal antenna or back off the rf gain if necessary, so your receiver is not overloaded and the S-meter reaches a maximum without pinning the needle. Reset your receiver dial hairline if required for accurate calibration.

The actual netting of your 2 meter crystals is simple. Feed your transceiver, preferably into a dummy load. Turn your low band receiver audio gain down to minimum to prevent audio feedback. Use little or no receiver antenna or reduce rf gain if necessary to avoid overloading. With the low band converted receiver set to the desired 2 meter frequency, adjust the netting capacitor for maximum S-meter reading by alternately keying and adjusting the 2 meter gear. Double check your work by varying the receiver frequency slightly while keying your unmodulated 2 meter transceiver. The S-meter reading should peak sharply at the desired frequency, especially with the receiver in the CW mode.

I've found I can get to within about ± 1 kHz using the above . . . and for $10 that's a good bargain! As a bonus, a low band receiver-converter can be used to receive FM (somewhat poorly though) in an emergency by detecting it off the bandpass slope in the low band receiver. ■

RTTY With the KIM

-- features built-in display!

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Annandale VA 22003

0300	40	ltrs	0320	40	ltrs
0301	FO	K	0321	89	(
0302	E7	Q	0322	86	1
0303	9C	U	0323	87	7
0304	20	figs	0324	20	figs
0305	9E	J	0325	82	'
0306	BE	W	0326	DB	2
0307	F7	A	0327	CO	–
0308	94	X	0328	D2	/
0309	F1	F	0329	8A	!
030A	EE	Y	032A	FD	6
0308	ED	S	032B	00	bell
030C	FC	B	032C	D3	?
030D	DE	D	032D	86	$
030E	C9	Z	032E	A2	"
030F	F9	E	032F	CF	3
0310	EA	V	0330	C5	;
0311	D8	C	0331	C1	:
0312	F3	P	0332	BF	0
0313	84	I	0333	FF	8
0314	BD	G	0334	C6	&
0315	DO	R	0335	E6	4
0316	B8	L	0336	8F	)
0317	40	line feed(ltrs)	0337	40	line feed (ltrs)
0318	B7	M	0338	98	.
0319	D4	N	0339	8C	,
031A	F6	H	033A	88	
0318	80	space	033B	80	space
031C	DC	O	033C	EF	9
031D	80	car ret (space)	033D	80	car ret (space)
031E	F8	T	033E	ED	5
031F	88	blank	033F	88	blank

Fig. 1. Character set.

The classic RTTY receiving setup consists of a terminal unit to change RTTY tones to dc pulses and a teleprinter which mechanically decodes the pulses and displays the resulting message. The KIM-1, which many hams are using today, has those elements. All that you need is the proper program and one simple connection between the station receiver and the KIM-1, and you will be displaying RTTY on the seven segment readouts. The displayed character set may take a bit of getting used to, but can be read with surprising ease. For instance, there is no way to get a perfect "Z" into a seven segment readout, but the displayed character "≡" becomes recognizable easily enough when read in context. The idea for this sort of readout is not all mine, but was developed simultaneously by several KIM-1 users. I have tried to put together a fairly uniform and sensible character set, however. This character set is shown in the program listing starting at address 0300.

At this point, you might ask how much can be read using only 6 displays. Surprisingly, most words longer than 6 characters can be easily read with almost no practice, proving, I suppose, that you really don't need all those letters anyhow.

As the terminal unit, I use the KIM-1's own tape interface circuit. This is a 565 phase locked loop and op amp buffer connected to an

020F	2C 00 17
0212	30 08
0231	2C 00 17
0234	30 06
0264	2C 00 17
0267	10 06

Fig. 2. These changes, when inserted in the program, will make the KIM-1 a teleprinter only. The input is PA7 (pin 8 of the applications connector).

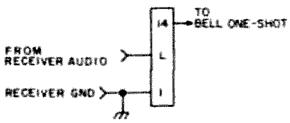

Fig. 3. KIM-1 applications connector hookup for full RTTY system. If you wish for the bell function to operate, have pin 14 key a one-shot driving a Sonalert.

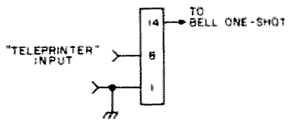

Fig. 4(a). Connections for teleprinter display operation only (no KIM-1 TU).

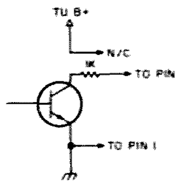

Fig. 4(b). Method of connecting TU slicer transistor to KIM-1 I/O port without using TU B+.

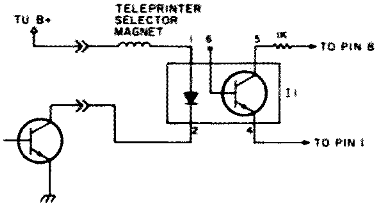

Fig. 4(c). Method of connecting RTTY 60 mA loop with KIM-1. I1 is Monsanto MCT-2, Texas Instruments TIL 111, Motorola MOC1000, Fairchild FCD 820, GE H11A1 or Clairex CLI-3.

Data pulse (ms.)	Baud	Address 023D	0255	02CO
22	45.5	OF	14	15
20	50	OC	12	13
18	56.9	08	11	12
13.33	75	06	OC	OD
10	100	04	09	OA

Fig. 5. Timing bit table for different RTTY speeds.

I/O port. While it is no Mainline ST-6, it will give adequate performance on strong wide shift signals.

The first part of the program (see Fig. 6) is an adjustment loop to aid in setting the TU properly. A low tone should light all segments of the left data digit (displays an 8); a high tone will light the right digit. On some receivers (like mine) that are response limited because of sideband filters, it may be necessary to adjust the KIM-1's pot (VR-1) to get the TU to operate. Adjust this pot so that the not on digit is completely off. If both digits are lit, it indicates that the PLL is "hunting," and no readable display will result. Ideally the display should appear to be moving from one digit to the other. When you have this display, simply move to the decoder portion of the program by pressing the F button. The characters should start to display themselves on the seven segment readouts moving from right to left.

The microprocessor is doing the same thing as a mechanical decoder. First it waits for the start bit. Then, when it has detected this bit, it delays a set time until the middle of the Baudot start bit. The timer is then set to a different time that will not let the TU look at the data until enough time has elapsed and the middle of the first Baudot data bit is available

```
0200  20 6A 1F  KEY    JSR 1F6A     Get key subroutine.
0203  C9 0F            CMP SOF
0205  F0 1D            BEQ START
0207  A9 7F            LDA S7F      Change segments to output.
0209  8D 41 17         STA 1741     Turn them all on.
020C  8D 40 17         STA 1740
020F  2C 42 17         BIT 1742     Look at the PLL.
0212  10 08            BPL HI       If a high tone go to HI.
0214  A9 11            LDA S11      Select the left data bit.
0216  8D 42 17         STA 1742
0219  4C 00 02         JMP KEY
021C  A9 13     HI     LDA S13      Select the right data bit.
021E  8D 42 17         STA 1742
0221  4C 00 02         JMP KEY
0224  A9 7F     Start  LDA S7F      Initialize for display.
0226  8D 41 17         STA 1741
0229  A0 06            LDY S06
022B  A2 09            LDX $09
022D  A9 00            LDA $00      Put ltrs in the ltrs, figs byte.
022F  85 E4            STA 00E4
0231  2C 42 17  INTL   BIT 1742     Look for a start bit.
0234  10 06            BPL SET
0236  20 D9 02         JSR DISP     Call the display subroutine.
0239  4C 31 02         JMP INTL
023C  A9 0F     SET    LDA S0F      Set the timer for the first delay.
023E  8D 07 17         STA 1707
0241  A9 00            LDA S00      Clear the new character register.
0243  85 E7            STA 00E7
0245  A9 10            LDA $10      Set up the bit position register.
0247  85 E5            STA 00E5
0249  20 D9 02  DECO   JSR DISP     Display and check for time out.
024C  2C 07 17         BIT 1707
024F  30 03            BMI BITE
0251  4C 49 02         JMP DECO
0254  A9 14     BITE   LDA $14      Set timer for second delay.
0256  8D 07 17         STA 1707
0259  20 D9 02  WAIT   JSR DISP     Wait for the timer to time out.
025C  2C 07 17         BIT 1707
025F  30 03            BMI RDBT
0261  4C 59 02         JMP WAIT
0264  2C 42 17  RDBT   BIT 1742     Read the bit.
0267  30 06            BMI SHIFT    If 0 do not load.
0269  A5 E7            LDA 00E7     Load the bit.
026B  05 E5            ORA 00E5
026D  85 E7            STA 00E7
026E  46 E5     SHIFT  LSR 00E5     Shift the bit position register.
0271  A5 E5            LDA 00E5     Check for all 5 Baudot data bits.
0273  C9 00            CMP $00
0275  F0 03            BEQ MKBI
0277  4C 54 02         JMP BITE
027A  A5 E7     MKBI   LDA 00E7     Complete the byte with ltrs/figs prefix.
027C  05 E4            ORA 00E4
027E  A8               TAY          Look up the byte.
027F  85 E3            STA 00E3
0281  89 00 03         LDA 0300, Y
0284  85 E7            STA 00E7
0286  24 E7            BIT 00E7     Check for command.
0288  10 17            BPL FUNC
028A  A2 EC            LDX $EC      Move all characters 1 space to the
028C  B5 00     MOVE   LDA 0000, X  left and insert the new character
028E  E8               INX          in the right display location.
028F  95 00            STA 0000, X
0291  CA               DEX
0292  CA               DEX
0293  E0 E6            CPX SE6
0295  F0 03            BEQ SETX
0297  4C 8C 02         JMP MOVE
029A  A2 09     SETX   LDX $09      Prepare the X and Y registers for
029C  A0 06            LDY S06      use in DISP.
029E  4C BF 02         JMP FINSH
02A1  06 E7     FUNC   ASL 00E7     Decode and execute ltrs command.
02A3  24 E7            BIT 00E7
02A5  10 07            BPL FIGS
02A7  A9 00            LDA S00
02A9  85 E4            STA 00E4
02AB  4C BF 02         JMP FINSH
02AE  50 07     FIGS   BVC BELL     Decode and execute figs command.
02B0  A9 20            LDA $20
02B2  85 E4            STA 00E4
02B4  4C BF 02         JMP FINSH
02B7  A9 01     BELL   LDA $01      Execute bell command.
02B9  8D 01 17         STA 1701
02BC  8D 00 17         STA 1700
02BF  A9 15     FINISH LDA $15      Set for third delay.
02C1  8D 07 17         STA 1707
02C4  20 D9 02  LOOK   JSR DISP     Display and check timer.
02C7  2C 07 17         BIT 1707
02CA  30 03            BMI BACK
02CC  4C C4 02         JMP LOOK
02CF  A9 00     BACK   LDA $00      Turn off bell.
02D1  8D 00 17         STA 1700
02D4  4C 31 02         JMP INTL
02D7  EA               NOP
02D8  EA               NOP
02D9  C0 00     DISP   CPY S00      Display subroutine.
02DB  D0 04            BNE STILL
02DD  A0 06            LDY S06
02DF  A2 09            LDX $09
02E1  B9 E7 00  STILL  LDA 00E7, Y
02E4  84 FC            STY 00FC
02E6  20 4E 1F         JSR IF4E
02E9  88               DEY
02EA  60               RTS
```

Fig. 6. When tuning is satisfactory, as described in text, press button F to start display.

from the TU. When all 5 data bits have been decoded and stored in a memory byte, another memory byte is looked at to see if the upper case/lower case bits are set. With this information, the alphanumeric character may be looked up in the character table and tested to see if it is a character or a command. If it is a character, the data byte is loaded into a display location, and the display is shifted one space to the left. If it is a command (bit 7 set to 0), the command is decoded, and the appropriate action taken. The timer is then loaded with a timeout time which gets the microprocessor out of the last Baudot data bit. When this time expires, it is again time to look for a start bit. The display is run continuously whenever the microprocessor is not busy doing anything else.

For those of you who already have a TU and would like to use only the display portion of the KIM-1, I have included (Fig. 2) the necessary changes to the program to use one of the regular input ports (pin 8) as your input connection.

Since the KIM-1 timer is variable, you can also decode baud rates other than the standard amateur 45.5 baud (60 wpm) that the program is set for. Fig. 5 shows the necessary changes to the timing bits to decode other RTTY speeds. To decide which baud rate applies, measure the length of a data pulse with a scope, then consult the table for the data pulse length which fits and insert the timing bits accordingly. Do not, by the way, expect to decode everything you hear. All that frequency shifts is not necessarily Baudot. Many commercial stations are using ASCII these days and others encrypt. ■

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Build A Meter With Class

-- simple field strength device

The manual for my rig suggests that a "better procedure" for loading it up is to use an swr bridge on forward or a field strength meter to peak plate and loading controls for maximum output power. The field strength meter seemed the easy way out, since a bridge costs fifteen dollars. The meter would cost me next to nothing to build considering the present status of my junk box. Therefore, I decided on the junk box approach to measure output power.

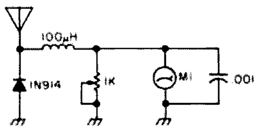

Fig. 1.

While building the field strength meter, I consulted an article in the July, 1976, issue of *73*. The article dealt with building the world's smallest field strength meter. The design given was standard and allowed wide margins for parts substitution. Recently, another ham wrote *73* about an rf choke that cost four dollars, adding that amount to the cost of his otherwise free field strength meter. I just thought I'd mention that all parts in my field strength meter came from junked PC boards, with the exception of the meter movement.

When you go scrounging parts for this project, remember about the choke. Anything that will choke rf works. So, substitute freely, but don't change from a diode to a resistor.

As I said, the design is standard, but the antenna is quite unconventional. Instead of using a piece of twelve gauge bare copper or coat hanger wire, I used twenty-two gauge tinned copper wire bent into the form of my initials.

Construction

Select the amount of wire you feel necessary to complete your initials or whatever. Straighten the wire with a vise and a pair of pliers. Starting at the top of the left initial, make a bend to form the beginning of the antenna. Try to use one continuous piece of wire to make the antenna. To insure this, draw your idea on a piece of paper first. If you use one piece of wire the antenna will look a lot better, and you will eliminate having to solder on extra pieces of wire. The joints make bulges in the antenna which just don't look as nice on the finished meter. Solder a few spots to hold this thing together. While the iron was still hot, I also attached a banana plug.

With the antenna done, I built the guts of the meter. The easiest way to go is to mount the pot and use its terminals as tie points. The wiring is the easiest you'll ever do and is almost impossible to screw up. My only problem was mounting the banana jack, which I solved by using two shouldered washers.

Conclusion

Taking a lead from modern art, you can make just about anything for an antenna on your FSM. You've got to admit, now that we have an alternative, that bare copper does look a bit uncouth! This meter may not be the best or the smallest, but it does have class! ■

Parts List

1 diode, 1N914 or just about anything else
1 50 uA meter
1 rf choke
1 pot, 1k or thereabouts (I have a 500 Ohm)
1 .001 uF capacitor
1 mini box
1 banana plug
1 banana jack
2 shouldered washers
Plenty of twenty-two gauge wire

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FSK for the FT-101

-- a simple mod for RTTY

The Yaesu FT-101 series transmitters (FT-101B, E, EE, and EX models) have now passed the 200,000 mark in production and are in use all over the world. Therefore this article is to show you how to easily convert these transceivers for teletype service.

The schematic in Fig. 1 is set up for "dry keying" and supplies 7.5 volts to the keyboard or tape reader. One word of warning: Do not apply voltage from a keyer or you will fry the components. You might mount all of the parts involved in a minibox. Put a jack in one side to plug in the keyboard. The potentiometer can be mounted in the minibox and is used to set the shift which is adjustable from 850 Hertz to less than 170. The latter shift is generally used on the HF bands while 850 Hertz is still heard on VHF, at least in the Los Angeles area.

The connections from the FSK device to your FT-101 are just three in number, with one going to the above ground side of the 3179.3 kHz crystal on PCB 1184A. Another lead goes to PCB 1314A, pin 14, which leads directly to the IC, Q4MFC6034A. The third lead is strictly a ground connection between the minibox chassis and the transceiver chassis. One side of the keyboard jack goes to this ground in the minibox as well. I would suggest that for this purpose a two wire shielded cable be used, between the minibox and the transceiver.

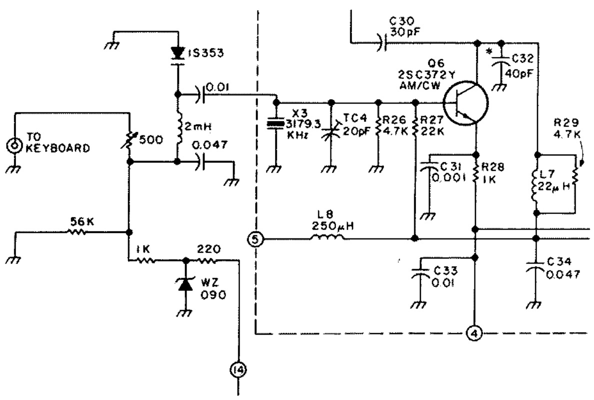

Fig. 1.

You will find that if you flip from one band to another you may have to readjust the "pot" to maintain your shift. Once done on each band by checking with the receive station, you can apply decals or scribe the box, however you choose, for resetting to each band. Obviously you want a pointer knob on the pot shaft for this purpose. If you are a purist, you could measure the pot resistance required for the shift used on each band adjustment of the pot and use fixed resistors of the correct accuracies instead. This would then require a switch in place of the pot and, by rotating the switch, you would then be able to move from one band to the other. The switch, of course, would have to have the correct number of positions for whatever number of bands you will be doing your RTTYing on.

All the components used in the FSK circuitry are garden variety parts found in any ham supply house or electronics store. Assembly time may take as long as an hour or two, depending upon your experience and whether or not you accidentally pick up the soldering iron by the wrong end while working.

Tune-up of the transceiver would be under AM loading conditions, as teleprinter operation is the same as CW (keydown), and the surest way to cause your transceiver to self-destruct would be to ignore this fact.

There seems to be quite an upsurge in teleprinter communications among radio amateurs these days. One of the reasons, perhaps, is that your friendly surplus store makes them available for as little as $25. This would be for the RTTY workhorse, the good old Model 15, which is a page printer, send and receive. Prices vary in the various stores as might be expected. "Big Daddy," the Model 19, generally can be located for under $100, and this provides for punching and transmitting tape while waiting for the other guy to stand by or for calling CQ, and thereby impressing people with your keyboard finesse until the tape runs out and you resume "hunt and peck."

These machines normally are found with synchronous motors and 60 word per minute gears; however, sometimes they are equipped with governed motors and 75 word per minute gears. Stay away from this type of machine, as these governed motors are noise generators and ham communications are at the 60 wpm speed (even though you don't type that fast).

Be seeing you on the green keys! ■

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Build A Drift-free T.U.

-- a quality RTTY demodulator

Since I have an old HRO-60 receiver which has a lot of drift, and since I wanted to copy RTTY with it, I had to find a circuit which would be easy to tune and compensate for the drift. I also required the facility to reverse the mark-space sense when coupled to a transceiver.

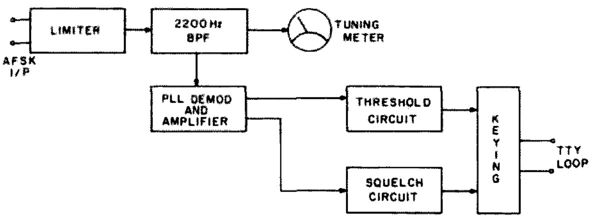

Fig. 1. Block diagram of RTTY demodulator.

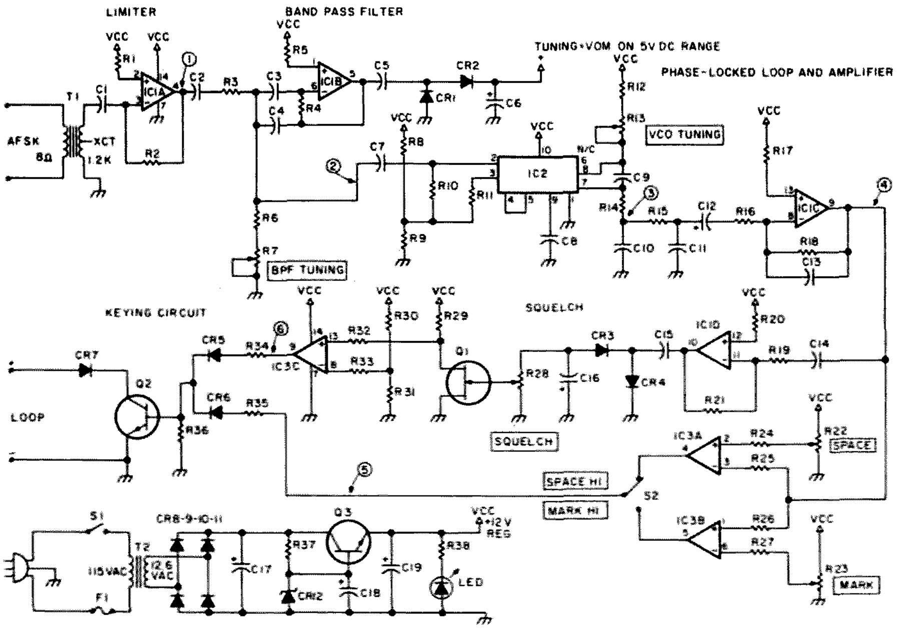

Fig. 2. Schematic.

The following circuit which was developed has the following characteristics:

1. Narrow shift detection;
2. Easy to tune;
3. Reversible sense;
4. Good signal to noise characteristics;
5. Auto mark-hold;
6. Easy to obtain parts;
7. Easy to adjust.

Block Diagram Operation (see Fig. 1)

Limiter: The audio from the receiver is hard limited to compensate for fading signals. The limiter will operate at approximately 1 volt peak-to-peak input and applies an 11 volt peak-to-peak square wave to bandpass filter.

Bandpass Filter: This has a center frequency of 2210 Hz and a "Q" of 10. The purpose of the filter is to improve the signal to noise ratio and to discriminate between close signals. There are two outputs: the high level output is used for the tuning indicator and the low level output is applied to the phase locked loop demodulator.

Phase Locked Loop: An LM565 is used to convert the AFSK tone to a varying dc level. The dc level is approximately +10.5 volts and changes by 50 mV in step with the mark-space shift. An amplifier stage is required to increase the shifted level to approximately 11 volts peak-to-peak. This is applied to two circuits, the threshold circuit and the squelch circuit.

Threshold Circuit: Consists of two comparators which determine if the shift meets predetermined limits. The outputs of the comparators are connected to an SPDT switch to enable sense selection. The comparator circuits are used to differentiate the amount of shift on a noisy signal and a good signal.

Squelch Circuit: Noise for the squelch circuit is derived through a differentiator from the phase locked loop amplifier. The noise is rectified,

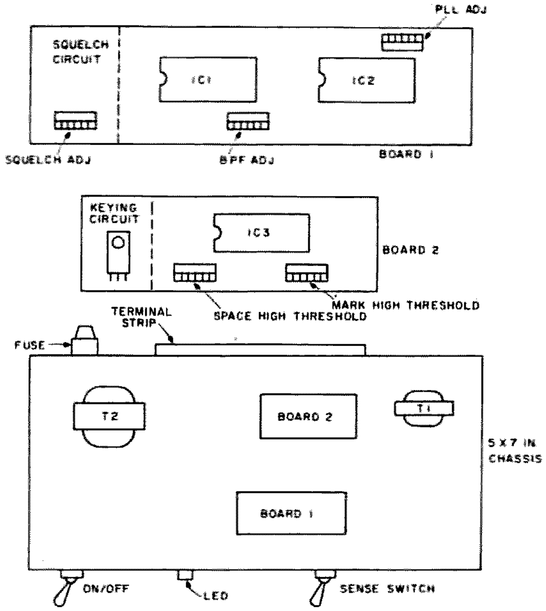

Fig. 3. Layout.

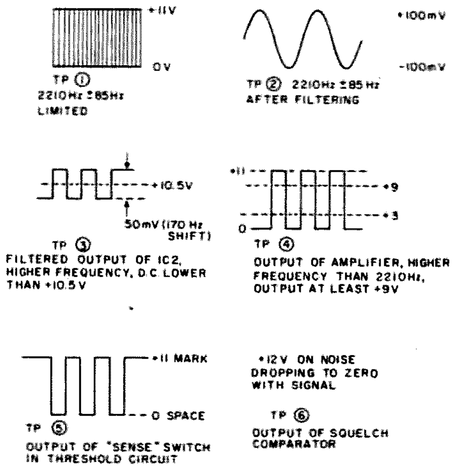

Fig. 4. Test points.

and controls an FET which produces a dc level which is +12 volts on noise. This is to prevent the teleprinter running "open" on noise or static crashes.

Keying Circuit: The output of the threshold circuit is applied via an OR gate to the keying transistor. The output of the squelch circuit is applied to a comparator which is used as a switch to disable the keying signal from operating the keying transistor. If the noise is greater than the signal, the keying transistor will continue to conduct, causing a mark-hold configuration. If the signal is greater than the noise, the squelch output goes LOW, enabling the keying transistor to follow the mark and space levels from the threshold circuit.

The schematic diagram is seen as Fig. 2.

Construction

The complete demodulator was built on two IC type Vero boards with a layout similar to Fig. 3.

The sense switch, +12 volt regulated power supply, and the input transformer were mounted on a 5 x 7 aluminum chassis with a terminal strip on the back. The two circuit boards were mounted on the top of the chassis to enable easy adjustments.

Adjustments

The following test instruments are required:

VOM or VTVM;

Dc coupled oscilloscope;

A tape recorder with a good recording of AFSK tones.

(This can be a recording of the output of an AFSK keyer, which can be obtained from your local RTTYer.)

Bandpass Filter Tuning: With the AFSK signal fed into the demodulator, adjust the bandpass filter tuning until maximum smooth deflection is seen on the tuning meter.

Phase Locked Loop: If you have a counter, set the VCO frequency for 2210 Hz at the junction of pins 4 and 5 of the LM565. If you do not have a counter, do the following: Connect a dc scope to the junction of the 1k Ohm resistor and the .47 uF capacitor at the output of the LM565. Adjust the scope so that there is maximum vertical gain and the dc level can still be seen. Use the vertical position control. (*Note: Do not use ac coupling.*) Adjust the VCO frequency until the dc level remains constant

RTTY Demodulator Parts List

C1, C7, C9, C14	.001 disc ceramic
C2	.005 disc ceramic
C3, C4	500 pF 5% polycarbonate or mylar*
C5	.01 disc ceramic
C6, C16	2 uF 25 V dc electrolytic
C8	.01 uF 5% polycarbonate or mylar*
C10	.47 uF mylar
C11, C15	.1 uF disc ceramic
C12	6.8 uF 25 V dc electrolytic
C13	680 pF disc ceramic
C17	500 uF 25 V dc electrolytic
C18, C19	100 uF 25 V dc electrolytic

*to limit the amount of drift due to heat.

All resistors ¼ Watt 10% except as noted.

R1, R5, R17, R20	4.7 megohm
R2, R18, R21	2.2 megohm
R3	1.0 megohm ¼ Watt 5%
R4	2.2 megohm ¼ Watt 5%
R6	7.5k Ohm ¼ Watt 5%
R7, R13, R22, R23	10k Ohm potentiometer, printed circuit type
R8, R9, R15, R30 R31	10k Ohm
R10, R11	4.7k Ohm
R12	12k Ohm ¼ Watt 5%
R14, R37, R38	1k Ohm
R16	3.3k Ohm
R19	150k Ohm
R24, R25, R26, R27 R32, R33	1 megohm
R28	100k Ohm potentiometer, printed circuit type
R29	15k Ohm
R34, R35	3.9k Ohm
R36	10k Ohm ½ Watt 10%
CR1, CR2, CR3, CR4	1N34A germanium diode
CR5, CR6	1N914 silicon diode
CR7, CR8, CR9, CR10 CR11	1N4007 rectifier
CR12	12 volt 1 Watt zener diode
LED	light emitting diode
IC1, IC3	LM3900 CN (National)
IC2	LM565 CN (National)
Q1	MPF 102 or equivalent N-channel FET
Q2	High voltage silicon NPN transistor (Sylvania ECG 228 or equivalent)
T1	1.2k Ohm center-tapped to 8 Ohm transistor type output transformer used backwards.
T2	115 V ac to 12.6 V ac ½ Amp filament transformer
F1	½ Amp fast blow fuse and holder
S1	SPST on-off switch
S2	SPDT sense switch

Miscellaneous

5 x 7 chassis, terminal strip, #6-32 nuts and bolts, insulated spacers for #6-32 to mount boards on chassis, holder for LED

with and without the AFSK input signal. You should also see the 50 mV shift in time with the mark-space frequencies.

Threshold Detector: The SPACE threshold potentiometer wiper should have +9 volts dc to ground, and the MARK threshold potentiometer wiper should have +3 volts to ground. These can be readjusted from on-the-air signals for minimum distortion and glitching of the copy.

Squelch Circuit: Connect the demodulator to the receiver and the teleprinter loop circuit. With the receiver picking up noise, adjust the SQUELCH level potentiometer until the machine just stops printing the noise. Different atmospheric and domestic noise may require more or less squelching action.

Operation

Very simply tune the receiver onto a RTTY signal until the tuning meter indicates a maximum. The teleprinter should start printing. If the copy is garbled, switch to the opposite sense. Fine adjustments may be required to the threshold circuit to produce glitch-free copy, but I found the +9 volt and +3 volt levels to be good enough.

Conclusion

This demodulator has been in operation at my location for over 4 months. It has copied very well through the local line interference and fading of the 20 meter band. With the Swan 350, on 20 meters I use MARK HIGH, and on 80 meters I use SPACE HIGH. The waveforms in Fig. 4 can be seen at the points indicated during normal operation of the demodulator. ■

Reference

National Semiconductor Linear Applications, 1973 copy, LM3900 and LM565 sections.

Noise Rejector

- - great for CW or phone receivers

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Here is another version of the outboard noise and interference-rejecting circuit for both phone and CW. It is an accessory aid to even the most modern of receivers. The unit is widely variable and flexible, doing a real job under difficult on-the-air conditions for which the unit was designed.

Throughout my more than forty years of hamming, I have tried many types and combinations of both simple and complex filter circuits, to find that indeed they all do some specialized job. But this circuit has proven to be simple, most effective, and a pleasure to build and use, providing much-needed QRN-QRM rejection and cutting background noise to almost nothing. Of equal importance — it is cheap and dirty. No doubt every ham has the components in the junk box, or can get them at the local electronics surplus store. This simple and straightforward circuit produces surprisingly effective results. The unit has only three controls: a 4-position rotary switch to select desired combinations of the noise-limiting diodes, an af filter notch control, and a tone control.

The unit is to be plugged into the receiver's headphone jack; the unit's output jack can take either phones or speaker. The circuit input begins by cutting sharp and heavy noise pulses in three steps with the 4-position rotary switch. The three diode combinations handle progressively more severe noise pulses.

This is followed by the af filter, which is simply an af T-notch circuit, a smoothly adjusting type, being quite effective in limiting the af passband over a sufficient range for both phone and CW uses. This filter is without any of the ringing of some filter types. The inductor is an 88 mH toroid, a common item. This part of the unit is also noise-limiting.

The filter is followed by an audio peaker circuit in order to overcome insertion losses of previous circuitry. The peaker restores the audio level back up to desirable level.

The output of the unit incorporates an old-fashioned and long-employed circuit to cut still other types of noise and adjust and clear up received signal problems: an ordinary tone control circuit. It is remarkable how much this simple circuit modifies signals and atmospheric conditions.

Try this simple unit on the workbench some evening, and see if it isn't a delightfully cheap and dirty way to enhance receiver performance and utility. Its noise control makes possible 160 meter operation all through the QRN season of the year, and I have been able to stay on the air on 160 in particular when others QRT because of atmospheric and Loran QRN and heavy QRM.

The unit is housed in a 6" x 3" x 2½" utility box. ■

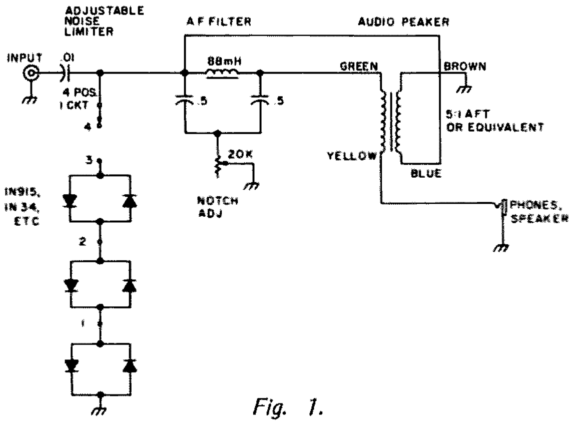

Fig. 1.

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RTTY CRT Tuning Indicator

-- still the best method

Tuning your receiver until the teleprinter stops printing Greek and starts printing English is one way to tune in a RTTY signal, but it obviously leaves much to be desired. The ST-6, with its "plus-plus" tuning meter, is a step in the right direction, but valuable information is lost using this method. One of the oldest, and still one of the best, methods makes use of a CRT display.

With the aid of the CRT display, one can tell at a glance if the station is narrow or wide and, with a little practice, can estimate how wide or narrow the station might be. In addition, the display depicts possible trouble with the discriminators in the demodulator. For example, if either the mark or space LC tuned circuits have changed, believe me, you'll be the first to know. If the other station is transmitting upside down signals (mark and space frequencies reversed), the CRT display will show this condition vividly. The phenomenon of selective fading, in which one signal, mark, or space is attenuated more than the other, is also readily seen. In addition, the CRT display is an excellent coarse tuning indicator. It enables one to tune in a station rapidly and then to fine adjust the signal using the ST-6 tuning meter. In general, the ST-6 tuning meter and the CRT display are not redundant – they actually complement each other.

Theory

Before we go into a description of the circuit, it would be wise to give some background information.

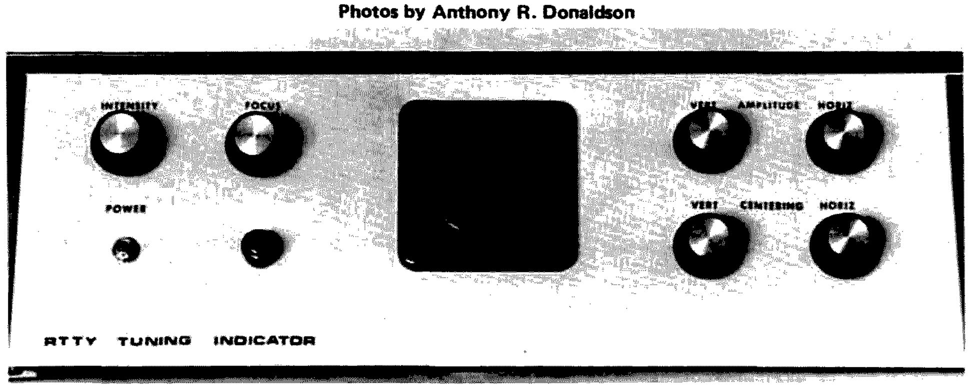
By convention, the mark signal is displayed horizontally, and the space signal is displayed vertically. There is, of course, no particular reason why the mark signal could not be displayed vertically and the space signal displayed horizontally.

A theoretically perfect display would show the mark signal as a perfectly horizontal straight line. The space signal would be shown as a perfectly vertical straight line. In the real world this is hardly the case. Because the bandwidth of the mark and space tuned circuits is rather broad, at least in the case of the ST-6, some of the mark signal gets into the space tuned circuit. The result is two ellipses rather than two straight lines. For this reason, when tuning in a station, one should ignore the minor axis or width of the ellipse and tune the receiver for maximum amplitude of the major axis.

Theoretically, these ellipses would be perpendicular to each other. Returning to the real world once again, we find this is not the case. Because there is a phase difference between the mark signal induced in the mark tuned circuit in the demodulator and the same mark signal induced in the space tuned circuit, the major axis of the mark ellipse is not horizontal. For the same reason, the major axis of the space ellipse is not vertical. In my case, I have found the major axis of the mark ellipse to be approximately -30 degrees off the horizontal axis and the major axis of the space ellipse to be approximately 20 degrees off the vertical axis. It is possible to add additional filtering to both the mark and space signals to approach the "perfect" condition of two perpendicular straight lines; however, this detracts from the display because one loses information in the process. For example, if the tuned circuits in the demodulator should shift slightly, chances are the display will not see the shift because of the extra filtering.

When constructing this project, you should be aware of one possibly critical point. Stray magnetic fields may deflect the spot, making it impossible to focus the spot to a fine point. For this reason, care should be exercised to keep the CRT as far as possible from transformers, especially the filament transformer. If you should be unable to focus the spot to a fine point, wrapping the CRT in iron or steel of high permeability should alleviate the problem. Tube type demodulators, such as the TT/1, will not require additional amplification to drive the CRT. However, more and more amateurs are building solid state demodulators such as the ST-6. The nominal mark and space

Photos by Anthony R. Donaldson



CRT RTTY tuning indicator.

signal from one of these units is 1.5 volts, hardly enough to drive the deflection plates of the CRT, which typically require a 30 volt signal for full face deflection. The objective, then, is to provide enough amplification to drive the CRT. There is, however, one other requirement of the design; it must have an extremely high input impedance. The reason for this is simply to prevent the loading of the mark and space discriminators in the demodulator. Fig. 2 shows the 741 operational amplifier connected as a noninverting buffer amplifier. In this configuration it will provide a modest voltage gain of 2 and have an input impedance well above 100 megohms. If the output from the demodulator is much less than 1.5 volts, additional amplification may be required. This is easily accomplished by changing the 47k feedback resistor connected between pins 2 and 6 of each 741 amplifier to 100k to obtain a gain of 3, or to 150k to obtain a gain of 4. The output of the 741 is capacitively coupled to a high voltage amplifier used to drive the CRT. This stage makes use of a high voltage transistor and, installed in the circuit, exhibits a voltage gain of 10. From there, the signal is applied to the electrostatic deflection plates of the 2AP1-A CRT. The 2BP1 is another CRT that works well in this application; however, it is not pin for pin compatible with the 2AP1-A.

High Voltage Power Supply

The high voltage power supply schematic shown in Fig. 3 provides the necessary voltage (270) for the deflection plates of the CRT, as well as the voltage (130) for the high voltage amplifier. The voltages are not critical, but is important that the ripple voltage be low. The supply is connected as a simple half wave rectifier with a goodly amount of capacitance on the output to reduce ripple.

Low Voltage Power Supply

If you have an ST-6, you can use the plus and minus 12 volt power from it like I do. Should this not be the case, Fig. 4 shows a power supply that may be used.

Adjustments

Turn the power on and, assuming there is no smoke, ascertain that the focus, intensity, and centering controls are working properly. Since there is no signal at this time, only a simple spot should appear on the CRT face. As previously mentioned, inability to focus the spot to a fine point may be indicative of stray magnetic fields.

Connect a voltmeter to test point 1 (T.P.1). If the voltage is not 65 volts (one half of 130), try different values of RV until the T.P.1 voltage is 65 volts. The purpose of this step is to center the signal so that it will be able to swing equal amounts on either side of this reference. If the bias were not set in this way, one side of the sine wave would be clipped, causing distortion. An identical procedure should be used for T.P.2. Different values of RH are used, until the voltage at T.P.2 is 65 volts. I found RV to be 150k, and RH to be 180k in my unit.

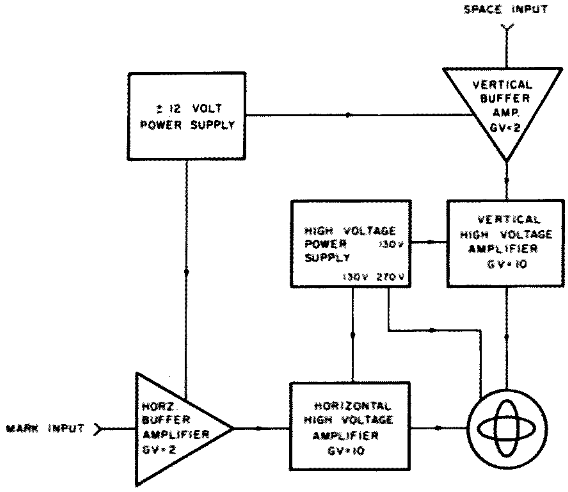


Fig. 1. Block diagram.

In case you have gotten used to working on circuits with the power on, because they were low voltage circuits (e.g., TTL circuits), I wish to remind you that the voltages in this unit are lethal. Turn the power off, and make sure the energy stored in the capacitors has dropped to zero before trying new values for RV and RH.

The next step is to position the CRT properly. This is accomplished by supplying a one volt audio signal (approximately 2 kHz) to one input and then the other. One should find a straight line is produced in each of these tests and that they are perpendicular to each other. The purpose of this step is to identify the position of the vertical and horizontal deflection plates. With the power off, rotate the CRT so that when the signal is applied to the mark input, the straight line on the CRT face is horizontal.

Tuning with a Scope

Tuning with a scope is a quick and simple process. The vertical and horizontal amplitude controls may be set by the individual to produce a display that nearly fills the face of the CRT screen; however, the two controls should be set to

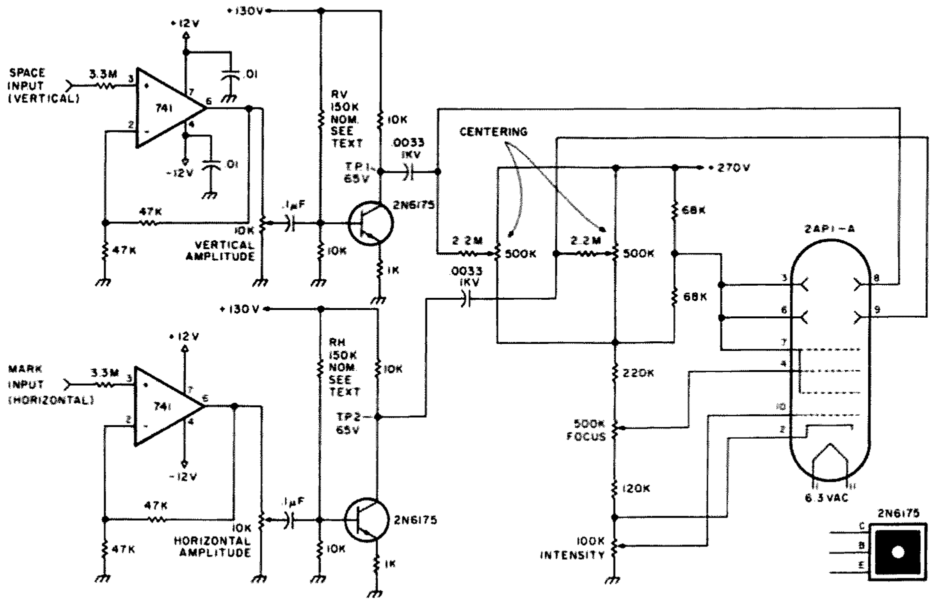
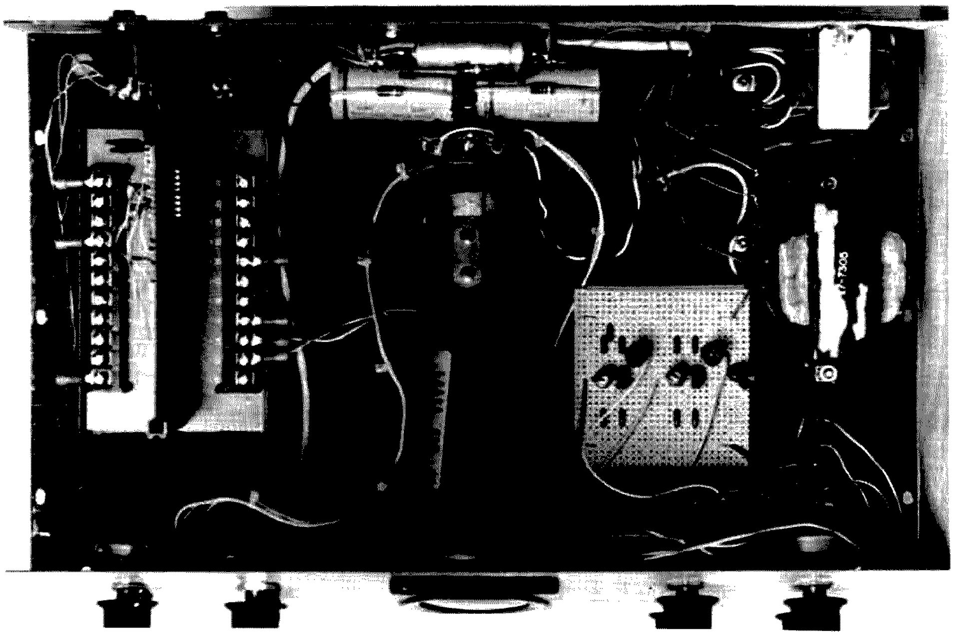


Fig. 2. CRT RTTY tuning indicator circuit.



The high voltage amplifier is located on the perforated board. The low level buffer amplifier is constructed on a PC board and is shown in the card holder. The low voltage power supply is not shown in this photo.

identical positions to give an accurate display. As previously stated, one should tune for the maximum amplitude of the major axis of each ellipse. If the shift of the station and the discriminators are identical, both amplitudes will peak at the same time. If the station is wide of narrow, one should tune for equal amplitudes even though they are not maximized. This method, called straddle-tuning, is perhaps one place where the ST-6 "plus-plus" tuning meter is superior. A typical application of this technique is found in tuning in commercial 425 Hz shift stations with 850 Hz discriminators.

One last note: When you tune in a station, it is best to have the limiter on (FM); once the station is tuned in properly, the limiter may be turned off (AM) if desired.

Conclusion

The CRT RTTY tuning indicator described in this article has been in use for over a year with no problems. The display provides a quick and accurate method to tune in a RTTY station. In addition, this method gives a great deal of information, much more than any simple meter could.■

References

1. "Improved Scope Display," Irv Hoff, ***RTTY Journal***, October, 1974.

2. ***Specialized Communications Technique for the Radio Amateur***, American Radio Relay League, First Edition, 1975.

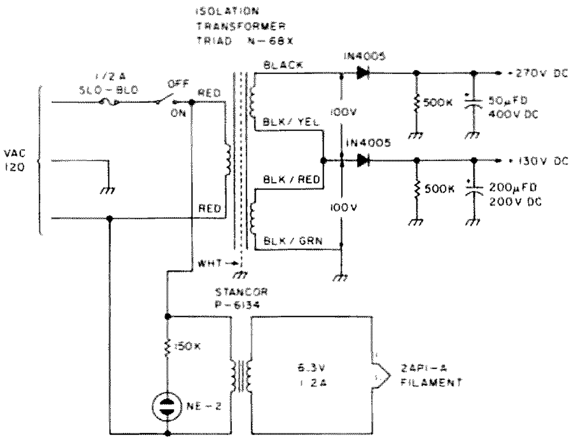


Fig. 3. High voltage power supply.

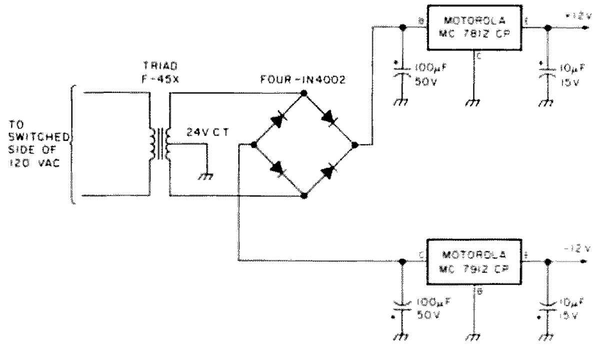


Fig. 4. Low voltage power supply.

EDITORIAL BY WAYNE GREEN

from page 64

. . . and then, after that, never acknowledge that his audio is being heard . . . etc.

With a little experience, *you* can write the book . . . and please do write to *73* and tell all of us what works and what doesn't work.

In case you get some hard ones . . . and you may . . . it doesn't hurt to have a fox hunting team with some practice. Get those Sunday morning fox hunts going. We're looking for articles on fox hunting equipment and techniques, by the way.

INSTRUCTOR'S GUIDE

It is a little scary at first to accept the responsibility for teaching a class of prospective Novices. It does get easier as you get into it . . . but there is nothing like a guide to the forest before you enter it.

We have such a guide available.

One amateur has been responsible for more other amateurs getting their licenses than anyone else . . . a chap named Bill Welsh W6DDB out in beautiful (?) Burbank. He's been at it for over twenty years, and has turned out thousands of hams from his classes. Bill has written a great guide for the instructor, and it is invaluable for anyone getting into this field.

Bill discusses the equipment and materials needed . . . the classroom requirements . . . the library that will help . . . the code . . . preparing the course . . . certificates . . . and finances.

This *Instructor's Guide* is free if you drop by the *73* HQ . . . and costs you $1 for handling and mailing if we send it to you. You won't run into a much better bargain if you're involved in teaching. Send $1 for *Instructor's Guide, 73 Magazine*, Peterborough NH 03458.

HAMFESTS – DAYTON . . .

The Dayton Hamvention was well attended this year – probably a little better than last year, though it was difficult to tell from inside at the exhibit booths because it seemed a little less crowded there. It's possible that the expanded flea market drew

Continued on page 175

73 Magazine *Staff*

Cassette-Aided CW and RTTY

- - inexpensive message storage

The "in" thing today is to use IC memories for functions such as routine CQs or special calls on CW, ID functions, RTTY test messages, etc. But, for individual station use, there is still a lot to be said for the use, for these functions, of a compact cassette recorder once it is equipped with the proper interface and signal conditioning circuits to handle digital data. Such recorders are inexpensive, reasonably reliable and can be used for both digital type signals and voice signal recording/playback. Unlike some IC memories where the data in memory is lost when the power is removed, there is no need to reprogram the memory (the cassette) of such a recorder every time it is used. A situation that particularly enhances the use of such recorders is the recent availability of endless loop cassettes at a reasonable price. Although such cassettes were available before from Phillips, they were relatively expensive. But now the Japanese have done it again, and such endless loop cassettes in a variety of loop times ranging from 20 seconds to 12 minutes long are available for $4-$5 from outlets such as Lafayette Radio. The shorter duration tapes (not the 12 minute one!) allow for a CQ call to be made on CW, a pause of 10-15 seconds to check for replies and then more repeats of the call. With a station wired for semi-break in, the operator only has to listen for replies at the right time. The tapes can be used in the same way for a phone station equipped with VOX.

Recording and playing back speech transmission is no problem with a cassette unit, although it is better to use the station microphone rather than a cheap cassette type. Also, it is worthwhile to pay a bit of attention to room acoustics and make the recording as good as possible. After all, the recording need not be made at the station location, but where conditions favor the recording process.

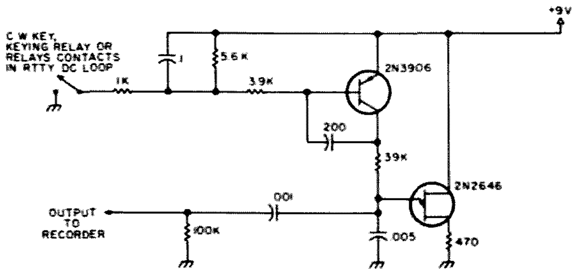


Fig. 1. Signal conditioning circuit for recording produces a keyed sawtooth signal at approximately 5 kHz.

Recording and playing back CW or RTTY transmissions requires conditioning circuits. Poor results will usually be obtained if one just audio records the output of a CW sidetone monitor, for instance, and uses the audio playback to activate a relay. A very good conditioning circuit for CW or RTTY recording and playback appeared some time ago (*Electronics*, April, 1974) and with some slight modifications is shown in Figs. 1 and 2. It has been used with several cassette units with good results. The circuitry has the advantage of using inexpensive components; it may be built inside most recorders and powered from the recorder's internal power supply.

Fig. 1 shows the record mode input circuit. The keyed signal is filtered to remove contact bounce and then it is used to turn on the 2N3906 stage which in turn gates the 2N2646 sawtooth oscillator. The 200 pF between the base and emitter of the 2N3906 is rf bypassing in case a transmitter is also keyed as a recording is made. The 2N2646 operates at about 5 kHz. If this frequency is too high for some inexpensive recorders, the .005 mF capacitor in the gate of the 2N2646 may be raised to .01 mF. The output is fed to a high impedance input or, if the recorder does not have such an input, to a low impedance input via a 470k resistor. In the latter case, it can be permanently left connected since it will not affect voice recordings.

The playback conditioning circuit is shown in Fig. 2. The recorded tone is rectified by the 1N4148 and applied to an

RC timing circuit. The decay voltage developed across this network, when the tone is removed, is used to turn on the 2N3904 and 2N3906 stages. Both transistor base-emitter junctions have 200 pF bypass capacitors across them for rf protection. Keep these leads as short as possible. The output of the 2N3906 stage may be used to drive a reed relay, as shown, or the relay may be replaced by a resistor. The positive voltage across the resistor which is developed during key down periods can then be used to drive the appropriate IC or transistor stages in an electronic keyer. The RC timing combination of .01 mF and 39k should be right for most CW keying and RTTY speeds. However, if clean output keying is not obtained at the speed desired, try varying the RC values slightly.

The total cost for the circuitry described should be on the order of \$5. A few endless loop cassettes, if that type is used, will bring the cost up to \$20 or so. But, it still represents a lot of operational convenience, economy, flexibility and data storage room as compared to IC memories. ■

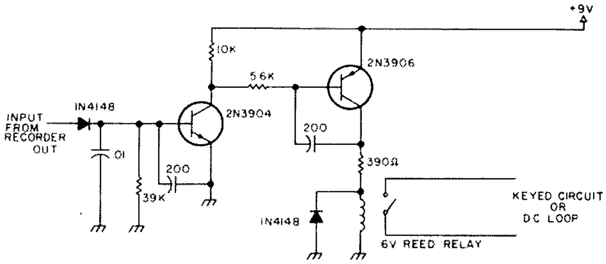


Fig. 2. Playback signal conditioning circuit.

A Practical 2m Synthesizer

-- who said it can't be built?

Michael I. Cohen WA3SYI
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A simple frequency synthesizer for use with amateur 2m radios is described below. It features portability, using state of the art CMOS construction, and it draws only 18 mA. A phase locked loop (PLL) is employed to achieve precise high purity output. The entire PLL circuitry includes only five transistors and four integrated circuits for low cost and small size. Most of the required parts are readily available from Radio Shack, including much of the CMOS logic and the circuit board. Coverage of the synthesizer is 140-150 MHz in 5 kHz steps. Frequency input may be obtained directly by thumbwheel or lever switches or indirectly by miniature keyboard and encoder. The keyboard encoder may be built from CMOS chips and includes an LCD readout and scanner. This circuit operates on only 0.4 mA total current draw. The synthesizer described here was built on a single board with favorable results. It draws a total of 20 mA and measures 4.5" x 5.0" x 2.4" overall. This synthesizer will interface directly to the Drake TR33C and to the Heathkit HT with minor modification.

The one I built fits right on the top of my TR33C with Velcro holding it in place. It is connected to the rig by a single length of RG-174/U cable, using the auxiliary jack on the back of the radio. The unit goes on and off with the TR33C, so there is no need for a separate ON/OFF switch on the synthesizer.

Photos by Michael A. Gray

The completed synthesizer with Drake TR33C transceiver.

Schematics

Fig. 1 shows a block diagram of the PLL synthesizer. This diagram shows the frequencies for 144-148 MHz, although these are not the limits of coverage. The diagram in Fig. 1 illustrates that the input frequency to the system is the reference signal. It is one input to the phase comparator. The other input to the phase comparator is the i-f ÷N, which varies directly with the VCO since the LO and N are constant. The phase comparator outputs a correction signal that is applied to the VCO through a low pass filter. The digital edge triggered-phase comparator used here will maintain inputs of both frequency and phase coherence at lock. Thus, the lock range is the capture range, and locking on harmonics is not possible.

Fig. 2 is a complete schematic of the PLL frequency synthesizer. Also shown are TR33C and Heathkit HT interface modifications. Synthesizer power must be regulated. The power supply is a 723 precision regulator. The 723 is wired with no external components. Consequently, the chip reference voltage of about 7.15 volts becomes the output voltage for the synthesizer. The 723 offers high ripple and noise rejection. Three terminal regulator substitutes are not recommended if any mobile operation is planned where alternator whine may become a problem.

The VCO is a grounded base Colpitts oscillator. It offers high stability and separate outputs for the rig and mixer buffers. L1, C1, and the varactor diode comprise the tuned circuit. C1 may be made variable to adjust the VCO center frequency and L1 fixed. Both L1 and C1 can be made variable so that both the spread

(L1) and center frequency (C1) of the VCO are adjustable. However, such control is not necessary. The rig buffer is a broadband amplifier. The load inductance is taped to match the cable going to the radio.

The VCO-to-mixer buffer is a single CMOS quad NAND gate chip. Each gate is wired as an inverter and is biased up for linear operation. This buffer configuration offers the following advantages: excellent reverse isolation from the mixer, four stages, low current draw, high input impedance, and few parts count. The mixer is a dual gate MOSFET with a resistive load. The dual gate MOSFET offers good isolation between the VCO and LO signals. However, drive to this stage should be the minimum required at each input to reduce crosstalk as much as possible. Following the mixer is an i-f amplifier. A grounded emitter circuit is used to achieve the high gain required to produce a CMOS compatible square wave i-f output. The reference oscillator and divider are obtained using a single CD4060 RCA CMOS chip. This reduces component count and simplifies wiring, although it may increase the cost a little.

The local oscillator employs a JFET for high stability and low current operation. As can be seen, the LO has a switchable capacitor to shift its frequency slightly. This is how the 5 kHz steps are implemented.

The divide-by-N and phase comparator are combined on one Hughes CMOS chip. The phase comparator is of the digital edge triggered type, so the duty cycles of the incoming signals are not important. The divide-by-N portion accepts three BCD and one 7 bit binary number, which are added together to form the final division integer. The binary inputs may be used to generate offset splits between transmit and receive, but only the BCD

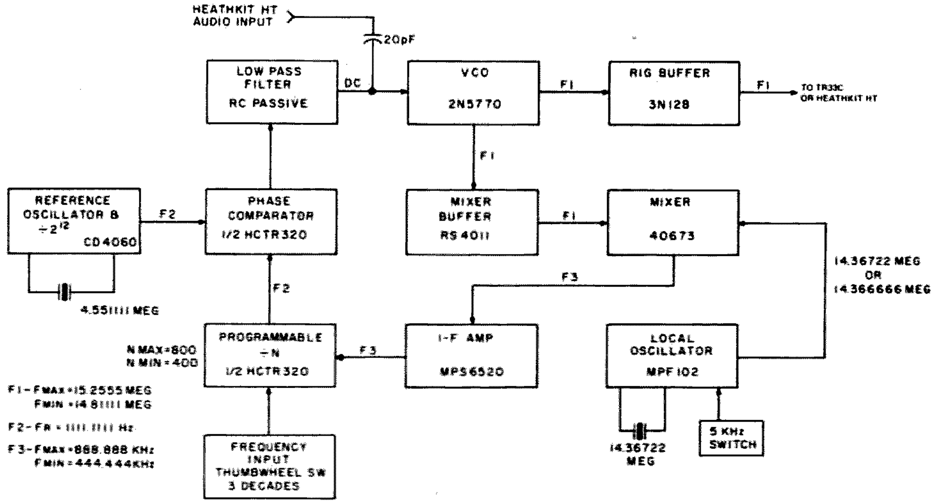


Fig. 1. Block diagram of the PLL 2m synthesizer showing the frequencies for 144-148 MHz coverage with TR33C.

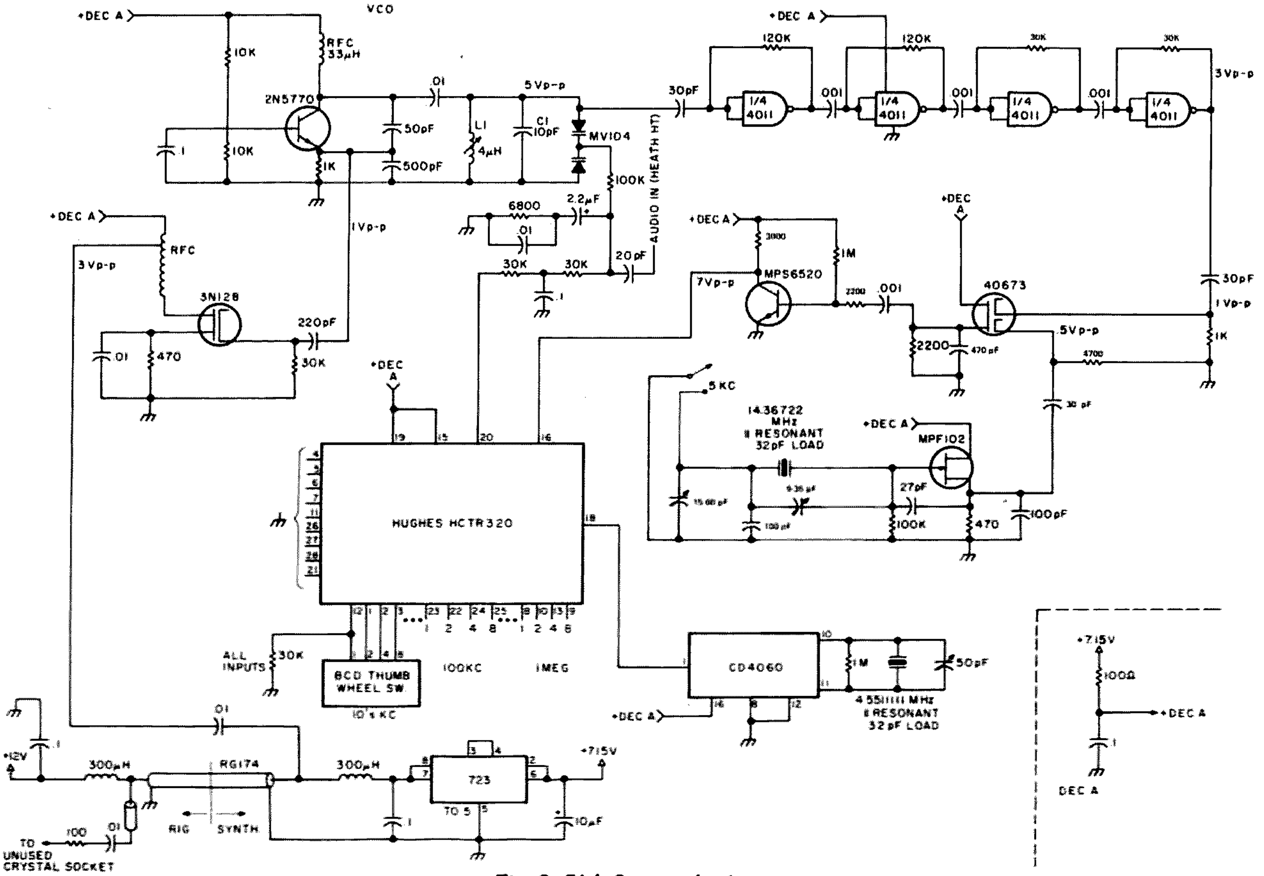
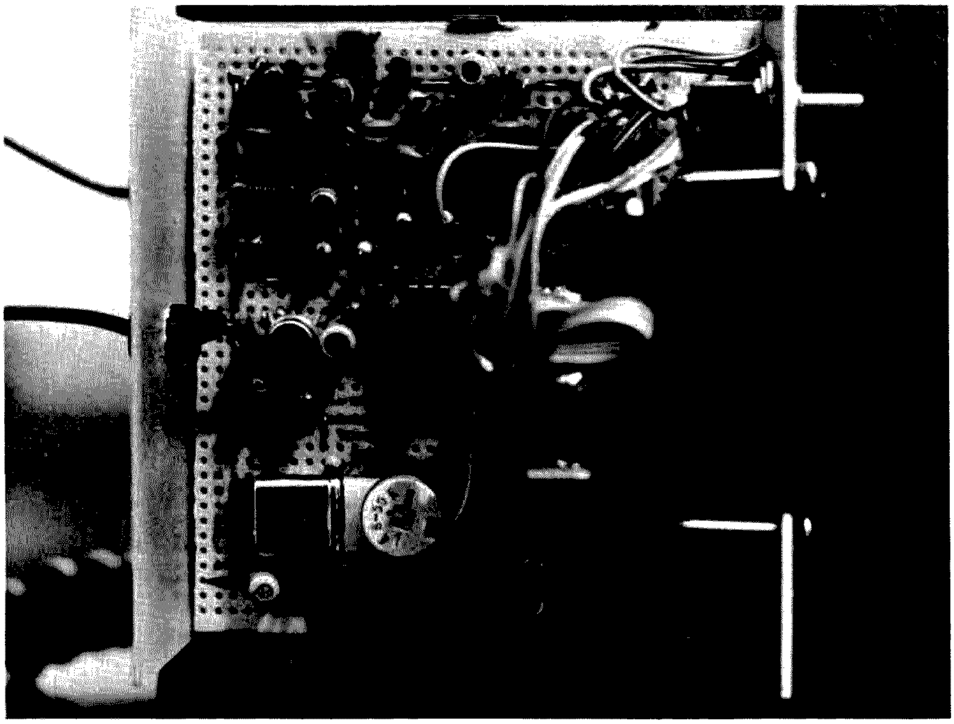


Fig. 2. PLL 2m synthesizer.



Top view of the synthesizer. Reference oscillator is located in the lower left portion of the perfboard.

inputs are used here and the binary inputs are all tied to ground. Also employed on the chip is a Schmitt trigger input for the i-f. The output of the phase comparator is filtered by the passive low pass filter and applied as input to the VCO in order to maintain lock.

Construction Tips

Either single or multiple board construction of the PLL synthesizer is possible. I used a single board approach employing the IC breadboard available from Radio Shack (#276-154). If a single board is used, then the component layout must be carefully planned. I put the VCO and LO on opposite corners of the board to help isolate them from one another. Fig. 3 illustrates the stage layout used. Before soldering the components in place, I arranged them for shortest lead length and fewest required jumpers. All stages must be either RC or LC decoupled from the supply line. RC decoupling is effective and less expensive then LC decoupling. The importance of having a sufficient ground plane cannot be overstated. If the Radio Shack breadboard is used, the ground plane must be provided after the PLL is operational. This is accomplished by cutting a piece of single-sided, copperclad, prepunched board to the same dimensions as the breadboard. Then ground leads are soldered at every stage on the breadboard to protrude from the copper foil side. These bare wires are then aligned with their corresponding holes on the copperclad perfboard. The two boards are sandwiched together and the numerous ground leads soldered to the perfboard ground plane as shown in Fig. 4. Also, hobby store "solderable tin" may be used to make stand-up shields between the rf stages.

If a multiple board arrangement is used, then the LO and reference oscillator should share their own circuit board as proposed in Fig. 6. The VCO and its buffers also comprise a sensible board. A preferable method would be to install the VCO and its buffers in a shielded box if space permits. In any configuration, the VCO components should be glued in place and its circuit board acoustically decoupled to minimize microphonics. Double-sided foam tape works well for this purpose. Braided strap should be used to make interboard ground connections. This strap is called slot car pickup cable in hobby stores.

Toroids are preferable to tubular inductors, and their use is encouraged if possible. This will help make the circuit less susceptible to nearby rf fields.

Alternative Stages

Every stage has a suitable alternative. The rf section works quite well, so I won't recommend any changes there. However, you may wish to substitute different transistors for the VCO, i-f amp, LO, or rig buffer. For the VCO you want a transistor with a low output capacitance and medium gain. The i-f amp should have a garden variety high gain device with low leakage current. Almost any JFET will work for the LO with the appropriate biasing. A JFET may also be substituted directly for the MOSFET shown as the rig buffer with little difficulty.

The Hughes HCTR320 synthesizer chip was selected to conserve board space, to reduce component count, and to simplify wiring. However, if board space is not a problem for you, or if you have difficulty obtaining this chip, it may be replaced by two readily available chips as shown in Fig. 5. The

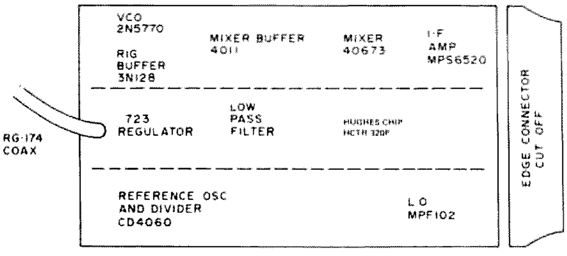


Fig. 3. Single board synthesizer layout using Radio Shack breadboard and Hughes synthesizer chip.

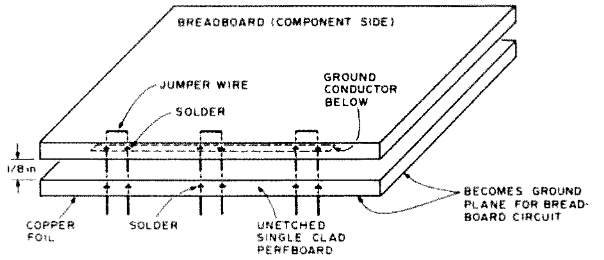
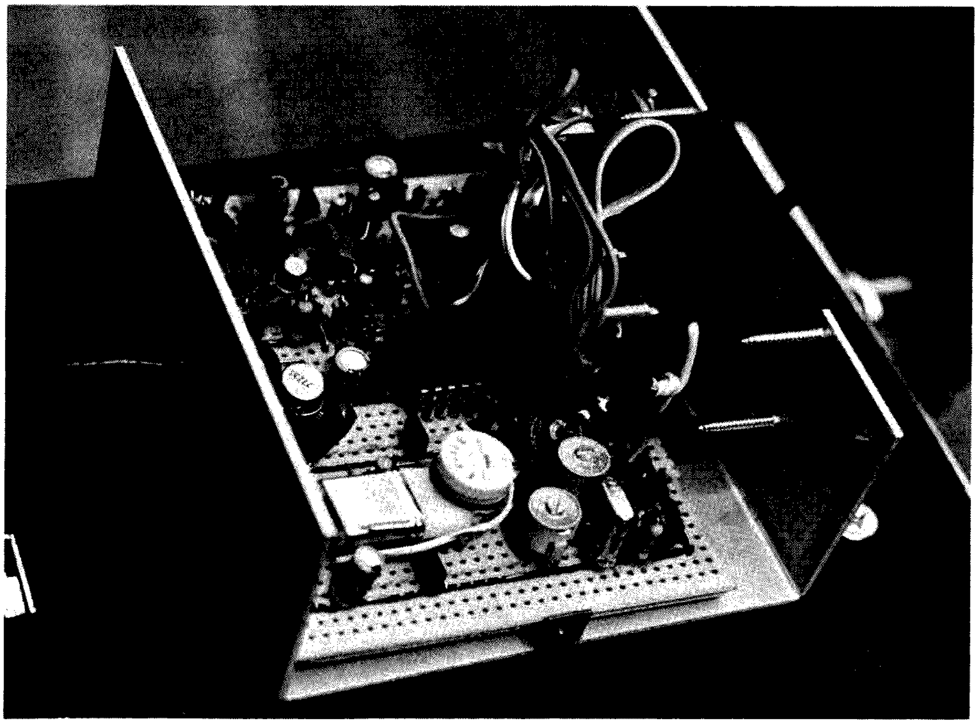


Fig. 4. Method for supplying a ground to breadboard circuits.

divide-by-N function is now handled by the RCA CD4059 programmable divider, and the phase comparator is obtained using two type D CMOS flip-flops. Alternatively, the phase comparator number two on the CD4046 phase locked loop chip may also be substituted for the digital edge triggered type called for above. It should be noted that, if the Hughes chip is eliminated, an additional stage of i-f amp may be required to properly condition the i-f signal for the CD4059 counter.

Troubleshooting

Not much difficulty is anticipated in getting the PLL operational. If something is amiss, start with the VCO. Verify the output amplitude and frequency as well as range of the VCO. Make sure that you have not forgotten the 100k Ohm resistor between the loop filter and the VCO. Check the signal levels at the mixer inputs. Verify that the local oscillator is working properly. Once the mixer is operational, check the i-f amp for a high amplitude clean output. Check the output of the divide-by-N chip to see if the chip is responding to the i-f signal. If it is not, then adjust the i-f amp components until an acceptable signal is presented to the divide-by-N chip. On the Hughes chip, pin 14 is the divide-by-N output. Once the appropriate signal is appearing at the output of the divide-by-N logic, check to make sure the reference oscillator is working and the divider is generating the required reference frequency. Verify the inputs to the divide-by-N chip and make sure none of the CMOS inputs are floating. Look at the output of the phase comparator with a dc coupled oscilloscope. If the output is saturated, go back to the rf section and start with the VCO to look for the problem. If the output is oscillatory, then you probably just need an adjustment of the low pass filter. Try changing the damping resistor and/or integrating capacitor in an effort to stop the loop from oscillating. If this fails, seek references on phase locked loop low pass filters in the library. The Signetics analog manual has a thorough discussion of the loop filter used here.



Another view of the 2m synthesizer. The complete circuit is assembled using point-to-point breadboard techniques.

Interfacing

The synthesizer will work without modification for the TR33C. This ham uses the Drake Mike Encoder to achieve touchtone capability, which frees the mini jack on the rear panel for synthesizer application. As shown in Fig. 2, the dc supply to the synthesizer goes through the center conductor of a length of RG-174/U coax. In return, the synthesizer sends its rf output back down the same wire and connectors. Thus, there is no inconvenience associated with this synthesizer. The dc supply and rf are isolated by rf chokes at each end, and the rf is coupled by capacitors at both ends. The rf goes to an unused crystal socket in the rig. The dc supply comes from the 12 volt switched line in the radio, so there is no need for an ON/OFF switch on the synthesizer.

The same system used with the TR33C may also be used for the Heathkit HT. However, the TR33C applies the audio modulation to the 10.7 MHz transmit mix-up oscillator so the synthesizer need not be interfaced with audio signals. In the case of the Heathkit HT, audio will have to be applied to the VCO in order to accomplish frequency modulation. This

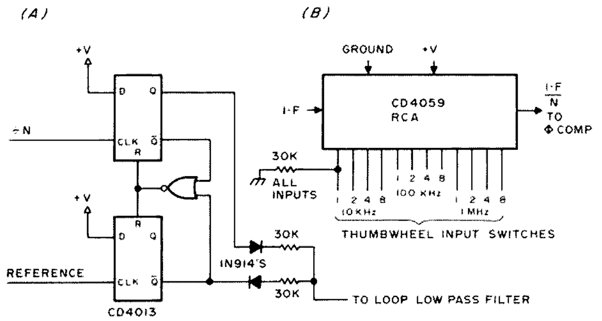


Fig. 5. Alternative digital logic for the PLL synthesizer. a) Phase comparator (CMOS); b) ÷N (CMOS).

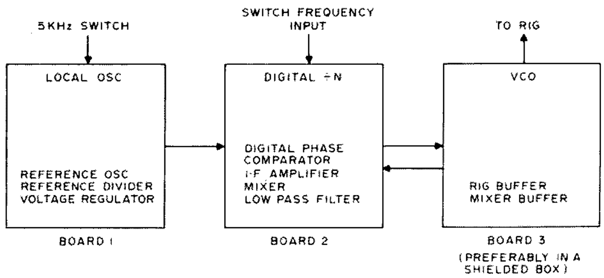
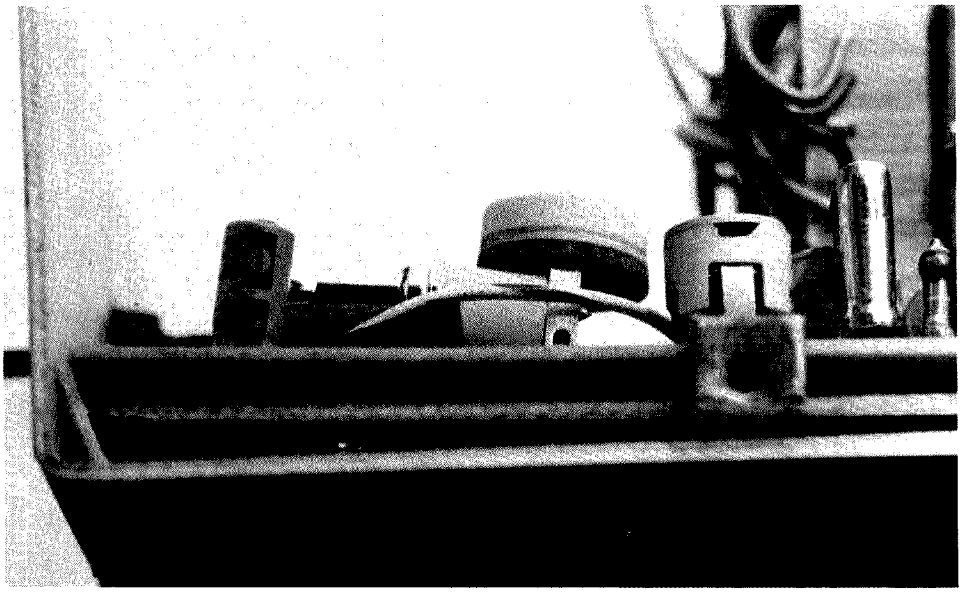


Fig. 6. Suggested multiple board synthesizer.



Close-up of the mounting bracket employed to secure the two perfboards. Oscillator components are visible above the bracket.

connection is shown in Fig. 2.

Of course, the basic synthesizer will work with any radio if the appropriate changes are made. Primarily, these changes involve the mathematics of the phase locked loop relative to the desired application. Tutorial information regarding the design of phase locked loops is available from RCA and Motorola upon request. Some sources are listed as references below. It should be pointed out that spurious responses in the synthesizer may result due to undesired interstage coupling or ground loops. The synthesizer described above offers inherent immunity to this problem. However, extreme layout or ground plane deficiencies can promote spurious interactions in any multifrequency system. It is your responsibility, as a ham, to check for and eliminate any spurious responses in your home brew synthesizer. Therefore, multiple board construction is recommended but is not necessary for the experienced rf home brewer.

A Keyboard Entry System For Your PLL Synthesizer

Here is a CMOS circuit that enables you to have keyboard frequency entry for your 2m synthesizer. It draws only 0.4 mA, has 4.5 digit LCD readout, and a built-in scanner capability. This is a viable alternative to thumbwheel or lever switch frequency input.

The circuit is shown in Fig. 7. It uses a Hamlin 3909 reflective LCD readout available through most Resco stores on order. RCA

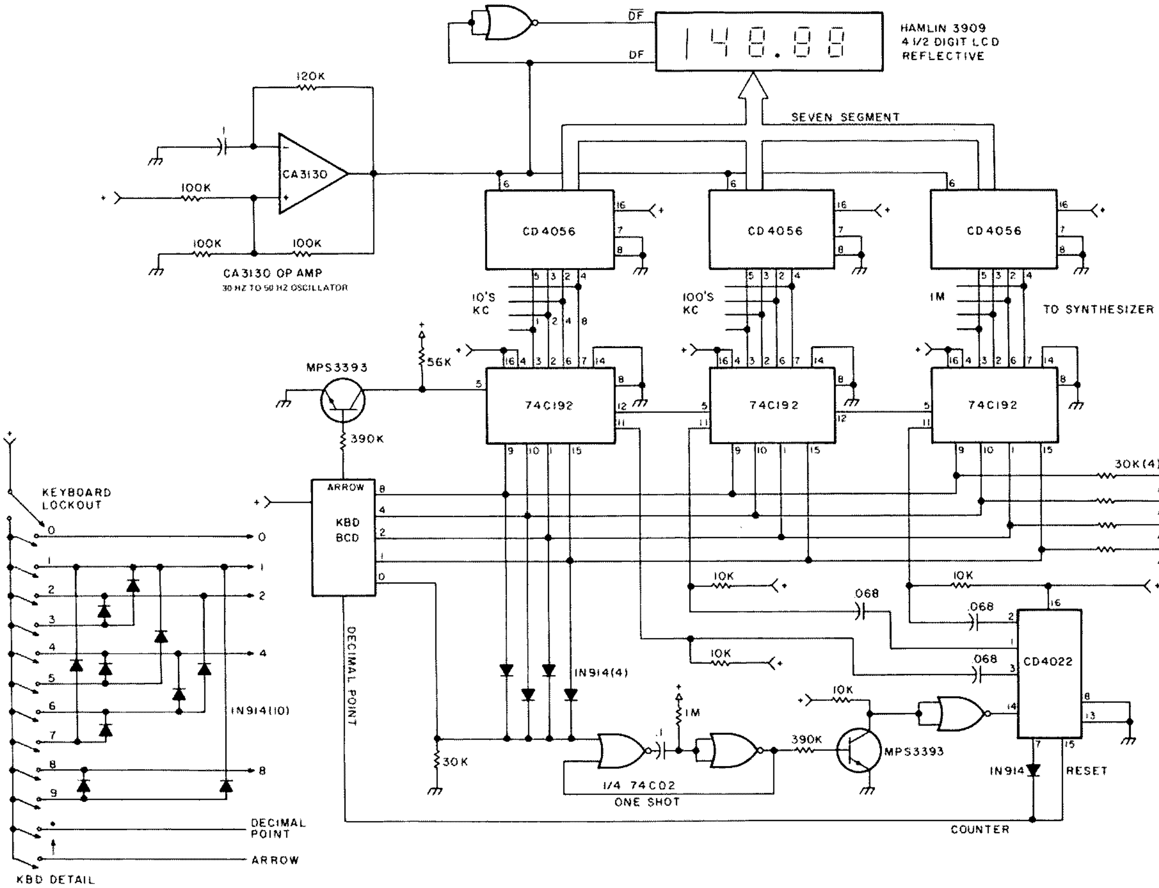


Fig. 7. Keyboard entry system.

CD4056 LCD drivers are also employed. The drivers and display may be replaced by a conventional LED arrangement in the interest of reduced overall cost, if current draw and portability are not important to you. The LCD readout is quite attractive, though, and is of the latest — black on white — FET LCD variety. The numerals are large and clearly visible in bright sunlight.

When a key is depressed, the one shot fires, causing the CD4022 counter to increment. Meanwhile the keyswitch places the appropriate BCD data on the input lines of the 74C192 presettable decade counters. By now, the falling edge of the previous output of the CD4022 causes the load line of one of the 74C192s to become active, thus loading the data into that counter. The load line is restored to an inactive high state before the data is removed from the input lines. The data is then removed after releasing the keyboard switch. The one shot cycles for the next entry. Inadvertent double entries are almost impossible due to the one shot. The cheapest noisiest keyboard switches may be used due to the adjustable duration of the flash picture the 74C192s take of the data lines.

Output from the presettable counters goes to the synthesizer input and to the display decoder-driver. Note that pull down resistors at the inputs of the programmable divide-by-N chip are not required if this encoder is employed, but are required if thumbwheel or lever switches are used. A keyboard lockout switch may be included if the keyboard is located where it is susceptible to accidental entries. ■

References

1. RCA, ICAN 6101, ICAN 6267, ICAN 6498, ICAN 6716.
2. Motorola, AN 564, AN 535, AN 553.
3. *Signetics Analog Manual,* 1976.

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Buying Surplus

-- how to remain sane

Is inflation getting you down? Tired of fighting the high cost of living? Prices are rising everywhere — in the metropolitan area the inflation factor hovers between 10 and 15 percent. Maybe you are thinking of taking up stamp collecting or some less expensive hobby? Don't give up. Help is on the way!

If you are a builder of ham gear, or even if you do a little experimenting, you may be pleasantly surprised to learn that many of your supplies and electronic components can be purchased at discount prices. How? Simply by buying at surplus. Some of these prices taken from a recent catalog may seem high to you: type 1625 tube, $11.25; dc meters, from $15 to $20; relays, $5 to $6. But did you know that these same components can be purchased as new merchandise from surplus sources at prices of $1.25, $3 to $4, and $1 to $2, respectively?

Let me point out that the situation is not all peaches and cream. There are certain factors in the surplus market which should be understood in order to reap the greatest benefit. The most prominent difference in the surplus market lies in the fact that it is not a substitute for the regular electronics dealer who generally offers for sale whatever you may wish to purchase. The surplus dealer is a seller of what he has to offer. Once you have grasped this fundamental difference, you've bridged the gap. If you can utilize some of the merchandise offered by the surplus dealer, tremendous savings are possible.

This proposition suggests a certain flexibility of mind. If a certain component is needed, the chances are good that it can be bought at surplus, but if you insist upon a part made to certain specification, perhaps made only by one manufacturer, then the odds are that you will not see it offered for sale in the surplus market. Also, one should try to put himself in the surplus dealer's shoes, so to speak. To my way of thinking, the surplus shops are roughly akin to the thrift stores presently being patronized by knowledgeable women ... if you can use what's available, substantial economies are possible.

How do you pick a good surplus dealer? If you are located near a large city, why not drop in and see for yourself? If this is not convenient, you can ask for the various catalogs that are available. I have noticed that many of the better surplus houses generally have a supply of such catalogs. In some cases, you may be asked to pay for the cost of mailing the catalog.

With the catalog in hand, you are in a much better position to see for yourself the size, shape and style of what is being offered for sale. Often this helps to clear up any doubtful points that might exist. If you can't find what you need in catalog A, there are others that may carry the wanted item. Sometimes a catalog may offer merchandise in groups of several pieces, all at bargain prices. This economy allows you to buy at the lowest possible cost and still have something left over for the spare parts box. Over the years, I have amassed a fair sized collection of catalogs from various surplus dealers. While I do not believe in favorites, a few outfits have served me without headache or heartache for more years than I care to recall, among them Meshna and Fair Radio. Naturally, there are many other respectable firms dealing in surplus.

Finally, if you should experience any trouble, real or otherwise, in your business dealing with any surplus firm, my advice is quite simple: Holler, loud and clear. Amazingly simple and effective, that formula!

When you order from any mail-order house, it is always wise to state in big, bold letters: No substitutes/no back orders/no credit slips/refund any overage in check or stamps.

Good surplusing! ■

Gary McClellan
1001 W. Imperial Hwy.
La Habra CA 90631

How To Buy Surplus Parts

-- pick a good supplier

Sooner or later even the most dedicated parts scrounger must buy parts for his projects. Some people build equipment using the latest, state-of-the-art semiconductors and parts. They have no choice; they must buy all of their parts, and usually from an industrial supplier at that! But if you are like most people, you fit somewhere in between these extremes. Most projects send you to both the junk box and the local electronics store.

The problem is that you may not be able to get what you want, or you pay too much or too little and don't realize it. Purchasing electronic parts (or anything else for that matter) is an art unto itself. If you pride yourself on quality projects at lowest prices, you'll want to learn more about electronic purchasing. To my knowledge (dating over 10 years), no one has published a good general article on electronic parts buying. Hopefully, this article will be the first!

Actually, this article was prompted by one thing. Readers interested in building some of the construction projects I have published have written to ask how to get certain parts. After reading some of the letters, it dawned on me that not everyone has good sources of supply and that I should write about how to go about getting parts. I might add, at this point, that the techniques I write about were developed during about 10 years at the school of hard knocks. So my methods are based on experience. If there are any professional buyers reading this, I apologize for some of my rather unusual methods!

Before getting into specifics, there are a few things you should do to make your purchasing easier. It is important that you have good suppliers. If you don't, you can waste both time and money running around for your parts. By good I mean suppliers who usually carry the items you need and can be trusted to help when your purchases aren't what you want or are defective. When you find you have a good electronic supplier, be nice to him. And dump the bad ones in a hurry. Here's how to go about choosing your suppliers.

Picking out a good electronic supplier is a job like selecting a reputable car dealer. You first locate him, size him up, and then perhaps buy a car from him. Later you may have some after-sale servicing done, and so on. So it is with the electronics dealer. You want to find him first. Get out the phone book for your area and look under "Electronics." Jot down on a piece of paper the names and addresses of any listings. You are only concerned with *retail* distributors at this point, if you are an individual. Wholesale distributors and some manufacturers may show you the door if you don't have a resale number. (A resale number is a number issued to you by the State Franchise Tax Board. It allows you to buy goods without paying state sales tax. However, you must resell the goods and have the customer pay the tax, or keep the goods and you must pay.) While collecting the names and addresses of distributors, check the phone book of any large city you happen to live by for more prospects. If you happen to live in a rural area, like I once did, give the phone book a glance and then refer to the various mail-order ads in this (and other) magazines.

The next step is to find out what sort of people the dealers you found are and what kind of parts they carry. You may be tempted to skip this part, but don't! You want to know more about your suppliers in order to make better buys. Suppose one dealer had some 7490 ICs for $1.69 each, and another had the same thing for 5 for a dollar. Chances are that if you want that IC, you would walk into the $1.69 place first (revised Murphy's Law). If you were aware of the second dealer, you could have gotten not only that 7490, but 4 others for future projects and paid only a dollar at that! And that is the way it often is in electronics.

In your spare time, pay the dealers nearest to your home a visit. You don't have to be building anything to call on them. While you are there, take mental notes on the stock available and how useful it is to you. For example, you like to work with ICs. Does the distributor have

many different kinds of ICs? How about resistors, caps, cabinets, etc? You might want to jot down next to the dealer's name on your list some of the things he has in quantity or has low prices on. You might also note whether he has surplus or new stock – surplus electronics can be real money-savers! When you have either the time or the opportunity, drop by the distributors farther from your home. There's no sense in ignoring anyone simply because they are a distance from your house. And with the larger outfits, a telephone call will bring your order to your door COD. But check with your distributor before you try a COD; not all firms are set up for it.

After you have made up your list of dealers with addresses, phone numbers, and hopefully any comments about their stock, keep it in a safe place until needed.

When you are ready to start a project, locate as many parts as you can from your junk box or from generous friends. Then dig out that list of dealers and scan it for prospects. Either visit or call those dealers who might have your parts. Check to see how much they are and if they are readily available. If you are in a hurry (say you are putting up a tower and need extra coax), you will have to buy from the distributor who has the parts in stock. But if you were foresighted enough to plan ahead and have more time to shop, you can save by trying at least one other store for your parts (preferably two others). Be careful of the dealer who says he can have it for you in a week. If you know he keeps his promises, fine; if not, try somewhere else if your time is limited. Electronic parts are notoriously hard to get on schedule, even for the best of dealers.

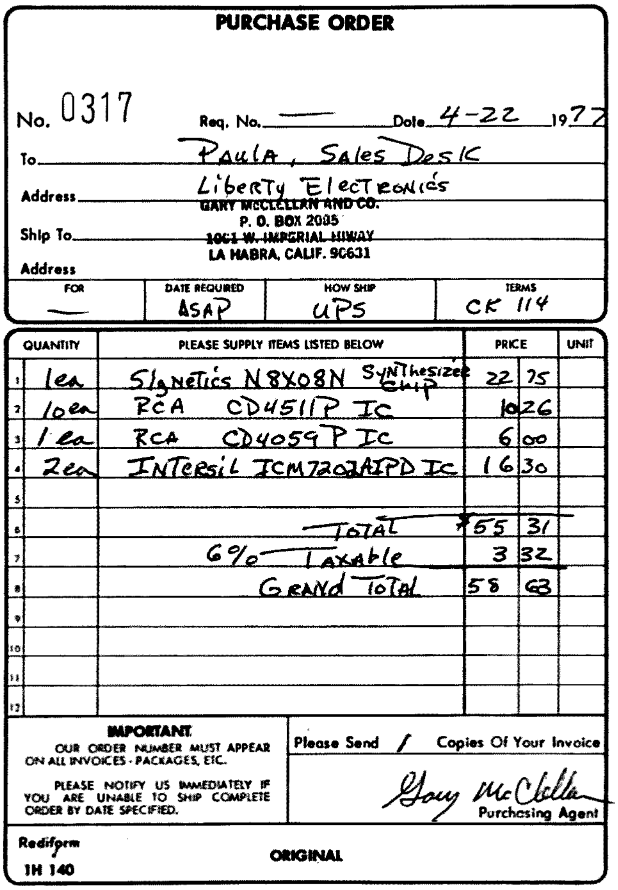
Here are some tips for buying parts: Concentrate on the most expensive parts when you shop. Then worry about the cheaper ones. It's easy to sweat over a few resistors and then blow dollars on a cabinet without a second thought. Note that some parts tend to have the same prices all over your area. Nationally known brands of tubes and semiconductor universal replacements are good examples, and it doesn't matter too much where you buy them. Availability will probably mean more to you at this point.

Don't be afraid to use several distributors for all your purchases; this is normal more often than not. Recently I built a synthesized commercial AM/FM tuner. It cost $100 in parts, which I ordered from 2 local stores, 4 mail-order houses, and one industrial supplier. And, in addition, I received a part sample from a major IC house, free. So this is what a big order can come to! I ordered this way, because the mail-order houses had the ICs cheaper, the industrial distributor had the state-of-the-art type parts unavailable elsewhere, and the locals happened to have the various odds and ends. I saved about $35.00.

So you build your project, confident you bought good parts and saved money. If it works, congratulations! If not, and you trace the problem to a bad part, you really get to check out your dealer! Actually, this tests you as well as the dealer, because your attitude can influence whether you get your part exchanged or not. That's just human nature. I have seen too many people vent their spleen on a salesman, who then gets mad and gives the customer the most shopworn part in stock. If you are reasonable, you are far more likely to get a replacement part and perhaps a cup of coffee and a little advice. Try it! Then too, you get to see how a dealer performs. If he replaces it, fine. If not, or if he sends you to another place of business, or tries to sell you a replacement at a discount price, look out! I am rather wary of outfits like these, personally. I also don't care for those who have signs all over proclaiming, "No return or refund." Why? The manufacturers of electronic parts (especially semiconductors and tubes) will replace bad parts from a distributor free.

Now that I have discussed the basics of buying from the local dealer/distributor, let's go on to some special cases. Take the mail-order house, for instance. I believe that mail-order suppliers are popular because they offer parts at low prices that are often hard to get. Here's how to deal with them.

Dealing with most mail-order houses is easy. But there are a few things you can do to get better service. The first thing you do is make up a parts shopping list. Then look in the back of *73* for names and prices. Also, it would be wise to pick up copies of *Popular Electronics* and *Radio Electronics* magazines for other names. Not all mail-order houses advertise in more than one magazine. And sometimes you can get better prices from another mail-order house. Be careful of very low prices on certain parts. This usually means either the supplier made a large purchase (which he would shout about) or is selling junk. Junk is just what the name implies, and you often get what you pay for. You should be aware that junk ICs, for instance, are parts rejected by the IC manufacturer for various reasons, and then barreled and sold to the highest bidder. The buyer (dealer/mail-order house, etc.) tests them, puts a part number on them, and sells them dirt cheap. You can tell because these parts don't have the manufacturer's name on them – just the part number written on in pencil or stamped on. I strongly advise you not to use them;


PURCHASE ORDER

No. 0317 Req. No. —— Date 4-22 1977

To Paula, Sales Desk

Address Liberty Electronics

GARY McCLELLAN AND CO.
P. O. BOX 2085
1061 W. IMPERIAL HIWAY
LA HABRA, CALIF. 90631

Ship To

Address

FOR	DATE REQUIRED	HOW SHIP	TERMS
—	ASAP	UPS	CK 114

	QUANTITY	PLEASE SUPPLY ITEMS LISTED BELOW	PRICE		UNIT
1	1ea	Signetics N8X08N Synthesizer Chip	22	75	
2	10ea	RCA CD4511P IC	10	26	
3	1ea	RCA CD4059P IC	6	00	
4	2ea	Intersil ICM7208IPD IC	16	30	
5					
6		Total	55	31	
7		6% Taxable	3	32	
8		Grand Total	58	63	
9					
10					
11					
12					

IMPORTANT
OUR ORDER NUMBER MUST APPEAR ON ALL INVOICES - PACKAGES, ETC.
PLEASE NOTIFY US IMMEDIATELY IF YOU ARE UNABLE TO SHIP COMPLETE ORDER BY DATE SPECIFIED.

Please Send 1 Copies Of Your Invoice

Gary McClellan
Purchasing Agent

Rediform
1H 140

ORIGINAL

Fig. 1.

the money you save will be made up in lost time troubleshooting later. Compare ads and look for the best prices. Then order.

A good way to deal with a mail-order house is to write a purchase order. See Fig. 1. You can get these forms from your local stationery store. Just ask for Rediform 1H140. Fill out the form with the parts you want and then the total prices. Make sure that you specify what package you want your ICs to come in ("14 pin DIP" or "TO-5 can" are OK) and that you include shipping costs. Note that some outfits ship small items postpaid. Also, some have handling charges. Total up the cost, and enter it at the bottom of the page. Then make out a check or money order for the amount. Never send cash; it may not reach its destination. Then write in your address and the company you are buying from. For best results, print in large numbers and letters. If you bought the Rediform I suggested, you will have a duplicate of the PO you just wrote. Keep it until your parts arrive, and then check them off the list as they are unpacked. You might also hang on to the PO and the canceled checks for tax purposes if you are in business. Why write a PO? Many businesses in mail-order do not send an invoice telling what you bought. This way you have a record that will serve as a reminder, ending the "Did I get what I ordered?" blues.

The best way to see how good a mail-order house is is to send them a small order (say $10 or so). This is the way I evaluate a new firm. I get to see how fast they handle it, the quality of their parts, and how they react to returns if I don't like their merchandise. I might add that I have dealt with essentially all of the people advertising in this magazine over the years, and I have found only one house that was suspicious in its dealings. They aren't around anymore. You will find houses that have excellent service but lousy parts, and vice versa. A few offer excellent parts and service, and if you do much buying by mail-order, you'll quickly find out who they are.

The next and last step up the ladder is the industrial electronics distributor. In the old days you would think Allied and Newark, but today you call on other firms. Dealing with an industrial distributor involves a certain ritual, and you must be able to meet their minimum order requirements. In the Los Angeles area, for example, Hamilton Electro Sales has a minimum order of $5.00 or more. Cramer Electronics has a $25.00 minimum. It would be wise for you to either pool orders for several projects or get several interested friends together for one order to make the minimum order and get better service.

The first step is to locate those outfits near your home. If you did your homework with the phone book, you may have some good leads. Generally, these outfits are located in major cities like New York, Chicago, Los Angeles, etc., so look there.

Once you have found some candidates, call them up and ask for the sales desk. Then ask the person who answers for either a catalog (Cramer has a good one) or a *line card*, and have it sent to you. Caution: If you are an individual, you may not get one. In fact, the salesperson may put you on hold for a half hour or hang up! If so, drop them fast and try another supplier. This treatment usually suggests what you'll get on your first order: the famous cold shoulder.

The ritual for ordering from an industrial distributor goes something like this: You call to get the current prices on your parts and find out whether they are in stock. With most outfits, you are talking to a person sitting at a computer terminal, and that means you must give him the exact part number and the manufacturer of the part. The manufacturer must be one on the industrial distributor's line card, a notebook-size piece of paper listing the manufacturers the distributor represents. If you can't cross-reference your parts over to a manufacturer he carries, you are out of luck. You must be able to tell him exactly what you want, or the salesman may not be able to help you. Ask for a "741", and he'll be puzzled. But ask for an "MC-1741P by Motorola" and you'll get results.

After you give the salesman the part and manufacturer, he'll ask for the quantity you need. Tell him. He'll check the terminal and give you the price of each and whether they are in stock.

At this point, there are three things you can do. Have the parts sent COD, have them sent and billed on your account, or mail an order and pay cash. Also, some outfits will accept your order and put it on "will call" for you. The first method is preferred for dealing with large parts houses. If you have the order sent COD, you get it sooner, and the extra cost is small. Also, there is less chance that a foul-up in the distributor's credit department will reach you. This approach is highly recommended if you are ordering as an individual. The second method is for business people only – you hold an account with the industrial distributor, and you are billed monthly. This method can work well if the credit bureaucracy is well organized. But, in my area, this isn't always the case. Recently I had to scream at the president of a large outfit and knock heads in the credit department over a simple computer error. Yes, I am well acquainted with credit problems. The third method works if you do it a certain way – call and casually inquire if your parts are available. If so, fine. Do not let the salesman talk you into placing an order! Instead, write up a purchase order and send it to that salesman. Enclose your check for the parts and any sales tax. You do not have to allow for postage; most outfits include it in their parts cost. If you send extra money for postage, they will pocket it. Keep your money. If they want postage, let them bill you. This method works well for cash customers, and it keeps the credit department out of the act. If you like, try "will call" service if offered. This is the quickest way of getting your parts if you are located close to the distributor.

There is a chance that you will get the wrong parts or get defective units. Industrial distributors usually require that you call their customer service department and get a *R*eturn *M*aterial *A*uthorization (RMA) number before returning the parts. You *must* return your parts with this number! Otherwise, your return will be (ulp!) ... returned! Without any action. Don't forget the RMA number. Also, be sure to enclose a note with your name/address, the sales order number (or your PO number), and the nature of the problem.

That's the gist of dealing with a commercial distributor. This may sound like a lot of bother to you for just a few parts, but you must go to a distributor like this if you are using either hard-to-get parts or state-of-the-art components.

Now that you know a little more about buying electronic parts, which places are the best for buying your parts? That's pretty simple. Are you in a hurry for your stuff? Buy from your local dealer/distributor or industrial disbributor. Use "will call," and pick them up yourself. Want to save some money? Use a local surplus dealer or mail-order houses. Need state-of-the-art or hard-to-get parts? Use an industrial distributor. If you are like me, you will probably end up using all three sources for a project. Good luck! ■

Social Events

BOSTON MA
AUG 25-27

Computermania, an exhibition of the new hobby computers, will be held on August 25, 26, and 27, 1977, at the Boston Commonwealth Pier. On exhibit will be hundreds of computers, memory boards, printers, floppy disks, new calculators, new TV games, demonstrations, forums, talks, and prizes. Over 250 exhibits. For info, write Computermania, Peterborough NH 03458, or call Toll Free (800) 258-5473.

ROLLAG MN
SEPT 2-5

The Western Minnesota Steam Threshers reunion will be held in Rollag, Minnesota, Sept. 2-5, 1977. Featured will be amateur special events station WMØSTR. Plans are being made for operation of CW and SSB on 80 through 10 meters, and possibly on 6 meters. QSL certificate will be sent upon verification of the log and receipt of an SASE. Send to: WBØLRK, PO Box 596, Fertile MN 56540.

SAINT ANDREWS-BY-THE-SEA
NEW BRUNSWICK
SEPT 3-5

The All Saints Amateur Group will hold their Family-Holiday Hamfest on September 3rd, 4th, 5th, 1977, at the Algonquin Hotel in Saint Andrews-by-the-Sea, New Brunswick. The program includes: a technical forum, flea market, antique radio show, outstanding speakers, exhibit of leading ham equipment, prizes and awards, transmitter hunt, and much more. A full range of accommodations is available. For more information write: Hamfest 77, R.R. 325-8, Rothesay, New Brunswick, Canada E0G 2W0.

DANVILLE IL
SEPT 4

The Danville Hamfest will be held on Labor Day weekend, Sunday, September 4, 1977, at beautiful Douglas Park, one block from I-74 Bowman Ave. exit in Danville, Illinois. The Danville Hamfest is cosponsored by the Illiana Repeater System and the Vermilion County Amateur Radio Association. For more information write Don Russell, R5, Danville IL 61832.

CLEVELAND OH
SEPT 10

The Cleveland Hamfest Association presents the 1977 Cleveland Hamfest to be held on Saturday, September 10, 1977, from 6 am to 5 pm at the German Central Farms, 7863 York Road, Parma. Hamfest includes family picnic area, YL activities for the whole family, commercial displays of the very latest in ham gear. Door prizes throughout the day with final grand prize drawing at 1600. W8QV for mobile check-ins for number on 146.52 from 0600 to 1200 with mobile prize drawing at 1400. Early ticket donations are $1.50 before August 27th, $2.00 at gate for all over 12 years of age. Flea market parking $1.50 additional per space at 0600. For more information write Cleveland Hamfest Association, Box 43413, Cleveland OH 44143.

MELBOURNE FL
SEPT 10-11

The 12th Annual Melbourne Hamfest will be held Saturday and Sunday, September 10 and 11, 1977, from 9 am to 5 pm each day in the air conditioned Melbourne Civic Auditorium located on Hibiscus Boulevard. Donation is $2.50 per person. Full program includes forums, meetings, auction, swap tables, commercial exhibits, awards, prizes, etc. Contact K4HPT, 2749 Herford Road, Melbourne FL 32935 for swap table reservations. FCC exams on Saturday; donation not needed for exams. Form 610 must be filed with FCC, Room 919, 51 S.W. First Avenue, Miami FL 33130, not later than August 31, 1977. Hamfest talk-in on 25/85 and 52/52. Sponsored by Platinum Coast Amateur Radio Society. For more info write PO Box 1004, Melbourne FL 32901.

MENA AR
SEPT 10-11

The Queen Wilhelmina Hamfest will be held atop Rich Mountain on September 10 and 11, 1977. There will be door prizes, games, and exhibits for everyone. Talk-in on 3995 kHz, .52-.52, .19-.79. For more information contact Steven W. Myers WB5MFI, Rt. 1 Box 204, Hatfield AR 71945, (501) 389-6791.

FINDLAY OH
SEPT 11

The 35th Annual Findlay Hamfest will be held September 11 at the Riverside Park, Findlay, Ohio. Advance tickets are $1.50 and $2 at the gate. For tickets and additional information send an SASE to Clark Foltz W8UN, 122 W. Hobart, Findlay OH 45840.

FLINT MI
SEPT 11

The Greater Genesee Valley A.R.C. will hold a swap & shop on Sunday, September 11, 1977, from 8 am to 4 pm at the Southwestern High School in Flint, Michigan. Take I-69 to the Hammerberg Road exit located near downtown Flint. Tickets are $1.00 in advance, $1.50 at the door. Door prizes will be given away, and food sales available. Large tables will be available at reasonable price for sellers. No trunk sales. Talk-in on 31/91 and 52 simplex. For advance tickets, table reservation, and additional information contact Jack Walters WA8UXN, 1315 Butcher Road, Fenton MI 48430.

SOUTH DARTMOUTH MA
SEPT 11

The Semara Annual Picnic and Flea Market will be held on September 11 at the Stackhouse Street Fairgrounds, South Dartmouth, Massachusetts. Talk-in on 147.60-147.00.

HAMBURG NY
SEPT 17

The 6th Annual Hamburg International Hamfest 77 will be held September 17, 1977, at the Erie County Fairgrounds. Electronic flea market, amateur computer displays, manufacturers' displays, technical forums, women's programs, door prizes, etc. For additional information contact Fran Wilson 833-9631 or Bert Jones 873-3984.

HUDSONVILLE MI
SEPT 17

The Grand Rapids Amateur Radio Club will hold its annual Swap-N-Shop Saturday, September 17 from 8 am to 4 pm at the Hudsonville Fairgrounds in Hudsonville, Michigan, 12 miles southwest of Grand Rapids on M-21. Talk-in on 146.52 and 16/.76. $2 donation at the gate with plenty of refreshments and free tables available.

GRAYSLAKE IL
SEPT 17-18

Radio Expo '77 will be held September 17 and 18, 1977, at the Lake County Illinois Fairgrounds, Rts. 45 and 120, Grayslake, Illinois (halfway between Chicago and Milwaukee). Displays of the latest in electronic communications technical forums, gigantic flea market, thousands of dollars in door prizes, ladies' program, etc. Tickets $3 for both days, $2 in advance. Radio Expo Tickets, Box 1014, Arlington Heights IL 60006.

ROSS OH
SEPT 18

The Cincinnati Hamfest will be held at the *improved* Stricker's Grove, State Route No. 128, Ross (Venice), Ohio, on Sunday, September 18, 1977. Exhibits, contests, prizes, swaps, trades, thrilling and spectacular air show, group and net meetings, hidden transmitter hunt. Advance ticket $7.50 – at gate $8.00. Mail check or money order prior to September 11 to: Greater Cincinnati Amateur Radio Assn., c/o John P. Haungs WA8STX, Treasurer, 10615 Thornview Drive, Evendale OH 45241.

OAKWOOD GA
SEPT 18

Lanierland ARC will hold its fourth annual "Hamnic" at the Lanier Islands Dogwood Pavilion on September 18, 1977. Two large covered pavilions and large parking area for swap shop and exhibits. Food available. No entry fee for Hamnic; however, Lanier Islands charges $2.00 entry fee per car. Picnic, hiking, and swimming for the kids. First prize IC-22S. Many other prizes. Talk-in on W4IKR/4 on 3975 and .07/.67. For further information, write Terry Jones WB4FMJ, Route 1, Box 298, Oakwood, Georgia 30566.

MT. CLEMENS MI
SEPT 18

L'anse Creuse A.R.C. presents its 5th Annual Swap and Shop to be held on September 18, 1977, at L'anse Creuse High School, Mt. Clemens, Michigan, 0900-1500. Prizes, plenty of food and parking. Directions: I-94 eastbound, exit Metro Pkwy, Metro Pkwy to Crocker, left on Crocker to Reimold, right on Reimold to last school – L'anse Creuse High School. Admission: $1.50 at door, $1 in advance. SASE to WB8QFR, 32111 Harper Ave., St. Clair Shores MI 48082.

HARRISBURG PA
SEPT 18

The 4th Annual Electronic Swap Fest of the Central Pennsylvania Repeater Association will be held Sunday, September 18, 1977, at the Park and Shop Garage, 200 Block of Walnut Street, Center City, Harrisburg. Indoor parking for 1100 cars, so come rain or shine. Starts at 8 am. Registration $3.00. No charge for tailgating, wives or children. Talk-in on WA3KXG, 146.16/76, 146.52/52. For more information contact Roger Urben W3HUP, phone: (717) 761-7178.

PEORIA IL
SEPT 18

The Peoria Area Amateur Radio Club's 20th Annual Hamfest will be held Sunday, September 18, 1977 at the Exposition Gardens located on Northmoor Road just west of North University Avenue. Free coffee and donuts 8:30 to 9:00 am, free swapfest and free parking. Prizes will be given away. Advance tickets $1.50, door tickets $2.00. Talk-in on 146.94 simplex – call W9UVI. For hamfest tickets write Bruce Funston K9PWQ, 304 Indian Circle, East Peoria, IL 61611.

KENNER LA
SEPT 24-25

The Jefferson Amateur Radio Club and the Crescent City Computer Club would like to announce the New Orleans Hamfest/Computerfest which will be held at the Hilton Inn in Kenner LA (directly across from the New Orleans International Airport) on September 24 and 25. This is the ARRL Delta Division Convention for 1977 and is the largest ham outing in the deep south. This year's event will feature a banquet Saturday night with entertainment, two days of commercial exhibits, flea markets, forums, hospitality room, ladies' events, FCC examinations and more. Grand prize is a complete Drake "C-Line" ham

station. For more information contact the New Orleans Hamfest/Computerfest, PO Box 10111, Jefferson LA 70181.

MADISON WI
SEPT 25

The 5th Annual Madison Swapfest will be held Sunday, September 25 at Dane Co. Expo Center Youth Building, Madison WI. Rain or shine — inside facilities — doors open at 8 am. 12,000 sq. ft. of electronic equipment and components for hams, computer hobbyists and experimenters. Bring the whole family for delicious food and entertainment. Excellent overnite camping accommodations. Tickets — advanced $1.50; at door $2.00. Tables — advanced $2.00; at door $3.00. Make check or money order payable to M.A.R.A. — mail to M.A.R.A., Box 3403, Madison WI 53704. Reservations must be in by Sept. 10, 1977.

ERIE PA
SEPT 25

The 2nd Annual Erie HamJam will be held Sunday, September 25, 1977 at Rainbow Gardens, Waldameer Park. Door prizes, flea market, forums, large indoor facilities. For more information write Radio Assocation of Erie, Inc., PO Box 844, Erie PA 16512.

LOUISVILLE KY
SEPT 25

The Seventh Annual Greater Louisville Hamfest will be held on Sunday, September 25, 1977 at the Kentucky Fair and Exposition Center with marked exits off either I-65 or I-264. Indoor exhibitors area plus indoor or outdoor flea market areas. There will be meetings and forums, ladies' free bingo, also food and drinks available. Admission is $2 adults — 12 and under free. Flea market vendors pay admission price plus $2.00 per space indoor or $1.00 per space outdoor. For info contact Denny Schnurr K4GOU, 2415 Concord Dr., Louisville KY 40217, phone (502) 634-0619.

ADRIAN MI
SEPT 25

The Annual Adrian Hamfest will be held on Sunday, September 25, 1977 at the Lenawee County Fairgrounds, Adrian, Michigan. Prizes every hour! Grand prize drawing — 3 pm. Flea market and trunk sales. Tickets $1.50 advance, $2.00 at gate. Tables $2.50 half, $4.00 full. Talk-in on 31/91 and 52. For more information contact Adrian Amateur Radio Club, Box 26, Adrian, Michigan 49221, (517) 265-8016.

NEW BERLIN IL
SEPT 25

The Sangamon Valley Radio Club will hold its Second Annual Hamfest on Sunday, September 25, 1977 at the Sangamon County Fairgrounds, New Berlin, Illinois, 16 miles west of Springfield. Indoor display area and a covered pavilion. Food, refreshments, exhibits and ladies' activities. Overnite camping on grounds. Tickets $1 advance; $1.50 at gate. First prize — Wilson HT. Talk-in 146.28/.88 and .52. Info: Carole Churchill WB9QWR, 622 Magnolia, Rochester IL 62563.

WILLOW GROVE PA
OCT 1

The Mid-Atlantic States VHF Conference will be held on Saturday, October 1, 1977 at the Treadway Inn on Easton Road (Route 611, Exit 27 of the Pennsylvania Turnpike) in Willow Grove, Pennsylvania on the day before Hamarama 77 (at nearby Warrington, Pennsylvania). The conference will be an all day VHF program moderated by prominent VHFers. Advance registration is $2.50 (includes admission to Hamarama 77 on Sunday). Cocktail hour (cash bar) and get-together at 6:30 pm. Buffet dinner at 7:30 pm is $8.00. Special rates for rooms overnight. For advance registration contact Ron Whitsel WA3AXV, Chairman, PO Box 353, Southampton PA 18966, phone (215) 355-5730. Advance registration must be received by September 28, 1977. Indicate motel registration forms required.

MEMPHIS TN
OCT 1-2

The Memphis Hamfest, bigger and better than the 4,500 who attended last year, will be held at State Technical Institute, I-40 at Macon Road, on Saturday and Sunday, October 1 and 2. Demonstrations, displays, MARS meetings, flea market, ladies' flea market, too! Hospitality Room, informal dinners, XYL entertainment, many outstanding prizes. Dealers and distributors welcome. For further information contact Harry Simpson W4SCF, PO Box 27015, Memphis, Tennessee 38127.

WARRINGTON PA
OCT 2

The Mt. Airy VHF Radio Club (the Packrats) are holding "Hamarama 77" at the Bucks County Drive-In Theater, Route 611 (Easton Road), Warrington, Pennsylvania on Sunday, October 2, 1977, 8 am to 4 pm rain or shine. Registration $1.50, tailgating $2.00/space (bring your own table). Talk-in via W3CCX/3 on 52.525 and 146.52, WR3ACD on 222.98/224.58, WR3ADS on 147.63/147.03, and WR3AHC on 147.60/147.00. Advance registration to the Mid-Atlantic States VHF Conference includes admission to Hamarama. For information contact Ron Whitsel WA3AXV, Chairman, PO Box 353, Southampton PA 18966, phone (215) 355-5730.

CEDAR RAPIDS IA
OCT 2

The Cedar Valley Amateur Radio Club annual Hamfest will be held Sunday, October 2, 1977. Top prizes are Atlas 210X Xcvr, Wilson 1402 SM H/T, Heathkit HW-8 QRP CW Xcvr, Clegg FM-76 Xcvr, plus much more. Technical talks featuring Doug DeMaw W1FB. Manufacturers and dealers welcome. Talk-in on 146.16/.76, 146.52, 3.970, and 223.5 MHz. Advance tickets $1.50, $2.00 at the door. Write CVARC Hamfest, Box 994, Cedar Rapids IA 52406.

NEWPORT NH
OCT 2

Autumnfest, the first annual hamfest of the Connecticut Valley FM Association, will be held on October 2, 1977, at the Community Center, Belknap Ave., off Rt. 10, north end of the Common. Flea market opens at 9 am — auction at 2 pm. Program includes antenna gain contest, fox hunt on 52 simplex, frequency and modulation checks by W1RNZ, and talks and demonstrations throughout the day. Donation: $1.50 in advance — $2.00 at the door. Talk-in on 16/76 or on 52 simplex.

EAST RUTHERFORD NJ
OCT 8

The Knight Raiders VHF Club, K2DEL, presents its world famous Auction & Flea Market to be held at St. Joseph's Church of East Rutherford, New Jersey, Saturday, October 8, 1977 beginning at 10 am. Free admission — free parking. Flea market tables (in advance) $5 full table, $3 half table; (at door) $6 full table, $3.50 half table. Directions: take Rt. 17 north from Rt. 3 to East Rutherford, exit onto Paterson Plank Road, follow to traffic light with Diner on the corner, make sharp right, follow for one block, at light you will see St. Joseph's Church on your right, make right turn at corner and enter parking lot. For further information call: Bob Kovaleski (210) 473-7113, evenings only. Talk-in on 146.52. Send reservations and make checks payable to: Knight Raiders VHF Club Inc., PO Box 1054, Passaic NJ 07055 (reservations close October 1).

SHREWSBURY MA
OCT 8-9

The Heart Fund Hamboree (all proceeds to be given to the Heart Fund) will be held on October 8 and 9, 1977, at Simeon's Park on Route 9 in Shrewsbury MA. Program includes door prizes, trophies, special prizes and entertainment. For advance tickets send $1.50 donation (orders must be received by Sept. 15) — $2 donation at gate. Senior citizens and children 12 years or under free. For dealer space and ticket information write: Central Mass. 2-Way Radio Assoc., P.O. Box 154, Northboro MA 01532.

SYRACUSE NY
OCT 8

The Radio Amateurs of Greater Syracuse presents the Syracuse Hamfest, October 8, 1977 from 9 am to 5 pm at the Syracuse Auto Auction, Route 11, Nedrow, New York. Easy access from Route 81, 5 miles south of Syracuse. Food available all day at reasonable prices. Large exhibitor area and flea market under cover. Exhibitors: $13.00 (includes one 8-foot space, 8-foot table, two chairs and admission to hamfest). For further information: General info — RAGS Hamfest, Box 88, Liverpool NY 13088; exhibitors — Dale Mecomber WB2FJC, Box 87, Skaneateles Falls NY 13153.

YONKERS NY
OCT 9

The Yonkers Amateur Radio Club is holding "Super Hamfest 77" on October 9, 1977 (rain date Oct 16) from 9 am to 5 pm at Redmond Field, Cooke Avenue in Yonkers. Manufacturers displays, door prizes, raffles, refreshments and a general auction are all in store. Buyers $1, sellers $3 — bring your own table. Talk-in 146.265, 146.865, 146.52 simplex. For further information contact Doug McArtin WA2AUJ, 411 Bellevue Ave., Yonkers NY 10703, (914) 423-0515.

WINDSOR LOCKS CT
OCT 14-16

The Region 1 Air Force MARS Convention will be held on October 14, 15, 16, 1977 at the Howard Johnson's Conference Center, Center Street Exit 1-91, Windsor Locks, Connecticut. *73* publisher Wayne Green will be guest speaker.

SAN MATEO CA
OCT 15-16

The Greater Bay Area Hamfest and ARRL Pacific Division Convention will be a combined event this year held on Saturday and Sunday, October 15 and 16 at the Royal Coach Inn, centrally located on the San Francisco Peninsula just off the intersection of U.S. 101 and Route 92 in San Mateo. For more information contact the Greater Bay Area Hamfest, Box 751, San Mateo CA 94401.

TAYLOR MI
OCT 16

The Repeater Association of Downriver Amateur Radio (R.A.D.A.R.) Hamfest will be held on October 16, 1977, at the Kennedy High School located in Taylor, Michigan, on Northline Road, east of Telegraph (U.S. 24). Door prizes and food. Admission $2.00/YLs free. Reserved tables $1. Open 9 am until 3 pm. Talk-in will be on 52-52, 34-94, 93-33. For further info write: R.A.D.A.R. Inc., PO Box 1023, Southgate, Michigan 48195.

PLYMOUTH IN
OCT 30

The Radio and Electronics Swap and Shop, sponsored by the Marshall County Amateur Radio Club, will be held on Sunday, October 30, 1977, at the Plymouth, Indiana National Guard Armory, located at 1220 West Madison Street, from 8 am to 5 pm. Free tables, no charge for setup. Tickets $2 at door. Food, drink and door prizes. Talk-in on 146.07-67 and 146.52 simplex. For further information contact Wayne Zehner WA9INM, Rt. 3, Box 526, Plymouth IN 46563.

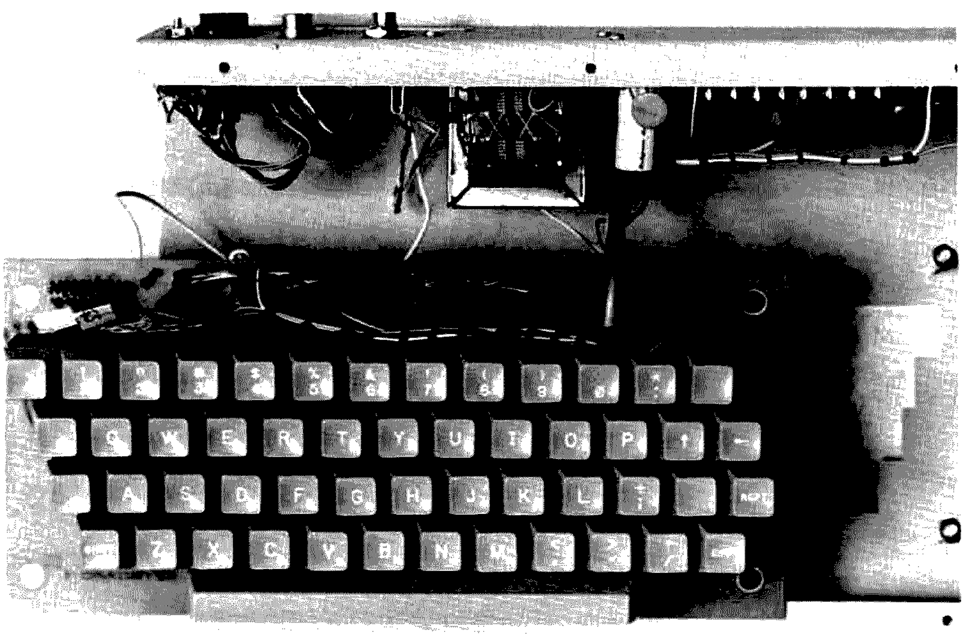
Richard R. Parry W9IF
38W255 Deerpath Road
Batavia IL 60510

RTTY RKB-1 Revisited!

-- auto machine functions

About 15 ms after I started typing on my Model 15 teleprinter, I realized that this was not at all like typing on a modern electric typewriter. There simply had to be a better way. HAL's RKB-1 electronic keyboard was a step in the right direction. However, it still required the time-consuming and monotonous carriage return, carriage return, line feed, letters (CR, CR, LF, LTRS) procedure at the end of each line. This operation is used by all good RTTY aficionados to help ensure that the machine is set up properly to print the next line. This article describes a circuit that will, when actuated, cause the RKB-1 to perform the CR, CR, LF, LTRS operation automatically.

Photos by Anthony R. Donaldson



Toroids T0 through T6 can be seen above top row of keys.

Encoding the LTRS Character

The first modification requires the addition of a LTRS character. Encoding characters in the keyboard is performed by a toroid matrix. This matrix is composed of seven toroidal transformers labeled T0 through T6. The photo shows the T0 toroid located above the number 9 key. Toroid T6 is located above and between the number 2 and 3 keys. The remaining toroids are numbered consecutively in between. Toroids T0 through T4 are used to encode the standard five bit Baudot code. Toroids T5 and T6 are connected to a case-sense circuit. The purpose of this circuit is to send a LTRS or FIGS character automatically before the actual character depressed is sent, if necessary.

Fig. 1 shows how a LTRS character, represented by MMMMM in the Baudot code, can be encoded in the RKB-1. The character is encoded by connecting a thin enamel coated wire (approximately #30 AWG) to pin 20 of the keyswitch printed circuit board. This point is located directly above the number 0 key. It is a common tie point for about 30 other wires. The wire is then passed through the center of toroid T5. If you wish to actuate the LTRS character externally, the wire must be connected to an unused key. I found the key to the left of the A key to be convenient. Should you not wish to access the LTRS character, the wire is connected directly to pin 9 of the 7445 shown in Fig. 3. This single wire acts as the primary of each toroidal transformer. T0 through T4 are not used, since the Baudot code for the LTRS character does not contain any spaces. Only those characters requiring a space are fed through these toroids.

To further illustrate the technique, should you wish to add other characters, Fig. 2 shows another example. It indicates the proper connections to encode the FIGS character, MMSMM.

You should be aware of, but not necessarily concerned with, an anomaly in the keyboard. Since the toroid primary of each character passes through either the

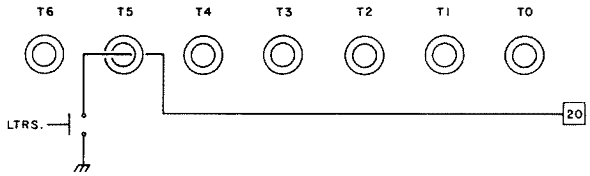


Fig. 1. LTRS encoding schematic.

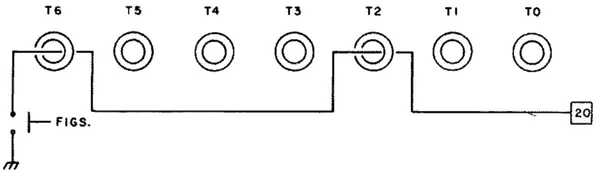


Fig. 2. FIGS encoding schematic.

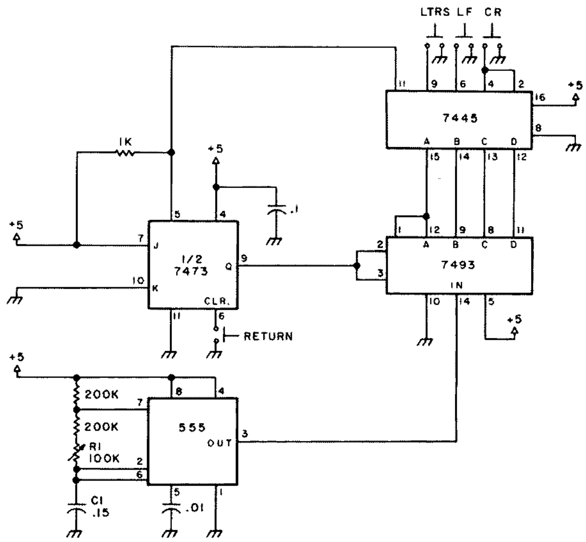


Fig. 3. Return circuit.

LTRS or FIGS toroid, T5 and T6 respectively, it is possible when depressing either the LTRS or FIGS keys to get two LTRS characters or two FIGS characters. For example, if you are in the figures case and then depress the LTRS key, the keyboard will produce a LTRS character generated by the case-sense circuit, toroid T5, and then an additional LTRS character will be generated due to the encoding of toroids T0 through T4.

Return Circuit

Now that we have the LTRS character, we must design a circuit that will in essence simulate magic fingers depressing the carriage return key twice, followed by the line feed key and, lastly, the LTRS key. The circuit in Fig. 3 will do just that. The 555 timer runs continuously. However, the 7493 binary counter will not count these pulses until the Q output of the 7473 J-K flip-flop is low. This occurs when the return key is depressed. It stays in this state until the automatic return process is over. With pins 2 and 3 of the 7493 low, binary coded digits will be sent to the 7445 decoder. This will in turn cause the 7445 to act as a distributor. Since the 7445 uses open collector outputs, they may be placed in parallel with the CR, LF, and LTRS keys to simulate the actuation of these keys. The last output of the 7445, pin 11, is used to reset the 7473. A convenient unused key that may be used for the return function is located in the extreme upper right hand corner of the keyswitch board.

Power for this circuit is derived from the keyboard's main power supply. The foil on the printed circuit board separating T4 and T5 is 5 volts with respect to ground. This is an easy and convenient point to pick off the power for the circuit.

Adjustments

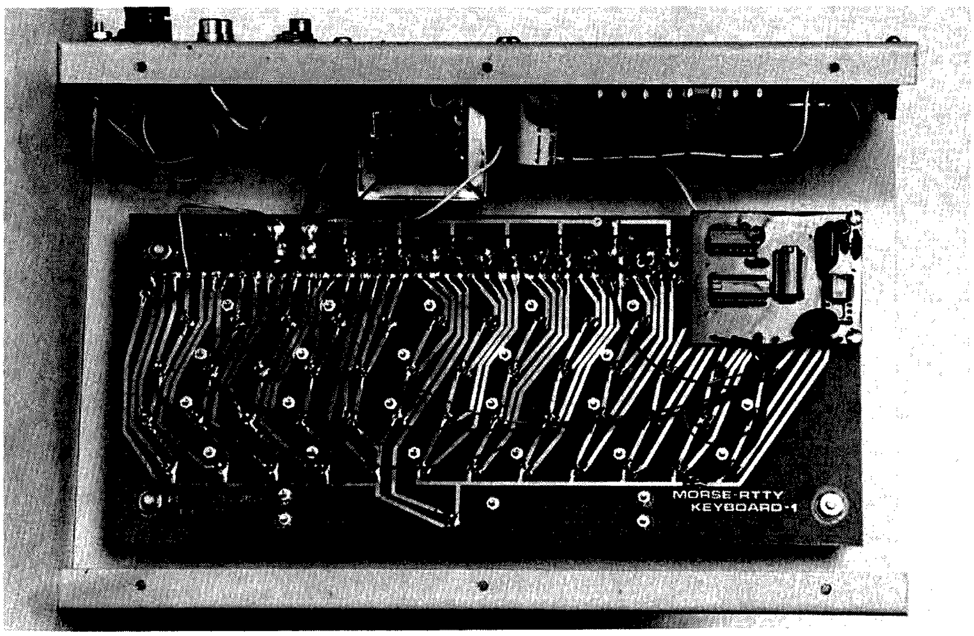
The 555 timer should be adjusted via R1 so that the CR, CR, LF, LTRS process is fast, but not so fast as to cause the characters to run into each other. The actual speed that you set the timer for will be function of the baud rate you usually operate at. For a baud rate of 45.45 (60 wpm), the timer frequency will be about 12 Hz.

The values of R1 and C1, as shown in Fig. 3, are primarily for 60 wpm operation. If you operate the keyboard at several speeds, you will want to externally vary the value of R1 as you change speeds. The main speed switch that comes with the keyboard is a 3P4T switch. While I have not tried this method, since I operate at only one speed, it seems like making use of this switch to change fixed resistors would be ideal for those wishing this feature.

Construction

The photo of the foil side of the keyswitch board shows the construction method that I used. The circuit was built on a perforated board and installed on the keyswitch board by using standoffs. The board was dipped in a coating compound, which accounts for its appearance in the photo.

The circuit has been in operation for about a year now, and I can't see how I ever got along without it. May you also have many happy returns.■



Return circuit is mounted to keyswitch board on standoffs.

W. Edmund Hood W2FEZ
116 W. Park St.
Albion NY 14411

Mobile Antenna Tips

-- for the beginner

This article is directed primarily to the novice – the experienced amateur won't find very much here that is new. Amateurs have been on wheels longer than CB has even existed. The techniques have changed somewhat since the advent of solid state inverters, so far as mobile power supplies are concerned, but antenna systems remain much the same as always, except for a few gimmicks to facilitate tuning.

The mushrooming popularity of VHF mobile transceivers augmented by repeaters has largely diverted attention from what this writer believes to be a fascinating, far more challenging phase of mobile operation – high power at low frequency.

It is one thing to power a ten or fifteen Watt transceiver from a twelve volt car battery and quite another to supply a 100 or 200 Watt unit. It is one thing to clamp a 19-inch whip to the gutter or mount it on the roof for 2 meter work, but something else to mount an eight foot whip and make it act like a thirty or sixty foot tower! Operating on two meters poses little in the way of noise problems: Tune up on 75 in a car and you pick up every spark plug, power line, and neon sign for miles around . . . unless you know what to do about it.

Let us, then, examine the various problems one at a time, beginning with what most mobile enthusiasts find to be the touchiest part of a mobile rig – the antenna. Amateurs have long been operating mobile on every band from 160 meters on up. We do, however, need to have an antenna that is resonant, and a resonant antenna is usually a quarter wavelength or multiple thereof. How, then, can we fit, say, a 75 meter antenna on a car? Somehow I can't imagine a Volkswagen going down the road with a 65-foot whip on the rear bumper. In fact, few mobile antennas are much more than eight feet long.

The secret lies in the fact that an eight foot whip, being less than a quarter wavelength, presents a capacitive load to the transmitter. But wait. A capacitor has at least two elements. Where is the other one?

The other side of the capacitor is the ground. In our case, it's the car body, which, incidentally, is the worst possible ground plane you can have at these frequencies. Still, it's the only ground available, so we have to make the most of it.

In Fig. 1 we see the way the capacity is distributed. While a formula exists to calculate the capacity, it is a monster, and, for eight foot whips, it has long since been calculated. See Table 1 for the values as they work out for various diameter whips.

OK, then, we have it established that a whip of known dimensions presents a definite value of capacity at the feedpoint. Now, if we add an inductance of the proper amount to resonate the whip to the operating frequency, the antenna is resonant and satisfies the prime requirement of an efficient radiator.

This inductor is added, either at the base where it utilizes the full amount of capacity and is therefore a lower value of inductance, or at the center where more inductance is required, but it distributes the antenna current more evenly. (See Fig. 2.)

The novice who has graduated from CB will recognize this as what many CBers call

	1/8"	1/4"	1/2"
6 feet	17	19	22
7 feet	19	22	25
8 feet	22	24	27
9 feet	24	27	30
10 feet	26	30	33

Table 1. Values expressed in picofarads.

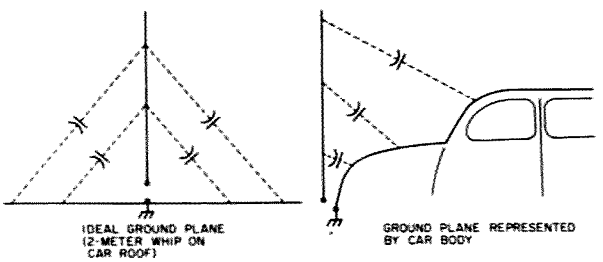


Fig. 1.

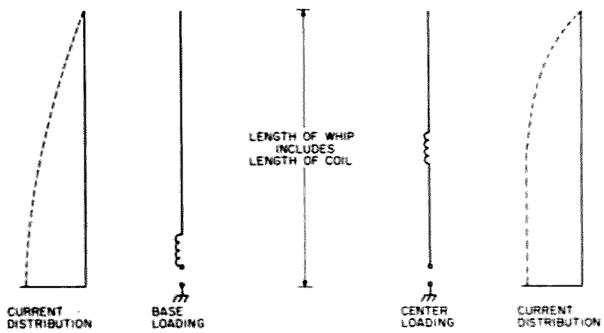


Fig. 2.

a booster coil. Whatever name it is called, it simply resonates the antenna to make it an electrical quarter wavelength. On the lower frequency bands, base-loaded antennas are preferred when the antenna is mounted on the trunk lid, and center loading is generally preferred with fender or bumper mounting. Of course, there are exceptions, mostly depending on an individual's personal tastes.

With the problem of resonating the antenna solved, there is yet another hurdle to jump. At these frequencies, an eight foot whip, even if it is resonant, presents a very low radiation resistance. Consequently, the greater part of the impedance it presents to the transmitter is resistive, and even then the impedance can be considerably lower than the 50 Ohm output of the transmitter. While some manufacturers offer lower than normal impedance cable, there is a better way to solve the problem.

An inductor or a capacitor can be connected directly across the feedpoint to *increase* the impedance to 50 Ohms. Now I know this goes across the grain of the average novice's knowledge of ac theory. However, it does work. Don't ask me why. I'll confess that I can't fully explain it even though I've written a book on antennas. The reasoning behind it is contained in a fiendish device called a Smith Chart, a round chart of reactance and impedance values which, after 25 years in ham radio, I still don't fully understand. In that respect, I belong to a very large club which excludes only engineers specializing in antennas. However, I've found to my satisfaction that it does work, and you will too, if you try it. (See Fig. 3.)

Approximate values are given for the lower amateur bands, using either base or center loading. These values do have considerable tolerance, unless you're finicky over swr. Even then, they're not extremely critical. Heathkit, for example, recommended a .001 capacitor on 75 meters, which is quite easy to get. The optimum value, however, is in the neighborhood of .00095. The .001 works quite well, however. (See Fig. 4.)

Once everything's connected, there remains the job of tuning up. I don't want to frighten you away, but, unless you have the right equipment, the initial tune-up of a low band mobile antenna can be a stinker. Don't even consider it unless you have an swr meter and a grid dipper or equivalent.

Tuning Up a Mobile Antenna

Position the vehicle where it will be clear of substantial objects (houses, trees, etc.) for a radius of at least 1/8 wavelength. Couple the dip oscillator into the base of the antenna, either by coupling into the matching inductor, or by adding a small loop of wire between the base of the antenna and the matching capacitor as shown. Adjust the telescoping top section of the antenna until the dip oscillator indicates resonance. (See Fig. 5.) It may be necessary to add or remove a turn or two on the loading inductor.

At this point I may add that in 25 years of amateur radio, I've yet to find a dip oscillator whose calibrations can be trusted. It is best to tune in the signal of the dip oscillator on a calibrated receiver so you will know where you are in the frequency spectrum.

Once the antenna is set into the right ball park with the dip oscillator, the next thing to do is to key the transmitter at low drive and measure the swr. Then adjust the telescoping section of the antenna, a quarter inch at a time, measuring the swr after each change, until you reach the point where the swr is minimum. This done, you can, if you really insist on a very low swr, juggle the matching capacitor or inductor in 5 or 10% steps to the point where swr is immeasurably low.

Sounds simple, doesn't it? The steps are very basic, yet the process is so extremely critical that it can be a frustrating experience. A quarter inch difference in antenna length at the operating frequency can push the swr up to 2 with 75 meter operation. On 160 meters, the total bandwidth with a given antenna length is scarcely enough to accommodate two SSB voice channels. If you're transmitting while in motion and a truck passes, you can see the swr momentarily go way up.

Now I've discussed the tune-up process on 75 and 160 meters where the most difficulty is experienced. As you go into higher bands, the tuning becomes less critical. Generally speaking, 40 is the more popular band for low band mobile operation. It is high enough in frequency to minimize noise problems, and low enough for impressive DX operation.

The mention of noise brings in the second biggest bugaboo of mobile operation – the biggest one after you conquer the antenna. For some reason, most natural and man-made static is vertically polarized. Since you have a vertical antenna, it is like having a noise magnet. On 75, the noise can be murder, especially when you are driving along a rural road where the power company is too tight to properly maintain their insulators and

Band	Matching Element (Base-loaded)	Matching Element (Center-loaded)
160	2000 pF, 3.7 uH	1100 pF, 5.73 uH
80	1000 pF, 1.4 uH	920 pF, 1.8 uH
40	660 pF, 0.72 uH	560 pF, 0.85 uH
20	390 pF, 0.31 uH	290 pF, 0.44 uH
15	220 pF, 0.25 uH	130 pF, 0.43 uH
CB and Up	CB – none needed. 8-foot whip naturally resonant; above CB – ¼ wave whip less than 8 feet	

Fig. 4. For a base-loaded whip, the loading coil inductance can be determined by calculating a series tuned circuit consisting of the whip capacity, the matching capacity or inductance, and the loading inductance. Use the formula:

$$L = \frac{1}{(2\pi F)^2 C}$$

For a center-loaded whip, the loading coil inductance can be determined by calculating a series tuned circuit consisting of half the whip capacity, all the matching inductance or capacity, and the loading inductance. Use the same formula.

When the antenna is inductively matched, L in the formula is the sum of the loading coil inductance and the matching inductance.

When the antenna is capacitively matched, C in the formula is the series result of the whip capacity and the matching capacity.

$$C = \frac{C_1 C_2}{C_1 + C_2}$$

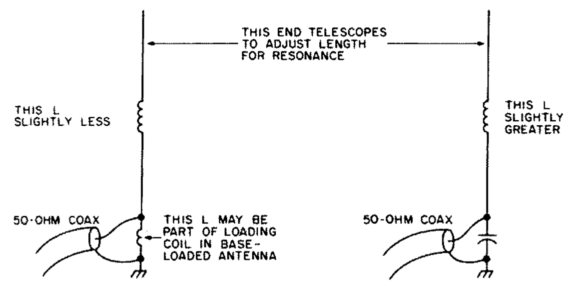


Fig. 3.

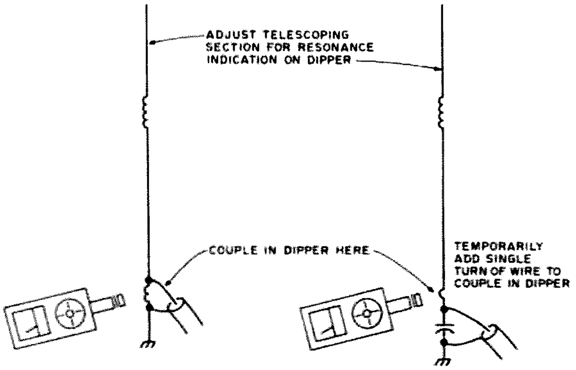


Fig. 5.

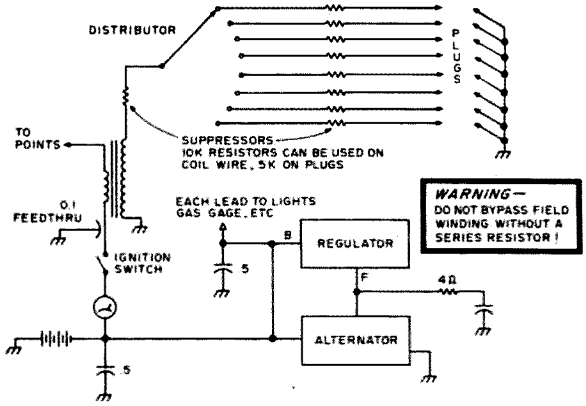


Fig. 6. For additional suppression, coil, distributor, and ignition wiring can be shielded.

transformers. Here in western New York State, for example, a certain rural road between the villages of Mount Morris and Nunda is known among mobile hams for the 20 over S9 roar it produces in their receivers. The power company tightwads must be wasting a tremendous amount of energy there.

If power lines were the only noise worry, mobile hams would have it made. Unfortunately, however, there are numerous other sources of noise. Mother Nature is one of them. I've seen the S-meter climb to over 40 above 9 when there were thunderstorms in the area. On one occasion, as I was hearing the results of a storm in the area of Buffalo 50 miles from where I was, I noticed a steady, whining roar, not too unlike the sound of rain on a tin roof. My rider said it was caused by a tornado, and I pooh-poohed the idea. The next day the papers said that a small funnel had been spotted in Erie county. It hadn't touched the ground, but my receiver had picked it up 50 miles away.

Even Mother Nature can, at times, quiet down. However, the mobile ham is carrying, in addition to his own transmitter, 4, 6, or 8 miniature spark transmitters, and he can't drive away from them. Now, you can't very easily fight the power company or Mother Nature, but you at least have a fighting chance against the noise generated by your car.

Noise can be produced, not only by the spark plugs, but also by the alternator, regulator, distributor, signal lights, horn, and even by the tires. Here is one place where the extreme popularity of CB has helped us. With all those CB radios around trying to pick 5 Watts out of the air, ignition interference suddenly gained high priority on the consumer market. Consequently, ignition suppressor kits are available almost anywhere.

Before you install ignition suppressors in your car, it might be wise to look under the hood. Some spark plugs have suppressors already built in. Some ignition wiring has suppression built in. If you add suppressors to a system that already has suppressor plugs and suppressor wiring, you might end up suppressing the spark that makes your engine go. (See Fig. 6.)

Shielded ignition kits are available. I've seen some advertised in *73 Magazine*. If this, together with all the steps recommended in Fig. 6, isn't satisfactory, there is still more you can do. Bond the hood and the car body together with lengths of heavy copper braid on either side near the hinges. Also ground the trunk lid in the same way. Connect the engine block to the car body with another length of braid, and ground the rig in the same way. Grounding the axles to the car body can suppress wheel static. Few amateurs have to take all these steps, but, on the other hand, no two amateurs have the same problems.

Finally, we come to the power supply, and it is here that the state of the art has seen the most dramatic changes in the last couple of decades. Right after World War II, solid state inverters were yet to be invented, so amateurs had to use other means of providing the needed high voltages for their rigs. Two types of supplies were used: vibrators and dynamotors, and they still provide the answer for the high-power men.

The vibrator supply used a vibrating set of contacts to chop the dc current, which was then fed into a transformer. At one time there were more different types of vibrators than there were circuits to use them in. Some even featured an extra set of contacts to rectify the high voltage. See Fig. 7(a). They had one main disadvantage in the large current demand which could quickly drain a battery.

A dynamotor is a motor operating at the battery voltage which then drives a generator to produce the high voltage. Some produce 115 volts ac, from which any rig could easily be operated. These have the disadvantage of

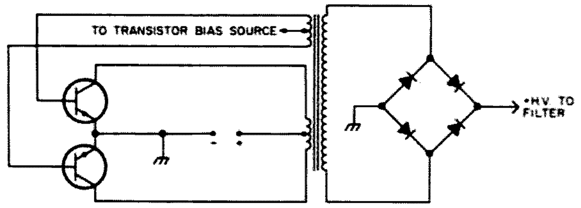


Fig. 8. Simplification of a dc to dc converter. The transistors form an oscillator circuit with the transformer providing feedback and transforming the voltage of the ac thus generated. Except for filter capacitor values, which are smaller due to the higher ripple frequency, the filter and regulation circuits are the same as in a conventional supply. Commercial manufacturers often use a more sophisticated oscillator circuit, employing a starter circuit to ensure that the oscillator always starts oscillating when the unit is turned on.

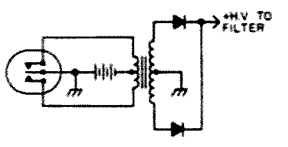


Fig. 7(a). Typical vibrator power supply. The vibrator coil and interrupter contact have been omitted for simplification.

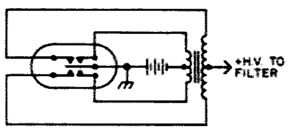


Fig. 7(b). Synchronous vibrator power supply in which an extra pair of contacts provided reactification.

high current drain as well as the arcing commutator. I've heard of a fellow in Buffalo who once tried to mount a dynamotor in his trunk. He very carefully drilled mounting holes in the trunk floor — right through the top of the gas tank. He did a neat job of installation and drove about for a while, unknowingly filling his trunk with fumes. Then he keyed the rig and blew his trunk lid clean off.

Nowadays most mobile power supplies utilize solid state inverters. An inverter is simply an oscillator, usually a particular variety of astable multivibrator circuit employing the primary of the power transformer, coupled into a feedback secondary winding. Alternating current is produced in the transformer primary by the flip-flop action of the transistors and transformed to the desired voltages, after which it is rectified and filtered in the conventional manner. Filter capacitors are usually smaller than those in ac supplies, since the oscillator operates at a much higher frequency than 60 Hz. The multivibrator circuit is preferred over a sine wave producing circuit, since the transistors in a square wave circuit waste much less power. However, the square wave requires a slightly different transformer, and the supply must be well shielded to prevent radiation of rf interference. (See Fig. 8.)

As a general rule, most hams prefer to buy their power supply and antenna. While there is nothing that exotic about these devices, the requirement of rugged construction discourages many home brew enthusiasts who don't have access to a machine shop. As for power supplies, in all too many circumstances, the transformer is designed specially for the manufacturer of a supply and is unavailable to the general public. ■

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

DOCKET NO. 21116

In the Matter of

Amendment of Part 2 of the Commission's Rules to prohibit the marketing of external radio frequency amplifiers capable of operation in any frequency from 24 to 35 MHz

To: The Commission

OPPOSITION TO PROPOSED RULE MAKING

The American Radio Relay League, Incorporated, the nationwide nonprofit organization of almost 140,000 amateur radio operators and enthusiasts in the United States, submits its opposition to the Notice of Proposed Rule Making released February 28, 1977 (42 F.R. 12203), and requests said proposal not be adopted.

In support whereof, the following is respectfully submitted:

I
Summary of Comments

The proposal to prohibit the marketing of external radio frequency amplifiers capable of operation on any frequency from 24 to 35 MHz, including the 28-29.7 MHz amateur band, is ill-conceived and impractical and, if adopted, not only will not reduce the unlawful use of such devices by the undisciplined Citizens Band (CB) Radio Service, but also will have a most severe impact upon and unfairly penalize the innocent, law-abiding and self-regulating Amateur Radio Service. The time has come — indeed, it is long past — for the Commissioners and the Commission's staff to concede that rules without effective enforcement are not worth the paper upon which they are written.

The state of the art is such that, unless such devices, including the components, are manufactured in strict conformance to a design either developed or specified by the Commission, any circuitry designed to prevent operation on frequencies from 24 to 35 MHz may be easily circumvented by persons with only minimal technical knowledge and experience. The Commission never has engaged in the development and design of equipment, and does not now propose to do so. In fact, the Commission may lack statutory authority to engage in such activities.

The League, as the only responsible spokesman for a substantial number of the nearly 300,000 licensed amateur radio operators in the United States, for years has been and continues to be extremely concerned about the undisciplined nature of the 27 MHz CB service, the inability of the Commission to enforce its rules, and the lack of Administration and Congressional support of the Commission's efforts. Most unfortunately, efforts of local jurisdictions to eliminate interference to television reception (TVI) from the 27 MHz CB service have had the practical effect of most severely penalizing the amateur radio operators in those jurisdictions. Numerous constructive suggestions and proposals made by the League over the years have been ignored. The League implores the Commission not to give similar treatment to the comments in opposition to the instant proposal.

The Commission is required to act in the public interest. A mere assertion that the public interest will be served by the adoption of rules such as proposed will not suffice; the Commission must demonstrate a reasonable possibility that any new rules are practical and stand a reasonable chance of producing the desired result. The League seriously doubts that any such showing can be made.

II
Circuits Intended To Prevent 24-35 MHz Operation Can Be Easily Circumvented

At the time the Commission adopted the present Section 2.815 of its Rules in 1975,[1] external radio frequency amplifiers almost without exception employed an output circuit tuned to the operating frequency. Operation on several frequency bands, e.g., the 3.5, 7, 14, 21, and 28 MHz amateur bands, usually was accomplished by switching into or out of the tuned circuit inductance, capacitance, or both.

About that time, amplifiers, both internal and external, employing broadband radio frequency transformers and capable of operation on any frequency between 3.5 and 29.7 MHz without any tuning adjustments appeared on the market. Thus, these amplifiers met the exemption of Section 2.815 and hundreds are manufactured and sold each day to CB operators.[2,3]

After explaining that the "24 MHz and 35 MHz limits were chosen so that practical circuitry could be used to achieve adequate suppression of radio frequency energy appearing on the CB frequencies" with only "a minimum effect upon the licensees of other services" (Notice, para. 8), the Commission states as follows:

> 9. Comments are also solicited concerning the practicality of such a prohibition and possible techniques which would be used to produce such an amplifier. Such comments should also address the problems associated with preventing the few unscrupulous manufacturers from including such features as accessible wiring which can be cut to provide operation on the prohibited frequencies, controls both external and internal which could provide for operation on these frequencies, or any other concepts which could be used to circumvent this prohibition.

Most unfortunately, there are not readily available at this time circuitry and techniques which cannot be easily circumvented by an unscrupulous dealer, service technician, or user, unless the Commission has the legal authority to specify certain manufacturing techniques such as, perhaps, encapsulated tuned circuits or transformers which not only are inaccessible but also cannot be substituted or bypassed. The League knows of no provision of the Communications Act of 1934, as amended, which gives the Commission authority over manufacturing design and techniques except for home television receivers which must be capable of reception of all VHF and UHF television channels.[4]

The frequency of an amplifier designed for operation on frequencies immediately below 24 MHz and employing at least one tuned circuit can easily be increased to 27 MHz by reducing either the inductance or capacitance, or both, of the tuned circuit. Reductions in inductance can be accomplished by any of several simple techniques such as increasing the spacing between turns, changing a tap, or shorting a turn. Reductions in capacitance can be accomplished by inserting another capacitor in series with the tuning capacitor, by removing a plate from a variable air capacitor, or by decreasing the meshing of plates of a variable air capacitor. The frequency of an amplifier designed for operation on frequencies immediately above 35 MHz and employing at least one tuned circuit can easily be decreased to 27 MHz by increasing either the inductance or capacitance, or both, of the tuned circuit. Increases in inductance can be accomplished by inserting magnetic material, such as a powdered iron core, in the field. Increases in capacitance can be accomplished merely by adding another capacitor in parallel with the capacitor of the tuned circuit.

The frequency response of the recently developed broadband transformer type amplifiers can best be limited by employing a low pass filter in amplifiers designed for operation on frequencies below 24 MHz, and

Continued on page 168

[1] § 2.815 *External radio frequency power amplifiers.* —

(a) As used in this Part, an external radio frequency power amplifier is any device which, (1) when used in conjunction with a radio transmitter as a signal source is capable of amplification of that signal, and (2) is not an integral part of a radio transmitter as manufactured.

(b) After January 23, 1975, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any external radio frequency power amplifier capable of use with a transmitter operated on any frequency or frequencies between 24.00 MHz and 35.00 MHz. Type accepted external radio frequency power amplifiers as defined herein may not be marketed after August 12, 1975.

(c) The proscription in paragraph (b) of this section shall not apply in the case of any external radio frequency power amplifier capable of use with a transmitter in the amateur frequency bands 28.00-29.70 MHz if the amplifier is an integral part of a unit or device having incorporated there power amplification capability in the bands 7000-7300 kHz, 14,000-14,350 kHz and 21.00-21.45 MHz.

(d) The proscription in paragraph (b) of this section shall not apply in the marketing to another licensed amateur radio operator of any single band external radio frequency power amplifier fabricated in not more than one unit of the same model by any licensed amateur radio operator, whose license affords him the privilege of operating on amateur frequencies between 1.80 and 29.00 MHz, for his own personal use at his licensed amateur radio station.

[2] The Notice of Proposed Rule Making in this proceeding states, in pertinent part, as follows:

3. To illustrate the manner in which the new rules were circumvented, almost immediately after the Report and Order (Docket No. 20118, 40 F.R. 1243) was released, there appeared on the market a device commonly called a "broadband linear." These devices may be considered to meet the strict letter of our Rules, inasmuch as they claim to provide for operation on the frequency bands specified under our exemption. However, these devices have an even greater potential for interference due to the higher levels of spurious emissions.

4. The advertisements for external radio frequency amplifiers generally carry a specific disclaimer to the effect that "Use of this equipment is not permitted in the Citizens Band (CB) Radio Service in the United States." However, the suppliers of such equipment consistently place their advertisements in publications which cater to the CB operator and seldom, if ever, advertise in publications that cater to amateur operators who could use such power amplifiers legally. Thus, some equipment suppliers see fit to comply only with the strict letter of the law, and at the same time disregard the spirit of the law, encouraging subversion of the Commission's regulations and efforts at improving the quality of the Citizens Band for all licensees. This is our next step in increasing the level of regulation applicable to the marketing of external RF power amplifiers.

[3] A recent report in a reputable electronic industry publication stated that a single manufacturer is producing 6,000 amplifiers each week. Another publication recently estimated that at least 4,000,000 stations are operating with power far in excess of the 4 Watts output permitted by the Rules.

[4] Section 303(s) of the Communications Act of 1934, as amended, provides as follows:

§ 303. Except as otherwise provided in this chapter, the Commission from time to time, as public convenience, interest, or necessity requires, shall —

* * *

(s) Have authority to require that apparatus designed to receive television pictures broadcast simultaneously with sound be capable of adequately receiving all frequencies allocated by the Commission to television broadcasting when such apparatus is shipped in interstate commerce, or is imported from any foreign country into the United States, for sale or resale to the public.

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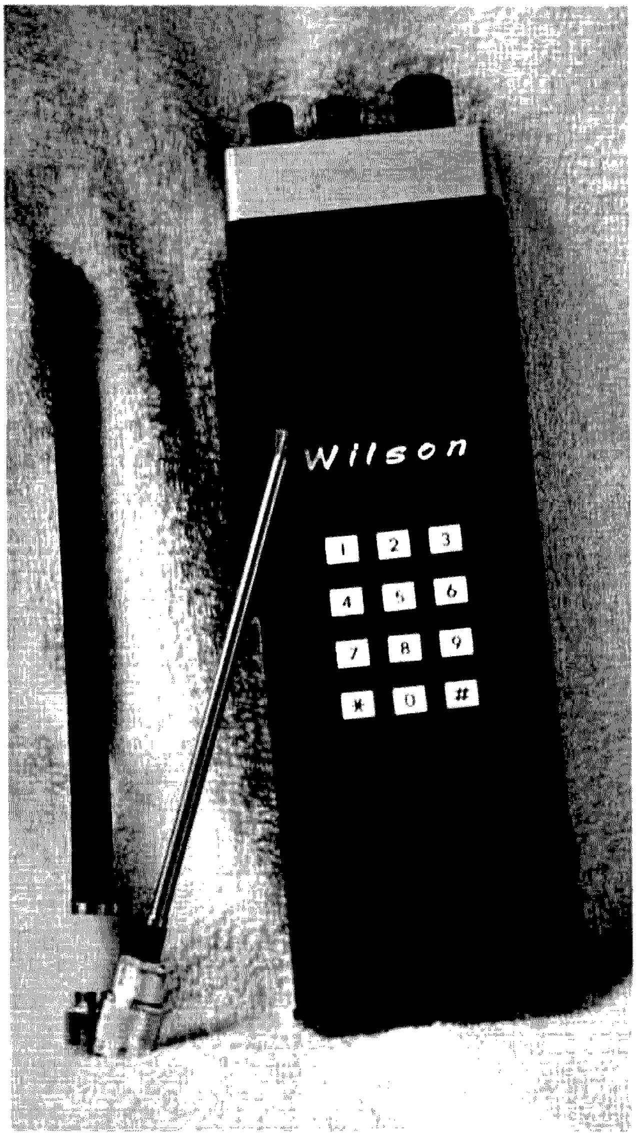
Super Wilson

-- several useful modifications



Super Wilson, with the modifications described in the text, is compact and original in appearance. The Digitran pad and full length antenna are shown.

One of the most flexible means of enjoying ham radio today is with the use of a small two meter handie-talkie. The capability of these rigs appears to be limited only by one's imagination. You can carry them anywhere and experience interference-free operation on a moment's notice. Likewise, the enjoyment of HT operation can be substantially increased if you add a few personal touches to your unit.

The following information describes such expansions that I added to my Wilson 1405 SM. These modifications are equally applicable to other handie-talkies which are presently available. You can mix and match these modifications as desired.

As I previously owned an elaborate, but low power, HT (Motorola HT 100 modified for 1 Watt on 4 frequencies as described in November, 1973, *73 Magazine*, page 77), I decided that my next HT should run the highest power reasonably available. Wilson's 5 Watt unit was the logical choice. After hassling with some minor purchase problems for a couple of months, I finally found time to modify the Wilson. Modifications included: 1) a special touchtone encoder, 2) carrier/"on" indicator, 3) extendable full length whip, 4) external antenna adaptor, 5) remote mike, 6) alternate blinker, and several other additions which will be discussed briefly at the end of this article.

Touchtone Encoder

The touchtone™ encoder consists of two parts: a small "SME" encoder manufactured by Data Signal, Inc., 2403 Commerce Lane, Albany GA 31707, and a Digitran touch pad obtained from Pipo Communications, Box 3435, Hollywood CA 90028. The "SME" was chosen because it perfectly filled the Wilson's only available free space, because the two tone levels could be independently adjusted (a necessity with the 1405 SM), and because of its previous outstanding performance.*

The newly-announced Digitran pad caught my eye because of its positive snap action, small size, and rugged construction. Mating these two units and mounting them in the Wilson can be a time-consuming project unless you follow a specific guideline similar to that described here.

Remove the HT's front cover and battery pack, and then ream a shallow trench inside the cover's back from the pad's connecting area to the cover's top. Mark the exact location for touchpad mounting/connection holes

*"The Shirt Pocket Touchtone," *73 Magazine*, Nov. 1976, pg. 58.

and carefully drill the holes. I did this by dipping the pad's bottom in the XYL's sewing chalk, and then sitting it on the HT. The white chalk left marks where each hole should be drilled. (I must have been too exacting on this because she doused me in leftover chalk shortly thereafter.)

Now secure a short length of small, flat 8 conductor cable (alpha wire makes a suitable cable), and ascertain that it fits flush in the reamed groove. Solder cable connections to the "SME", route the cable around the SME's bottom side, and tape it as shown in Fig. 1. Set the encoder and cable exactly in place as shown in Fig. 2; then trim leads and solder touchtone pad connections as shown in Fig. 1. This is also an ideal time to adjust high/low tone amplitudes for compatibility with the Wilson's frequency response. As the Wilson attenuated low frequency tones ≈3 dB (identifiable by its ability to dial all numbers except 1, 2 and 3), I paralleled the "low frequency 4.7k" resistor (R3 on Data's board) with another 4.7k resistor. This solved the problem perfectly. (Data Signal supplies complete instructions with each unit on adjusting tone levels to match rigs.) Wrap a layer of tape around the 1 MHz crystal and tape the encoder above the speaker's magnet (see Fig. 2).

Next, series connect a 500k pot and non-polarized 1 uF capacitor from the encoder output to the microphone's connection pad beside the mike. (Later the pot will be replaced with a fixed value 1/4 Watt resistor.) Surprisingly, my unit works only when this wire connects to the mike cable shield rather than the center conductor, so remember to swap connections if your unit doesn't tone. You are now ready to power up the opened HT and set tone level with the 500k pot. (I did this by actually dialing a number with the opened HT.) Now remove the pot, measure its resistance, and substitute a 1/4 Watt resistor for it. Wrap the resistor and capacitor in tape and fit them into available space. Finally, shift the encoder's position as required to avoid hitting the volume control, and reassemble the HT. Have patience and be careful not to force the case together. (Remember the tilt angle shown in Fig. 2?)

Carrier/On Indicator

Another useful modification for the Wilson HT is an incoming carrier indicator. This circuit activates a light emitting diode when a signal is on frequency, regardless of the HT's volume setting. An activating signal for this circuit is obtained from the junction of RØ66 and RØ67 in the Wilson. The best way to locate this point is with the use of a volt ohmmeter. Turn on the opened HT and switch it to an unoccupied channel. Make sure the rig is squelched. Set the VOM on a low voltage range and connect the negative lead to ground. Then, carefully touch the positive prod to the top of each resistor near Q118 and IC101. When you touch the proper resistor, the volt ohmmeter will deflect to approximately +2 volts. Unsquelching the HT will decrease this voltage to approximately zero. After locating this point, use a small soldering iron and carefully solder a small wire from that point to the input of Fig. 3.

Referring to Fig. 3, when the HT is squelched, +2 volts are applied to the base of Q1 through isolation resistor R1. This forward biases Q1, which conducts and shorts out the LED. The base voltage of Q1 rises from +2 to ≈ +6 volts during transmit; however, Q1 merely stays on. Base voltage on Q1 drops to zero when a signal is received, thus "opening" Q1 and allowing the LED to light. Current drain of this circuit is limited to ≈ .5 mA by R2. If this circuit is assembled as shown in Fig. 3(b), Q1 and R1 can be placed in the open area near Q118 and a small wire routed to an unused pin on the external mike connector. The LED and R2 are then mounted in the top of this connector, securing voltage from the appropriate pins (pins 4 and 5). A jumper is placed between the previously mentioned R1/Q1 pin and the junction of R2 and the LED. This provides incoming carrier indication. Removing this jumper allows the LED to function as a simple on/off indicator for the HT. A small cover/mount for the indicator may then be fabricated from cardboard and electrical tape.

Collapsible Antenna

A full length whip (which will substantially increase HT performance from fringe areas) is fabricated from the top part of a portable TV whip and a TNC rf connector. The whip is cut at 19 inches and crimped to hold the center connecting pin of this plug. Then the whip and pin are soldered for rigidity. A short piece of heat shrinkable tubing is affixed to the whip's bottom to prevent shorts, and the TNC's RG-58 reducer is slipped over the whip. A dimple is then added to prevent slippage, and the whip assembly (reducer, etc.) is screwed into the TNC plug. The collapsible antenna is now smaller than Wilson's rubber ducky and easier to carry.

External Mike and Antenna Connector

One of the main disadvantages of 2 meter mobile rigs is their high theft rate. Their only true means of protection is removing them every time you leave the car — no exceptions. My solution to this dilemma is to use the HT mobile and carry it with me when leaving the car. Thus,

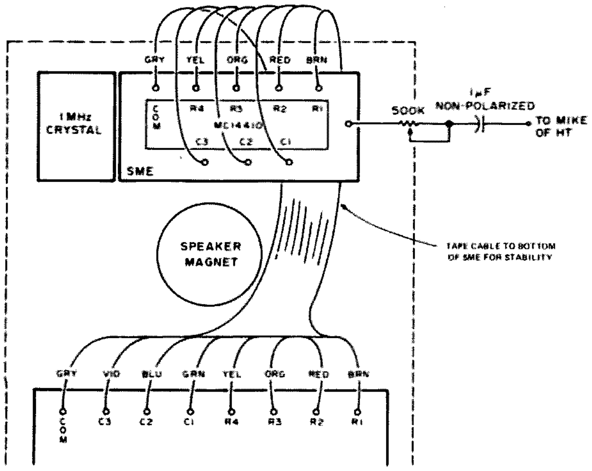


Fig. 1. Touchtone layout for inside of the HT's front cover.

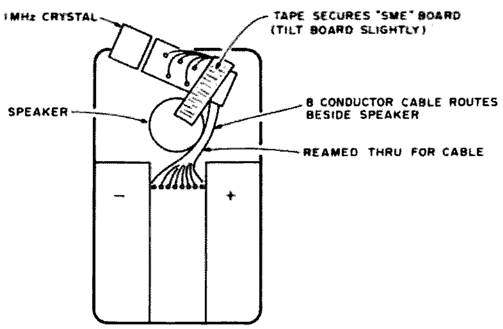


Fig. 2. A mounting suggestion for "SME" in the HT's front cover.

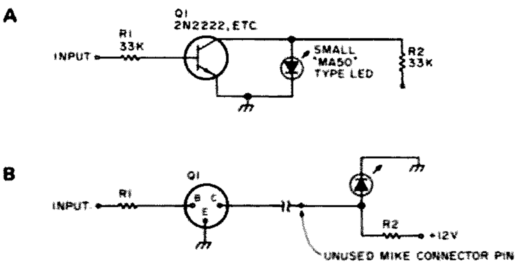


Fig. 3. a) Carrier indicator for the Wilson. b) Parts layout for the carrier indicator.

interesting QSOs are never missed due to chore stops. I merely grab the rig and continue the conversation. For mobile use, an extension rf cable is made from a 2 foot length of RG-184, a PL259 and a TNC connector. This cable and a magnetic mount 5/8 wave antenna provide very reliable mobile communications. An under-the-seat rf amplifier may be added here if desired.

Although I merely hold the complete HT during brief mobile excursions, I also fabricated a mobile mike for extended hands-free mobile use. This mike is constructed by placing a small Motorola HT mike at the end of a lightweight tube and cementing an alligator clip to the other end of this tube. Mike wires are routed through the tube and to the HT. This boom mike is clipped to my glasses during use. Transmit/receive switching is accomplished by mounting a stomp-to-talk switch near the auto's light dimmer switch. The rig can be used portable within seconds by disconnecting the external mike/PTT plug and antenna connector.

Alternate Flasher

As a special nonsense feature, I placed an LED on each side of the HT and connected them to a small 555 flasher circuit, which I mounted in the open (PL) area near the rig's bottom. The circuit for this blinker is shown in Fig. 4. This item doesn't do anything for the HT except make it look impressive. Build it small so you'll have room for more important modifications later. Component values are not critical, so feel free to use whatever junk box parts you have available. My circuit was assembled on a one inch piece of vectorboard as shown in Fig. 4. Power for the flasher is derived from the HT's battery pack. This may be accomplished by locating S202 (A and B) and moving the 1 Watt connections to the off position, and then securing flasher voltage from the 1 Watt position. The HT's hot wire is then connected through the unused squelch control switch for rig on/off functions. These flasher circuits were so enjoyable to build and use that I constructed several of them. Then I purchased some small paper maché animals with hollow insides from a local gift store and mounted the circuits in them. LEDs were placed in the drilled out eyes. A 9 volt transistor battery was placed in each unit for powering the flasher. Exclude the 2k resistor on pin 8 to +V if you use a 9 volt battery.

Latest Modifications

As mentioned earlier, I continue to modify the Wilson at every opportunity. Some of my latest ideas will now be described briefly.

Call Indicator — I often monitor one of our repeaters for calls at specific times, so I fashioned a simple set-reset circuit to indicate when this repeater was keyed "on". In the event I miss a call (or the HT's volume is low while I'm doing something else), an LED will be illuminated until it's extinguished by a reset button. As this circuit

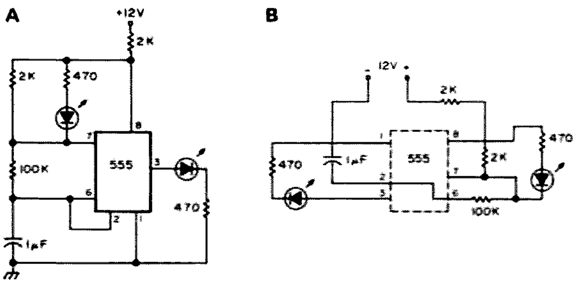


Fig. 4. a) The alternate flasher for the HT LEDs can be hamfest or Radio Shack specials. Resistor values are not critical. b) Parts layout for the flasher.

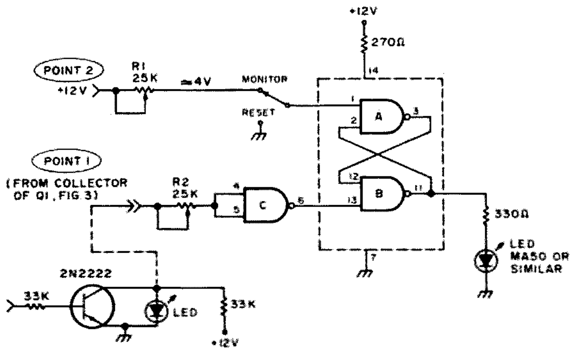


Fig. 5. Set-reset call indicator used on Super Wilson.

connects to the squelch-operated carrier indicator of Fig. 3, it can monitor any frequency to which the HT is switched. The "call LED" will illuminate when any carrier on frequency breaks squelch on the HT, but this is quite acceptable for my use.

Referring to Fig. 5, point 1 connects to the collector of Q1 in Fig. 3, and point 2 connects to the rig's +12 volts. R1 and R2 may be replaced by fixed resistors whose values are determined by the following procedure.

Set R1 and R2 to maximum before energizing the circuit, and then apply power and adjust R2 for proper "call LED" tracking (approximately 4 volts at pin 13 of IC1). Next, adjust R1 until the flip-flop resets properly (approximately 4 volts at pin 1 of IC1). Now measure R1 and R2 and replace them with the appropriate resistors. Don't forget to include the 270 Ohm resistor to pin 14 of the IC. Mount the complete circuit on a small piece of vectorboard and put it in one corner of the previously mentioned PL area.

Carry Strap/Holster — Like many of the popular HT's, my unit has two features which don't impress me — it's uncomfortable when carried on my belt, and it doesn't have an internally contained antenna. As an alternative to this inconvenience, I am having a local leather craft shop fabricate a shoulder carry strap/holster with a sewn-in 19 inch length of wire. One end of this wire will go to a connector which plugs into the HT's antenna jack. This antenna will primarily be used for receiving, rather than transmitting.

I'm also working on a mobile battery charger for the HT, and contemplating adding my Sinclair Black Watch to the unit. There's enough room available in the PL area for the watch's circuitry, and the readout can be placed above the touch-tone pad on the case front.

I see that Tec Kan has recently introduced a 6 channel scanner for the Wilson, so forthcoming modifications may be perpetual. ■

FCC

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by employing a high pass filter in amplifiers designed for operation on frequencies immediately above 35 MHz. In either case, the filter can easily be rendered ineffective by a single bypass wire. By their very nature, broadband transformers do not have sharp frequency cutoff characteristics.

There may be circuits or techniques of a proprietary nature not known to the League. If there are, it seems unreasonable to believe that they will be used voluntarily by a manufacturer not favoring the instant proposal.

A rule such as proposed may appear to a person without technical knowledge to be practical and desirable. However, as illustrated above, there are many ways in which an unscrupulous dealer, service technician, or user can circumvent the rule.

III
Restriction On Dissemination Of Information As To How The Rule Can Be Circumvented Would Be Unrealistic And Impractical And May Violate The First Amendment To The Constitution

The notice appears to invite comments as to whether the Commission can prohibit an unscrupulous manufacturer from including in the operation, instruction, or service manual information as to how the prohibition against operation between 24 and 35 MHz can be circumvented. Even if the Commission has the authority to dictate or restrict the content of such manuals, and the League knows of no provision of the Communications Act granting such authority, the information most certainly will be widely disseminated by other means, such as magazine articles, mailing pieces, telephone, and word of mouth. Violation of First Amendment constitutional rights undoubtedly would be raised should the Commission undertake any such restrictions.

IV
Small Scale Garage and Basement Manufacturing Would Occur Even If Circuits And Techniques Are Available To Achieve The Commission's Objectives

The components necessary to build an amplifier for use on the 27 MHz CB band are readily available and relatively inexpensive. Design and construction articles already are contained in numerous publications. Is it not reasonable to expect that many qualified persons will want to earn extra money by building amplifiers on a small scale basis? The League thinks so. Instead of having only a limited number of relatively large unscrupulous manufacturers, the Commission will be confronted by a very large number of small unscrupulous manufacturers as well as by countless thousands of home constructors. Once again, the rule would not achieve the intended result.

V
Prohibiting The Marketing Of External Power Amplifiers Capable Of Operation Between 24 and 35 MHz Would Not Prevent Illegal High Power Operation At 27 MHz

The maximum output of 27 MHz transmitters is 4 Watts average power for the amplitude modulation (AM) mode and 12 Watts peak envelope power (pep) for the single sideband suppressed carrier (SSB) mode. If the primary objective of the instant proposal is to prevent operation with higher powers, that objective cannot be achieved by limiting the frequency range of external radio frequency amplifiers as proposed in the Notice.

Many manufacturers, both domestic and foreign, now produce HF transceivers for operation on all amateur frequencies between 3.5 and 29.7 MHz with output powers from 50 to 500 Watts. The ready availability of such transceivers led the Commission in 1976 to increase the maximum input power to the final stage of transmitters operated by Novice Class operators from 75 to 250 Watts [Section 97.67(d), Docket 20282]. Within the last few months, transceivers with single sideband (SSB) output powers in excess of 1,000 Watts pep have appeared on the market and have been widely advertised in magazines catering to CB operators. Almost all of the HF transmitters can be operated in the 27 MHz CB band and on the frequencies between that band and the 28 MHz amateur band merely by substituting a quartz crystal, which can be purchased for $3.95 to $7.95, or by re-adjusting one tuned circuit. Tens of thousands of transceivers now are operated in violation of the Commission's rules on frequencies within and immediately above the 27 MHz CB band. If the primary purpose of the proposal of this proceeding is to limit or prevent 27 MHz CB operations with powers in excess of that authorized by the rules, it cannot be achieved by adoption of the amplifier proposal of this proceeding.

VI
Type Approval, Type Acceptance or Certification Would be Impractical

In companion Notice of Proposed Rule Making in Docket 21117 (42 F.R. 12204), released concurrently with the Notice in the instant proceeding, the Commission has proposed amendment of Section 2.983 of its rules to require type acceptance of equipment marketed for use in the Amateur Radio Service. Although the League is submitting separate comments in response to that Notice, a few observations at this time are appropriate.

The purpose of type approval, type acceptance or certification is to assure that certain equipments meet minimum specifications and standards set forth in the Commission's rules. For example, in the Amateur Service, spurious radiations from transmitters and oscillator circuits and receivers are legitimate concerns of the Commission. However, there is a substantial question as to whether the Commission's statutory authority extends beyond the electrical and safety characteristics to mechanical design. To illustrate, if an external amplifier which employs a low pass filter to prevent radio frequency output on frequencies above 24 MHz *meets* the specifications and standards for fundamental frequency and spurious radiations, can the Commission nevertheless *refuse* to grant type approval, type acceptance, or certification because the design permits the filter to be easily bypassed, thereby making possible operation at 27 MHz? The answer appears to be that the Commission has no such authority and must grant type approval, type acceptance or certification. This subject is discussed in greater depth in the League's comments in response to the Notice in Docket No. 21117.

VII
Construction Of Single Amplifiers Should Not Be Limited To Operators With General Or Higher Class Licenses

The Commission recognizes that many amateurs construct their own equipment and proposes that "to lessen the impact of this proposal upon the amateur operator who wishes to use the 10 meter [28 MHz] band, . . . a licensed amateur operator may construct one unit of a particular model amplifier for use at his own station" which he may also sell to another licensed amateur operator. Comments are invited to the proposal that "construction of these amplifiers will be restricted to those operators with a General or higher class license" (Notice, para. 10).

If the proposal to prohibit the marketing of amplifiers capable of operation between 24 and 35 MHz should be adopted, the League supports adoption of the exemption for amplifiers constructed by a licensed amateur for his own use. However, the League objects to the proposal that the amateur hold a General or higher class license.

The Commission's proposal is not limited to external radio frequency amplifiers having certain characteristics such as the radio frequency input and output powers. An ever increasing number of amateurs are specializing in low power (QRP) operation with transmitter powers up to 5 Watts. At least one QRP manufactured transceiver and at least one QRP transmitter kit are available, and QRP contests are conducted on a regular basis.

The limitation of amplifier construction to those holding a General or a higher class license would work a severe and unfair hardship upon Novice class operators. For example, many Novices operate QRP transmitters in the CW subbands of the 3.5, 7, 21 and 28 MHz amateur bands. Should the Commission's proposal be adopted, the Novice no longer would be permitted to construct an external amplifier capable of increasing his station's power from one or three Watts to fifty or one hundred Watts in the 28 MHz band, even though he may operate with an input power of 250 Watts in that band.

The Commission observes that consideration was given to "the higher degree of technical competence and experience which must be demonstrated to obtain such a (General class) license" (Notice, para. 10). A radio frequency amplifier, particularly one with relatively low power to cover two adjacent amateur bands, such as the 21 and 28 MHz bands, is a simple device which requires little technical competence or experience to construct.

Limiting construction of amplifiers to certain classes of operators would be unreasonable and unfair.

VIII
The Feasibility Of Prohibiting Sale of Amplifiers To Other Than Licensed Amateurs Should Be Explored

Chairman Richard E. Wiley concurred with considerable reluctance to the issuance of the Notice in this proceeding, and expressed the hope "that the comments we receive will suggest other and better alternatives to the Commission's proposals" and, at the same time, "recognize the tremendous task facing the FCC in regulating CB radio which, in the space of only 2 years, has grown from 50,000 license applications a month to over one million applications in January, 1977, alone."

From time to time in recent years, individual amateurs have suggested that dealers in amateur equipment be prohibited from selling amateur and amateur type equipment to persons not holding valid amateur licenses. A few dealers have adopted such a policy and practice. Most unfortunately, it appears that voluntary compliance with such a policy on a large scale cannot be achieved.

Two petitions for rule making proposing rules to permit the sale of amateur type equipment only to licensed amateurs now are before the Commission awaiting action: RM-2839, filed by the San Antonio Repeater Association on February 9, 1977, and RM-2866, filed by Frank W. Napurano, licensee of Amateur Radio Station K2OKA, on March 24, 1977. The R. L. Drake Co. has filed comments in response to RM-2839 which set forth a comprehensive and detailed plan to provide such controls. Numerous comments in response to the Notice in this proceeding suggest similar controls. Some of the respondents also have suggested that all amplifiers and transceivers bear permanently affixed serial numbers and a central registration office be established to aid in enforcement activities.

Although the League has considered the feasibility of prohibiting the sale of external radio frequency amplifiers, transmitters and transceivers to persons not holding a valid amateur license, it has serious doubts as to the statutory authority of the Commission to adopt such rules and practices.

The League strongly recommends that the Commission process with high priority the two petitions, RM-2839 and RM-2866, and either issue a notice of inquiry and notice of proposed rule making or deny the petitions with a statement of the reasons for the action. Should a denial of the petitions be based upon lack of statutory authority to adopt and enforce any such rules, requests for appropriate legislation then can be presented to the Congress.

IX
Effective Enforcement Of The Present Rules Is The Only Solution To The Problem Of Illegal Operations

The Commission has been aware of the widespread misuse of the 27 MHz CB and adjacent channels by unlicensed stations and by stations operating with powers in excess of that permitted by its rules since shortly after the Class D Citizens Radio Service was established in 1958. The Commission's requests to Congress for legislation granting it authority over unlicensed stations and equipments have gone unanswered for several years. Requests for funds to mount an effective are wide or nationwide enforcement program have been unproductive. The Commission is the laughingstock of millions of licensed as well as unlicensed 27 MHz CB operators. The chances of a CBer being apprehended for unlawful operation are far less than a motorist being apprehended for violation of the national 55 mile per hour speed limit in a state where only token enforcement is practiced.

Amateur radio operators have expressed their concern over the ever increasing unlawful operations in and close to the 27 MHz CB band over the years, and have been expecting the CBers to overrun the amateur bands like swarms of locusts and grasshoppers. Advance intruders already have appeared in the amateur bands, some using amateur callsigns either assigned to others or unassigned, and some operating only with pseudonyms or "handles" or phony callsigns.

Effective enforcement is the only solution. Millions of CB operators are losing respect for law and order by the excesses on the CB band. The Commission must find some way to impress upon Congress the need for funds to mount an effective enforcement program, not so much against the individual operator who may violate relatively minor rules, but against the flagrant individual violators, manufacturers, and sellers of the high power equipment used for such unlawful purposes. Perhaps legislation granting the Commission additional enforcement powers also is necessary. But one thing is certain: Adoption of unenforceable rules such as those proposed here will simply make matters worse and make even more difficult, if not impossible, the adoption of corrective measures in the future.

X
Conclusions

There must be some reasonable expectation that a rule will be effective before it can be adopted (Home Box Office, Inc., v. FCC, 1977). It is respectfully submitted that no useful purpose will be served by adopting a rule prohibiting the manufacture or sale of external radio frequency amplifiers capable of use between 24 and 35 MHz as proposed in this proceeding. Termination of this proceeding is respectfully requested.

Respectfully submitted,
THE AMERICAN RADIO RELAY LEAGUE, INCORPORATED
Robert M. Booth, Jr.
General Counsel

COMMENTS ON DOCKET 21117

Assuming Docket 21117 is adopted by the FCC in some form or another, manufacturers of amateur radio equipment will be faced with a number of difficult, and hard to answer problems.

For Example:

1. Will conformance of a product to federal standards at the time of manufacture provide an inherent defense against product liability suits?
2. Is there any statute of limitations to define how long after manufacture (or original purchase) that a manufacturer remains liable for the performance specs?
3. Will modification or alteration of the equipment relieve the manufacturer of further liability?
4. Does misuse of the equipment provide a defense?
5. Must defects be present at the time of manufacture in order to justify claims, or will manufacturers remain liable for developed defects?

These questions, and their answers, should point up a serious oversight in the FCC's thinking. Other commercial services do not "encourage experimentation" by owners or operators. By placing the responsibility for transmitter adjustments in the hands of licensed commercial radiotelephone/radiotelegraph operators, the responsibility for spurious, or incorrect, transmitter adjustments is limited to that known, tested, and (presumably) qualified group.

Contrast this with the typical amateur, as we know him, and it readily is apparent that equipment manufacturers are headed into stormy waters. Modification is the norm in the amateur service, misuse is common, and twenty-year-old equipment can be found in almost any ham shack.

Let me ask you (with what we now have from the FCC) if the manufacturer of a twenty-year-old antenna tuner is liable for a corroded screw terminal that causes excessive harmonic/interference, resulting in the ham being fined $500.00.

Grandfathering? That is no defense in 1987 for what we are producing in 1977. Nor will it be a proven defense until one or more of us is sued and successfully defends himself. From some ham whom the FCC fined 500 (or 5,000) bucks, and he blames the equipment.

To protect themselves from future legal hassles, manufacturers will be forced to increase their product liability insurance, and build a fund to provide legal defenses against future lawsuits by amateurs and various agencies of the government in addition to the FCC. With Docket 21117, OSHA, consumer groups, Customs, and God knows who else will have an interest in ham radio that they never saw before.

The net result of Docket 21117 will be to increase the cost to the purchaser, by enough to cover the extra QC recording, outside engineering lab work, UL approvals, product insurance premiums, legal defense fund, and the engineering freeze that is sure to occur in amateur equipment (as it has in commercial equipment).

These things frequently have a domino effect. By making it necessary to precisely identify the break-in point where a capacitor made by AEROVOX is substituted for an identical (or better) one made by TOSHIBA, the manufacturing engineer resists the substitution, and will only do it if the original is unavailable. Production is stopped totally at times in military work for this precise reason.

As a manufacturer, you must prepare your defense in advance by having absolute configuration control, with supporting documentation to prove that each change was necessary and justified. Do you now have a configuration control system? If not, then expect to add on that cost, too. How long should you retain the records? As long as you are liable, and right now there *is* no answer.

What are your chances of being nailed? Ask General Motors. They substituted equal or better Chevy engines for Pontiac and Olds engines. Their bill (so far) is over a million dollars.

Now, Docket 21117 is serious, and the amateur service was exempted from type acceptance requirements for very valid reasons. Amateurs are encouraged to experiment, develop new approaches, and modify their gear; commercial users are not.

QST runs "Hints & Kinks," and so does *Ham Radio, CQ, 73* and many, many non-ham publications such as *Popular Electronics*. Indeed, Yaesu is "blessed" with a group called the "FOX-TANGO CLUB," which monthly issues quantities of modifications, some of which even work. Will Yaesu be liable if some "FOX-TANGO" mod results in out-of-spec operation? Or a *73* mod? Or a *QST* kink?

These are the questions that we must press upon the FCC, hopefully to encourage them into some other, less harmful, course of action to solve their interference problem.

It is important to realize that the domestic issues presented so far pale into insignificance when viewed in terms of WARC '79. With amateur radio interests going unrepresented to any significant degree, the very real possibility is present that ham radio could go to a new philosophy entirely.

If, as one country suggests, HF operations were chopped to 20 kHz limits below 30 MHz, manufacturers can look forward to new designs and a shift away from traffic handling, DX hunting, and probably phone operation, because who would assign 3 kHz SSB slots into a 20 kHz band? CW would be the only practical mode — probably coherent CW, of the nature described recently in one of the amateur magazines. Lucky you!

Above 220 MHz? Fine, but with the loss of our wide choice of satellite frequencies, not much DX with countries who cannot come up with good UHF-SHF gear.

Lots of changes are coming, and soon.

What can you as a manufacturer do? You can band together in organizations like ARMA, to give you a means of doing things like lobbying and passing favorable rulings.

You can set up formal QC organizations and initiate a configuration control system that will withstand a legal assault.

You can begin examination of your advertising, to be sure that no legal grounds exist on which the FTC or consumer groups could bring suit. Have your lawyer *and* your chief engineer approve every ad before it is released.

Place your ads where the publisher is not hostile to manufacturers. Does that sound silly? It's not, because (as strange as it seems) some magazines are just bleeding us to finance other operations. You can sense the contempt in which they hold "store bought" equipment.

As far as I know, only one magazine has begun to actively support ARMA, and they even help the smaller advertisers make up ads. This is not to imply that the rest are hostile — just derelict, indifferent, or not comprehending the importance of what the ham radio manufacturing industry is undergoing.

Our company is not the smallest in the business, but we will look long and hard at our 1978 advertising budget, and we advise you to do the same. If the amateur population increases at 30,000 per year, this figure (when converted to dollar purchases and divided up among all companies from our size to the Ma and Pa outfits, plus sales of used equipment to new hams) simply does *not* represent significant, or even noticeable, growth. Unless everyone who struggles to make a dollar in the ham market presents a united front, the harassment that amateur radio is undergoing, and will be undergoing in the next few years, could spell its demise as an industry.

This united front must include not only the few manufacturers that exist within the U.S. and in foreign countries, but amateur radio dealers, the electronics publications (with spearheading by the ham publications), and grass roots hams. And, we cannot get hopeful about what the general amateur population might do to help, as it consists of a rather inarticulate group, largely young people or retirees — by tradition, they expect that someone else will come to their salvation. Doubtless the military will preserve their own out-of-ham-band frequencies for MARS use, but there are now only several thousand hams involved with this special service, and their pool of operators will diminish in proportion to the total ham population.

I want to emphasize as strongly as possible that we must press forward as soon as practicable with our ham ambassador program, or risk not having an industry at all! Without amateur frequencies, FCC actions affecting the amateur manufacturer become moot.

We must elicit answers from the FCC regarding precisely what the basis will be for acceptance/rejection of new designs of amateur gear, and what the requirements are for records (and how long must they be kept?). How detailed must a configuration control system be, with respect to prints, manuals, and engineering change orders?

The liability question must be studied, and limits put into the rules to avoid those problems now being experienced in other industries.

In short, we have two major projects, and possibly a third.

It has been put forward for discussion that amateur radio is totally represented to the world by the ARRL, and that a second organization, providing an alternative for individual amateurs, should be brought about in the near future.

Naturally, the ARRL is opposed to this idea, on the basis that it would provide a divisive picture to the FCC and the world, and result in damage to the ARS as a whole.

Several other arguments against a second organization have been put forth, but the possibility of damaging the amateur service by polarizing individual hams into two hostile camps is the only serious consideration we find valid.

Currently, the ARRL claims about 120,000 paid members, or roughly 40% of the 300,000 licensed amateur population.

The "sole and only" approach has been successful in the past, and anyone who thinks the ARRL has not made solid contributions in the amateur radio service simply has had his head in the sand.

Without the ARRL, DX awards, satellites, conventions, and a yard-long list of services would not have occurred at all, so it is small cheese indeed to cry that the ARRL is bad for ham radio. It is no exaggeration to say that none of us would even be in this business today if it were not for the League developing a market for us.

But the monolithic structuring of the ARRL has led to occasional blunders, and like most organizations (including my own), we (and they) have no desire to parade our failures, screw-ups, and outright bummers into public view.

Burying one's past mistakes is only human. Indeed, doctors do it all the time. But doctors are trained to learn from their errors, and occasionally even account legally for the malpractice.

Lacking checks and balances, the ARRL has shown increasing tendencies to turn a deaf ear to any voice west of the Allegheny Mountains, and for years has been laughingly pointed to as "living behind the codfish curtain."

So perhaps in the fullness of time, the ARRL has reached a "critical mass."

If the ARRL represents 40%, who represents the other 60% of the amateur population?

Would a new amateur radio group attract its membership from the ARRL's 40%, the uncommitted 60%, or both? Or neither? One of the first things to do would be to survey the amateur population and see if hams themselves want to join any new group.

The form of a "second ARRL" would probably determine its success or failure, so a great deal of thought should be given to where the ARRL must compete head to head, and to what areas the new organization would find itself exclusively owner of.

For example, the ARRL cannot lobby, so that would become an exclusive feature of the second group. Both would purport to represent amateurs, so a head to head contest for bodies would be natural. However, the ARRL would remain the sole purveyor of such invaluable technical aids as they now produce, along with their panoply of awards, certificates and so forth.

The ARRL has made it quite inviting for a new organization to gestate. They increased their dues again, as well as advertising rates, travel expenses, and salaries.

In a word, they are "fat."

Enough of the mechanics involved; what positive good would occur that would make ham radio prosper and grow?

I cannot answer that question to my own satisfaction, and admit that until more information is available, a second organization would be hard to endorse.

Nevertheless, it is essential that we in ARMA take up this question and give it the careful study it deserves. We, as a group, could make it happen, if we choose to do so,

and if it appears to be good for amateur radio to do so, we should grasp the nettle firmly and move with firmness and dispatch to start the ball rolling. If on balance it appears harmful to get a second organization into the act, then the matter should be dropped.

So the third major question is here: Should ARMA open up a second amateur radio organization, or not?

Thank you for your patience, your attention, and the privilege of sharing these thoughts with you.

Bernie Towers
Yaesu Radio Corp.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

DOCKET NO. 21117

In the Matter of

Amendment of Parts 2 and 97 of the Commission's Rules to require type acceptance of equipment marketed for use in the Amateur Radio Service

To: The Commission

OPPOSITION TO PROPOSED RULE MAKING

The American Radio Relay League, Incorporated, the nationwide nonprofit organization of almost 140,000 amateur radio operators and enthusiasts in the United States, submits its opposition to the Notice of Proposed Rule Making released February 28, 1977 (42 F.R. 12204), and requests said proposal not be adopted.

In support whereof, the following is respectfully submitted:

I
Summary Of Comments

The reasons given by the Commission for proposing type acceptance of equipment marketed for use in the Amateur Radio Service are (1) to control the design of transmitters, transceivers, and external radio frequency amplifiers to prevent their unlawful use with or without modification in the 27 MHz Citizens Band Radio Service, and (2) to "protect" the amateur bands from "store bought" equipment that does not at least meet minimum technical standards.

The League opposes adoption of the proposals for the following reasons: (1) the desired result, i.e., control of the design and marketing of transmitters, transceivers, and external radio frequency amplifiers to prevent their use in the 27 MHz CB band, would not be achieved; (2) no significant need for type acceptance of amateur equipment has been shown and none is known to the League; and (3) the statutory authority of the Commission to control the design and related characteristics of amateur equipment without specific legislation by the Congress is questionable.

II
Amateur Equipment Usually Is Designed To Cover Frequencies Outside The Amateur Bands

Most HF equipment now manufactured for sale to and use by amateurs is designed to cover frequencies outside the present amateur bands for one or more of the following reasons: (1) to facilitate design and construction; (2) to make possible operation of the amateur station as a Military Affiliate Radio System (MARS) station on government frequencies usually adjacent to the amateur bands[1]; (3) to provide for changes in amateur bands by World Administrative Radio Conferences[2]; (4) to permit operation on amateur bands available for use in some countries but not in the United States[3]; and (5) to permit use of equipment by other services with but minor modifications.[4,5]

The many variations in design and the flexibility of operation of HF amateur equipment makes impossible effective measures to prevent operation of such equipment with but minor modification or adjustment in the 27 MHz CB band. Restrictions on the design of HF amateur transmitters and transceivers, and perhaps of external radio frequency amplifiers, even if possible and practical, would eliminate the flexibility necessary to (1) accommodate future changes in the amateur bands, (2) participate in MARS, and (3) participate in Alaskan emergency communications on 4,383.8 kHz. Restrictions also would seriously inhibit the design and development of amateur equipment and the usefulness of such equipment to other services and, in time of national emergency, to the government.

III
The Commission's Objectives, To Prevent Use Of Amateur Equipment On 27 MHz CB Frequencies, Would Not Be Achieved

The primary purpose of the proposal to require type acceptance of amateur equipment is to prevent use of such equipment for illegal operation in the 27 MHz CB band and adjacent frequencies. In its Notice, the Commission states:

> 2. . . . The vast majority of amateurs now utilize commercially produced equipment, although the individual amateur operator often modifies this equipment to alter or improve its capabilities. This trend has resulted in a proliferation of equipment makes and models, and among them are now several types not only operable on amateur frequencies, but also, with no or only minor modifications, capable of operation on the 27 MHz CB frequencies. This quasi-CB equipment, as well as all other amateur equipment, does not now fall under the Commission's regulations on type acceptance and marketing, and we believe that the time has now come to amend our rules accordingly.
>
> ***
>
> 4. *We visualize the type acceptance requirement as a method to bring to our attention the quasi-CB equipment of the type mentioned above.* At that time, we can determine the suitability of permitting the marketing of the equipment. Under our type acceptance requirements, before a grant is made, we must determine not only that the equipment meets the applicable technical standards, but also that a grant of type acceptance would be in the public interest. Conditions which we would look for in deciding if a type acceptance grant should be made include, but are not limited to: any accessible wiring which, when cut, would allow operation on a frequency where use of the equipment is not permitted; the providing of circuit boards or similar circuitry to facilitate the addition of components, the purpose of which would be to change the equipment's operating characteristics in a manner not permitted under our rules; or, any internal or external adjustments or controls which are provided to facilitate operation in a manner not permitted under our Rules. Therefore, if a device met the technical requirements of the ARS (Part 97) but was presumably intended for illegal use in another service, type acceptance could be denied and the manufacturer would be denied the right to market that device. The manufacturer of devices intended for legitimate use would not be affected by this proposal. Comment is requested concerning specific details which should be placed in our rules concerning the conditions under which type acceptance could be denied. (Emphasis supplied.)

As shown in the discussion in the preceding section, almost all HF amateur transmitters and transceivers fall within the Commission's definition of "quasi-CB equipment." Just because the equipment may be easily adjusted or modified to operate on frequencies outside the present amateur bands, even including the 27 MHz CB band, does not and cannot create a presumption that the manufacturer intended that the equipment would be used illegally in the 27 MHz CB band.

It is apparent that the Commission contends that it may refuse to grant type acceptance to equipment which fully "meets the applicable technical standards" if there are some features of the design and construction it does not like. The League respectfully disagrees and submits that any other characteristics which might possibly bring about a refusal to grant type acceptance must be clearly and concisely stated in the rules. In the absence of such rules, how would a manufacturer know what standards he must meet to obtain type acceptance, how could the Commission defend itself against charges that refusal to grant type acceptance was arbitrary and capricious, and how could a court review upon appeal?

In the last sentence of paragraph 4, the Commission asks for "specific details which should be placed in our rules concerning the conditions under which type acceptance could be denied."

The League can offer no such suggestions, for the following reasons: *First*, present day design and construction practices provide the frequency flexibility necessary for full and complete amateur operation now and in the future. *Second*, as discussed later in these comments, there is serious question that the Commission has statutory authority to adopt and apply restrictions on the design and construction of amateur equipment.

The inescapable fact is that the Commission's objectives, to prevent use of amateur equipment of 27 MHz CB frequencies, cannot be achieved through the guise of type acceptance.

IV
Statutory Authority To Use Type Acceptance To Regulate Electrical and Mechanical Design Is Doubtful

It is apparent from paragraph 4 of the Notice, particularly the third and fourth sentences, that the Commission believes it has the statutory authority to withhold grant of type acceptance even though the equipment fully "meets the applicable technical standards."

The League knows of no provision of the Communications Act of 1934, as amended, or other statutes, which gives the Commission authority to regulate the electrical and mechanical design and manufacturing techniques of equipment, with but two exceptions. The first exception is where safety of life or property may be endangered. The second is Section 303(s) of the Communications Act which granted the Commission the authority to adopt and enforce rules requiring that all television receivers be capable of adequately receiving all VHF and UHF television broadcast channels — the all-channel receiver bill.

It appears from the third sentence of paragraph 4 that the Commission believes it has authority to determine that equipment not only "meets the applicable technical standards, but also that a grant of type acceptance would be in the public interest." "The public interest" is a nebulous standard. Under the guise of the "public interest" and nothing more, an agency could act in a most arbitrary manner. It is respectfully submitted that equipment which meets all "applicable technical standards" and presents no safety hazards must be granted type acceptance without a supplemental "public interest" conclusion.

The public interest required that television receivers be capable of receiving all VHF and UHF channels. Without such receivers, the demise of early UHF stations was imminent, and growth of an effective UHF television service was doubtful. The Commission concluded in 1961 that it lacked authority under its "public interest" power to adopt and enforce regulations requiring all-channel receivers. If the Commission found it necessary to seek statutory authority to adopt rules for all-channel television receivers, it would appear that statutory authority must be obtained from the Congress to adopt and enforce rules to prevent amateur equipment, particularly transceivers and external amplifiers, from being capable of operation in the 27 MHz CB band.

The League respectfully suggests that this matter be carefully considered before any rules such as proposed here are finalized. The size of the amateur market is sufficiently large that the possibility of an appeal is great should the proposals of this proceeding be adopted.

V
Need For Type Acceptance Has Not Been Shown

Some need for adoption of a rule must be shown or be apparent. Except for the desire to prevent use of amateur equipment for unlawful 27 MHz CB operation discussed in paragraphs 2 and 4 of the Notice (which are quoted earlier in these comments), the only need or justification appears in general language in paragraph 5 of the Notice:

> 5. Although the rules will continue to place the responsibility for meeting high technical standards upon the individual amateur, and we will continue to encourage experimentation and testing of equipment, we believe that those marketing amateur equipment must share in the responsibility to provide equipment capable of meeting these standards. Moreover, type acceptance of commercially marketed equipment does offer certain benefits to the amateur community. In addition to closing the amateur "loophole" that allows illegal CB "linears" to be openly advertised and sold, these requirements will also assist in preventing the marketing of inferior equipment to amateurs. The amateur band will be protected from "store bought" equipment that does not at least meet minimum technical standards.[6] This should result in fewer occurrences of interference to television receivers, other home electronic equipment, and other radio services including the amateur service itself.

It has been the League's experience, particularly in recent years, that amateur

[1] Some MARS frequencies and bands are adjacent to the HF amateur bands, and others are scattered throughout much of the HF portion of the spectrum.

[2] The League has urged the Commission to support a proposal that the United States propose new amateur bands in the vicinity of 10, 18 and 24 MHz at the WARC to be held in 1979. Tentative proposals prepared by the Commission contemplate the following changes in the present HF amateur bands: from 7.0-7.3 MHz to 6.95-7.25 MHz; from 14.0-14.35 MHz to 13.95-14.4 MHz; from 21.00-21.45 MHz to 20.95-21.45 MHz; and a new band, 25.76-25.86 MHz (Fifth Notice of Inquiry, Docket 20271, released May 23, 1977).

[3] The band 26.96-27.23 MHz was withdrawn from amateur use in the United States in 1958 and made available for the Class D Citizens Radio Service.

[4] Amateur equipment of at least one manufacturer was purchased by the Department of Defense during the Viet Nam action and is widely used at the present time. The amateur equipment of another manufacturer is used in the Maritime Mobile Radio Service with only minor modifications. Sources of equipment are readily available in times of national emergency.

[5] Amateur stations in Alaska may operate on 4,383.8 kHz with a maximum power of 150 Watts for emergency communications with other authorized stations in and within 50 nautical miles of Alaska.

[6] Recently, a case of commercially marketed amateur radio equipment operating in the 2 meter band caused harmful interference to a radio navigation system used by aircraft. It was found that the equipment was generating spurious emissions which were disrupting operations of this source of interference required investigation by the Commission, in addition to assistance from the amateur operators. The operators involved cooperated by ceasing operation until the equipment problem was corrected. It is anticipated that such situations will be minimized by requiring the equipment suppliers to demonstrate to the Commission the capability of their equipment to comply with the appropriate technical standards before they are permitted to market it to the amateur community.

equipment is designed and built to very high standards. Equipments of many manufacturers have undergone extensive testing in the League's well-equipped laboratory before advertising has been accepted for *QST* or before descriptions of equipments have been reported in *QST*. As far as the League has been able to ascertain, every manufacturer of receivers, transmitters, transceivers, and external amplifiers either owns modern up-to-date test equipment including spectrum analyzers, or has access to such equipment through contract with a qualified laboratory. Spurious radiations, if they do occur, are more likely to result from malfunctioning of some component than from any deficiency in design. The single example in footnote 6 of interference from spurious emissions from an amateur station illustrates the effectiveness of amateur cooperation in eliminating interference conditions. Have not the manufacturers learned a lesson from that incident? Are dozens of manufacturers to be ensnared in government red tape because of a single incident involving a single manufacturer? How could the higher prices which would be required be of benefit to the individual amateurs? The answer is obvious. One instance of unsatisfactory equipment does not establish a need for type acceptance of all equipment.

The League is not opposed to type acceptance if there is a real need for it. It does oppose the instant proposal, however, both because it knows of no substantial need and because the real purpose is to achieve control over the design of equipment in an effort to prevent its use in the 27 MHz CB band. There is no way even to estimate at this time the effect type acceptance and the modifications required to prevent a "change in the equipment's operating characteristics" (Notice, para. 4) which the Commission may impose, would have on the basic design and construction, the adaptability for operation on other frequencies such as those of MARS and those which may be added by the 1979 WARC, ease of servicing, and cost to the amateur.

Unless and until a more persuasive showing is made that type acceptance, as proposed in this proceeding, would not have an adverse impact upon the Amateur Radio Service and its equipment, the League must oppose the proposal.

VI
The Proposed Limits On Spurious Emissions And Radiations Are Unnecessarily Severe

As recently as March 2, 1977, the Commission amended Section 97.73 of its Rules to establish the following limits on spurious emissions:

> §97.73 *Purity of emissions.*
>
> (a) The mean power of any spurious emission or radiation from any amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency below 30 MHz shall be at least 40 decibels below the mean power of the fundamental without exceeding the power of 50 milliwatts. For equipment of mean power less than 5 Watts, the attenuation shall be at least 30 decibels.
>
> (b) The mean power of any spurious emission or radiation from any amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency above 50 MHz but below 235 MHz shall be at least 60 decibels below the mean power of the fundamental. For transmitters having mean power of 25 Watts or less, the mean power of any spurious radiation supplied to the antenna transmission line shall be at least 40 decibels below the mean power of the fundamental without exceeding the power of 25 microwatts, but, in any event, need not be reduced below the power of 10 microwatts.
>
> (c) Spurious emission or radiation from an amateur transmitter or external radio frequency power amplifier being operated with a carrier frequency above 235 MHz shall be reduced or eliminated in accordance with good engineering practice.

The Commission now proposes even stricter limits for type acceptance. After stating in paragraph 6 that, while the limits of Section 97.73

> may be adequate for equipment used by the individual amateur, we propose to require a 43 + 10 log (mean power in Watts) decibel suppression for type acceptance purposes, inasmuch as such equipment may be available in large quantities and thus, in the aggregate, will have a greater potential for interference. This degree of attenuation was chosen to correspond to the requirements for the land mobile and broadcast services.

It is respectfully submitted that there is no sound basis for suppressing spurious emissions of amateur equipment beyond those set forth in Section 97.73. Unlike transmitters in the land mobile and broadcast services which are designed to operate on one or a limited number of discrete frequencies, most amateur HF transmitters, transceivers, and amplifiers are designed to operate on any frequency within five amateur bands between 3.5 and 29.7 MHz, and some equipments are designed to operate in the MF 1.8 MHz band as well as four or five HF bands. The design of equipment operating over such a wide range of frequencies is much more difficult than for equipment operating on fixed frequencies. In addition, should spurious emissions occur, they probably would fall within the amateur band and not cause interference to any other service. Any potentially objectional spurious emission probably would be a harmonic and, because of the harmonic relationship of the amateur bands, might very well fall within an amateur band. Finally, when complaints of interference are received, whether because of spurious emissions, overloading of the complainant's receiver, or other causes, the amateur invariably installs a low pass filter in the output of his transmitter which attenuates all harmonic emissions above the designed cutoff frequency by at least 60 dB and often more than 80 dB. The end result is that there is only a very slight possibility of spurious emissions from an amateur station even without the limits of Section 97.73.

One other concern must be expressed. The building of amateur equipment from kits supplied by several manufacturers is an extremely important aspect of amateur radio. Not only does the kit builder often obtain high quality equipment at a price lower than that of manufactured equipment, but also he improves his technical knowledge and learns to service his equipment should malfunctioning occur.

Under the circumstances, it is respectfully submitted that no need has been shown and none exists for increasing the spurious emission limits for type acceptance beyond those specified in Section 97.73.

VII
Interference From Operation In The Amateur 10 Meter Band Has Not Been A Problem

In a further effort to justify its type acceptance proposal, the Commission states as follows:

> 7. Traditionally, the amateur operators have been in the forefront in developing techniques for solving interference problems, both through the use of external filtering and through actual modification of the transmitting equipment. This, in addition to the lesser degree of proliferation of equipment as compared to transmitters in the Citizens Band Radio Service, is our reason for not requiring the attenuation level of these transmitters to be as great as for the CB band. However, it may be necessary in a future rule making proceeding to readdress this matter if frequent problems from interference occur. Of immediate concern is operation in the 10 meter band. A Notice of Inquiry and Proposed Rule Making in Docket 21000 released November 30, 1976, addressed the matter of requiring 100 decibels of attenuation for spurious and harmonic emissions generated from transmitters in the Citizens Band Radio Service. Any actions taken in Docket 21000 may be reflected in our actions in this proceeding. Therefore, the attenuation level of spurious and harmonic emissions for transmitters operating in the 10 meter band may be made equivalent to any attenuation levels which may be adopted in Docket 21000.

Presumably, the Commission is referring to television interference.

The number of complaints of television interference from amateur operations in the 28.0-29.7 MHz band has been commensurate with complaints from operation in lower frequency amateur bands. The techniques referred to in paragraph 7 of the notice consist of installation of low pass filters between the output of the transmitters and the input to the antennas, and, at times, a high pass filter between the television receiving antenna and the input to the tuner of the receiver. Occasionally, additional shielding and/or grounding has been necessary.

To equate amateur 10 meter operation with the 27 MHz CB service is unfair in the extreme. A CB operator is not required to have any knowledge whatsoever of radio theory. All that is required is enough money to buy a transceiver, an antenna, and a transmission line, and file a simple application for license with this Commission. As noted by Chairman Richard E. Wiley when he reluctantly concurred in the issuance of the instant Notice of Proposed Rule Making:

> My concern is that, in attempting to deal with the rapidly proliferating and sometimes troublesome CB service, we may appear to be penalizing the amateur community which, in my judgment, is one of the most "professional" and self-regulated services within the Commission's jurisdiction.
>
> * * *
>
> I look forward to a healthy and vigorous discussion on the proceedings which the Commission has opened today. Whatever their ultimate outcome, I wish to take this opportunity to express my respect and admiration for the amateur community. I hope and trust my colleagues will give these dockets, and the comments filed by the amateur community (as well as others), careful attention prior to reaching any final conclusion.

Should the Commission find it desirable or necessary to apply even more rigid standards on equipment capable of operation in the amateur 28 MHz (10 meter) band, a further notice of proposed rule making would be appropriate and is requested.

VIII
It Is Not Clear If Existing Manufactured Equipment Would Be "Grandfathered"

It is not clear from the Notice if manufactured equipment now in the possession of amateurs would be granted "grandfather rights" to permit the continued use and unrestricted sale of such equipment. The following appears in the Notice:

> 8. We wish to stress that although *we propose to require the use of type accepted equipment at stations in the ARS*, we have made specific exemptions for equipment constructed or modified by individual amateurs for use at a licensed station in the ARS. While manufacturers would be prohibited from marketing equipment prior to the receipt of a grant of type acceptance, the individual amateur would be permitted to construct his own equipment or to modify his equipment, whether home built or commercially procured, provided the modified equipment was for use at a licensed amateur station. In addition, the amateur would be permitted to sell his home built or modified equipment to another amateur. However, the amateur operator who decides to build or modify equipment in quantity for sale to other amateurs will be considered a manufacturer and will be subject to the type acceptance requirement. We feel that this will place the minimum burden upon the individual amateur radio licensee and will still encourage the experimentation and testing of equipment which, in the past, has been a major characteristic of the amateur community. (Emphasis supplied.)

Any changes in the rules obsoleting equipment would impose a very heavy financial burden upon amateurs. Unlike commercial users of radio, amateurs cannot amortize for tax purposes the cost of their equipment.

The Notice leaves unanswered several important questions. Must an amateur modify his manufactured equipment in some manner to continue to use it or to sell it? A similar ambiguity in the Notice of Proposed Rule Making and in the First Report and Order in Docket 20777 led to the filing of several petitions for reconsideration and brought about clarifying amendments to the rules adopted by the First Report.

Should the substance of the rules proposed in this proceeding be adopted, the League urges that the lessons learned in Docket 20777 be applied here, and that the report and order as well as the rules specifically provide that all equipment now owned by amateurs be exempt. The League also recommends that ample lead time be provided before any new or amended rules become effective to enable manufacturers to set up new production lines and distributors and dealers to sell equipment now in the distribution system.

IX
What Has Happened To The Commission's Program of Deregulation?

Under the leadership of Chairman Wiley, the Commission embarked upon a program of deregulation four years ago. Insofar as the amateur service is concerned, a few deregulation actions were taken, followed shortly thereafter by more restrictions under the guise of deregulation. Now, in a number of proposals including Dockets 21000, 21116, and 21117, all pretense of deregulation has been abandoned.

The League is constrained to ask, "What has happened to the Commission's program of deregulation of the Amateur Radio Service which almost every Commissioner for the last 40 years has praised for its self-regulation?"

X
Amateurs Are Cognizant of And Deeply Concerned About The Illegal High Power Operations In And Adjacent To The 27 MHz CB Band

In the almost 20 years since the Class D 27 MHz CB service was established, literally thousands of amateurs have expressed to the Commission and to members of Congress their concern about the excesses in 27 MHz operations by both licensed and unlicensed stations. Particularly since the growth of the 27 MHz CB service exploded two years ago, amateurs have been unjustly blamed for television and other interference actually caused by high power operation of 27 MHz CB equipment in violation of the rules, with the result that countless municipalities have adopted ordinances severely restricting the use of outdoor antennas by amateurs.

The League's objection to the proposals of this proceeding and to those of Dockets 20282, 20777, and 21116 should not be construed as a lack of awareness of the extremely serious problem of illegal CB type operations facing the Commission?[7] The League is most desirous of assisting the Commission in finding a solution to the dilemma, but it cannot sit idly by while the Commission proposes regulation after regulation which will have the cumulative effect of emasculating the amateur service.

XI
The Feasibility Of Prohibiting Sale Of Amateur Equipment To

[7] It is respectfully submitted that the critical comments in paragraph 3 of the Notice are not warranted. The method to be used for determining power of an amateur transmitter is unrelated to the instant proposal.

Other Than Licensed Amateurs Should Be Explored

Chairman Wiley concurred with considerable reluctance to the issuance of the Notice in this proceeding, and expressed the hope "that the comments we receive will suggest other and better alternatives to the Commission's proposals" and, at the same time, "recognize the tremendous task facing the FCC in regulating CB radio which, in the space of only 2 years, has grown from 50,000 license applications a month to over one million applications in January, 1977, alone."

As long ago as 1971, the League suggested in comments filed in opposition to RM-1747 and in opposition to the proposal for a Class E CB service in the 220 MHz amateur band (Docket 19759) that the Commission consider prohibiting sale of amateur equipment to other than licensed amateur operators and requiring the registration of serially numbered equipment. Similar suggestions have been received from other amateurs over the years. A few dealers in amateur equipment have adopted a policy and practice of refusing to sell to non-amateurs. Most unfortunately, it appears that voluntary compliance with such a policy on a large scale cannot be achieved.

Two petitions for rule making proposing rules to permit the sale of amateur type equipment only to licensed amateurs now are before the Commission awaiting action: RM-2839, filed by the San Antonio Repeater Association on February 9, 1977, and RM-2866, filed by Frank W. Napurano, licensee of Amateur Radio Station K2OKA, on March 24, 1977. The R. L. Drake Co. has filed *comments in* response to RM-2839 which set forth a comprehensive and detailed plan to provide such controls. Numerous comments in response to the Nótice in this proceeding suggest similar controls. Some of the respondents also have suggested that all amplifiers and transceivers bear permanently affixed serial numbers and a central registration office be established to aid in enforcement activities.

Although the League has considered the feasibility of prohibiting the sale of external radio frequency amplifiers, transmitters, and transceivers to persons not holding a valid amateur license, it has serious doubts as to the statutory authority of the Commission to adopt such rules and practices.

The League strongly recommends that the Commission process with high priority the two petitions, RM-2839 and RM-2866, and either issue a notice of inquiry and notice of proposed rule making or deny the petitions with a statement of the reasons for the action. Should a denial of the petitions be based upon lack of statutory authority to adopt and enforce any such rules, requests for appropriate legislation then can be presented to the Congress.

XII
Effective Enforcement Of The Present Rules Is The Only Solution To The Problem Of Illegal Operations

The Commission has been aware of the widespread misuse of the 27 MHz CB and adjacent channels by unlicensed stations and by stations operating with powers in excess of that permitted by its rules since shortly after the Class D Citizens Radio Service was established in 1958. The Commission's requests to Congress for legislation granting it authority over unlicensed stations and equipments have gone unanswered for several years. Requests for funds to mount an effective areawide or nationwide enforcement program have been unproductive. The Commission is the laughingstock of millions of licensed as well as unlicensed 27 MHz CB operators. The chances of a CBer being apprehended for unlawful operation are far less than a motorist being apprehended for violation of the national 55 mile per hour speed limit in a state where only token enforcement is practiced.

Amateur radio operators have expressed their concern over the ever increasing unlawful operations in and close to the 27 MHz band over the years, and their fear that CBers may overrun the amateur bands. "Intruders" already have appeared in the amateur bands, some using amateur callsigns either assigned to others or unassigned, and some operating only with pseudonyms or "handles" or phony callsigns.

Effective enforcement is the only solution. Millions of CB operators are losing respect for law and order because of the lack of enforcement of the rules and the excesses on the CB band. *The Commission must find some way to impress upon the Office of Management and Budget and upon Congress the need for funds to mount an effective enforcement program.* Any such program should be directed not so much against the individual operator who may violate relatively minor rules, but against the flagrant individual violators, manufacturers, and sellers of the high power equipment, both transceivers and external amplifiers, used for such unlawful purposes. Perhaps legislation granting the Commission additional enforcement powers also is necessary. *But one thing is certain: Adoption of unnecessary and unenforceable rules such as those proposed here will simply make matters worse and make even more difficult, if not impossible, the adoption of corrective measures in the future.*

XIII
Conclusions

The League well understands the demands of constituents to their representatives in Congress "to do something to clean up the CB mess" which interferes with their television reception, the urgings by members of Congress that the Commission take some affirmative action, and the pressures upon the Commission's staff to come forward with some solutions. The League and the entire Amateur Radio Service are just as desirous of finding a solution to the CB mess as is the Commission.

Amateurs, because of their technical training and practical experience acquired under the Commission's comprehensive and effective programs and policies, are uniquely qualified to evaluate the effectiveness of proposals intended to find at least a partial solution to the troublesome CB problems. The comments of the League and numerous individual amateurs opposing the proposals in this proceeding and the companion proceeding in Docket 21116 should be considered as being constructive. The Commission's hope that adoption of the proposals in these two proceedings will be effective has been misplaced.

If even one lesson has been learned from this proceeding and from the basic 27 MHz CB problem, it is that a personal radio service such as the 27 MHz CB service must never again be placed on frequencies in close proximity to amateur frequencies. The other lesson has been that the relationship to television broadcast channels must be considered when assignments are made in the future.

The Commission must recognize that, even should a type acceptance program for amateur equipment be successful, there are other techniques available which will permit continued operation with high power in and close to the 27 MHz CB band.

In conclusion, the Commission is urged to not adopt the proposals of this proceeding but, in cooperation with other interested parties, develop a more realistic program which will have some chance of success.

Respectfully submitted,
THE AMERICAN RADIO RELAY LEAGUE, INCORPORATED
Robert M. Booth, Jr.
General Counsel

photo-flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi power lo pass filter, 6M preamp, 3 wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 index.

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar 7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16-wave 2M ant, Hallicrafters SX 111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T 44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

Since there's little to get stale in back issues of 73 (our magazine is not padded . . . like others . . . with reams of activity reports), you'll have a fantastic time reading them. Most of the articles are still exciting to read . . . and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted . . . and more. You'll really get a kick out of the back issues.

OCT 75. A deluxe TTY keyboard (part 1), Op Amps: a basic primer, an introduction to microprocessors, 2m Synthesizer (conclusion), Satellite Fax System (conclusion), regulated supplies (dispelling the mystery), Digital Logic made simple, FCC interview, a contest uP system, digital clock time bases, the operating desk, QRP 432, ham PR.

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed, breakthrough in fast scan ATV, strobing displays is cool, the tuned lunch box (antenna tuner for HF transceivers), a deluxe TTY keyboard (part 2), the 127' rotating mast, less than $100 multi-purpose scope for your shack (part 1), predicting third order intermod, feedline primer, QRMing the Third Reich, why tubes haven't died, instant circuits – build your own IC test rig, the K2OAW synthesizer PROM-oted, a ham's intro to microprocessing, Ground Fault Interrupter (a keep alive circuit for yourself), a $1 strip chart recorder, an even simpler clock osc., the Fun City surplus scene, updating the Heath IB-1101 counter, 256 pages!

JAN 76. Clocks – Really Simplified, De-Strain your Ham—M, An Automatic Dialer for the Deluxe Mobile, Zapping Dead Nicads to Life, The Computer QSO Machine, $50 Self-Powered Counter, Save Money on Coax, How to Pass Exams, Using a Bargain Surplus Keyboard, Improve Your SSTV with the FRAMER, and more. The first 73 in new large format! (Includes 1975 index to 73).

FEB 76. Build a Starfleet Communicator – Trekkies Special, Synthesized IC Frequency Standard, You Can Make Photo PC Boards, How's Your Speech Quality?, ASCII to Baudot Converter, RTTY Autocall – the Digital Way, Improving the FT-101, Night DXing on 10 and 15m, Really Soup Up Your 2m Receiver, Put Your SB-10 on 160m.

MAR 76. Special Surplus Issue – Tunable FM Receiver Strips, Surplus Circuit Boards – A Gold Mine of Parts, Space Age Junque, A PC Board Bonanza, Government Surplus: Is It All Gone?, Stereo – A New Type of CW Filter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Pots

APR 76. Special FM Issue – A Program[illegible], Put That AM Rig on FM, A COR for your Rep[illegible] Amplifier, Build a 220 MHz Repeater [illegible] Your Regency, Long Distance C[illegible] TT Decoder, One IC Tone Burster, Th[illegible] A Versatile TTY Generator, The PLL – Exp[illegible] HR-22 Tips, Computers Are Ridiculously Simple

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MAY 76. Special Antenna Issue – The Magnificent Sevens Microhelix, An Allband Inverted Vee, Closed Loop Antenna Tuning, The 75-80m Broadbander, The Magic of a Matchmaker, How to Coax Your Antenna, 40m DXing – City Style, The Secret 2m Mobile Antenna, An Inverted Vee for 160/80m, The Dipole Dangler, Amateur Weather Satellite Reception, Scan Your HR212, A Very Cheap I/O – the MOdel 15, Code Converter Using PROMs, A Nifty Cassette-Computer System, The Ins and Outs of TTL, Build a CW Memory, 5/8 Wave Power for Your HT, 555 Timer Sweep Circuit for SSTV, AM is Not Dead – It Never Existed at All, Computer Languages – Simplified.

JUN 76. VHF Special – Super COR – Digital of Course!, Touchtone Decoder – Using a Calculator Readout, Simple Amateur TV Transmitter, Amateur TV Receiving System, Mobile Autodialer, Autocall '76 – Using a Touchtone Decoder, Build The Lab Type Bridge – and Measure Transformer Impedances, How Those Triangle Things Work – a Sort of Op Amp Handbook, Those Exciting Memory Chips – RAMs, ROMs, PROMs, etc., ASCII/Baudot with a PROM – for Ribbonless RTTY on Computers, Aim Your Beam Right – With a Programmable Calculator

JUL 76. Perfect CW – Drive 'em Crazy with the Keycoder I, The Mini-Mite Allband QRP Rig – A Mighty 7 Watts, A Fun Counter Project – Under $50, Build a FAX from Scratch – Then Get Satellite Pictures and Other Things, Dev Repeatermeter – Repeater Control with ID, The Giant Nixie Clock, Creative SSTV Programming, CW Regenerator/Processor, What's Up on 156 MHz?, TT Pad for the Wilson HT, Power Supply Testing – To Save Your Digital Circuits, A RTTY/Computer Display Unit, Your Computer Can Talk Morse, Gain for Your HT – a Half Wave Whip, The Super Transmatch, Simple VHF Monitor.

AUG 76. How Do You Use ICs? – Fundamentals, Surprising Miniature Low Band Antenna – the DDRR (Part I), MINI-MOS – the Best Keyer Yet?, The Skinflint's Delight Breadboard – Cheap Imitation of a Commercial IC DIP Board, More PLL Magic, The Logic Grabber – Selected Interval Logic Tracer, Global Calculations for the DXer – Using a Hand Calculator, Instant Counter Calibration – Using Your TV Set, Simple 450 MHz Rig – Go ATV With a $42.50 Module, The First Computer Controlled Ham Station – Grand Prize Winner, The Which Chip Dilemma! – 4, 8, 12, or 16 bits: pros and cons, Meaningful Conversations with your Computer – What All Those Mysterious Languages Are All About, A Baudot Monitor/Editor System, A Logic Probe You Can Hear, Satellite Orbit Predicting – Using a Pocket Calculator, FSK with the SB-401, Build the Safari RTTY Terminal, El Cheapo Signal Tracer – Test Gear for the Cheapskate.

SEP 76. The Surprising DDRR Low Noise Antenna (part II), Ultrasimple Regulation with New IC – Power Supply Design Greatly Simplified, Can an Indoor Antenna Work – Making the Best Out of a Bad Bargain, Inexpensive 12 Volts for Your Base Station, A Test Lab Bonanza – Using a Transistor Radio, Protect Your VHF Converter – Novel Antenna Relay, Ridiculously Simple RTTY System, How to Catch a CBer, A 450 MHz Transceiver for Under $130, Space Age Junque II, PROM Memory Revisited, Eight Trace Scope Adapter, The PROM Zapper, Sneaky Baudot – With an ASCII Keyboard!, Simple Graphics Terminal – Using surplus, Counters are Not Magic – They're Simple

OCT 76. Build a Weird 2 Band Mobile Antenna, Build a Counter for Your Receiver, How do You Use ICs? (part III), QRP Fun on 40 and 80 – Have a Real Ball with Just 5 Watts, The Hybrid Quad – Low Windload, Expense, Hassle!, Frequency Detector for Your Counter, Programmable CW ID Unit – for RTTY, Repeaters, Mobile, etc., New ICs for the Counter Culture – Simpler Counters with Less Used Power, Is My Rig Working or Not? – Build an Effective Radiated Field Meter and Know!, Quickie Collinears for 15 and 10 – a Satisfaction Guaranteed, Build a Super Standard – Goes Right Down to 1 Hz, The Incredible Lambda Diode, Mechanical RTTY Buffer, Have You Used a Triac Yet?, How to Interface a Clock Chip – Baudot, BCD, or ASCII Conversion, A TTL Tester – Great for Unmarked Bargain ICs, The New Ham Programmer – Making Those Confounded uPs Work, BASIC? What's That? – the Basics of BASIC, The Soft Art of Programming (part I).

NOV 76. Blockbuster 288 pg issue! Cordless Iron Tips, Bicycle Mobile, Build a Simple Lab Scope – Costs Less Than $20!, Get on Six with Surplus – The El Cheapo RT-70 is a Natural, The Beam Saver – Rotor Memory System, Updated Universal Frequency Generator, The Short Pocket Touchtone, Liquid Crystal Display Guide, Self-Powered Mike Preamp, The Wind Counter, The S38 is Not Dead!, The Amazing Inverted L – Antenna for 20, 40, and 80m, Battery Chargers Exposed, How Do You Use ICs (part III), Thirty Years of Ham RTTY, Big Noise Burglar Alarm, Dandy Digital Dial Decoder, Weather Satellite Display Control, Ham Time-Sharing is Here for You!, The Soft Art of Programming (part II), OSCAR Orbits on Your Altair, ASCII/Baudot Converter for Your TVT, The Smoke Tester – Power Supply Tester, The Man Who Invented AC – Tesla, the Greatest Pioneer of Them All!, Baudot to ASCII – You Want to Learn Programming?, Baudot and BASIC – an Interpreter for a Baudot Computer, Toward a More Perfect Touchtone Decoder, Using a Wireless Broadcaster, The Quiet Spy – Amateur Unknown Spy Ring in the US!, The Benefits of Sidetone Monitoring – And How to Do It.

DEC 76. Go Tone for Ten – Simple Subaudible Encoder, World's Simplest Five Band Receiver?, How Do You Use ICs? (part IV), A Super Cheapo CW IDer, The ZF Special Antenna, CT7001 Clock-buster, Saving a CBer, A Ham's Computer, What's All This LSI Bunk? – an Ostrich's Eye View of the Microprocessor, The Soft Art of Programming (part III), Put Snap into Your SSTV Pictures – Using a $20 Frequency Standard, What's all This Wire-Wrap Stuff? – Talk About Cold Solder Joints!, Exploding the Power Myth, Exploding the SWR Myth, The IC-22 Walkie – Portabilization with Nicads, Watch DX with a Spectrum Analyzer, DXing with a Weather Map.

HOLIDAY 76. 55 article issue! An Inexpensive 400 Watt HF amplifier, How Do You Use ICs? (part V), Mobile Smokey Detector – 10.5 GHz: Use It or Lose It!, Add RIT to Your Transceiver, DXpedition: Memories for a Lifetime – Reflections of HK1TL, Design Your Own QRP Dummy Load, Failsafe Super Charger – Multi-rate tool, The Amazing 18" Antenna for 160m, Replacing the Knife Switch – Simple TR System for the Novice, Now You Can Synthesize – the VHF Engineering Approach to 2m Happiness, Hutchinson's Remedy – the Chirpless CW Machine, The Mod Squad Does the Pocket Scanner – Radio Shack Pro-4 Update, TR-22 Mod Squad, What Computers Can and Can't Do, A Ham Shack File Handler – Program in BASIC for QSLs, Repeaters, etc., Print Your Own Logbook – On Your Nearest Computer, Showing Your HT, Cash In on the CB – Installation for Fun and Profit, Tuning Those Big Antenna Coils, The 2m Mod Squad Tackles the Weather Radio – and Wins!, Hamming by Laser, A 60 Foot Antenna on a 20 Foot Lot – Solving a 40m Novice problem, Dual Voltage Power Supply, An Autopatch Busy Signal, Inside the GLB – a Gutsy Look at a Synthesizer, How to Bug an Automatic Keyer, A 450 Duplexer – That Fits in Your Car, Will Silver-Zinc Replace the Nicad?

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WEST COAST	14	7A	7	7	7	7	7	14	14	14	14	14

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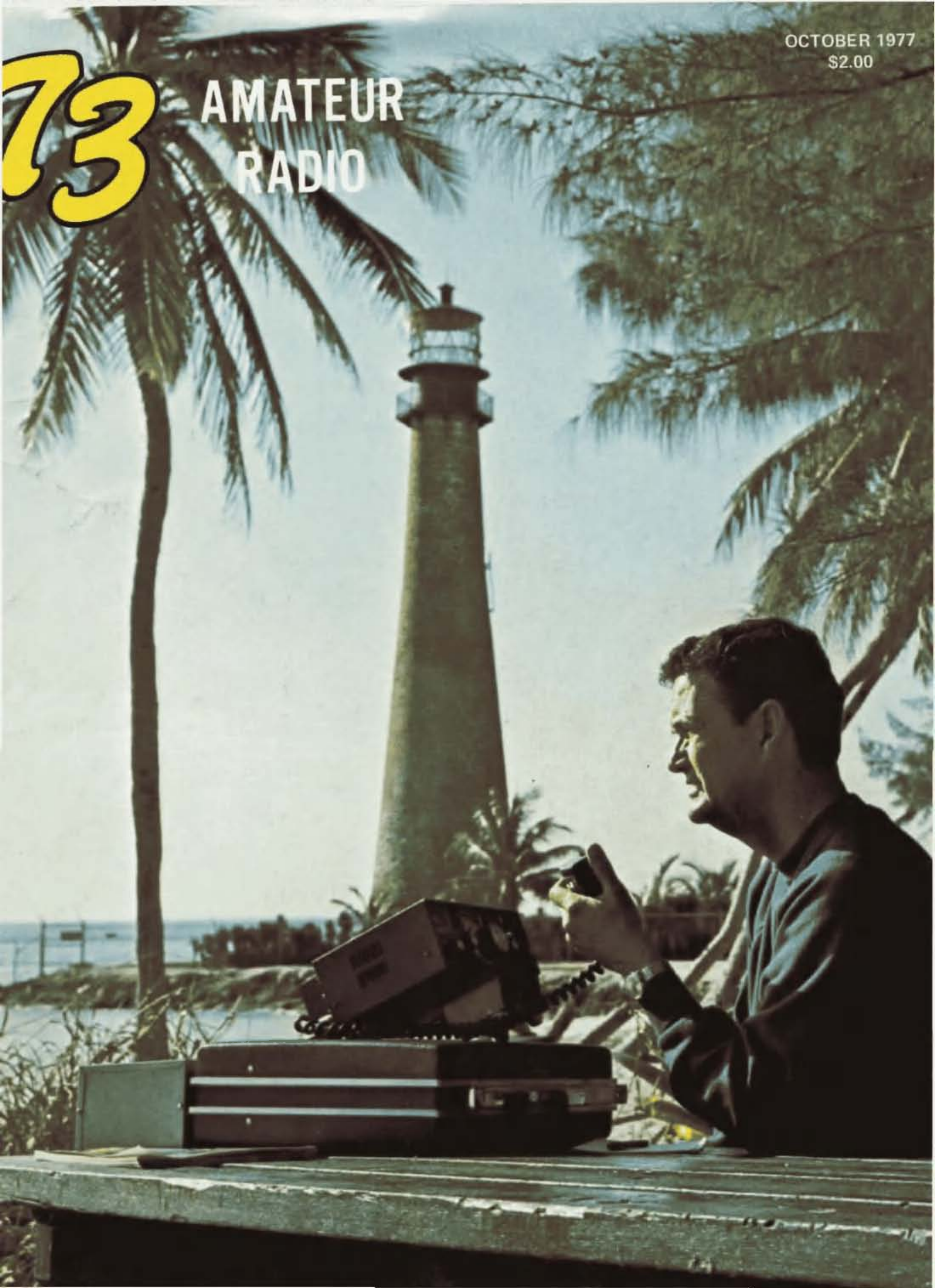
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14A	14A
SOUTH AFRICA	7	7	7	7	7B	7B	7B	14	14	14	14	14
U. S. S. R.	7B	7B	7	7	7B	7B	7	7	14	14	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	14	14	14	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

1977			SEPTEMBER			1977
SUN	MON	TUE	WED	THU	FRI	SAT
				1 G	2 F	3 G
4 G	5 F	6 F	7 P	8 F	9 G	10 G
11 G	12 F	13 G	14 G	15 G	16 P	17 G
18 G	19 G	20 F	21 P	22 P	23 F	24 G
25 G	26 G	27 F	28 G	29 G	30 G	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COVER: Photo by Delia Coya. Article begins on page 66.

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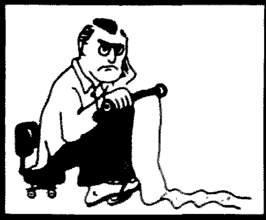

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

CAN THE QCWA SAVE AMATEUR RADIO?

The Quarter Century Wireless Association (QCWA) has been around for a long time, but has had little impact on events. As an editor of a ham magazine, I've been getting a little newsletter from the QCWA for years. It dwelt mostly on the departed and the departing, so I had an impression of the club as one of retired old-timers who were doing little more than waiting to die.

When my 25th anniversary as a ham arrived, I gave little consideration to joining the QCWA, not yet being ready to consider myself an old man. Eventually a good friend of mine, Harry Gartsman W6ATC, got rather involved with the club, so along about my 35th hamming year, I joined. Nothing came of it.

For some obscure reason, the QCWA invited me to give the talk at their yearly banquet — held in Seattle, during the ARRL convention. The League was pretty upset about this, but since it was not their banquet, they couldn't stop it. Mary Lewis, one of the organizers of the convention, asked me to speak to a couple of the convention groups — one on microcomputers and the other on hamming, for which blasphemy the ARRL appears to be making every possible effort to block her appointment as SCM. Petty politics, but routine.

Just judging from the QCWA newsletters, I'd gotten the impression that most members were old ARRL stalwarts, now living on social security and still afraid of trying anything new or experimental. I'd tried speaking to several ham clubs which were controlled by this type of old-timer, only to find that the minds were so tightly closed that there was no way for a new thought to penetrate. These are the musty ham clubs where you find virtually no new hams — no youngsters — and heaven help the CBer that wanders in for a meeting!

Not being willing to give up without a fight, when it came my time to speak at the banquet, I decided to find out who and what the QCWA was really made up of. I asked for a showing of hands of those present who had pioneered FM back before WW II (el biggo). Much to my surprise and pleasure, about fifteen hands went up. Hmmm.

Next I asked how many had helped pioneer narrow band FM in the late 40s, and again a bunch of hands went up. I was more impressed.

My critical question — how many were active on RTTY before 1950 — these had to be hard core pioneers. About 30 hands went up around the room. Very impressive for a group of about 500.

Well, okay for the long past, but what have they done for us recently? I asked about sideband pioneering and almost a third of the people in the room had been active on SSB before 1957. How about SSTV? Again, up went the hands! About 20 of them had been involved with moonbounce work and at least 50 were active on OSCAR. These were not just ordinary old men; these were the men whose pioneering has made amateur radio what it is today.

AMATEUR RADIO NEEDS LEADERSHIP

Readers keep getting exasperated with me for talking down the ARRL. I wish that these people would try for a moment to suspend blind belief in what they read in *QST* and talk with some of the old-timers who pioneered the hobby we have today and find out the true place the ARRL holds in history. It is not a nice one.

For instance, right now I doubt if you would be able to find one amateur anywhere in the world with any real grasp of the WARC situation who would take a bet that we will come out with even one ham band below 50 MHz. Yet you see little of this in *QST* and you hear nothing about it during the ARRL forums at conventions.

This is a complicated story, but it is one of which you should be aware, for this will have a profound effect on your hamming in a few years.

The QCWA members, far from being a bunch of withering old men, turned out to be representative of the very heart and spirit of amateur radio. These are the people who made amateur radio what it is today — the ones who pioneered and invented the circuits which we and all of the commercials are using. And they did all this with little help from either the FCC or the ARRL. Perhaps this group could do the job which the ARRL is not doing and help us to save our ham bands.

Before I explain the situation in detail, I should give some of my own background.

MY CREDENTIALS

Old-timers know me pretty well. Newcomers to amateur radio may not, so I'll take this opportunity to introduce myself. I should do this at least once every ten years anyway, and it is now about ten years overdue.

I first got attracted to amateur radio in the mid-30s, building my own shortwave radios along in 1936 and getting seriously into hamming by 1937. I started subscribing to *QST* in 1938, and have been a member of the ARRL ever since. That'll be 40 years next year. In 1941, I was quite active, mostly on 160m, and I even managed to win the ARRL Sweepstakes contest for my section that year, working entirely on 160m.

When the war came along, I enlisted in the Navy and went to radio and radar school, an experience which had a profound effect on me. The Navy school was splendid and made my later college work insignificant by comparison. I served on a submarine (*USS Drum SS228*) and went on five war patrols. For those of the readers who are particularly interested in submarines, I've been publishing a *Drum* newsletter which records the reminiscences of the crew, complete with a lot of 30-year-old pictures. I took a lot of pictures at the time and still have them all. We were one of the top scoring subs, by the way.

After the war and after college, I went into radio broadcasting as an engineer-announcer, then into television, first as an engineer and then as a director and producer. The TV work didn't turn out to be as creative as I'd hoped, so I left it and got into hi-fi, putting a speaker cabinet on the market in 1952, back in the early days of high fidelity. That business did very well, but when the chance came along to edit *CQ*, I picked that . . . wouldn't you?

Along in 1946, I got involved with the first narrow band FM experiments. I built several transmitters using NFM and had a lot of fun with it during those years. NFM would be with us today on the low bands if receiver manufacturers had built FM discriminators into their ham receivers. Using the slope of the i-f for NFM detection worked fairly well, but AM signals wiped out the FM, so NFM never really made it on HF. It was just the ticket for VHF though, and here FM detectors were being used — about 95% of the VHF and UHF communications today is by NFM.

About this same time, I got involved with RTTY. In 1948, I was working with WPIX (TV) in New York and had my 2m ham station set up on top of the News Building next to the WPIX transmitter. I was using a 522 (I had the first of them) and worked out all over the place from

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LETTERS

HOOKED!

Way back in Oct., 1960, I subscribed to a new magazine which I found I enjoyed immensely. I didn't always agree with you, but I always enjoyed you. However, after about seven or eight years, I found that my interest in ham radio in general had waned and I let my subscription lapse. I have done just enough operating to keep my license current, but that's all.

Then, a couple of months ago, there arrived in the mail an announcement about a new magazine (where did you ever get my name?). It sounded interesting, especially with the name Green on the masthead, so I subscribed. Wow, hooked! This whole business of microprocessors sounded fantastic. So, I went out and bought an Intel evaluation board as one way to get started in this thing. In the process, the proprietor of the Byte Shop where I bought the board threw in a few recent issues of *73*. You know, it's even better than I remembered. So, enclosed is my check for another subscription. You have rewhetted my appetite for ham radio. I am looking forward to amalgamating these interests. Don't let anyone talk you out of continuing the I/O articles in *73* — it's obviously the future of the hobby, just like SSB was back in the 50s and repeaters have been recently.

Dr. Jerrold Goldman WB6MOE
Milbrae CA

STANDARDS

I just got done reading your last issue of *73* and I must say I enjoyed it very much, as usual. But there are a couple of things I would like to get off my chest.

First, I must say that I *was* a CBer, but after much frustration, I decided that there had to be something better in life, so I went to work on my ham ticket, code and all. And sure enough, it paid off when I worked WB6TVX — no great amount of DX, but I was a ham and very proud of it. I hope we will fight to keep our standards high enough to be proud of our licenses. They weren't just given to us — we had to earn them, and for some of us, it took a lot of work. Needless to say, it's something I value very much.

Hopefully, any CBer who wants to upgrade will take on the responsibility that comes with a ham ticket — that means code and all.

Also, as far as the I/O section and the computer articles, I don't understand much of it now, but I didn't even understand a simple amplifier circuit when I started. I am excited about the possibilities of computers in ham radio; it's a very high goal and a big challenge for me, but it's not impossible.

So, keep up the good work; it's a worthy cause.

Eugene Morgan WB7RLX
Ogden UT

COSMAC

To all 1802 users: *The 1802 Exchange*.

Very little software for the RCA CDP1802 is currently in the public domain. To remedy this situation, I am going to publish a ten-page booklet listing available software. If you desire to sell or even give away your software, please send me a listing for my review. My booklet will provide a complete description and cost information with a reference number corresponding to a number on an ordering coupon.

I plan to charge $1 for the booklet. This amount will also cover the costs associated with processing the coupons. The use of the coupon will reduce the costs to the person ordering from more than one source.

The publication date is set for early December. Advance orders may be made at $1 per copy. Here is your chance to buy a good selection of software as well as sell some. Send all orders, software listings, and other correspondence to:

Ross Wirth
1636 S. 108 E. Ave.
Tulsa OK 74128

TSETSE NIT

Pardon me while I pick a nit.

I enjoyed Sam Kelly's article on Soviet test gear (Aug. 77), but spotted one miniscule error. I'm sure that this important bit of information will be of great importance to all of your readers.

The VOM discussed and pictured is not a U-4341. The designation is Ts-4341. Although that letter may look like our "U," it is not the same. Note that it is somewhat square and has a tail. Transliterated, the letter is called "tse." (For what it's worth, the Cyrillic "U" sound looks like our "Y" — but that's another story.)

Now, aren't you glad that I spotted that grievous error?

William F. Blinn
Worthington OH

Got it! Thanks, Bill. — J.M.

MORE 220

This is in response to the letter "220 — No Loss" from M.P. Lewton WA6PHR, appearing in the August issue of *73*. I am sure that Mr. Lewton has not taken the time to examine the problems involved with an adjacent (or shared) amateur/CB 220 MHz allocation. We now realize that the allocation of 11 meters to the Citizens Service was a mistake, if only because of the proximity of the desirable amateur frequencies and the availability of equipment which is obviously illegal for use by the CB licensee. I, for one, do not want any of the three 220 MHz repeaters in Columbus to be infested by the uncontrollable illegal use that would occur if a CBer merely had to buy a crystal to cross the line. Perhaps Mr. Lewton would propose a CB band at 148.0 MHz?

M.P. suggests that we could still use the frequencies with our CB licenses, so there would be no loss to us. If I wanted to operate as a CBer, I would be a CBer and not bother with the FCC examinations in the amateur service. I am an amateur, I have not found any reason that requires me to get a CB license, and I don't foresee any reason that would make a CB license necessary or desirable for me in the future. 220 MHz is ours now, and we are getting along quite well without undisciplined intrusion.

Concerning the suggested reduction in prices on 220 rigs due to the CB mass production — where have you been, M.P.? Look in *QST* for May, 1977, page 169. The Midland 13-509, one of the best available 220 rigs, sells for $149 from AES, and similar prices from other suppliers all over the country. The Clegg FM-76 is similarly priced. The prices, when compared to two meter rigs of similar quality, are so reasonable now that it is unreasonable to assume that the EIA manufacturers will make any effort to reduce the price of 220 CB rigs.

The matter of whether CB really needs (or more importantly, *deserves*) more frequency allocations is really irrelevant — 220 is currently used extensively in some areas by a disciplined, licensed service. 220 MHz activity is growing strongly in many areas of the country as 2 meters becomes more and more congested, and the promise is for increased development as a practical, logical alternative.

Add to this the objections of Canada and Mexico, the widely-held view of a 220 MHz CB band as a governmental reward to CBers for their excellent success in creating a bastion of garbage and illegal activities on 11 meters, and the reluctance of the FCC to place a CB service in a frequency range that would allow the use of available amateur amplifiers, and you find the finger pointing to 900 MHz as the only reasonable spot to stick any expanded CB service.

So, Mr. Lewton, I suggest you get in touch with some 220 group in your area and learn some of the facts concerning the current amateur 220 MHz band. Maybe we'll see you there soon — as an amateur, *not* as a CBer.

Jeff Maass WB8JXS/WR8AOV
Central Ohio Area
Repeater Group
Columbus OH

DOES NOT COMPUTE

Please relieve me of the duty of removing that big thick book from my tiny apartment size mailbox, and the obvious advertising it gives the neighbors when placed in the adjacent junk mail collection box.

The last straw was the "article" in Aug., '77, "When the Lights Go Out — prepare yourself." Please, prepare first, like a good scout. Also, jelly for sandwiches for five days? Jelly spoils when opened in hot humid climates. Why leave out good old peanut butter? It keeps without cooling, is very nourishing, and is politically expedient.

Amateur radio *as it used to be* is still my favorite hobby. I can still remember listening to Pitcairn Island on 20 meter AM on a single tube superrengenerative receiver. And the thrill of the very first xtal clear CW on a homemade two tube receiver. And listening to Tennessee and Kentucky on 5 meters, back in Wisconsin, on a June day in '39.

Try *that* on your doggone newfangled computers.

Roy A. McCarthy K6EAW
Anaheim CA

WELL DONE

Our congratulations to Stew Perry, "King of 160," on his thirty years in amateur radio. I was impressed with his station as pictured on the cover of your June issue, but he really should do something about the accuracy of his clocks!

Chuck LaPointe WD9DXF
Orland Park IL

THANKS

This letter is to express my sincere appreciation to you for publishing my letter in the August issue of *73*, in which I asked assistance in getting information on ham radio for the deaf.

The response was immediate and dramatic. Only this morning, Gene DeGroot from Randolph WI called me. He has accomplished some remarkable work in this field. His advice has saved me many hours of ground work. Moreover, he has put me in touch with some ham operators who are deaf . . . and some both deaf and blind.

I do not mean this as a criticism of *QST* or ARRL, but as a high compliment to you.

Over a period of 4 months, I wrote Mr. Baldwin *twice* requesting this

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...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 4

that beautiful location. My 16 element beam didn't hurt either. It was one built by UHF Resonator, Bill Hoisington, who many years later would write a long series of articles for *73* and would move to Peterborough to be near the magazine.

By late '48 I was deeply into RTTY and helped John Williams W2BFD set up the first ham repeater in the country in the Municipal Building in New York in 1949. It lasted a few months and then the FCC closed it down. The FCC worked for years to do all it could to prevent amateurs from pioneering and inventing . . . and they are still at it, though things are getting better.

In 1951, I started a RTTY newsletter; this ran until 1955 when I became editor of *CQ*. It was during this period that I became aware of the heavy hand the ARRL had on amateur radio and the way they worked with the FCC to discourage amateur pioneering. A group of us worked for years to get RTTY permitted on the low bands, with the ARRL fighting us every inch of the way.

When I became editor of *CQ* in January, 1955, I began to really get the inside dope on what was going on in amateur radio, and the more I heard, the more disgusted I got with the ARRL. Having known Harry Dannals W2TUK for several years, I figured almost anyone would be better as a Hudson Division Director, so I backed another chap — who won. This chap in short order put the League into good financial shape, got rid of the old general manager, and had things running better than they had been in years.

73 STARTED

After leaving *CQ* in January, 1960, I tried my hand at working for an ad agency, and then decided it was time to see if I could get a new ham magazine started. The projected expense for starting a new magazine was about $500,000, so I didn't have a lot of luck getting investors — I couldn't find one. Oh, well — I decided to go ahead without money and do it anyway.

Before I got into editing and publishing *73*, I was doing reasonably well . . . I had two Porsches, a nice Chris Craft Express Cruiser, a plane, yearly trips to Europe, and my own Arabian horse. Starting a magazine is akin to taking vows of poverty when joining a religious order . . . except that you can get out of the religion. No more Porsches, yachts, planes, or horses . . . and darned few European trips. After 17 years, I've become accustomed to working 100 or so hours a week, and since I have virtually no private life whatever, I am sort of amused at even the concept of a "personal expense."

Mind you, I'm not beefing. I signed up for this when I started *73* . . . and I aggravated it when I started *Byte* and *Kilobaud* magazines. There is a degree of self-destructiveness involved, too. Obviously this will catch up with me one of these days and bam, silent keys. My long-range goals are to try to make the world a little better place. Through the magazines, I provide entertainment, education, and help people have a lot more fun. Since I have little interest in money other than as a necessity for getting things done, I'm an enigma to many people.

Enough of all that — the main subject at present is the future of amateur radio. I've participated in many of the developments of the past: working personally with NFM, RTTY, SSB, SSTV, moonbounce, repeaters, OSCAR, DXing, DXpeditioning, and so forth. There isn't much that's gone on in the last 40 years of amateur radio that I haven't

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Looking West

Bill Pasternak WA6ITF
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FOUR DIFFERENT KINDS?

When I am invited to talk to an amateur group, I often begin by asking a rather simple but *loaded* question: "How many different kinds of repeaters are there?" Usually, I get as a first response exactly what I expect. An amateur raises his hand and says, "Two: open and closed." Then someone in the back of the room will shout out: "You forgot autopatch!" Most of the time it stops there, and the discussion starts.

Southern California relay communication is steeped in areawide traditions, and out of this has come acceptance of four different categories of relay operation: open, closed, private, and the individually owned and operated, remotely-controlled amateur base station radio, more commonly known as a remote base. To complicate matters even further, these four categories of relay systems operate under one of two operational formats: basic and advanced. Let's cover the latter of these two designators first.

Until about a year and a half ago, very few people gave much consideration to operational format. A repeater was a repeater, and remote bases were those "things" that popped up on .94 once in a while and were usually heard on .46. However, as technology progressed, so did a need on the part of some to show their own individuality. Out of this grew the terminology, "advanced format" and "basic format."

How, though, does an "advanced format" system differ from one of "basic format"? Really, it's in the peripherals and the use a system is put to. In many ways, the microprocessor had a lot to do with it, I guess. Many "advanced format" systems utilize microprocessors for overall system control and security. Then there is the concept of interlinking on a wide scale basis. Some of these groups have intentions of building national interlinked networks, by which they will be able to "function up" any city they wish at the touch of a finger on a tone pad. Some are well on their way to achieving this goal. From the foregoing, you might imagine that most "advanced format" systems are also private systems. Your assumption would be correct. In fact, "super private" would be far better terminology. This type of advanced state-of-the-art communications requires a totally controlled environment, and it is for this reason that no such system is found on two meters. Those involved in "advanced format" amateur relay communications tend to go to spectrum where they can achieve their objectives without taking away valuable spectrum from the average ham. They "do their thing," bother no one, and (most important) help advance communications technology. If there is one point of consternation, it is that such systems are not available for use by the average "Joe Ham"; their basic structure precludes this. Sometimes a system such as this is "down" for months of redesign, and very few "users" are willing to put up with this. By and large, they are made up of small groups of a dozen or fewer dedicated experimenters, who seem to live for a "mission" of finding a better way to "do it," to talk farther. In actuality, the terms "advanced" and "basic" have come from those involved in the former, as a way of letting the world know that their particular operation is indeed different from the norm. Anything that does not meet the criteria of an "advanced format" system is then considered "basic format." Having an autopatch does not count.

Now, let's discuss categories of repeaters. We are talking "types" and not access coding. Open repeaters? Yes, we have our share of them. In fact, this state boasts more open repeaters than anywhere else in the nation. Want to involve yourself in emergency communications? Want to rag chew? No matter what you are looking for, there is a repeater somewhere to meet your needs, an open repeater, there for your use. Most licensees and/or sponsoring organizations only ask that you use and support such systems and not abuse them. Some have very lenient system regulations, while others might well constitute a structured mini-society. Whatever your preference, you will find it.

How, then, do "closed" and "private" systems differ from open systems and from each other, and, under the structure of FCC regulation, how can they exist? The latter answer is indeed simple. Justification for such systems comes from official recognition of their existence. Such was the case during the early days of deregulation, when, in its report and order on remote control, the FCC specifically recognized the concept of the closed system and granted such systems the ability to operate under the doctrine of "fully automatic remote control" (while at the same time granting only "semi-automatic remote control" to open systems). There are also the statements made by FCC personnel when questioned on this topic, such as that of Dick Everett at SAROC's FCC Forum last January, when he stated that no amateur is obligated to provide any service to any other amateur. Then, too, there is the question of the constitutional right of an individual to use his amateur station (his own personal property) in any way he sees fit, as long as its use does not bring harm to others.

Suffice it to say that the FCC and the overall amateur community have come to recognize the existence and operation of relay systems whose access is available only to a limited segment of the amateur community. I realize that to some the existence of such systems is a sore spot; however, the fact is that the concept of the "limited access system" is growing out here, and I suspect that we are indicative of what's happening nationally. You in your area know far better than I. By present count, southern California holds (on 2 meters) twenty such classified systems, up three from last year. 220, a band most thought would be a haven for open systems, is about 30% limited access. However, here such systems are forced to share channels with other such systems. So while there may be twenty SCRA-coordinated closed and private systems on 2, only part of that number of channel pairs is in use by them.

"Closed" systems differ from "private" systems in the following way. A "closed" repeater is one in which membership within the sponsoring organization is required in order to use said system; however, such membership is available to all interested members of the amateur community. Systems dedicated to emergency services, such as RACES and ARES, wherein all communication content must be of either an operational or "drill" nature, would probably be fair examples. On the other hand, a "private" repeater also requires group membership. However, membership and thereby system access is at the total discretion of the system licensee and/or his sponsoring organization. Therein lies the difference.

I'd like to dispel the long-standing myth among amateurs that a repeater is automatically to be considered "closed" or "private" if it requires that users equip themselves with tone coding devices to activate the system.

I call this a myth because that is exactly what it is. However, even such an austere organization as the ARRL seems to live under this total misapprehension, as was made evident in their July, 1977, issue of *QST* ("Washington Mailbox" column, p. 74), in which the writer states something to the effect that any repeater that requires a tone to activate it is a closed repeater. While placing a tone-activated device on a system's input can have the effect of limiting usership, such is not the proper use of such devices. Tone coding in its many forms, including burst, digital burst, CTCSS, and digital CTCSS, was developed for use in the commercial land mobile radio sector as a means of increasing spectrum loading — not to keep people off repeaters.

Here is how such a system works. Most commonly used in the land mobile service is CTCSS, which stands for Continuous Tone Coded Squelched System. You might be more familiar with it under one of its trade names, such as Motorola Private Line (PL) or General Electric Channel Guard. These are registered trademarks of these manufacturers. They enable more than one person to operate on a given channel (or channel pair, in the case of relay devices) on a minimal interfering basis. Such an entity might be a "community repeater," as we shall now describe.

Most of us consider a repeater to be a device with which one group of people communicates via a given channel pair. In commercial service, one repeater may be set up to serve the needs of two, three, or even a dozen individuals or business groups. This is accomplished by assigning individual tone code assignments to each person on the system. In our example, let's say that we have three businesses sharing a commercial repeater. Let's call them Smith's Delivery Service, Tom the Plumber, and City Bus Service. Each has a specific communications need, and CB radio will not suffice. They all wind up on a given "community repeater." Each is assigned a specific EIA standardized tone code of the CTCSS variety. Smith is assigned 1A, Tom gets 3B, and CBS gets 4B. However, all operate through the same repeater and transmit and receive on the same channel pair.

Contained within the electronics of both the repeater and each user's radio are tone encoders and decoders. The repeater itself has the ability to decode and regenerate all three of the CTCSS tones installed, while the users' radios only respond to their preassigned codes. Let's suppose that Mrs. Jones, the dispatcher for the bus company, wants to tell Tim, the driver, to go over to the Little Red Schoolhouse. She removes the microphone from its cradle. When she does this, a switch built into the cradle automatically closes and defeats the internal decoder, allowing her to hear any channel activity that's not being directed toward her. Hearing nothing, Mrs. Jones calls her mobile and passes her message. Had she heard another conversation in progress, she would have been obliged to wait for its conclusion. In the meantime, when no traffic is being directed at her, her radio is silent, even though the channel may be under heavy use. The same holds true for each of the channel users. They only hear traffic directed at them — unless they want to listen in for entertainment purposes. I suspect some do.

The ability to share, to increase channel loading, and thereby to use spectrum more efficiently, is the true purpose of tone coding. To use it to restrict those "unwanted" by you or your group is defeating its intent — tone coding was never meant to be a means for security, and besides, with tone codes EIA-standardized, how much and how effective a security method can it really be?

This being the case, what really makes a repeater "closed" or "private"? It's attitude, the attitude of those people placing such systems into operation and the attitude of those invited onto such systems. In our part of the country, we have a number of totally "open" systems which, due to either co-channel assignments or nearby adjacent channel assignments, have utilized tone coding as a method to minimize interference to their operation. Still, these systems are in every sense of the word "open"; they are available to any amateur who wants to use them. By the same

token, we have a few "private" repeaters that require no tone access whatsoever. Yet these systems are truly "private" in every sense of the word. In each case, it is the attitude of those involved with a given system that decides its category — tone coding enters not.

How can amateurs make better use of methods such as CTCSS? On an individual basis, it's been happening for years on WR6ABB and a few other LA area repeaters. Following the lead of the commercial sector, a number of individual sub-user groups have taken to installing CTCSS encoder/decoder packages in their radios, with automatic mike cradle switches as earlier described. In this way, they can still hear the messages directed toward them, even though they are not forced to listen to all the channel chatter. One might call this "private" groups functioning through "open" repeaters.

Another method is that of channel sharing in crowded urban areas, where coordinators have run out of available spectrum and are faced with an ever-mounting deluge of channel assignment requests. What I am about to describe may not now be popular, but wait four or five years and then read it again.

Suppose that an area is totally out of spectrum upon which to coordinate another repeater without causing massive interference to existing area activity. On the coordinator's desk sit 100 or more demands for repeater pairs. If he does not act soon, he may have a hundred or more pirate systems challenging existing activity. A hundred repeater wars. Then an idea hits him . . . CTCSS! "Why not?" he says to himself. "Why not assign all existing activity of open repeaters a given areawide CTCSS tone, and then assign a second tone and the necessity for a lockout receiver to all the next generation of repeaters — and then coordinate them atop one another?!" In essence, all existing systems would become primary channel activity, and any new system could only operate when existing activity of the initially coordinated system ceased. Now, it might not work for every channel pair, but it would be fine for those of low activity. In fact, you could possibly put six or seven per channel, with each assigned a different tone and each required to lock out when it heard any other tone of any system of an earlier coordination date.

Okay, there are obvious pitfalls to such a system. The largest is getting any group of hams to agree totally to anything. With ever-mounting pressure on urban area coordinators and councils, however, do not be too surprised to see something along these lines in the not-too-distant future. Note that many of the new radios coming to the marketplace have tone coding built in — or at least a provision for it. Do the manufacturers know something that the rest of us don't?

Let's finish this by putting this myth to rest forever. It is not tone coding that makes a repeater "closed" or "private," but rather the attitude of the people who own and use it. If tone coding has one asset, it is that of a "sign" or "symbol" that states to the rest of the world that it is for use by and for members only.

What about the fourth category, the aforementioned "individually owned and operated, remotely-controlled amateur base station radio"? How does it differ from a repeater, and why is there a rather phenomenal growth lately in the number of these systems? Statement of fact: A remote base is not a repeater. The only similarity lies in the hardware, and that is where the similarity ends. The root structure is "simplex ability using relay technique." Suppose you lived in a bad spot for direct station-to-station communications, but for some reason did not want to use a repeater to communicate. In fact, you wanted the total flexibility of your base station radio, with the added ability of long distance communication. You could relocate atop a mountain, but is it not better to just move your radio atop a mountain and then operate through it by remote control? In its purest form, that is exactly what a remote base is.

However, today's *modern remote* base is far and away a lot more than that. First, if you can put a two meter downlink radio on the hill, why not six, 220, or 10? Why not 160 through 10 on CW and/or SSB, as well? Why not an autopatch function? How about the ability to "swing" a tri-band beam or remotely tune in single kHz steps all of the low bands? Remember, unlike a repeater, whose licensee has a specific responsibility to a given usership, a remote base is technically individually owned. Therefore, the licensee can do things with it that might bring chaos to the average open repeater. With a remote rather than a repeater, the owner is totally free to experiment and operate to his heart's content — and never once worry about the responsibilities that an amateur running a repeater for a given usership has. I suspect that it is this overall total freedom that is responsible for the dramatic growth in such systems.

While by law an individual by himself must own a remote (in the eyes of the Commission), this does not mean that there's always one remote per ham. While a good number of single owner/user systems abound, at least an equal number are organized as closed membership amateur communications organizations. These organizations, usually numbering no more than ten individual amateurs, are very closely knit, and in virtually every case are made up of individuals of exceptional skill in the art of two-way VHF/UHF communications.

I said earlier that a remote is a "simplex" device using relay technique. Taking this further, most remotes come into being because an individual or group is interested in expanding their ability to talk without the aid of a repeater. They do not want the restrictions of "3-minute timers" and of having their QSOs interrupted every two minutes by breakers. They want the same ability from their mountain as they have from their home ham shack. By utilizing the concept of the remote base, they achieve their individual objective. At present, there are an estimated 300 or more such systems in this area alone; hardly a day goes by without running into someone who tells you that he is building one also. I might be wrong, but I would be willing to venture a guess and say that the modern remote base is possibly the fastest growing of all forms of amateur relay communications currently to be found out here.

THE GOOD GUY

While back east a while ago, one of my scheduled stops was at Clegg Communications in Lancaster, Pennsylvania, both to see Ed again and to do a "Manufacturer Profile" story for this magazine. It was about 90 miles to Lancaster from Valley Stream, Long Island, where I was staying, so early that particular morning I made a beeline into Brooklyn to pick up Larry Levy WA2INM, who was to act as my photographer. The two of us then headed toward Lancaster in my father-in-law's '73 T-Bird.

By five that afternoon, we were ready to head back to New York. We bid good-bye to Ed and his staff, and jumped back into the car. It started fine, but when we placed it into "drive," we found that it had decided that it liked Lancaster a lot and wanted to remain. The transmission had died — or so we thought. Not knowing exactly what to do, Larry and I ran back into Ed's office just as he was about to depart. We explained our plight, and in short order Ed had literally solved every problem for us.

First, he found us an auto mechanic who later turned out to be one of the most righteous individuals I have ever run into. Then, though he had a rather important dinner and meeting to make, he personally took the time to take us around and help us find transportation back to NYC, finally dropping us at the airport in Lancaster. We had hoped to make a commuter flight to Philadelphia and then grab either TWA or American back to JFK. As luck would have it, the commuter flight (which was the last one) was a sellout, but National Car Rental came through with an Olds Cutlass that got us back to the "Big Apple" in fine fashion by midnight.

If "LW" could give a "good samaritan" award, my first nomination would be Ed Clegg W3LOY. He did not have to go out of his way for us. Even though he had important appointments to keep, an act of human kindness to a friend he deemed more important. Both Larry and I probably will never find the proper words with which to say thanks. We both hope that this is a proper beginning. This being my first trip to the Lancaster area, I was quite at a loss when the situation arose; having someone extend a warm hand of friendship at that moment was very welcome indeed.

THE BIG LINK

What do repeater stations WR5AFS in Houston, Texas, and WR6AWQ in Los Angeles have in common? What event did repeater stations WR6AWS and WR6AAE also share in part? Answer: probably the record for the longest duration repeater interlink between two cities separated by over 1,000 miles. Would you believe three hours and forty-two minutes? Not that this record is important. More so is what happens after the initial shock of a two thousand mile link wears off.

I have been involved, in one way or another, in linking efforts before. In fact, one of the very first, between Waltham, Mass., and Los Angeles (about five years ago), was a direct result of an offer by one of our local repeater owners to try such an experiment that was printed in one of the earliest "LW" columns. Not long ago, we reported on Sam Davis WA1GQY/6 and his "Linking America," which at last report is still going fairly strong. However, most of the latter consisted of people at both ends exchanging callsigns, salutations, and requests for QSL cards.

WR6AWQ and WR5AFS are quite different from one another. WR5AFS is an open repeater located in Houston, with about 70 to 100 regular users. It is a two meter system, sponsored by an organization known as the Houston ECHO Society. WR6AWQ, on the other hand, is a private 220 MHz system that is itself part of an organization called Westlink, the objective of which is to organize a network of autonomous intertied repeaters to provide statewide communication. As I mentioned earlier in this column, a good number of such organizations exist. With the differences in operational category and format between the two, what would you imagine the outcome to be?

It was, for all participating, one of the most fascinating and educational evenings ever spent. After "initial shock," which lasted for about a half hour, one began to realize that QSO after QSO was taking place — meaningful QSOs, in which everything from system operation to things of a far more human nature were being discussed. It was a Sunday evening, and the Houston group had been involved in their weekly net as the link started. For part of the linkup, the Los Angeles AWQ group took part in a net in a city a couple of kilomiles away!

What happens, then, when you link two repeaters? People talk, and out of this gain a far better understanding of

their fellow man than they could when isolated by the coverage restrictions of an average repeater. Both systems are eager to do it again. If your system is interested in linking with either or both, drop me a note, and I'll act as a clearinghouse and pass it on to the proper party. WR5AFS and WR6AWQ may hold the current record for the longest repeater interlink, but I suspect that they also might account for the greatest number of new friendships evolving from amateur radio in one evening.

220 IS ALIVE, WELL, AND GROWING IN HOUSTON

According to Kent Marshall W5TXV, six months ago there were about ten intrepid souls in the Houston, Texas, area who were playing around on 220. What a difference a few months can make. At present, there are over fifty amateurs now on 220, and an experimental repeater is operating on the high .34/.94 pair, under the callsign WR5ATG. Kent credits this growth to two factors: the Clegg FM-76, and a gentleman named Doug Burns W5FUH, who is spearheading 220 growth. In Texas, as here in California and elsewhere, amateurs have come to like 220 because it is still uncrowded. Even via a repeater, one can hold a true conversation — a feat which is fast becoming impossible on two in many places. How long this will hold true is anyone's guess, since 220 seems to really be taking off. Here in southern California, the last of the available 220 pairs was recently coordinated, and now Tom Rutherford W6NUI and his SCRA 220 Technical Committee are involved in multiple co-channel coordinations. Nineteen such coordinations have already been made, with many more expected to follow.

In Texas, 220 is growing, and if what I hear about Texans is true, I suspect that 220 will get the "Big Texas Treatment" that has helped two to grow and prosper. Amateurs have headed the call of "220 — Use It Or Lose It!", and while we must never be complacent, I have a sneaky feeling that Class E CB would find it quite hard to manifest itself up there in quite a few places, contrary to what certain EIA-oriented information might say. Good work, Texas!

SOUTH CENTRAL U.S. MAY ADOPT CALIFORNIA TERTIARY PLAN

While no official announcement has been made as of this writing, according to informed sources the Texas VHF-FM Society, along with coordinating groups from Tennessee, Mississippi, Louisiana, Oklahoma, and New Mexico, will shortly announce formal adoption of the Modified SCRA Inverted Tertiary Plan for split-split repeaters. This would signify two things. First, that interest in VHF relay communications among amateurs continues to grow, and thus a need to expand the number of available channels has reached these areas of the nation. Second, it signifies that endorsement of this plan by the ARRL in a recent *QST* article on the subject (October, 1976, pp. 47, 48) has had a profound effect on its acceptance by the amateur community.

It is my sincerest hope that these areas have as much success with this plan as we have in southern California. The ARRL has stated that the best chance of technical success seems to come through this method, and I think our overall success during the past three years has shown this to be true. The SCRA still has available a technical paper written by Bob Thornberg WB6JPI on this subject, and an 8½ x 11 SASE with a bit of patience on your part will bring a copy. Send your request to SCRA, PO Box 2606, Culver City CA 90230. Though written three years ago, the concepts contained therein are as practical today as they were then. They are the basis for a good part of this area's successful coordination effort.

TSARC CARES

As you are already aware, in May I was back east. I happened to show up at just the right time. Well, to be truthful, I had been made aware beforehand by Dave Minot WA2EXP, TSARC chairman, that the Tri-State Amateur Repeater Council would be holding an open general membership meeting. Dave extended a personal invitation for me to attend and meet the group.

What intrigued me was a discussion underway when I arrived. It dealt with a matter very close to my heart: willful and malicious interference to amateur relay communications by the "sickies" of this world. Now, nothing new came of this discussion. What in my mind may be precedent-setting, though, is the fact that a repeater council had felt it was in the interest of all amateurs to involve themselves in some way in trying to solve this problem. Maybe for the first time ever, such a body was saying "we've had enough" and was beginning to turn their heads toward finding a way to take action. I personally wish them all the success in the world, and pledge to do anything in my power to aid them or anyone else so inclined.

Their structure is a bit different from that of the SCRA, and perhaps a bit of comparison is warranted. As you may be aware, the SCRA's chairman appoints two Technical Committee heads, one for two meters and one for 220, who in turn form technical committees whose makeup is representative of each geographic area administered by the parent organization. The committees discuss all coordination requests, evaluate them for technical merit and compatibility with existing activity, and assign or deny coordination by majority vote.

The TSARC, however, has an individual coordinator. He makes such decisions, based on the same criteria, and works with the organization proper on sort of an "advise and consent" basis. As I understand it, the overall responsibility for the implementation of his rulings rests with the council itself. The council also retains the prerogative to override the coordinator's decisions, request reevaluation, and/or implement a decision of its own.

Which system works better? It's hard to say. Each fits the overall needs of an area, and each has proven to be successful. Each has its own form of controls and restraints built in, and each affords representation to any and all systems that request and require such. As Dave said to me, "Duke Harrison has been doing such an overwhelmingly successful job that there is no reason to change things."

Everyone I met seemed satisfied with the structure of the TSARC and with the dedication that they have shown to that area's relay communications needs. They also care a lot about what's happening and where we are heading. If they were to adopt a motto, I guess it would be "Technical Competence With An Eye Toward Tomorrow."

10 METER NON-RELAY BAND PLANNING COUNCIL FORMED

According to Norm Lefcourt W6IRT, the large and continually growing number of amateurs in southern California who are converting CB radios to channelized 10 meter activity, after evaluating all of the band plans offered, have concluded that what they originated late last year is best. They have now begun to form a council for the purpose of implementing this on a wider scale.

It was felt by 10 meter interests in this area that with all the band plans that have been proposed, and with everyone taking off in different directions as was the case before the days of repeater councils for relay communications, some organization has to be formed for voluntary coordination of 10 meter non-relay channelized operation. I spoke with Norm the other morning via WR6ABN and on .52 simplex, and he told me that a pilot organization has been formed and that they would soon be holding an open meeting to adopt a title, construct a constitution and bylaws, and formalize the organization.

As I have been led to understand, this organization intends to adopt the southern California 10 meter band plan which was presented earlier in this magazine, and possibly coordinate specific forms of activity or utility to each channel. It's too early to even surmise the kind of impact that this will have on the future of non-relay operation on 10 meters — and on non-FM operation as well. One thing is sure, though: 10 meters AM is possibly the biggest thing to hit the southland since the two meter repeater. It was only a matter of time until some form of organization to direct its growth took root out here.

WHEN ALL ELSE FAILS, TRY MY ANSWERING MACHINE

Take this number down. If you have something that you feel the rest of your peers may be interested in but don't have the time to write a letter, you can place a call anytime, 24 hours a day, to my unofficial "LW" hotline at (805) 259-8243. One catch, though: My machine will only take a fifteen second message. If you plan to call in, I suggest that you write down what you intend to say and then edit it to the most necessary information. Start with your name and callsign when you hear the first "beep," and stop when you hear the second "beep." I will try to send you a postcard within a few days to confirm the receipt of the information.

One such piece of information that came to me via "Elmo" (the pet name for our answering machine) is this, passed on from Oliver W7WEW to K6UQJ via Westcars and then via phone to me. It concerns a brand new repeater system serving the area around Prescott, Arizona, from a point 7800 feet up atop Mingus Mountain. Its callsign is WR7AFC, its channel pair is 147.60 in/147.00 out, and it's open for all to use.

AMSAT

AMSAT has received Circular No. 1273 dated July 12, 1977, of the International Telecommunication Union's International Frequency Registration Board giving advance publication information on a planned amateur satellite network of the USSR. The published information is summarized below.

General Information: "The USSR Administration wishes to inform countries, members of the ITU, that the USSR is working on the establishment of an amateur-satellite service system. This system 'RS' will be based on 3-4 satellites on a circular near-polar orbit. The amateur satellite stations are designed for multiple access with re-transmission and frequency translation without demodulation on a real time scale."

Date of bringing into use: 1977-1978.

Number of satellites: 3-4.

Orbital information: Inclination, 82°; Altitude of apogee & perigee, 950 km (circular orbit); period, 102 minutes.

Uplink characteristics: 145.8-145.9 MHz (100 kHz bandwidth); quarter-wave receiving antenna, circularly polarized; user uplink power, 10-15 Watts to 10-12 dB antenna; transponder receiver noise temperature, 3000° K.

Downlink characteristics: 29.3-29.4 MHz (100 kHz bandwidth); half wave transmitting antenna, circularly polarized; transponder power, 1.5 Watts peak to 0 dB gain antenna.

Maximum communications distance: 6,000 km (3,700 st. mi.).

From the advance publication orbital information, it seems likely that the "RS-OSCARs" will be launched piggyback with the Meteor meteorological satellites from the Plesetsk launch site.

CONTESTS

Editor:
Robert Baker WB2GFE
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Atco NJ 08004

VK/ZL/OCEANIA CONTEST

Phone
Starts: 1000 GMT
Saturday, October 1
Ends: 1000 GMT
Sunday, October 2
CW
Starts: 1000 GMT
Saturday, October 8
Ends: 1000 GMT
Sunday, October 9

Sponsored by the Wireless Institute of Australia. Entry classifications: single transmitter-single op, multi-op (outside VK/ZL only).

EXCHANGE:

RS(T) plus serial number starting at 001.

SCORING:

Oceania stations score 2 points per QSO with VK/ZL, 1 point for QSO with Oceania other than VK/ZL. All other stations score 2 points per VK/ZL QSO, 1 point per Oceania (other than VK/ZL) QSO. Final score is derived by multiplying total QSO points by the sum of VK/ZL call areas worked on all bands. The same VK/ZL call area worked on different bands counts as a separate multiplier.

ENTRIES AND AWARDS:

Logs must show, in this order: date/time in GMT, callsign of station contacted, band, serial number sent/received. Underline each new VK/ZL call area contacted and make separate logs for each band. Summary sheet must show callsign, name, address (please use block letters), details of equipment used, and for each band — QSO points for that band and total of VK/ZL call areas worked on that band. All band score will be total QSO points multiplied by sum of VK/ZL call areas on all bands while single band scores will be that band's QSO points multiplied by VK/ZL call areas worked on that band only. Attractive colored certificates will be awarded top scorers. You may obtain contest results and next year's rules by enclosing one IRC or mint stamps of your country to value of one IRC. Certificate winners will receive results and next year's rules regardless. Send entries to: WIA-VK/ZL Contest Manager, GPO Box 1002, Perth, 6001, Western Australia, or WIA-VK/ZL Contest Manager, N. Penfold VK6NE, 388 Huntriss Road, Woodlands, 6018, Western Australia — posted to reach Australia before Jan. 31.

OCTOBER QRP QSO PARTY

Starts: 2000 GMT
Saturday, October 8
Ends: 0200 GMT
Monday, October 10

Sponsored by the QRP Amateur Radio Club International Inc., this contest is open to all amateurs and all are eligible for awards. Stations can be worked once per band; general call is CQ QRP DE . . .

FREQUENCIES:

CW — 3540, 7040, 14065, 21040, 28040. SSB — 3855, 7260, 14260, 21300, 28600. Novice — 3720, 7120, 21120, 28040. All frequencies ± 5 kHz to avoid QRM, as license permits.

EXCHANGE:

Members send RS(T), state, province, or country, and QRP number. All others send RS(T), state, province, or country, and power input.

SCORING:

Each member QSO counts 3 points, non-members count 2 points per QSO, stations other than W/VE count as 4 points. Multipliers based on input power of transmitter: greater than 100 Watts — x1; 25 to 100 Watts — x1.5; 5 to 25 Watts — x2; 1 to 5 Watts — x3; less than 1 Watt — x5. Total score is QSO points times total number of states or provinces or countries per band times power multiplier.

ENTRIES AND AWARDS:

Certificates to highest scoring station in each state, province, or country, other places depending on activity. One certificate for the station showing three "skip" contacts using the lowest power. Send full log data, including full name, address, and bands used, plus equipment, antennas, and power used. Entrants desiring results please enclose a #10 SASE. Logs must be received by Nov. 30 to qualify. Send all entries to: QRP ARC Contest Chairman, E. V. Sandy Blaize W5TVW, 417 Ridgewood Drive, Metairie LA 70001.

MANITOBA QSO PARTY

Starts: 2200 GMT
Saturday, October 15
Ends: 0200 GMT
Monday, October 17

Sponsored by the Amateur Radio Clubs of Manitoba and dedicated to ARLM (Amateur Radio League of Manitoba) to commemorate their 25th anniversary in 1977. Stations may be worked once per band and mode. VE4 mobiles can be worked each time they change municipalities. ARLM members will be bonus stations for out of province contacts. VE4 to VE4 and 2 meter simplex QSOs will be permitted.

EXCHANGE:

RS(T), name, QTH (municipality for VE4).

SCORING:

VE4s multiply number of QSOs times number of US states, VE provinces, and DX countries. All others multiply number of QSOs times number of Manitoba municipalities, local government districts, provincial parks, and forest reserves (134 max.) times the number of ARLM members worked.

FREQUENCIES:

SSB — 3770, 3905, 7195, 7230, 14190, 14285, 21245, 21355, 28600. CW — 3705, 7105, 14065, 21205, 28205.

ENTRIES AND AWARDS:

Certificates to high score in each province, state, and country. Plaques for high VE4 and high out of province station. Additional plaques if warranted. Send log data and signed declaration no later than Nov. 14 to: Doug Bowles VE4QZ, 1104 First Street, Brandon, Manitoba, Canada R7A 2Y4.

CQ WE CONTEST

October 22 and 23

See schedule for times and frequencies!

Sponsored by the Murray Hill ARC, the contest is open to all licensed amateurs employed by or retired from Western Electric, Bell Labs, and Teletype Corp. Also, participation of employees and retirees of AT&T and AT&T Long Lines is permitted. The contest is divided into four sessions with a total allowed operating time of 20 hours. A separate QSO may be made with a station on each of three modes — phone, CW, and RTTY. No form of cross mode, cross band, or repeater operation will be permitted. There is nothing in the rules to prohibit operation outside of the suggested schedule, but it is hoped that by using the schedule as a guide, many more QSOs will be made by knowing when and where to listen. If conditions do not favor a particular band called for in the schedule, participants are free to move elsewhere, preferably to the next band scheduled. However, please observe the contest time periods. Each station must be operated by a single operator with a single transmitter. Club stations operated under the club station callsign may compete to submit a score for that location's total. These contacts may not, however, be counted toward an individual's personal score. Successive contacts with the same station may not be made by changing mode! Violation of any rules of this contest, or any of the current FCC rules and regulations governing amateur radio service, can result in disqualification of the station involved.

EXCHANGE:

RS(T), name, location code. A location shall be counted once for each band for which that location is worked in each of the three contest sections.

SCORING:

Contacts with a Novice or Technician on an HF or CW Novice band will count 10 points; contacts with a retiree will count 5 points; all other contacts count 1 point.

ENTRIES:

All logs must be in GMT and should be forwarded to your local "Works Coordinator" as soon as possible after the contest. They should be to your coordinator no later than Nov. 15. All local coordinators should forward their location summary and log sheets to reach Murray Hill by Dec. 15. In order to create an incentive to get your logs in, you may add 10 points to your score if you sign a statement that your entry was forwarded to

CALENDAR

Oct 1	Open CD Party — CW
Oct 1-2*	California QSO Party
Oct 1-2	VK/ZL/Oceania — Phone
Oct 8-9	VK/ZL/Oceania — CW
Oct 8-9	RSGB 21/28 MHz Phone Contest
Oct 8-10	October QRP QSO Party
Oct 12-13	YLRL Anniversary CW Party
Oct 15-16	Open CD Party — Phone
Oct 15-16	RSGB 7 MHz Phone Contest
Oct 15-17	Manitoba QSO Party
Oct 22-23	CQ WE Contest
Oct 22-23	CARTG RTTY Sweepstakes
Oct 29-30	CQ WW DX Phone Contest
Nov 3-4	YLRL Anniversary Phone Party
Nov 5-6	ARRL Sweepstakes — CW
Nov 5-6	RSGB 7 MHz CW Contest
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest — RTTY
Nov 12-13	Missouri QSO Party
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes — Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Nov 26-27	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

*Described in last issue.

TIME AND FREQUENCY SCHEDULE FOR CQ WE CONTEST

Session One: HF/VHF Phone — 1700 to 2200 UTC Oct. 22, 1977
Suggested operation:

1700-1800	VHF/160 meters
1800-1900	10 meters
1900-2000	15 meters
2000-2100	20 meters
2100-2200	40 meters

Session Two: HF/VHF CW and RTTY — 2300 UTC Oct. 22 to 0400 UTC Oct. 23, 1977
Suggested operation: CW on the hour, RTTY on the half hour.

2300-0000	20 meters
0000-0100	40 meters
0100-0200	VHF/160 meters
0200-0300	80 meters
0300-0400	80 meters

Session Three: HF/UHF CW and RTTY — 1700 to 2200 UTC Oct. 23, 1977
Suggested operation: CW on the hour, RTTY on the half hour.

1700-1800	VHF/160 meters
1800-1900	10 meters
1900-2000	15 meters
2000-2100	20 meters
2100-2200	40 meters

Session Four: HF/VHF Phone — 2300 UTC Oct. 23 to 0400 UTC Oct. 24, 1977
Suggested operation:

2300-0000	20 meters
0000-0100	40 meters
0100-0200	VHF/160 meters
0200-0300	80 meters
0300-0400	80 meters

Suggested Frequencies:

Band	CW	RTTY	Phone
160	Use segment permitted locally		
80	3540-3570, 3730	3605	3900-3960
40	7040-7080, 7130	7055	7260-7300
20	14040-14050	14080	14280-14330
15	21040-21080, 21140	21095	21380-21420
10	28150	28150	28675
6	50.1-50.13	50.1-50.13	50.1-50.13
2	145.05-145.1	145.05-145.1	145.05-145.11, 146.52

your local works coordinator before Tuesday, Nov. 1.

CARTG RTTY SWEEPSTAKES

Starts: 0200 GMT
Saturday, October 22
Ends: 0200 GMT
Monday, October 24

Sponsored by the Canadian Amateur Radio Teletype Group, VE3RTT. Not more than 30 hours of operation is permitted, with non-operating periods taken at any time during the contest. Summary of times on and off must be submitted with score. Use all amateur bands authorized for F1 emission (RTTY). Country status as per ARRL country list; KL7, KH6, and VO to be considered as separate countries. Classes of entry include: single op, single transmitter; multi-op, single transmitter; and SWL printer. Individual operators of multi-operated stations may submit their logs singly instead of a group log.

EXCHANGE:

Messages will consist of message number, time in GMT, and zone.

SCORING:

All 2-way RTTY QSOs with own zone will earn 2 points; all others as per CARTG zone chart (send SASE if needed). Stations may not be contacted more than once on any one band. Multiplier is number of different countries contacted including one's own on each band. Each US and VE district also counts as a separate country. Total score is total number of exchange points times number of countries worked times number of continents (6 max.). Canadian bonus points to be added last — 100 bonus points for each VE/VO contact on all bands.

ENTRIES AND AWARDS:

Use separate log sheet for each band. Log sheets and zone charts available from CARTG for SASE or IRCs. Logs must be received before December 31 to qualify. Engraved plaques to top 10 scorers plus 6 special categories. Certificates to top scorers in each US and VE/VO district and each country. Send logs, summary, and scores to: CARTG — VE3RTT, 85 Fifeshire Rd., Willowdale, Ontario, Canada M2L 2G9.

CQ WORLDWIDE DX CONTEST

Starts: 0000 GMT
Saturday, October 29
Ends: 2400 GMT
Sunday, October 30

Sponsored by *CQ Magazine*, the contest is open to all amateurs worldwide. Use all amateur bands, 160 through 10 meters. Entry classifications include: single op, single and all band; multi-op (all band), single or multi-transmitter.

EXCHANGE:

RS(T) and zone.

SCORING:

Contacts between stations on different continents count 3 points; stations on same continent but different countries 1 point, except for North American stations only! — contacts between stations within North American boundaries count 2 points. Contacts between stations in the same country are permitted for zone or country multiplier credit, but have zero point value. Multipliers are number of different zones on each band and different countries on each band. Final score is result of total QSO points multiplied by sum of zone and country multiplier.

ENTRIES AND AWARDS:

Many various awards in different classes and categories. Plaque to highest club score. Logs should include all times in GMT; indicate zone and country multipliers only first time worked on each band. Logs must be checked for duplicate contacts; use separate sheets for each band. Each entry must be accompanied by a summary sheet showing all scoring information, category of competition, name and address in block letters, and a signed declaration that all contest rules and regulations have been observed. Official logs and summary sheets and zone maps are available from *CQ*; include a large SASE. All entries must be postmarked no later than Dec. 1 for phone and Jan. 15 for CW. Send logs to: CQ WW Contest Committee, 14 Vanderventer Avenue, Port Washington, LI, NY USA 11050.

Check *CQ Magazine* for any last minute rule changes!

ISLANDS OF THE WORLD AMATEUR RADIO ACHIEVEMENT AWARD

Sponsored by amateurs residing on Whidbey Island, the award is available to all licensed amateurs in the world. All contacts must be made after October 1, 1977! The award will be issued for: 50 islands, including contact with Whidbey Island; 100 islands, including contact with Whidbey Island; 150 islands, including contact with Whidbey Island; maximum possible, including contact with Whidbey Island.

Islands are taken from the "prefix by countries list" as they appear in the *Radio Amateur Callbook*, with the exception of Whidbey Island. Each island must also be recognized as such by the National Geographic Society. To obtain the award, proof of contact must be submitted on a self-prepared list showing the island's name, callsign of amateur contacted, date of contest. This list should be arranged in alphabetical order by island. *Do not send QSL cards!* This list must be verified by at least two amateurs, General class or above, or by a local radio club secretary. Send your verified list of contacts, which must include Whidbey Island, $1.00, and a self-addressed stamped envelope, to: Bill Gosney WB7BFK, 4471 40th N.E., Whidbey Island, Oak Harbor WA 98277 USA. Foreign amateurs may exclude the fee and stamps on their return envelopes.

The rules that govern this award will be reviewed annually on October 1!

CARTG MERIT AWARD

A plaque has been offered for this award complete with engraving, and the CARTG is requesting names of suggested qualifiers. The award was created in 1967 to be presented annually to the radio amateur chosen for his outstanding contribution to the art of amateur radio teletype communications. It need not necessarily be confined to technical contributions but recognition of any outstanding achievement worldwide: experimental work, articles, traffic handling, net operation, DX, or any other outstanding RTTY achievement. Send complete information to: CARTG — VE3RTT, 85 Fifeshire Rd., Willowdale, Ontario, Canada M2L 2G9.

ALL VE/VO ON RTTY

The CARTG is also offering a certificate to anyone working all VE/VO on RTTY. There is no charge for the award, but QSLs must be included with the request and will be returned. An official of a RTTY group or society may inspect and send a *signed* list of such QSLs in place of sending the actual cards. Send all requests to CARTG — VE3RTT, 85 Fifeshire Rd., Willowdale, Ontario, Canada M2L 2G9.

New Products

JMR MOBILE-EAR CLEAR-1 MICROPHONE

A common problem faced by FM and SSB operators is inadequate microphone gain and directivity. A poor mic can make a TS-820 or Hy-Gain 3750 sound like an early phasing rig. Most modern FM transceivers employ audio limiting circuits which are designed to provide consistent modulation under differing audio conditions. Unfortunately, most "stock" microphones do not have sufficient output and the directional capability required to enhance the transceiver with which they are used.

This month I reviewed the Clear-1 microphone by JMR Systems Corp. The Model 40 mic is advertised as a high output device, capable of driving any audio circuit to its fullest extent. The mic is also highly directional, allowing it to be used in noisy mobile environments.

All it takes is one look at the Model 40 Clear-1 to realize that something is different. The microphone is shaped like a small Derringer pistol, with a push-to-talk button on one end. The microphone element is a capacitor device, mounted behind a tiny brass screen on the top of the transducer. The Model 40 contains a built-in FET preamp requiring an internal battery, and a variable gain control is provided. A five conductor cable is used to interface the user-supplied mic connector. Normally open and normally closed PTT contacts are available, allowing the Clear-1 to be used with any transceiver. Mic output is a high -42 dB, and audio response is 200-600 Hz . . . most definitely communications quality! The high upper-end frequency response is responsible for the quality "sound" of the Model 40.

I tested the JMR mic with the Hy-Gain 3750 transceiver on 20 and 75. Good reports were received – with the compressor in the 3750 disabled. The output control on the mic can be left about one-eighth open under normal "close-talk" conditions. I found that it was possible to clip the Hy-Gain by using excessive mic output – a good audio reserve is present! By carefully adjusting the JMR's level control, I was able to hold the mic at arm's length and talk in a normal tone . . . undetected by the listening station.

I have a popular 2m SSB transceiver in my shack – when I use it with those who know me, I am accused of having a cold or some other disgusting nasal malady. The standard mic supplied with this rig does not cut it, a classic case of anemic audio. This rig was the perfect test situation for the Model 40 on VHF. I changed microphone connectors and fired up. Amazing – no more Donald Duck with the flu! The transceiver sounded like its designers had intended. It was not possible to overdrive the 2m rig, probably because the audio limiter has good range.

The only shortcoming I noted is the lack of VOX capability with the Model 40. Since the internal preamp is battery powered, it would have to be continuously activated for VOX operation. This limitation is understandable when it is considered that the Clear-1 was indeed designed for mobile operation. I normally use PTT on HF, so it didn't make any difference.

In my opinion, the Mobile-Ear mic performed exactly as specified. Its performance on VHF was most impressive. The mic is light enough to survive even the longest "white-knuckle" sessions. It should also be indicated that the JMR Clear-1 microphone is compatible with most CB transceivers! The microphone is priced at $44.95. *JMR Systems Corp., 168 Lawrence Rd., Salem NH 03079.*

John Molnar WA3ETD
Executive Editor

RADIO SHACK TRS-80 MICROCOMPUTER SYSTEM

Computers are about to become a part of everyday life in American businesses, schools, and homes, according to Radio Shack, the nationwide electronics store chain.

The company has just introduced their new Radio Shack TRS-80 Microcomputer System. Not a kit, the TRS-80 comes completely wired and tested, ready to plug in and use.

The TRS-80 system consists of a 53-key professional-type keyboard and microcomputer plus regulated power supply, a data cassette recorder which is computer-controlled through an interface, and a 12" video display monitor.

A comprehensive owner's manual will be supplied with the TRS-80 that will explain everything necessary for its operation, from plugging it in through programming.

Radio Shack will also supply prerecorded cassette programs for such applications as a small business payroll, general ledger accounting, accounts receivable, and inventory control.

For educational purposes, the microcomputer can be used to teach mathematics, music theory, and virtually any subject through programmed teaching methods.

Just for fun, a variety of game programs will be available, including blackjack and backgammon. Other uses around the home would be personal finance management, storage of recipes, menu planning, and use as a message center.

Provisions have been made in the TRS-80 for later addition of accessory, or "peripheral," items such as an additional tape recorder, "disk" programming, and a printer which would create a permanent, typed record of the computer output.

At the heart of the Radio Shack TRS-80 Microcomputer System is a Z-80 microprocessor chip that serves as the central processing unit, or "brain," of the microcomputer. This remarkable device, about the size of a watermelon seed, is one of the most advanced microprocessor chips available today.

The Radio Shack TRS-80 Microcomputer System is priced at $599.95, complete with video display monitor and data cassette recorder. The microcomputer alone will sell for $399.95.

Leading the way in electronics since 1921, Radio Shack is a division of Tandy Corporation (NYSE), headquartered in Fort Worth, Texas, which is also where the TRS-80 is manufactured. Radio Shack presently has more than 6,000 stores and dealers in all 50 states and Canada, as well as nearly 500 stores overseas operating under the name Tandy International Electronics. *Radio Shack, 2617 West Seventh Street, Fort Worth TX 76107.*

FLESHER PS-170 RTTY PRESELECTOR

Last month I described the new RTTY terminal unit from Flesher Corp., the DM-170. This device has considerable built-in filtering which allows good isolation of the mark and space tones. However, in conditions of extreme QRM and noise, additional selectivity is required to reliably copy RTTY signals. Flesher has responded to this need by providing an active filter preselector that can be used with the DM-170 TU, or any other demodulator.

The PS-170 filter is connected between the receiver's audio output and the input of a terminal unit. This allows narrow shift (170 Hz) tones to pass, and not much else. The PS-170 has two outputs. The normal output couples the filter directly to the TU, while the limiter output provides an additional stage of hard limiting, which removes amplitude variations from the received signal.

The PS-170 is tiny. It consists of a 2" x 2" PC board, which can be mounted in any existing enclosure. Requiring ±15 V dc at 12 mA, the PS-170 can steal power from the terminal unit, or may be powered from a simple, zener regulated supply. I found that the preselector operated fine on voltages between 12 and 15. The 3 dB bandwidth of my PS-170 is 400 Hz, between the frequency range of 2000-2400 Hz. This differed

JMR Clear-1 microphone.

The new Radio Shack TRS-80 Microcomputer System features a built-in 53-key professional-type keyboard and one of the most advanced microprocessor chips available today, the Z-80.

slightly from the published frequency range of 2025-2400 Hz. I measured frequency response with an audio oscillator and VTVM, using the non-limited output.

Careful tuning is required when using the PS-170. The bandpass is such that even slight mistuning causes the tones to be excessively attenuated. However, the reception quality under heavy QRM and noise is fantastic! I used the DM-170 and ST-5 for comparison tests. The PS-170 was switched between the two terminal units, and under conditions of extreme interference was the difference between copying and missing weak RTTY signals. The DM-170 already has bandpass filters incorporated; the ST-5 does not. Thus, the ST-5 benefitted most when the PS-170 was used. I have since incorporated the PS-170 into the same cabinet with the Flesher TU. An SPDT switch selects either the normal or limiting output.

The PS-170 is available in kit or factory-built form. The kit takes about one half hour to build and align. The components are all resistors, capacitors, and ICs. Tune-up is accomplished in the same manner as was used in aligning the DM-170. Resistors are substituted into the circuit until the proper response is obtained – the op amps require only resistance changes to modify the response curve – no 88 mH toroids to prune! The Flesher PS-170 is priced at $11.95 in kit form and $18.95 factory assembled and aligned. *Flesher Corporation, Box 902, Topeka KS 66601.*

John Molnar WA3ETD
Executive Editor

NEW PERSONAL COMPUTER FROM OHIO SCIENTIFIC

Challenger IIP from Ohio Scientific is an exciting new personal computer complete with BASIC in ROM and RAM (4K) for programs in BASIC. All you have to do is turn it on and go!

Challenger IIP is a fully self-contained personal computer with a full size keyboard and a 32 x 64 character video display interface.

Complete with an audio cassette interface, the Challenger IIP simply connects to a video monitor or home TV set via an rf converter (not supplied). A cassette recorder can be used for program storage.

Challenger IIP comes complete with a 4 slot backplane and case for $598.00 fully assembled, and is expandable via compatibility with all Ohio Scientific computer accessories. *Ohio Scientific, Hiram OH 44234.*

GARY MODEL 101 DIGITAL VOLTMETER KIT

A complete DVM kit for $29.95? You've got to be kidding! That's what I thought when I received the Gary McClellan Model 101 Digital Voltmeter kit to review. Why not? The end result of the kit is a four digit DVM, complete with sign, auto zero, and overvoltage blanking!

The DVM market is similar to the calculator industry. Several years ago, the DVM was an exotic test instrument found only in electronic labs. Capable of extreme accuracy, the DVM is based on an LSI A/D (analog to digital) converter. The output of the converter is multiplexed and displayed on seven-segment displays, exactly as in some digital clocks. The price of DVM chips has plunged, aided by the mass production of calculator and microprocessor chips. The Gary DVM is based upon the Motorola MC14433 A/D converter, and has a basic range of 0-±1.999 volts.

The Gary DVM took exactly two hours to build and calibrate. The display mounts on a small PC board, which is fastened to the larger DVM board. All components appear to be quality devices, and the CMOS chips are first run units! Molex pins are used to mount the DVM chip and two other CMOS packages. The four digit display is multiplexed to reduce power consumption. The associated transistors and resistors for the display require a bit of close wiring, but Gary's eleven page manual contains detailed instructions and several photos of the completed unit. No special problems were encountered while wiring the kit.

The most enjoyable part of kit building (for me) is applying the juice for the first time. It sure is nice when things perk right from the opening gun, but I was doomed to disappointment this time. The Model 101 requires a single five volt supply, which should be regulated. I happened to have a little supply based on an LM-309K which was used in microprocessor experiments. I connected the supply, turned it on, and nothing! Then I thought I had better read Gary's instructions. There is a single screwdriver resistor that is used to calibrate the DVM. My control was all the way to one end; that's why the display was dark. Shorting the probe leads, I adjusted the control, and sure enough, the display illuminated. I adjusted for a reading of -000 volts, which is the normal condition with no signal input. The minus sign blinks to indicate that the DVM is functioning.

I should have read further, because the next thing I did was connect a handy 9 V transistor to the DVM. The display blanked out! Again consulting the manual, it turns out that the 101 DVM has a basic range of 0-1.999 volts. Any overvoltage blanks the display – a nice touch! Calibration is accomplished by adjusting the control until the reading corresponds to a known source. I used the Gary Model 120 DVM calibrator, which I will review next month. A good reference source is a single mercury cell, which has a no load voltage of 1.35 volts, or very nearly that. After calibrating the 101, I checked my year-old standard mercury cell. Not bad, 1.352 volts. Amazing!

The 101 DVM has a sign function, which means the probes do not have to be reversed when measuring minus voltages. It looks like I will have to retire my old trusty Knight VTVM – boy, I sure hate the constant reversing of the polarity switch!

The only problem, if you can call it a problem, is the low range of the 101 basic DVM. An attenuator is required to measure voltages of greater magnitude than 1.999 volts. Gary provides an attenuator for his DVM, the Model 101-1 four range kit. It includes a .05% resistor network and switch. The accuracy of the basic kit is .05%, so make sure to use quality resistors if you build your own attenuator.

All in all, I am very impressed with the 101 DVM. Its features are found on much more expensive devices, and the quality, accuracy, and flexibility are hard to beat in a $29.95 kit! It is small enough to custom mount, and can be used as the basis for a complete multimeter or digital tuning display. The input impedance is 1000 megs, and it only draws 80 mA maximum at 5 volts. Gary also provides a full line of of accessories for the 101 DVM. *Gary McClellan Company, 1001 W. Imperial Hwy., La Habra CA 90631.*

John Molnar WA3ETD
Executive Editor

NEW SERIES OF FREQUENCY SYNTHESIZED TWO METER AMATEUR TRANSCEIVERS, AMPLIFIERS, AND ANTENNAS FROM HALLICRAFTERS

Darrell Fletcher, Chairman of the Board of the Hallicrafters Company, and Cliff Mathews, Vice President of this leading manufacturer of para-military and government FM and SSB portable and manpack communications systems for the international market, have announced the introduction of a new series of two meter transceivers, amplifiers, and antennas for the domestic USA amateur market and international markets.

The new series of amateur transceivers features a military-type frequency synthesizer for up to 800 channel operation in 5 kHz steps in the FM mode and digital frequency readout for operating on both simplex and repeater modes. The all solid state rf power amplifiers provide up to 1/4 kilowatt power output on FM and up to 300 Watts peak envelope power on SSB for either base or mobile operation. Completing the new equipment series is Hallicrafters' new line of two meter base and mobile antennas having high rf power handling qualities and featuring a magnetic mount mobile antenna for easy installation and removal.

"Hallicrafters' new line of two meter amateur equipment is a natural expansion of Hallicrafters' traditional line of VHF and UHF-FM and HF-SSB communications products sold in international markets," says Darrell Fletcher. "The frequency coverage plan features and 5 kHz channel spacing enables the equipment to be used in any market in the world," claims Mathews, who says the equipment will be marketed directly in the USA and Canada by selected amateur equipment dealers and internationally by Hallicrafters International, Inc.

Continued on page 67

Ohio Scientific's new personal computer, Challenger IIP.

John W. Molnar WA3ETD
Executive Editor

Communicate On 10.25 GHz

-- with a simple transceiver

Many hams feel that the world of amateur radio ends at two meters, or even twenty in some cases! As the frequency increases, the amount of commercially available gear diminishes. Above 450 MHz, the operator must build his equipment – little prebuilt equipment is around. Thus, the bands above 450 are underpopulated, and misunderstood by the majority of hams. Possibly you have eyed those "microwave" frequencies starting at 1220 MHz . . . and wondered how to operate or experiment there. Well, let's see . . . 1296 might not be too bad – you can triple an old Motorola transmitter strip, and come up with a converter for your 2m rig. Definitely a project for two hams, as it is nice to have someone to talk with after the construction is done! However, if you desire to experiment with waveguide, horns, and point-to-point communications, the 10.5 GHz band is the place to go.

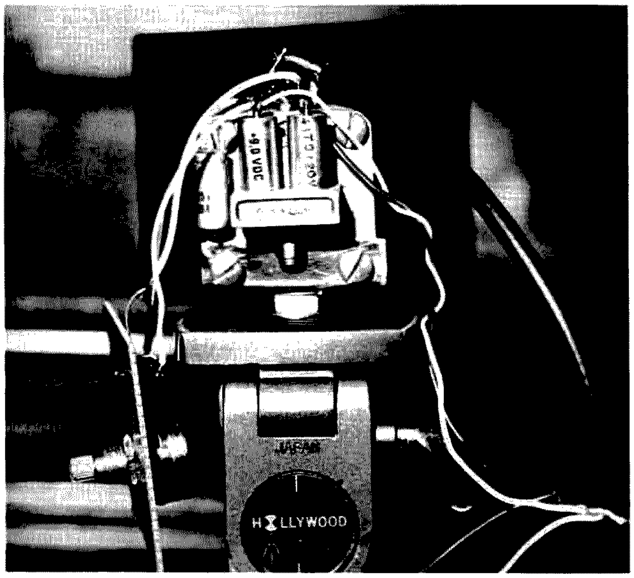


Fig. 1. A rear view of the Microwave Associates MA-87108 Gunnplexer. The Gunn diode is in the cavity under the left barrel. The tuning varactor diode is under the right barrel. Electrical tuning control is mounted on the perfboard, and the i-f connection is visible at the top of the rf head. The homemade bracket for tripod mounting is attached to the lower two bolts. A ¼ inch nut is sweat soldered to the bottom of the copper flashing. Refer to the text for details.

Why 10.5 GHz? The possibilities for experimentation are endless. If you need a true point-to-point link for your repeater, microwaves are the answer. A low power link can provide reliable control for remote bases, with a lower long-term cost than phone lines! Everyone is familiar with police radar, which is, incidentally, located just above the ham band. Experiments with Doppler radar are possible on 10 GHz.

The road to 10 GHz has not been easy. Little military gear is available, and a machine shop is often required to build microwave gear. The problem of equipment has stifled most amateur ventures into the world of microwaves. However, this problem no longer exists!

Enter the Gunnplexer

A progressive company in Massachusetts has introduced a line of microwave gear specifically designed for amateurs operating on 10.5 GHz. Microwave Associates, Inc., provides a microwave transmitter and receiver front end in a single package. Dubbed the Gunnplexer, this device produces 20 mW of microwave energy. A portion of that energy is coupled to a receiving diode, which, in the presence of another microwave signal, produces a low frequency i-f signal. The Gunnplexer is easily incorporated into a complete communications system. All that is needed is a Gunnplexer, i-f receiver, and power supply. This article describes just such a system. This transceiver can be used for two-way communications on 10.5 GHz, as a control link, or for Doppler effect radar. Before starting, let's look at the Gunnplexer and discuss its operation.

A Gunn Diode Is the Key

The Gunnplexer consists of five main parts. The heart of the rf head is a Gunn diode. This diode produces a microwave energy directly from dc when it is properly mounted in a resonant cavity. Similar to the familiar tunnel diode, the Gunn diode exhibits a negative resistance region under certain bias conditions. Microwave oscillations occur in this region. The diode employed in the Gunnplexer produces about 20 mW at 10 volts. Current drain is about 225 mA. Referring to Fig. 1, the Gunn diode is contained in the left barrel on the rear of the rf head.

The second component of the device is a varactor diode, housed in the right barrel, next to the Gunn diode. The varactor is used to control the frequency of the microwave radiation. If af modulation is applied to the varactor, FM will occur. The varactor can shift the frequency of the Gunnplexer 60 MHz. A crystal or other high output microphone may be coupled directly to the diode – no preamp is required on a simple system.

The receive components

comprise the third and fourth areas of the Gunnplexer. A tiny portion (about .5 mW) of the transmitted energy from the Gunn diode is coupled to a microwave mixer diode. An i-f signal is produced when a received signal is heterodyned in the mixer. Mixer injection is accomplished by a ferrite "circulator," located next to the mixer diode (Fig. 3). Injection is also controlled by a screw protruding into the body of the Gunnplexer. The standard i-f frequency used by amateurs is 30 MHz. However, different i-fs can be produced by mechanical and electrical tuning of the Gunnplexer. Remember, the transmitted signal also provides mixer injection! A standard FM broadcast receiver can be used as the i-f receiver in a simple transceiver. More on this later!

The normal Gunnplexer frequencies are 10.250 and 10.280 GHz. Thus, it can be seen that the difference frequency is 30 MHz, even though the local oscillator injection is different at each end of the communications link.

The last major part of the Gunnplexer is, as expected, an antenna. The body of the Gunnplexer is actually a section of UG-39/U waveguide. This guide can be bolted to transmission waveguide, or a gain horn antenna may be attached. Microwave Associates provides a 17 dB gain horn for the Gunnplexer (Fig. 4).

Using the Gunnplexer as a Transceiver

A microphone, i-f receiver, and power supply is required to turn a Gunnplexer into a complete transceiver for 10.25 GHz. A well-regulated 10 volt supply is required for the Gunn diode. About 4.5 volts of bias is needed for the varactor to maintain frequency. The Gunn diode output drifts as temperature changes, at a rate of -350 kHz per degree Centigrade. Quite a drift factor!

Thus, a change in temperature of only a degree will move the Gunnplexer frequency 350 kHz – right out of your i-f passband! In some cases, afc is required to maintain communications, especially when a narrow i-f passband is employed. A simple transceiver can use a voltage divider with the varactor supply to "tune" the Gunn transceiver. This scheme is adequate, especially in a system with wideband i-f capability. Refer to Fig. 2 for details of the bias voltage divider.

The most important element (next to the Gunnplexer) in the transceiver is the i-f receiver. A low noise figure is required. The i-f channel must also match the 200 Ohm impedance of the mixer diode for optimum results. Of course, the receiver must have an FM detector! An additional consideration is the i-f bandpass characteristic. If a narrow (10 kHz) i-f is used, Gunnplexer range increases – up to 100 miles under good conditions!

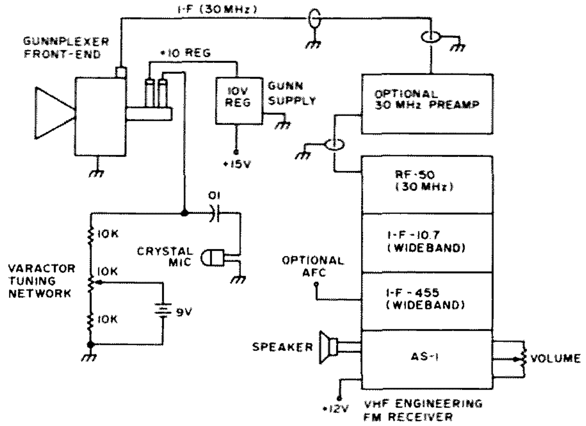


Fig. 2. Block diagram of the simple Gunnplexer transceiver. Details of the bias supply are shown, as well as all interconnections. This circuit uses VHF Engineering receiver strips for the receiver i-f and FM detector. A National Semiconductor LM-317 regulator chip is employed to provide the 10 volts required by the Gunn oscillator.

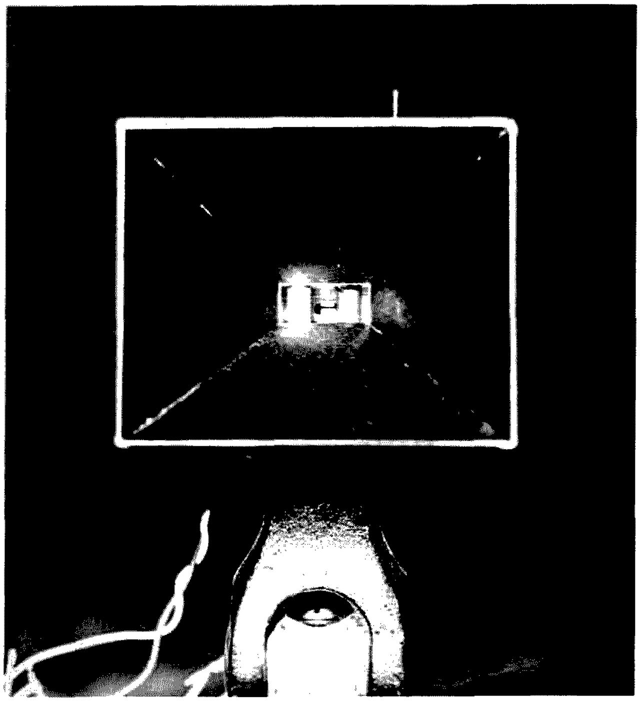


Fig. 3. Big Brother is watching you! This shot shows the mixer diode (left) and the ferrite mixer circulator in the waveguide. The tuning screw can be seen between the diode and circulator. Microwave energy is generated in the cavity behind the oval "iris," which is visible directly behind the tuning screw. The wire extending from the top of the horn is not a scratch in the photo, but rather a ground bus mounted on the rf head.

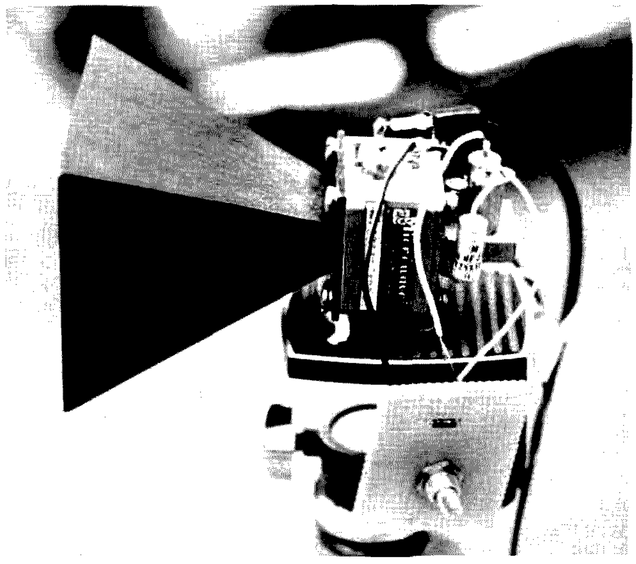


Fig. 4. Side view of the Gunnplexer. The 17 dB horn is clearly visible, as well as the tuning control, cavity, and mounting bracket.

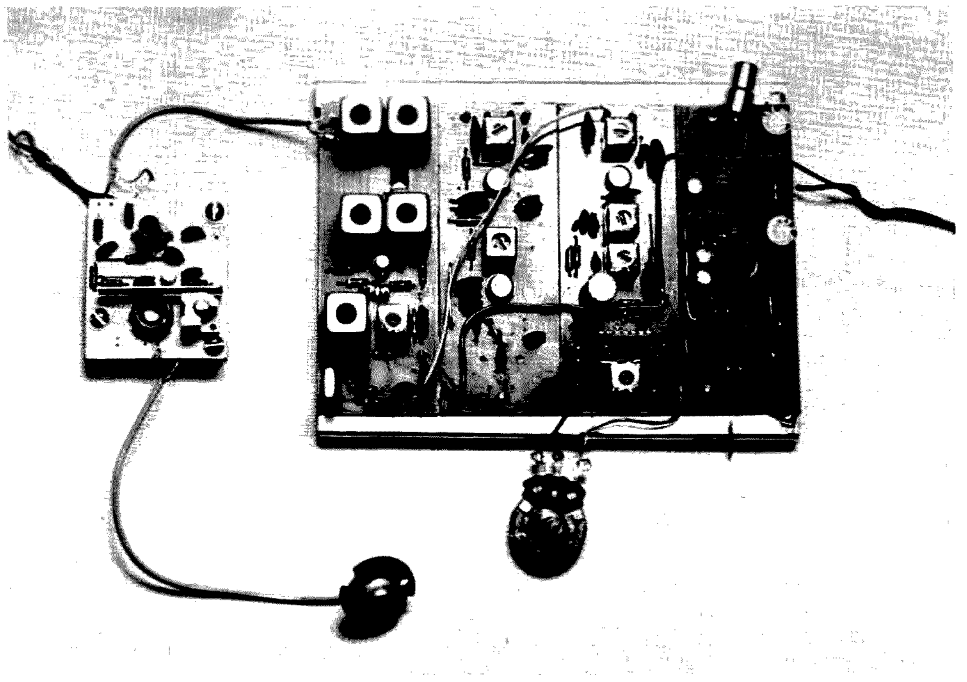


Fig. 5. The i-f receiver and preamplifier. The wideband VHF Engineering receiver consists of the rf module (second from left), two 100 kHz 10.7 MHz i-f amplifiers, and an audio amplifier. The pot is the volume control. No squelch is used on my system. A converted OSCAR 30 MHz preamp is also illustrated. The rewound toroid matches the 200 Ohm Gunnplexer mixer diode.

However, as mentioned earlier, afc is required on a narrowband system. Afc can be produced by comparing the i-f to a standard, and using the error voltage to tune the varactor. Additional details are provided in the Microwave Associates bulletin, number 7624A.

A wide i-f passband decreases effective range. However, the drift problem is eliminated. Range with an i-f passband of 100 kHz is about 50 miles. As indicated earlier, a commercial FM broadcast receiver can be used in experimental systems. The bandwidth of commercial FM broadcasting is 150 kHz; thus the commercial receiver is a viable i-f system. If used, the broadcast receiver should have a good front end. Provision should be made to match the receiver's input to the Gunnplexer mixer diode.

My goal was to construct a simple i-f receiver that would perform in an experimental system. I also wanted to use available parts around the shack. Let's see . . . an FM receiver, battery operated, simple? My first thought was an unused VHF Engineering receiver once used for 2m experiments. The only real problems were that the i-f was 10.7 MHz, and narrowband at that! I needed a 30 MHz i-f with a bandpass of 100 kHz. The first problem was solved by building a converter from International Crystal modules. This scheme used an International OF-1 oscillator with an inexpensive OX crystal oscillator, and an MXX-1 mixer module. The EX crystal provides injection at 19.3 MHz, thus matching a 10.7 i-f when 30 MHz is present. The only item purchased was the EX crystal.

If you try this technique, increase the link coil on the MXX-1 several turns to match the Gunnplexer. The mixer must be mounted as close as possible to the mixer diode on top of the Gunnplexer. A short run of RG-174 coax couples the converter to the VHF Engineering receiver. The mixer and oscillator were powered by a 9 volt transistor battery. This system worked fairly well. However, the mixer is noisy, and is not sensitive enough to complement the Gunnplexer.

I decided to use a better converter in my system. VHF Engineering makes a 30 MHz receiver strip, called the RF-50. This receiver has an FET preamp, and can be tuned over a range of 30-50 MHz. Remember to wind the coils for the 30 MHz option! This rf module is then used with the VHF receiver, consisting of the IF-10.7, IF-455, and AS-1 audio module. If you order these strips from VHF Engineering, specify the "wideband" option. The wideband kit consists of 10.7 MHz transformers that replace the 455 kHz units normally used. The wideband option converts the double-conversion receiver to a wideband (100 kHz) single-conversion job, suitable for Gunnplexer use.

It is best to wideband your modules immediately. I had to convert mine, which was a messy, time-consuming job. All the old 455 i-f transformers had to be removed from the PC board – ugh! Fig. 5 details the completed i-f receiver, mounted on standard VHF Engineering rails.

Preamp Option

An additional problem exists when using the VHF receiver. The input impedance of the RF-50 is 50 Ohms, and the Gunnplexer diode impedance is 200 Ohms. A simple balun could be used to effect a match, or the input coil on the receiver could be rewound. In the interest of performance, I chose another tack. I just happened to have a small, low noise OSCAR 10 meter preamp available. This preamp has a broadband toroid as an input circuit. It was a simple matter to rewind the toroid to produce a 200 Ohm input impedance. This preamp is visible in Fig. 5. A preamp is *not* necessary. I used one because it was available. I think the best method of matching the mixer in a simple system is to modify the input coil on the RF-50. The system will work if a 200-50 Ohm mismatch is present – you won't even notice it in close range tests!

Putting It All Together

Since my system is experimental at this point, I did not mount all the components in a single enclosure. I coupled the mixer to the OSCAR preamp (Mode X?), and ran a piece of RG-58 from the preamp to the RF-50. A nine volt battery powers the preamp, while a 12 volt nicad is used for the VHF receiver. The Gunn oscillator requires regulated power at 10 volts. I derived this voltage by using a National LM317 three terminal regulator (Fig. 6). This regulator requires an input voltage at least 2 volts higher than the regulated output. I built a battery producing about 16 volts from old AA nicad cells. Remember that the Gunn diode draws considerable current, and carbon cells probably won't last during experiments. Fig. 2 is a block diagram of the system. The voltage divider is constructed from a 10k pot and two 10k

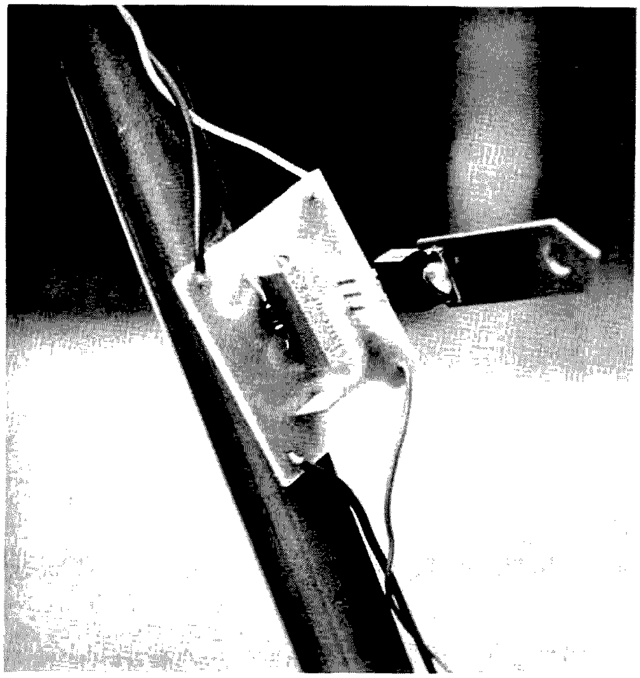


Fig. 6. The Gunn oscillator voltage regulator. A National LM-317 variable regulator, set for 10 volts, is used. The PC board and resistor are part of an evaluation device from National Semiconductor. The regulator is mounted on a leg of the tripod in my experimental system.

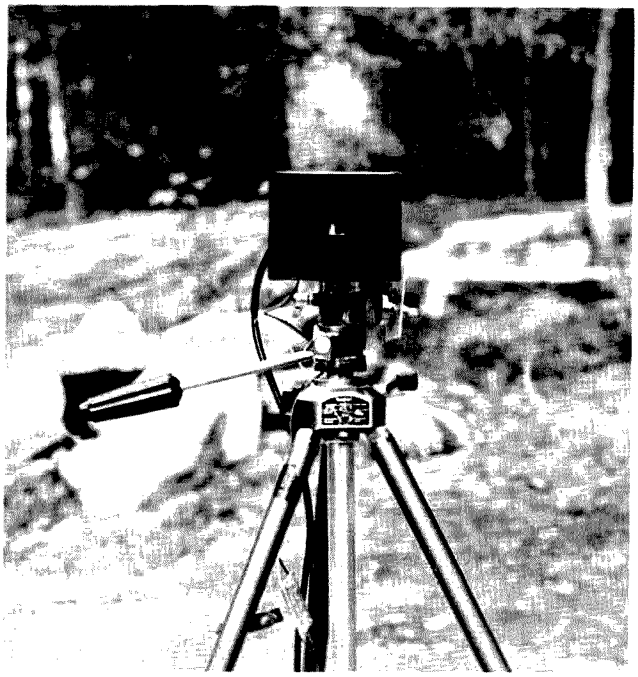


Fig. 7. Not a Martian, but a Gunnplexer transceiver rf head. The i-f amplifier and power supply is at the base of the tripod. Two transceivers should be separated by 25-50 feet for initial test. Ultimate range is 50 miles with this system.

resistors in series with a 9 volt battery. The varactor bias is developed at the slider. The negative side of both the Gunn supply and bias supply should be connected to the body of the Gunnplexer. I mounted the Gunnplexers to standard photo tripods by making a simple mount out of copper flashing. Drill two ¼" holes in a 2" piece of flashing to line up with the bottom screws holding the Gunn baseplate to the Gunnplexer body. Bend the flashing around the bottom of the Gunnplexer, and sweat-solder a ¼" nut to the flashing. The nut will mate with the bolt built into most tripods.

Tuning Up

My system consists of two Gunn transceivers. When initially checking your system, position the two transceivers about 50 feet apart, facing each other. Adjust the bias supply so that about 4.5 volts is present at the varactor diode on each transceiver. Apply Gunn voltage. If a 0-500 mA meter is available, check current drain. The Gunn diodes should draw about 225 mA at 10 volts. This is not standard; different diodes draw slightly different currents. Adjust the varactor voltage divider on *one* transceiver. Tune very carefully until the receiver quiets – there, you're on 10.25 GHz! This system is full duplex – you will hear yourself in your receiver when talking. Occasional tweaking of the bias will be required to keep the transceivers locked ... however, once they are temperature stabilized, remarkable stability will be noted with a 100 kHz i-f.

At this point, you will probably begin experimenting with the transceivers. Try reflecting the signal around a 90 degree corner with aluminum foil. I won't even attempt to suggest experiments and applications – if you've followed me this far and built a system, you don't need my prodding! However, I will be continuing this series with practical experiments and applications involving radar. Don't keep us in the dark, however. I would appreciate hearing from anyone experimenting with Gunnplexers and will welcome articles featuring the device. Write me, in care of *73*.

A Word of Caution

If you have been following my editorial in *73*, what follows will be repetitive. Microwaves are potentially dangerous. Do not needlessly expose yourself to the microwaves generated by the Gunnplexers. Although the level is very low, why take a chance? Opinion concerning microwaves varies, but one fact is certain: Microwave radiation can damage the tissues of the eye. The effects are cumulative, so treat the Gunnplexer with the same respect afforded a high voltage plate supply. *Never* look into the horn of an operating microwave transmitter. Avoid looking at the mixer diode in a Gunnplexer while it is operating; if you see it you're being exposed. I personally do not stand in front of a Gunnplexer at distances under 25 feet. When operating indoors, I use a cheap police radar detector to monitor the Gunnplexer – it's too easy to leave the Gunn supply connected ... no noise is generated by a Gunn diode! Happy experimenting!

Interesting effects are liable to occur if you operate your Gunn transceiver mobile in a police radar zone. Their radar is broadband by nature, and will respond to your legal microwave transmission, exactly as my detector responds to "out of band" signals from the Gunnplexer. Have a copy of your amateur ticket available – I would hate to learn that your transceiver was impounded. Newfangled devices, what's the world coming to?

I would like to thank Dana Atchley, Jr. of Microwave Associates and Bob Brown of VHF Engineering for their advice and suggestions. ■

References

Gunnplexers are available from: Microwave Associates, Inc., Burlington MA 01803.
VHF Engineering products from: VHF Engineering Corp., 320 Water St., Binghamton NY 13901.

Home Brew Tilt-Over

-- the water pipe special

Max Holland W4MEA
Hiwassee College
Madisonville TN 37354

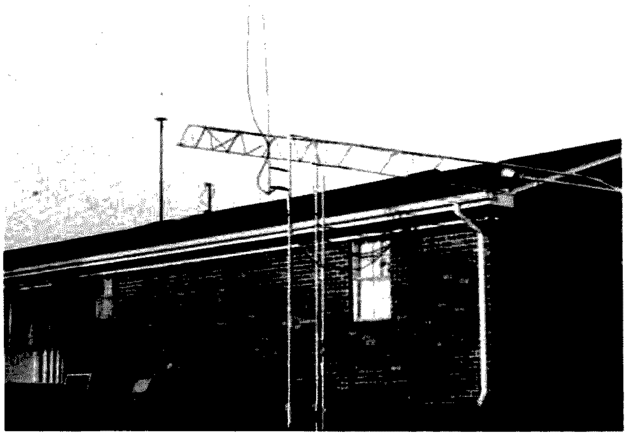
A primary disadvantage of antenna work is the need to constantly climb up and down the tower. A tilt-over tower is very desirable; however, the expense is often prohibitive. If a person has access to a fairly heavy-duty welder and is interested in building his own tower, this design seems to be a fairly good compromise between height and convenience. The very tall towers have such extreme weight when tilted over that they require some heavy-duty cable and construction.

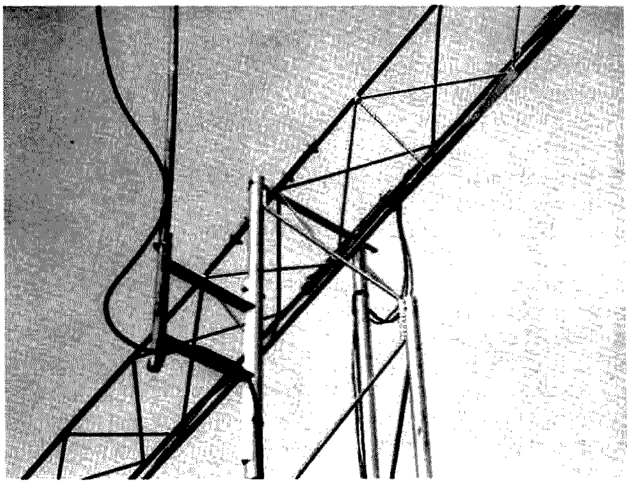
This tilt-over tower was constructed using galvanized water pipe and reinforcing bars (called "rebars") purchased at the local junk yard. The total cost, not counting labor and the welding expenses, was approximately $100. The dimensions given in the accompanying diagram will be of great help in getting started.

Basically, the construction consists of determining the dimensions of the base section and making up two plywood forms with the holes drilled in the shape of a triangle. One and one quarter inch water pipe is put in the holes, and the rebars are cut and tack-welded in place. The final welding is done after the necessary alignment has been checked.

The base section calls for one cubic yard of concrete. The hole was dug 3 feet by 3 feet by 3 feet. Gravel was put in the bottom of the hole, and the legs of the lower section were put down into the gravel to allow for the drainage of any accumulated water. Wires were attached to the legs of the tower, and additional rebars were placed in the sides of the holes at this time.

After the concrete has set, the top or tilt-over section of the tower is hoisted into position, using the cable and winch attached to the tower. After the top is placed in position, a 5/8 inch diameter bar is required. Then the cable and the winch can be moved to the end of the tilt-over section of the tower, and the tower can be pulled up into a vertical position. A





yoke, in which the tilt-over section of the tower lies, is then made, secured by at least 6 stainless steel clamps (the kind used on automobile water hoses). A more suitable method of attachment may be used; however, this method provided good side clearance between the tilt-over section and the base section. After two years of use, it seems to be more than adequate for the weight involved.

The total height of the tower is around 35 feet. The top section was made out of conduit tubing, for the additional benefit of light weight. Three quarter inch conduit fits over the one half inch galvanized pipe used for the tilt-over section. Once again, rebars were put into the tower section in triangular shapes for additional strength where the tower bends. Additional rebars and reinforcement were used to keep the tower from collapsing at that point.

A metal plate was attached inside the tower and a CDR Model AR 22 rotator was mounted. A Model 44 or Ham-M rotator could be mounted in the space, but the holes for the mounting plate would have to be changed accordingly. The pipe upon which the antenna mounts is 1-1/4 inch aluminum with the topmost part being 1-1/8 inch aluminum tubing.

The tower was given a coat of aluminum paint, and seems to be holding up fairly well after 2 years. The aluminum paint will probably last 3 or 4 years. The total time to paint the tower (considering all the small and minute parts) amounted to about 6 hours. Spray painting could be used if desired.

The winch is sold by Sears, Roebuck and Co. The cable is rated at about 1500 pounds.

As an additional safety precaution, when the antenna is in the vertical position, a heavy-duty chain and lock is wrapped around the legs of both sections. The triangular shape of the leg braces for the base of the tower discourages the climbing of the tower.

The feedline for the antenna can travel along the legs of the tower. There is enough clearance between the two sections to tape the coax cable directly to the tower. The bracket mounted on the side of the tower (see photo) is used to support a 10 foot long pole, which is used as a center support for an 80 meter wire dipole. ■

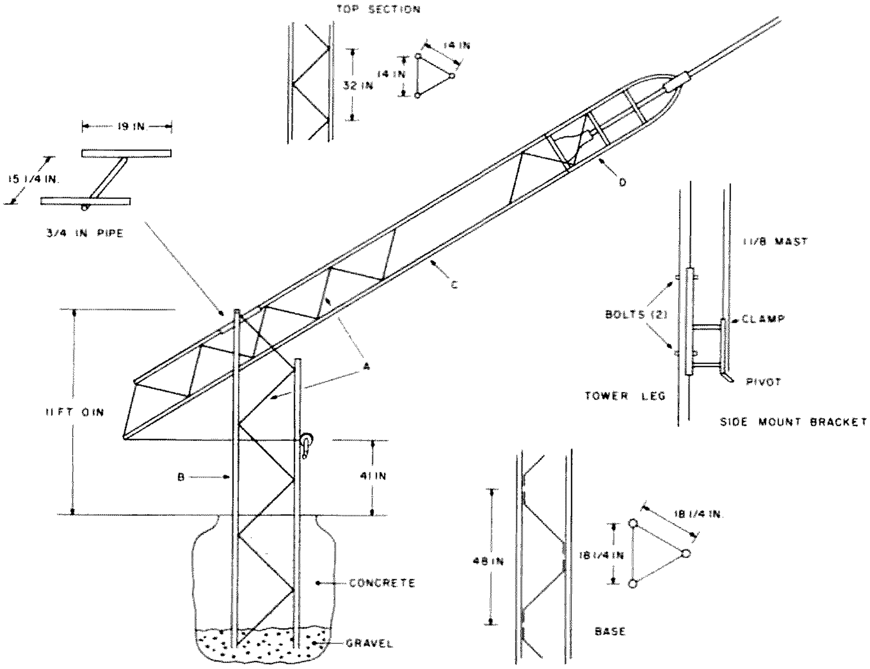
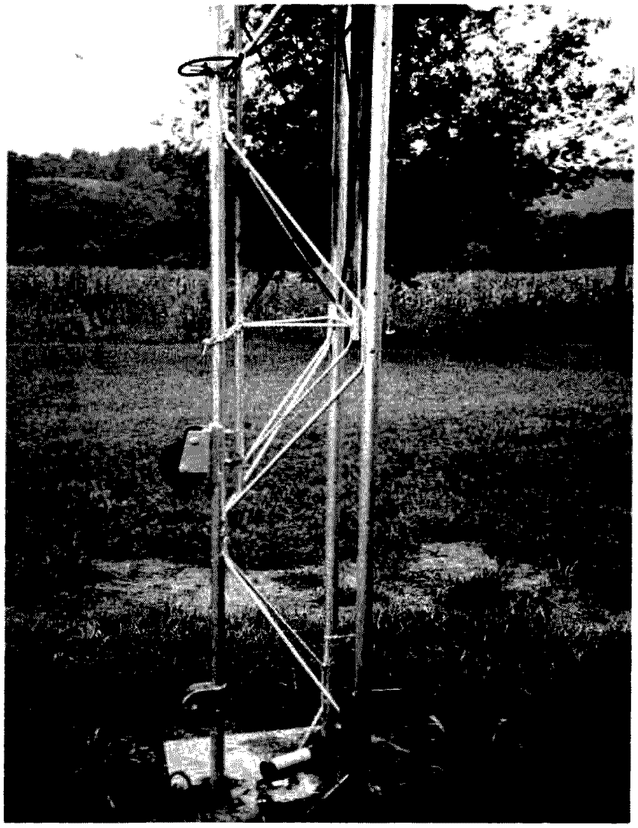
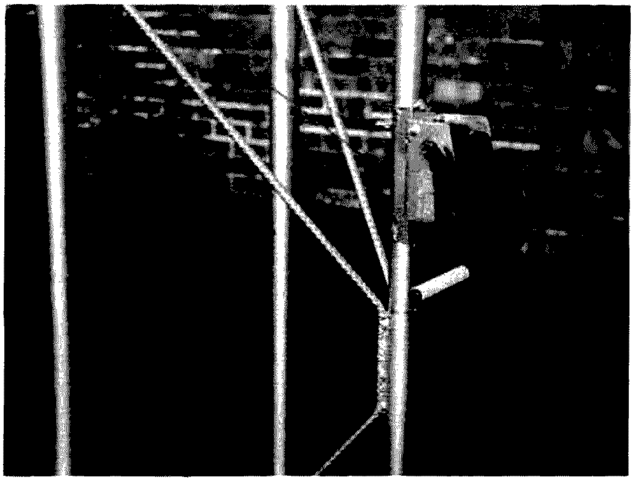


Fig. 1. A = 3/8" rebar. B = 1¼" galvanized pipe. C = ½" galvanized pipe. D = ¾" conduit tubing.





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Minimize Feedline Loss

-- UHF buffs, front and center!

It has been pointed out on occasion, but not often nor emphatically enough, that the standing wave ratio (swr) as measured down in your cozy ham shack is not the same as the actual swr up at your antenna. The swr at the antenna will always be higher than what you measure it to be at the transmitter end. The reason that the swr is lower at the transmitter end is because of losses in the transmission line between transmitter and antenna. So, while it is undeniably nice to have a low swr at the transmitter, line losses are not exactly the most efficient way to go about it.

How do line losses lower the swr at the transmitter end and fool you into thinking that your antenna is a better match than it really is? Glad you asked. Here's the answer. That little swr meter atop your transmitter measures the reflected power relative to the forward power. The swr is proportional to the ratio of reflected to forward power, or more precisely:

$$\text{swr} = \frac{1 + \sqrt{\dfrac{\text{reflected power}}{\text{forward power}}}}{1 - \sqrt{\dfrac{\text{reflected power}}{\text{forward power}}}}$$

Unfortunately, the ratio of reflected to forward power which the swr meter sees down in the shack is not the same as that which the antenna sees. Because of the losses in the line, the forward power at the antenna is less than that leaving the transmitter, which is what the swr meter sees. What's more, the reflected power which the swr meter measures is less than the reflected power at the antenna, again, by the amount of loss in the line. This is because the reflected power travels backwards through the same lossy line from the antenna to the swr meter and transmitter. If you are algebraically inclined, you can see that in the equation for swr, the reflected power in the numerator of the square root terms is made lower by the line loss, while the forward power in the denominator of these same terms is made higher. Both effects cause the square root terms to be less, which results in the value of swr being lower. Thanks, or no thanks, to line loss, the swr at the transmitter end is lower than the actual swr of the antenna.

"So what," you say. Well, for those skeptics who may be sitting back reading this article after calling CQ for fifteen minutes straight with no replies, let me present an example of just how significant an effect this can be.

Consider a ham who operates on ten meters using 150 feet of RG58/U coax to feed his antenna. One night his antenna blows down, leaving the feedline dangling in thin air on his roof. The next morning, unaware of the disaster which befell his antenna, he sits down for a few hours of operation. Tuning up, he checks his swr meter. It reads about 2.1:1, a little worse, perhaps, than usual, but not too bad. It will do for now, or so he thinks. After an hour of fruitless CQing, he throws in the towel and goes out for a walk, tripping over his antenna on the front lawn. An extreme example, you think? Not at all. It has happened to me and I'll bet to many others.

The startling fact is that the swr at the antenna end of the feedline (where the antenna *used* to be) is infinite; all the power is reflected because there's nowhere else for it to go but back. Yet the swr meter in the shack reads 2.1:1. This clearly demonstrates the kind of difference line loss can cause between actual and apparent swr.

And that's not all the bad news. Remember that power reflected from the antenna (let's assume again that there *is* an antenna) is reduced by the effect of line losses as it travels back from the antenna towards the transmitter. This is lost power, just the same as power is lost in going forwards from the transmitter to the antenna. But this reflected power loss is a function of how much power is reflected in the first place. Or, put another way, the additional power loss (in the reflected wave) is a function of the antenna swr. The higher the antenna swr, and the higher the rated attenuation of the feedline, the more the additional loss will be.

So now that you are a believer, you will want to know what your antenna swr *really* is, and how much additional power loss that swr is causing in your line. Thanks to a friendly computer, the answer is easily found. Just look it up in Table 2. To use Table 2, all you need to know is the *rated* attenuation for the type and length of feedline you are using, as well as the reading of your swr meter at the transmitter. The rated attenuation of feedlines is available in manufacturers' literature and in the various radio handbooks. Don't be surprised if you find the values from different sources differing by up to a dB or so. But so you don't have to go searching, I've summarized the rated attenuation per

	Type of Cable			
Band	**RG58A/U**	**RG59B/U**	**RG8A/U**	**RG11A/U**
80/75m	0.9	0.63	0.3	0.38
40m	1.3	0.91	0.44	0.54
20m	1.9	1.3	0.66	0.77
15m	2.45	1.65	0.84	0.95
10m	2.9	1.95	1.0	1.1
6m	4.1	2.7	1.4	1.5
2m	7.6	4.8	2.7	2.7
1¼m	9.7	6.1	3.4	3.4
3/4m	14.5	9.0	5.2	4.9

Table 1. Attenuation in dB per hundred feet for common coaxial cables. Source: Alpha Wire Corporation, Catalog W-8.

hundred feet of line for some of the more popular coaxial cables in Table 1.

Measured swr at Transmitter	Actual Antenna swr	Rated Line Loss in dB	Actual Overall Loss in dB	Overall Efficiency of Line
1.0	1.0	0.5	0.5	89.1%
1.5	1.58	0.5	0.55	88.2%
2.0	2.19	0.5	0.64	86.2%
3.0	3.56	0.5	0.89	81.4%
4.0	5.12	0.5	1.18	76.1%
5.0	6.94	0.5	1.51	70.7%
1.0	1.0	1.0	1.0	79.4%
1.5	1.67	1.0	1.11	77.5%
2.0	2.45	1.0	1.33	73.6%
3.0	4.40	1.0	1.94	63.9%
4.0	7.18	1.0	2.73	55.4%
5.0	11.45	1.0	3.74	42.3%
1.0	1.0	2.0	2.0	63.1%
1.5	1.93	2.0	2.28	59.1%
2.0	3.24	2.0	2.91	51.2%
3.0	8.64	2.0	5.05	31.3%
4.0	39.83	2.0	10.26	9.4%
1.0	1.0	3.0	3.0	50.1%
1.5	2.33	3.0	3.58	43.9%
2.0	4.97	3.0	5.03	31.4%
3.0	890.01	3.0	25.23	0.3%
1.0	1.0	4.0	4.0	35.5%
1.5	3.59	4.0	5.98	25.2%
2.0	11.30	4.0	8.74	13.4%
1.0	1.0	5.0	5.0	31.6%
1.5	4.44	5.0	7.04	19.8%
1.0	1.0	6.0	6.0	25.1%
1.5	8.82	6.0	10.19	9.6%

Table 2. Note that for rated line loss above 2 dB, the measured swr at the transmitter end will never go very high, even with very large swr at the antenna.

An example will serve to illustrate the proper use of these tables.

Let's say that you have one of the popular 100 Watt output SSB transceivers feeding a trap tribander through about 150 feet of RG58A/U coax. You tuned the antenna for the CW end of the bands because that's where you spend most of your operating time. At your favorite frequency of 14.026 MHz, the swr meter sitting atop the rig reads about 1.2. On occasion, you QSY up the band to 14.335 MHz to keep a weekend sked there and add to the QRM. Up here in the high end of the phone band, your swr meter reads about 2.0. Darn good, you think. But let's see if it is.

From Table 1, the loss per hundred feet of RG58A/U is 1.9 dB in the 20 meter band. Now, since your line is 150 feet long, its rated attenuation will be (150 feet/100 feet) x 1.9 dB = 2.85 dB. Going to Table 2, we find that line which has a third column entry ("Rated Line Loss in dB") closest to 2.85 dB (it will be 3.0 dB), *and* a first column entry ("Measured swr at Transmitter") closest to the 2.0 your meter reads (it will be 2.0). Finding this line, the actual swr at the antenna is given in the second column ("Actual Antenna swr") and we note that it is 4.97, almost 5 to 1! A lot higher than you thought, isn't it? The value in the fourth column ("Actual Overall Loss in dB") gives you just what it says, the real losses in your line in dB, including the effects of the actual swr and losses in reflected power.

This is 5.03 dB. *Surprise!* And now for the final shocker. The last or fifth column, labelled "Overall Efficiency of Line," reads 31.4%. This just about says it all in a single figure, and possibly explains why you have such a tough time completing that sked. Of the 100 Watts your transmitter is putting into the lines, only 31.4 Watts is actually delivered to the antenna for radiation. You've been working QRP and you didn't even know it.

Now you should be prepared to check out the real facts of life in your own antenna system. I hope it won't turn out too badly for you, but I'll lay odds that it will be worse than you thought it was. Well, back to the drawing board.

Just what can you do to improve things? A full answer is far beyond the scope of this article. But a few things you can do would have to start with getting *low loss* feedline. Every tenth of a dB of loss hurts you two ways – forward power loss and reflected power loss. No single factor will improve your overall efficiency as much as using the lowest loss feedline feasible. That's one reason why open-wire line sometimes works so well. It is *extremely* low loss. After you have gotten your line losses down as low as your finances will permit (lower loss, bigger bucks), then work on reducing the swr *at the antenna* feedpoint, by tuning, matching, trimming, or whatever is appropriate to your particular antenna. After that, there's always a matchbox or antenna tuner as a new addition at the transmitter end. Now understand this very clearly: A matchbox at the transmitter end will not in any way reduce the kind of transmission line losses discussed in this article, except over that short portion of line connecting the matchbox to the transmitter. A matchbox will, however, provide a very low swr to the transmitter which will enable it to put out all the power it was designed to, even though we know some will be lost in the line. Without a matchbox, it is quite possible that the transmitter will be unable to put out its full rated power in the first place. Incidentally, it is probably worth mentioning that the "Measured swr at Transmitter" in Table 2 and in the discussion implies that it is measured on the antenna side of any matchbox, if one is used. This should be obvious, but probably won't be to everyone. The swr at the transmitter side of a matchbox is normally 1.0 if the matchbox is tuned correctly, but something quite higher at the antenna side. So if you already have a matchbox and are going to make these measurements, be sure to move the swr meter to the antenna side, after first tuning the matchbox for minimum swr going into the transmitter.

There is no one big secret to a stand-out signal, just a lot of small ones. Now some of them aren't secret any more. ■

How About 6 FM?

- - it's easy

with a modified HE-50

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Dresher PA 19025

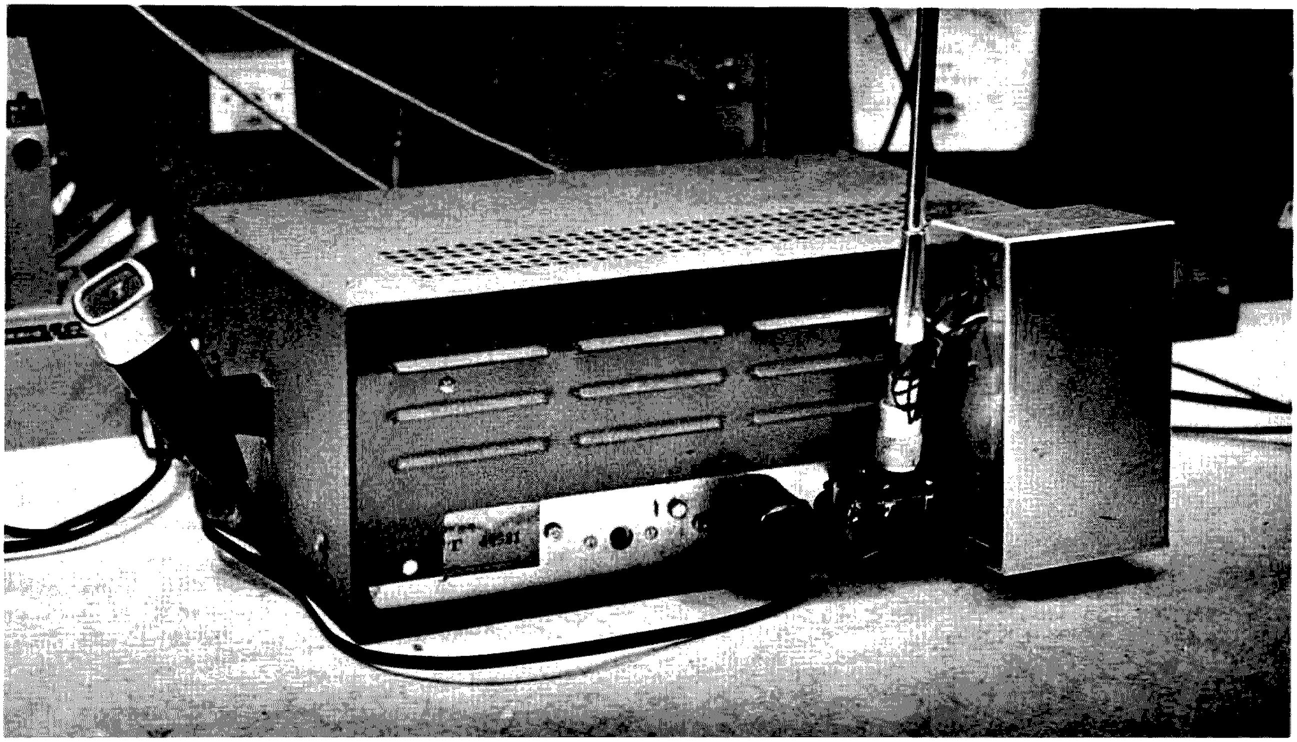
WR3ABE is a fine, well-managed six meter FM repeater in our area. I have had access to it on a mobile basis for some time, but never had gotten around to installing a base station at the QTH. The search for such a facility had been an off again, on again type of romance until fate intervened. W3GHH announced that his Lafayette HE-50, a little old-time ten meter transceiver, was available if anyone had a use for it. Examination of the contents of the box and its schematic showed great promise for a good six meter conversion. The receiver is single conversion with an rf amplifier, two stages of 1650 kHz i-f, a good noise limiter, plus capability of operating on either the 110 volt line or on 12 volts dc.

The transmitter consisted of two tubes, a 6EA8, and a 2E26 in the final. The triode section of the 6EA8 worked as an oscillator/doubler. The pentode section of the 6EA8 worked as a second doubler, and the 2E26 worked straight through on ten meters.

The transmitter conversion consisted of getting six meter output on the repeater frequency using 8 MHz crystals. Then the AM modulation had to be removed from the final and an FM modulator installed. The first doubler coil was pruned so the stage would now be a tripler. Thus its output was in the 24 MHz area. The pentode doubler was left a doubler, but its tank circuit was altered so it would tune to six meters. The same operation was performed on the final tank coil. Thanks to a grid dip meter, this operation took about 3/4 of an hour, and the transmitter was putting about five Watts out on six meters. The normal dc input to the final is about 12 Watts. The rf conversion included clipping and discarding a built-in TVI harmonic trap which had been connected from output of the pi network to ground. With some five Watts of rf available, it was time to attend to the change in modulation.

Fig. 1 shows the final form of the FM modulator. The AM modulation was divorced from the final by the simple expedient of changing the B+ feed to the final so that it got no audio. The 5k 5 W resistor was added as a load across the modulator output to replace the class C rf load that had

Photos by WA3PTC



been removed. A small audio transformer with a 20,000 Ohm primary and a 600 Ohm secondary was fed from the old modulator through a 0.01 uF capacitor to isolate the B+ from the primary. The varicap network was wired across the 600 Ohm secondary and coupled across the crystal. A 45 pF trimmer was put in series with the crystal to put me on the nose with the repeater input frequency. There are those who will shudder at the lack of frills in the modulator, e.g., no dc bias on the varicap, etc., but the proof of the audio is in the hearing and reports have been uniformly favorable.

With the transmitter so nicely under control, attention was paid to the receiver. The lineup consisted of an rf stage, a converter, two i-f stages, and the usual functions after this point. The initial thought was to convert from six to ten meters using an external converter. Then, second thoughts came to bear as the front end was examined more closely. Fig. 2 shows the first several stages of the receiver. The thought that came through was to examine the possibility of making the rf amplifier a converter, add a crystal-controlled local oscillator for injection, and leave the rest of the receiver untouched.

A six meter tuned circuit was put in the grid circuit and dipped to frequency. The bench signal generator was used as an injection oscillator, with very satisfying results. An order went out for a 23.64 MHz crystal, which produced the hardest part of any building or conversion . . . waiting for the mail! Naturally, being human and subject to impatience, I put the thing on the air for an initial contact through the repeater. With the assistance of WA3RMA, I overcame such obstacles as a varicap that decided to head west, an intermittent mike cable, and other standard assorted griefs. If the signal generator that I was using as the converter injection oscillator could have been condensed, I might have been tempted to call it a day and button up the case. As usual, though, reason did prevail and the wait for the crystal began.

The received audio from the repeater is so good by merely using slope detection that all thoughts of installing a conventional FM detector vanished. This may, in part, be due to the excellent rf signal that the repeater puts into my QTH. In any event, armchair copy exists here without any detector changes.

As the crystal-controlled

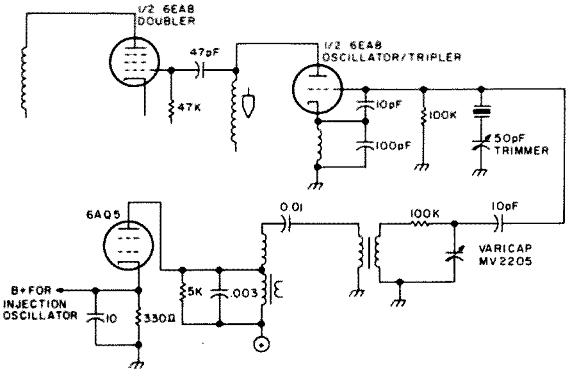


Fig. 1.

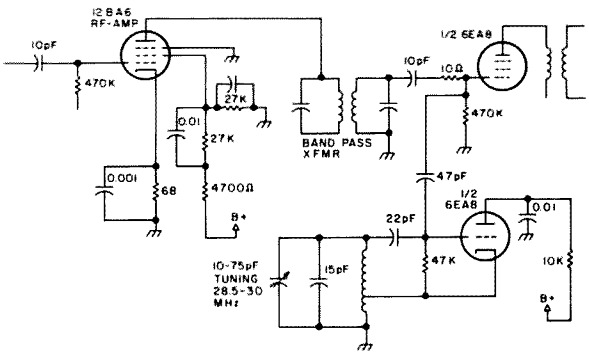


Fig. 2.

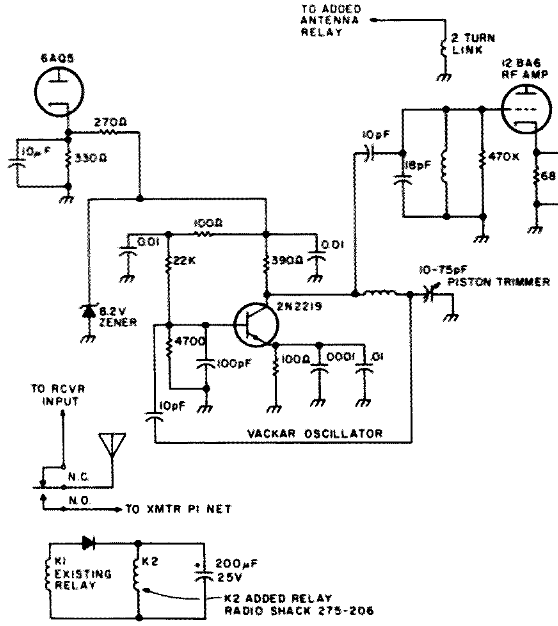


Fig. 3.

injection oscillator was going to be solid state, a source of low voltage was needed. The cathode bias resistor of the 6AQ5 proved to be a handy source of plus 10 volts, solving this problem.

Nothing could spoil this fine forward progress except the mailman, or more precisely, the mail person, as he is really a she. The postcard was from the Great American Pool Table and Quartz Crystal Company. It said: "Dear Cur: Your crystal will be along in about eight weeks."

Not only were they making me wait two months for the crystal I wanted yesterday, but they also had included a finely drawn character analysis in the message.

Fortunately, I had heard of Mr. Vackar and his driftless, easy-to-roll VFO. This little item (Fig. 3) worked extremely well, and was installed in a minibox on the rear of the transceiver. The design information was abstracted from a fine article in the February, 1968, issue of *Electronic Engineer*, written by Gary Blake Jordan. A rough check of stability showed a drift of about 100 Hz over a period of about three hours after turn-on. There is plenty of room inside the transceiver for this unit, *but* there is a hostile tube-induced heat problem that I wished to avoid — hence the external mounting site.

The only other item of business was to install an antenna transfer relay. You might well ask, if it is already a transceiver, why do you have to install one of these? The answer is simple. The original design had the transmitter output and the receiver input tied together as shown in Fig. 4. It worked fine on 10 meters, but I could not get it to behave on 6 meters — hence the added relay.

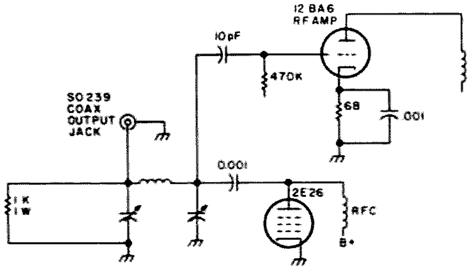


Fig. 4.

Afterthoughts

The nice part about a globe like the 12BA6, in contrast to a transistor, is that it has three possible ports of entry for the injection oscillator. I tried all three, cathode, control grid and suppressor grid. The control grid injection seemed to give the greatest gain, and thus was used in the finished conversion.

The original press-to-talk relay is actually an ac relay which has a resistor thrown in series with it when the unit is used on 12 volts dc for portable use. This explains why the diode and the filter cap appear along with the added relay as shown in Fig. 3.

The FM modulator deserves a special note. Perhaps due to personal preference and how the gods smile at the time, I have always had good luck with the varicap modulator *when* it gets its audio from a relatively low impedance winding of a transformer. For some delightful reason, the diode does not seem to care which end is up, and there is no polarity problem. It also seems to be perfectly happy without any obvious dc bias, so why fight fortune?

The vertical antenna shown mounted on the rear of the unit is OK for short hauls, but there is nothing that can take the place of a good skyhook as high up as reason will allow.

There are many similar units that have fallen into disuse as the times change, just waiting to be rescued and put to good use. Try it — you'll like it. ■

Ham Help

I would appreciate your technical help on an antenna problem. Because I live in an apartment, I decided to go with a mobile antenna and operate from my car. I bought a Hustler mobile antenna and a 40 meter resonator. Much to my surprise, it worked quite well. Later, of course, I wanted to at least listen to the radio inside my apartment. I bought an extra mobile mount and assembled the antenna, adding a single wire to the mount — the length of the car. The reception was still very good. Now the problem. I tuned up the transceiver (a Kenwood TS-520) and found a 1 to 1.3 swr. Can I go ahead and transmit and not cause harm to my transceiver? I would rather not go to the expense of a transmatch unless really necessary. If this antenna system will work, where did I go right?

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I am interested in a simple tube converter circuit to observe received signals on my general purpose scope, which has a horizontal sweep range of 250 kHz and a transceiver i-f of 3180 kHz. Transceiver is a Yaesu 101-B. General purpose scope is Dumont type 304-AR.

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I have been trying to locate a source that has Gunn diodes for the 10 GHz range to use in an oscillator for microwave bench experiments, as in *73*, March, 1974, page 33. I have an oscillator cavity, once part of an intruder alarm, but the Gunn diode is gone. It seems similar to what Microwave Associates calls style 30 case. I have had no luck calling companies for a possible replacement. Might any of your readers be able to supply an exotic device such as this at a reasonable price for 1-2 units? Thank you.

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111 Hendrickson Ave.
N. Merrick NY 11566

Having recently upgraded my license, I have begun thinking about other forms of ham radio. I would like to put a 2 meter antenna on my Cessna Skyhawk, but so far I have not been able to find one which will pass FAA requirements and not cost several hundred dollars. Any help in solving this problem would be appreciated.

Richard H. Seslar WD8BTW
173 Fairview Drive
Marysville OH 43040

W.A.S. -- Easily!

-- catching the last few

Dave Waterman W7FGD
1810 E. Terrace Way
Kelso WA 98626

Regardless of whether you have had your ticket for quite a while now or you are just getting on the air for the first time, I would like to present you with a challenge. The purpose of this article is to give you some hints and techniques to enable you to work a ham in every state of the United States and to get a QSL card back from him.

The ARRL has awarded over 25,000 Worked All States certificates to hams all over the world, and you can get one, too! It requires a little patience, a lot of listening on the bands, and a bit of work. Oh, come on now! You're not afraid of a little work!

A WAS award is a lovely certificate to frame and hang on the wall of your shack, a fine conversation piece to show friends and family, and working for it will sharpen your operating skills. The ARRL offers one as do several other organizations and magazines.

But how do I work all 50 states? How can it possibly be done on the crowded Novice bands? How do I get that elusive Delaware contact? Or Wyoming? Or South Dakota?

Hopefully, we will answer these questions for you and get you started down the road to a WAS award.

Starting Off

First you must get yourself organized for the task. Take a sheet of lined paper and list all 50 of the states on it in two vertical columns, one down the left margin, and one down the center. Most lined paper has 25 lines on it, so you can get half the states in each column. This is to be a check-off sheet for you to mark your progress. Each time you get a QSL from a new state, put a check beside that state on your list. As time goes by, this list may become dog-eared, so I would suggest a clear plastic cover for it to protect it. Keep this list at your operating desk where it can be seen at a glance. This list serves several purposes. It not only shows the states you've worked, but shows you the states you still need. If you hear a station give his QTH, a quick look at the list will tell you if you need him. Don't rely on your memory – use the list. Another thing this list does is help keep you on your toes and very aware of the states that you need.

Antennas

OK! You've got your check-off list prepared. Now what? In your studies to get an amateur license and in almost all literature that you've come across concerning operating, you've been told time and time again that your antenna is the most important part of your station. I'm sorry to do this to you, but we're going to talk about this subject again for the million and first time, because it is so very, very important. You absolutely *must* get the best antenna you can for the bands which you choose to operate. If you have an oversized lot, lots of trees for wire arrays, neighbors who will let a few wires spill over onto their property, pat yourself on the back and light up a cigar; you're a lucky fellow. (I fall into this select category and realize how very fortunate I am.) Most hams are not so fortunate, and we're going to assume that you're one of them.

For the purpose of this article, we will assume that you run 100 Watts and use a dipole or an inverted vee antenna, which is capable of operation on 80, 40, and 15 meters. Ten meters is so sporadic these days we will disregard it. I may be doing a disservice to this band, but you can't rely on it right now.

Now our next step is to trot outside and take a close look at that antenna of yours. Is there any possible way to put up a full wave loop or Delta loop for 40 or 80? If so, do so! If not, can you raise that dipole any higher? How about adding a sloping dipole off one or both ends of its supports? Slopers are very effective antennas, and also hear very well. Info on these antennas can be found in the many antenna books available either by mail or from your local ham store. (You do have a local ham store?)

You say you can't do a thing different, huh! OK, make sure your antenna is radiating in the direction of a maximum number of states.

A north-south radiating antenna in Southern California isn't going to do too well in the Eastern seaboard. Of course, power lines and TV antennas slue radiation some, but check to see which way your signal is going. If you have any questions about this, refer to the antenna books. What you want is as low an angle of radiation as you can get, in the desired direction.

Now, how about the coax (or whatever feedline)? Check your connection to the antenna. Is it corroded? Just one hard rain can seriously lower signal levels if you haven't weatherproofed your feedline connection to your antenna. A W2AU balun*, or one similar, is ideal for this weatherproofing and eliminating feedline radiation with coax. Assuming your antenna is satisfactory, now look at your ground system. Ground system, not a ground wire! You need a ground wire going out of your shack to a buried cold water pipe (if at all possible). In *addition* to this, you need a separate counterpoise for each band you operate on. Check the antenna books again for info on these. They're simply lengths of wire cut to various lengths for each band — simple to install and effective in boosting your transmitted signal.

Having maximized antenna and ground systems, we now turn to take a look at your shack. Do you use an antenna tuner and swr meter in your feedline? You say you don't! Oh, come on, I'm trying to help you, not start a fight, but really now!

An antenna tuner and swr meter are essential for minimizing losses, especially if you're trying to utilize that dipole of yours on 15 meters. There are many plans for building tuners in past ham magazines (*73* has had several). You can build one for next to nothing, with a large coil and a wide spaced tuning capacitor from an old AM radio. Please get a tuner if you don't have one already. Some day you'll thank me.

If you operate a transceiver with VOX, you need not worry about a transmit-receive switch. If you run separate receiver and transmitter, you will. (Don't try and hide that knife switch you use. I can see the guilty look on your face.) If you have been using a separate switch to go from transmit to receive, carefully disconnect it, hold it firmly in your right hand, and throw it as far as you can. Now build, buy, beg, trade, or steal some sort of a T-R switch to use. It's hard enough to get that elusive Rhode Island contact when his signal is 339, the QRM is 599, and the QRN is 40 over. You don't need to be flipping switches while that is going on. It will be plenty hard enough as it is. This is the electronic age and you're a member of the brotherhood of ham radio operators. Use your electrical knowledge and get rid of that old knife switch.

As for the swr meter, they're available at every CB store, ham emporium, and from every gypsy on the street in every city of the US (and by mail order).

We have upgraded all the hardware now, except for one item. There is still one link in your communications system we need to look at. That's you!

As long as there are different people in the world, there are going to be different operating techniques. What this is really boiling down to is the psychology of what makes you — you. But before we get into this very deeply, let's look at the different ways there are to work all states. You mean there's more than one? Yes! Actually there are three ways, all separate and distinct, in which a ham can achieve WAS. The first is to be a contestor. That is, operate in the large number of contests that occur each year. Successful contestors usually have years of experience and large numbers of them work all states every contest they enter. They have a high degree of competitiveness and a great pride in their gear, antennas, and especially their skill. They are after contacts and multipliers; they want all the stations they can work, the more, the better. They seldom rag chew. They are above our level of operation and they're not reading this article anyway, so we'll forget them.

The second way to work all states is to get on the air for an hour a night, every now and then, and possibly two or three on the weekends. Chat for hours at a time, long and lengthy, about the height of the tides and the phase of the moon with every station that answers your CQ. Sooner or later, this operator will obtain a WAS certificate by chance. It is entirely possible, however, that the Sphinx will have turned to dust, the Rockies will be a desert, and everyone will have moved to Andromeda by then.

The third way, and the one that you need to take, is to sit down with some sort of an organized plan, listen to the stations that are on the air, find the ones you need, and slowly check off the blank spaces on your check-off list as you move closer and closer to your goal. Here is where the psychology angle comes in. You need to ask yourself, what kind of person am I? Do I like to talk? Do I talk, maybe too much? If so, it could be that while you're chatting away for 45 minutes to Ralph in the next county, that Maine station 3 kHz down from you that you didn't even know was on the band, has worked twenty stations and went QRT for the night. Now please don't get me wrong. I'm not against rag chewing. As a matter of fact, I'm very much for it. I

W7FGD

1810 E. TERRACE WAY
KELSO, WASHINGTON
98626 - U.S.A.
COWLITZ COUNTY

THIS CERTIFIES THAT ______________________ IS AN OPERATOR OF UNPARALLELED SKILL AND PATIENCE. IN SPITE OF THE QRM AND QRN, HERE AT THIS STATION FROM FOUR LITTLE GIRLS, ONE WIFE, AND AN INCESSANTLY RINGING LANDLINE, HE HAS MIRACULOUSLY BEEN ABLE TO CONTACT AND MAINTAIN A ________ QSO OF ________ 19___ AT________. FREQ________. RST________. RIG________. ANT_________. THIS STELLAR ACCOMPLISHMENT CAN ONLY BE LAUDED WITH THE HIGHEST OF PRAISE, THE BEST OF 73'S AND A FOND WISH FOR GREAT DX.

MARAC - R653
ISSB - 9393

David Waterman

*Brand name.

dislike formalized QSOs and have made many, many great QSOs with interesting people. But a serious fisherman, when he goes fishing, is after fish. If the fish aren't biting and are not to be found, then they sit back and watch the sun set. You can very easily spend far too much time in a QSO during prime band hours if you like to chat. You need to look at yourself and the way you operate and ask yourself what you get out of ham radio. Are you operating correctly? Are you achieving what you want? If you love to chat and enjoy people, that's great. If you find it hard to open up to strangers, shorter QSOs will be your norm and you will log more stations in a given time than one who is more long-winded. Maybe you're not going after stations with enough aggression. If you're really serious about this WAS award, go after it with gusto. Keep your QSOs short and be alert for the next fellow down the line, at least during prime band hours.

Enough Talk – Let's Get At It

OK, we're starting off. Let's quickly look at our bands. 15 meters is usually a daytime band, with some seasonal variations to different parts of the country. Check it out. It can be your most valuable band when it's open. Your dipole and 100 Watts won't make you a powerhouse, but many stations that you work will be using beams and that will help. 15 meters is a fun band and you have a little elbow room to move in. Favor it as much as possible. It can get those states on the opposite seaboard that you need. It can also get most everything in between.

40 meters begins to come in strong during late afternoon (out here in Washington, anyway!) and will drop out in middle evening. 40 also has seasonal variations. Winter is best. Summer brings static, but hang in there if you can. There is still a lot of action if your eardrums can take it. 40 will get you the midwest and the south easily.

80 meters is best in early to late evening. Summer brings much static, too. Keep in mind that we are being very general about all this and that sunspots and cold fronts and other factors can change things greatly. 80 will get you the adjacent states and midwest and south, too.

In your early quest for WAS, a lot of CQing can be beneficial. You need to work most every state. The states will come quickly and it will be great fun to watch the cards come in and check off the states on your list. But, as time goes by, and your check-off sheet gains marks, new states will get harder and harder to come by. Here is where the real work will begin. (Remember, I never said it would be easy!)

Now you're going to have to change your operating habits a bit. You're going to have to listen more and be more selective in the stations you work. After your twenty-fifth 6-land QSL, you really won't have to work very many more for a while now, will you? In this respect, the guys in California have it rough, but there's nothing to be done about it. Just grit your teeth, California, and carry on.

Call areas will begin to slowly fill in. When you work all the zero-land states, forget them and move on to the others.

In order to get those remaining states, you're going to have to *listen*. Also, I would recommend a couple of techniques that have helped me. Buy a brand new *Callbook*. (Gulp – I know what they cost, but you're going to need it.) Practice using that book on calls that you hear on the air. Practice to the point that you can find a given call in about ten seconds. (Easy, huh? Just try it!) Now you have a valuable tool. In your tuning across the band, any station that you think you may need can be quickly looked up to find where he is, and not only him, but the guy he's talking to. I can hear you complaining about this from here. But look, you have doubled your chances to find those missing states you need. You need not now wait for him to give his QTH – look him up quickly. As you progress toward your goal, you will come to appreciate this technique.

Moving Right Along

OK. We have progressed along. You're spending more and more time now listening to the bands. You're learning how to fight the QRM and pick out the weak signals. You are looking for weak signals, aren't you? You don't expect that KH6 to come in 599 in New York, do you? He's probably going to be a 339, if that. You're going to have to listen for the weak ones and be very alert. Here you're going to suffer from the QRM problems on the Novice bands. There's a lot of you guys out there and you're all trying to work each other. It's only natural that the first time you hear that KL7 you need so badly, half the world is going to want him, too.

Audio filters, crystal filters, or just anything that will increase your selectivity is going to be a real asset to you.

If you find that the station you need is being called by a zillion other guys, there are two things you can do (three, if you consider quitting, but I'm assuming you've got gusto!). The first is to join the pack and have at him. For this you will need patience and perseverance. Be of stout heart and don't give up if you need him, even after the tenth time you called him and he went back to someone else. Or the twentieth. If he just won't come back to you, try tuning off his frequency just a little. Maybe there are so many people calling him that he can't make your signal out. Timing is important here. You'll just have to face a few of these and you'll learn fast. But there is another course of action left to you in a pileup. Be cagey! If the band is open to KL7-land and everyone is after one guy, maybe there's another KL7 down band a ways. Or maybe something just as juicy. If you hear a big pileup, check down band. When all the cats are out chasing a rat, the mice are left to play.

With everyone else after the same station, QRM drops down band and weak signals come through. In actual practice, on our crowded Novice bands, this situation would probably never happen. I can't really imagine every station in the band all on one frequency after one station. On twenty meters, yes, that happens; on the Novice bands, probably not. But I wanted to get the point across to you. You're going to have to be alert and think.

Now, let's say we've progressed further. Time has gone by and by spending more and more time on the air, and patiently listening, looking up calls in your book, and working the ones that you needed, you've got down to the point where you need just a handful. Let's say you need six more. You've spent weeks and weeks, now turning into months and months, and you haven't heard any station in those states. You spend your evenings on 40 and 80. Your Saturdays and Sundays are spent on 15. You spend so much time on your radio that the forest service is proclaiming your lawn a national park. Your dog bites you when you come home from work. Your two year old daughter cries when she looks at you out of fear of a stranger. All this and still nothing. OK, here are some things you can do.

First, watch for the state QSO parties in the states that you need. Most states have QSO parties once a year.

Some combine several states into one party, but it's all the same thing. At these times, operators in these states are more active than usual and are looking for contacts. Another thing you can do is spread the word to your friends that you are desperate for these states and if they hear them on the air to give you a call. Four, six, or eight sets of ears are better than one. Here's another idea — get copies of *QST* and look up the listings each state SCM sends in each month. Find out what's going on in those states you need. Sometimes you can get a valuable clue as to when and where a club or special events station will be on the air. Also try your hand in operating in a contest. The best one for you is the Novice Roundup. Your chances of having an operator on in a needed state are improved. However, the increased QRM caused by the contest makes it harder to get through. Still, it's something to try.

Suppose none of this works. You're going around muttering. "What the hell's happened to Delaware anyway. Why don't they send a DXpedition there?" Your job is suffering. Your wife is threatening divorce. And still nothing.

Get on your ham friends again. Keep on them. Check with any DXers in the area, any you might faintly know, any you may have heard of. DXers, county hunters, and regional net men have friends all over the country. Maybe one of them can fix up a schedule and give you a hand with the contact.

If all is for nought, and you still need some states, here's what you do. First put an ad in the ham magazines requesting a sked with the states you need. If that's fruitless, as a last resort, look up in the ham magazines, contest winners in the states you need. If a man is a contest winner, he probably has a better than average rig and antenna setup, and probably is more skilled than most. Sit down and write him a letter explaining your plight and beg him for a schedule at his convenience. That should work if nothing else will. I would do it for you, and I think most other hams would also. This should be considered as a last, last, last resort only. It is an imposition on people's time and themselves, and should not be requested lightly.

With the techniques I've outlined, plus a lot of time on the air, you should be able to contact a ham in all 50 states. But we're not done yet. Contacting them and getting a QSL are two different matters.

A QSL card should be a representation of yourself. It's all the other guy will have to remember you by. It should be different from the run-of-the-mill cards, and, if at all possible, unique. I would recommend to you that you have some special cards printed up. I have included one of my own cards to show you what I mean. It's not that my card is so great, but it is different, and reflects my own personality. I am constantly getting comments about it — just get something different that reflects you. Don't you dare copy mine; just get something out of the ordinary that people will remember, a photo card if you want.

Now, when you have that special card of yours, you're going to have to do one more thing. Do you know what an SASE is? It stands for self-addressed stamped envelope. Use them. At today's postage prices, please don't expect someone in a far-off state to spend his own money to send you one of his cards. Many will, but many won't also.

If you use a distinctive QSL card, filled out properly, with a polite thank you and a line or two about yourself on the back, together with an SASE, I'll guarantee you a 95% return rate (excluding calamities at the Post Office).

Have I made it sound easy? Well, it's not! It's hard work and at times very frustrating. QRM will be your biggest problem. Remember, all you have to get is the RST reports both ways to have a valid QSO.

Summary

Let's summarize what we've covered:

1. To earn your WAS, you're going to have to make it your goal. That means work for it.
2. Make your check-off list.
3. Maximize your antenna and ground systems.
4. Use an antenna tuner and swr meter.
5. Get a T-R switch if you don't have one already.
6. Spend time on the air and listen for the states you need.
7. Get a *Callbook* and be able to use it quickly.
8. Plan your operating time to take greatest advantage of open bands (prime time).
9. Take advantage of special operating events or state QSO parties.
10. Be alert and keep thinking.
11. Listen for the weak ones.

Lastly, you're going to have to look at yourself and evaluate yourself a little. If you're having trouble getting those states, maybe it's something you're doing wrong. Change your operating habits. Get on the air at different times than you did before. Listen longer. Listen harder.

Well, I've done all I can do. Those 50 states are out there waiting for you. It's a great challenge and a fine reward to work all states. Good luck to you. ■

Tracking the Hamburglar

RIPPED OFF: Hallicrafters FPM300 MKII, s/n K530010, taken during break-in at home weekend of July 22, 1977. Bronx 52nd Police Precinct complaint no. 4565. Marty Greenbaum K2HTO, 3070 Hull Avenue, Bronx NY. Tel. (212) 231-3635.

SHANGHAIED: Heath Model 2021 handie-talkie with Model 201 touchtone pad built-in. Channel switch wired wrong in that channels 3, 4, and 5 go to crystal sockets 3, 2, and 1. Crystalled for 146.52 (ch. 3), 146.655 (ch. 4), and 146.94 (ch. 5). Stolen July 23, 1977 in Westport, Connecticut. S. W. Daskam K1POK, 38 Settlers Trail, Stamford CT 06903, (203) 329-0187.

LOOTED: Clegg FM27B, s/n 4647 was taken from my truck on August 11, 1977. Contact: K1ZUW, PO Box 102, Hudson NH 03051.

STOLEN: Clegg Mark III, 2 meter transceiver, serial 750,187 with .52-.52 from Dick Haskin W6KEC, 149 Mauna Loa Dr., Monrovia CA 91016.

STOLEN: Drake TR-4 SSB transceiver #16491, AC-3 power supply #18572, L-4B linear amplifier #1102, L-4PS power supply #1124, Hallicrafters SX-100 receiver #151257. These items were stolen in a break-in on April 27, 1977, at a local radio store in Louisville KY, where they were held on consignment for Ev Ballard WA4ACJ. Any information would be appreciated. Contact him collect at 502-451-8923 or 812-294-4819, or write 2438 Longest Ave., Louisville KY. (Also: Jefferson County Police Department, 502-588-2111.)

PURLOINED: Standard SRC 826M 2 meter FM transceiver, SN: 104207. Stolen on June 27, 1977 from Bill Myers WBØMCS, 942 E. Mississippi, Denver CO 80210, 303-777-3353. Has the following frequencies installed: 146.94-94, 52-52, 16-76, 34-94, 28-88, 88-88, 31-91, 148.01-01, 37-97, 19-79, 25-85, and 91-31. Has KØKGA scribed on receiver board. Receiver crystal board has been rebuilt. Channel 12 — 91-31 transmit is 450 cps. high in frequency; transmit trimmer for this channel is different from others.

RIPPED OFF: Icom IC-22A, s/n 9900 with 12 sets of crystals. Call and SS no. etched on back. Pete Jordan WA1AXK, 832 Temple Street, Whitman MA 02382.

Webb Simmons
1559 Alcala Place
San Diego CA 92111

Fool the Wire Wizard

-- a computer would have helped

Once upon a time, far, far away, there lived a wire wizard. The time was during World War II, and the place was on a US Navy warship. The wizard was an old Navy warrant officer with a nimble brain that was like a bear trap for facts of every description. One of his many skills was the ability to quickly give almost any information about soft drawn copper wire. For example: What is the resistance of 533 yards of 13 gauge wire? What is the cross section area of 33 gauge wire?

Mr. Steele, for that was his name, had a habit that just about drove me to distraction. He liked to bet on various matters. He always bet exactly $5.00, and he *never* lost a bet. When I would bet with him, he would tell me I was foolish because I knew he never lost. But, what the hell, I knew I was right *this* time (the *this* was for *every* time). But I wasn't, and he won again. One time he asked me who invented the audio amplifier. I replied, "Dr. Lee De Forest, who invented the audion (triode vacuum tube)."

"Nope," he said, "someone invented an audio amplifier before him."

"Who?" said I.

"Thomas Edison, that's who."

Aha! I had him. Old Tommy invented a passel of things, but not an audio amplifier. But I lost again because Edison invented a carbon microphone, and this was easily shown to be an audio amplifier. When the earpiece was placed over the mouthpiece of an old-fashioned country telephone, the thing would whistle on its own.

All of us pestered Mr. Steele to tell us how he could produce wire table facts so quickly, but he would never say. One day I asked him if he always bet when he knew he would win. "Absolutely," was his reply, "that is a cardinal principle with me." I then bet him $5.00 he could not teach me his wire table methods. Now he was boxed in. He thought about it a little, and then he told me he wouldn't bet because I might be too stupid to understand even though the method was simple. However, he offered to teach me on the sole condition that I would never tell it to anyone else on the ship. That particular ship has rusted on the bottom of the Pacific Ocean for more than 30 years now, so it seems fairly safe that I can now speak freely on the matter.

He told me to take a lined tablet and, on one of the lines about a third of the way down the page, to write the numbers 1, 10, 100, 1000, and 10000. He said that among these numbers was a fairly typical wire gauge which I was to select. It could only be ten gauge. One gauge is possible, but not common, while the other numbers are ridiculous as a wire size.

Mr. Steele then asked how the resistance of copper wire is given. The answer to this is in Ohms per 1000 feet, which takes care of the 1000 on the line of numbers. One can compute the cross section of a wire in circular mils by squaring the diameter in mils (a mil is 1/1000 of an inch). 1·1 = 1 is no help because it uses one value for two different data. We can't use 10·10 = 100 because 10 is already spoken for as the gauge number. The only other possibility is 100·100 = 10000 to give us a diameter of 100 mils and a cross section of 10000 circular mils. The 1 that remains is the resistance of one Ohm per 1000 feet.

There you have it for 10 gauge, soft drawn copper wire. One Ohm per 1000 feet, 100 mils diameter and 10000 circular mils cross section.

"Now," he said, "number

Resistance (Ohms)	Gauge	Diameter (mils)		Cross Section Area (C.M.)
.125	1	283		80000
.156	2	253		64000
.185	3	226		51200
.25	4	200		40000
.313	5	179		32000
.39	6	160		25600
.5	7	141		20000
.625	8	126		16000
.781	9	113		12800
1	10	100	1000	10000
1.25	11	89.4		8000
1.56	12	80		6400
2	13	70.7		5000
2.5	14	63.2		44000
3.13	15	56.6		3200
4	16	50		2500
5	17	44.7		2000
6.25	18	40		1600
8	19	35.4		1250
10	20	31.6		1000
12.5	21	28.3		800
16	22	25		625
20	23	22.4		500
25	24	20		400

Table 1. The characteristics of soft drawn copper wire as developed by the wire wizard.

upward and downward from the 10 for the wire size." So above the 10 in a column I placed 1 through 9, and below the 10 I wrote 11, 12, etc., until I got to the bottom of the page. In the resistance column, he told me to skip two lines and double, skip two more and double again, etc., to give 2 Ohms for 13 gauge, 4 Ohms for 16 gauge, 8 Ohms for 19 gauge, etc. As the resistance goes up, the cross section goes down in the same proportion; thus the cross section for 13 gauge wire is 5000 circular mils, 16 gauge is 2500, and so forth.

After doing all of these and taking square roots of the area to get the diameters, I still had many gaps in the table. The next step was to go ten places on the size and increase the resistance by ten times to give us 10 Ohms per 1000 feet for 20 gauge wire. Now we can go up from 20 gauge to fill in for gauges 17, 14, 11, 8, etc. From 11 gauge we can go down 10 for 21 gauge, and so forth. In a very short time we get the complete table as shown in Table 1.

It is a pity this table is not quite exact, but it is close enough for any practical purpose. Mr. Steele also showed me how all of these numbers can be read from an ordinary slide rule. I will not go into this because slide rules are now ancient history.

Now I can't rightly say how this discussion of soft drawn copper wire will improve your life unless you join up with a few nuts like we were with entirely too much free time on our hands during the big blowout. An interesting coincidence to me is the fact that a wire three gauge numbers smaller than another can handle only half the power (it is half the size), and cutting the power in half is a change of 3 dB (decibels). In like manner, a change of six gauge numbers changes the power capacity by 6 dB, and so forth. ■

De WA3ETD

John Molnar WA3ETD
Executive Editor

WIN MONEY!

A new contest is starting in *73* this month that should interest authors and readers alike. Get ready for this one!

The author of the best article published each month will receive a check for $100 – in addition to our regular payment for the article. I can hear the questions now! How will the winning author be selected? Not by the staff, that's for sure . . . otherwise I would insure that my editorial would win each month!

The readership of *73* will select the winning article each month by voting on the reader service card in the back of the magazine. It's simple to cast your vote. On the bottom of the reader service card there will be a small box with the word "Winner" close by. Place the *page number* of the article's title page in the box. This eliminates all possibility of confusion, as some issues contain multiple articles by the same author. After voting, make sure to fill in the rest of the reader service card – advertisers appreciate the attention, and hopefully will continue to manufacture ham gear! Each month Dynamic Doreen (5'7", blond, blue eyes) will present me with the totals indicating the winner. In order to avoid confusion and late votes, each month's ballots will be accepted until the next issue of *73* is mailed. Start writing, authors! An extra C-note *will go* a long way toward a major piece of new gear.

An additional Christmas present will be presented to the best article of the year, voted upon in the December issue. The yearly top prize is a check for $500! Dream about that for awhile!

We have not forgotten those readers who vote each month. A periodic drawing will be held from all reader service cards containing a vote. If you need a nice piece of new gear for your shack, this might be the way to get it. Drawing dates will be announced well in advance.

10 GHz

Well, as promised, I finally completed an article on the Gunnplexer transceiver. If you have been following this column, you know that the Gunnplexer is a microwave front end that can be used in communications systems and Doppler radar devices. Working with microwaves is fun, and I think you will enjoy experimenting with Gunnplexers if you are into UHF tinkering. My article concerning the transceiver is in this issue, and it can be built for under $200 – depending on the state of your junk box. Cost is much lower if you use a broadcast FM radio as an i-f receiver.

Microwave Associates, the outfit that makes the Gunnplexer, has an interesting information package concerning experiments with amateur microwave equipment. Most of the serious experiments have taken place in Europe and England. Hopefully it won't be long before American hams get going on 10 GHz.

Don't fail to keep me posted of your experiments with the Gunnplexers. I will respond to any and all related correspondence. I'll see if I can talk Wayne into a prize for the best microwave article of the year – check here next month.

COMING EVENTS

Our OSCAR special issue is next month (November issue). You won't want to miss this one, as it is full of info about the new satellite. There are also plenty of new antenna projects – especially related to portable operation. I just built a 432 MHz circular polarized groundplane from one of the articles, and it works great. Details about the new Russian satellites will also be provided. Make sure your subscription is up to date!

Oscar Orbits

Oscar 6 Orbital Information				Oscar 7 Orbital Information			
Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W
N 22682	1	0014:57	67.3	13159 B	1	0141:56	80.0
NA 22695 BTN	2	0109:52	81.1	13171 A	2	0041:16	64.9
N 22707	3	0009:48	66.1	13184 BQ	3	0135:33	78.4
NA 22720 BTN	4	0104:44	79.8	13196 A	4	0034:54	63.3
NA 22732 BTN	5	0004:40	64.9	13209 BX	5	0129:11	76.9
N 22745	6	0059:36	78.6	13221 A	6	0028:32	61.7
NA 22758 BTN	7	0154:31	92.4	13234 B	7	0122:49	75.3
N 22770	8	0054:27	77.4	13246 A	8	0022:09	60.1
NA 22783 BTN	9	0149:23	91.1	13259 B	9	0116:27	78.7
N 22795	10	0049:19	76.1	13271 A	10	0015:47	58.6
NA 22808 BTN	11	0144:14	89.9	13284 B	11	0110:04	72.2
NA 22820 BTN	12	0044:10	74.9	13296 AX	12	0009:25	57.0
N 22833	13	0139:06	88.6	13309 B	13	0103:42	70.6
NA 22845 BTN	14	0039:02	73.6	13321 A	14	0003:03	55.4
N 22858	15	0133:58	87.4	13334 B	15	0057:20	69.0
NA 22870 BTN	16	0033:54	72.4	13347 A	16	0151:37	82.6
N 22883	17	0128:49	86.1	13359 BQ	17	0050:58	67.5
NA 22895 BTN	18	0028:45	71.1	13372 A	18	0145:15	81.0
NA 22908 BTN	19	0123:41	84.9	13384 BX	19	0044:35	65.9
N 22920	20	0023:37	69.9	13397 A	20	0138:53	79.5
NA 22933 BTN	21	0118:32	83.6	13409 B	21	0038:13	64.3
N 22945	22	0018:28	68.7	13422 A	22	0132:30	77.9
NA 22958 BTN	23	0113:24	82.4	13434 B	23	0031:51	62.7
N 22970	24	0013:20	67.4	13447 A	24	0126:08	76.3
NA 22983 BTN	25	0108:16	81.2	13459 B	25	0025:29	61.2
NA 22995 BTN	26	0008:12	66.2	13472 AX	26	0119:46	74.8
N 23008	27	0103:07	79.9	13484 B	27	0019:06	59.6
NA 23020 BTN	28	0003:03	64.9	13497 A	28	0113:24	73.2
N 23033	29	0057:59	78.7	13509 B	29	0012:44	58.0
NA 23046 BTN	30	0152:54	92.4	13522 A	30	0107:01	71.6
N 23058	31	0052:50	77.4	13534 BQ	31	0006:22	56.5

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.
OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.
Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

Ultra Simple Diode Checker

-- for grab bag specials

Marion D. Kitchens K4GOK
7100 Mercury Ave.
Haymarket VA 22069

This simple diode checker is an up-to-date version of an idea that has been around for a number of years. It can be built in one or two evenings from the parts in most experimenters' junk boxes. The parts required are one resistor, two LEDs, and any 117 V ac transformer that will provide from 3 to 25 V ac. Discarded audio interstage transformers from old tube-type radios and TVs can be used. If all new parts are bought, the cost will be about $5.00, including the small aluminum box. The small cost can be recovered many times over by buying unmarked, untested, manufacturers' closeouts, diodes by the pound, etc., available from most discount mail-order houses (like Poly Paks). Bad diodes can cause disastrous results in some circuits and can be difficult to detect and locate in other circuits. It is a wise precaution to check them all before installation. This simple diode checker was conceived and built for just such purposes.

The Circuit

The simple schematic is shown in Fig. 1. The transformer provides a low ac voltage, through the current limiting resistor, to two LEDs connected back-to-back. The diode to be tested is connected in series with this combination and the return side of the transformer. The LEDs will respond to the four possible conditions of the diode under test. If the diode is open, no current flows and neither LED will light. If the diode is shorted, one half cycle of the ac voltage will light LED1 and the other half cycle will light LED2. Since each LED is lit 60 times per second, a shorted diode will cause both LEDs to appear lit continuously. If the diode is good, LED1 will light when the diode's anode is toward the return side of the transformer and LED2 will light when the diode's cathode is toward the transformer return side. By proper physical arrangement of the LEDs and diode, the LED near the diode's cathode will always light.

The resistor should be sized to limit the current through the LEDs to about 10 mA. Most LEDs will have a voltage drop of about 1.5 volts across them, and most signal-type diodes will have from 0.1 (germanium) to 0.5 (silicon) volts drop across them. The resistor value can then be found by subtracting

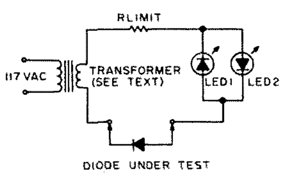


Fig. 1. Schematic.

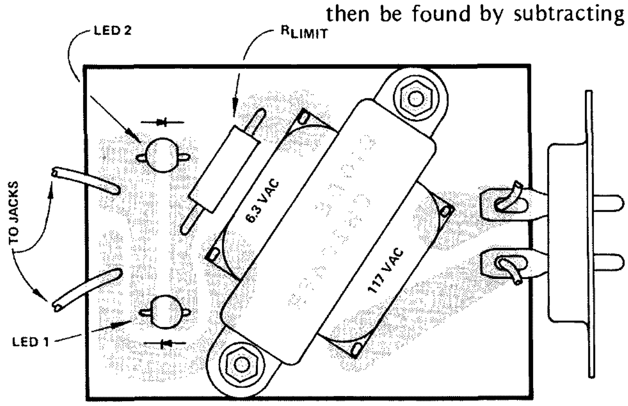


Fig. 2. Parts placement drawing.

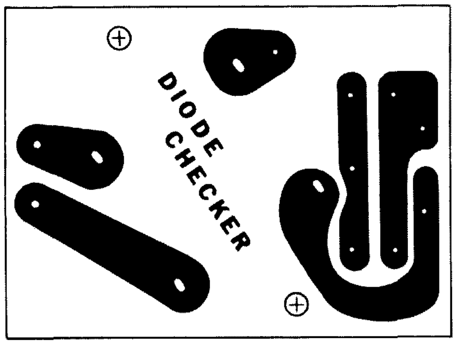
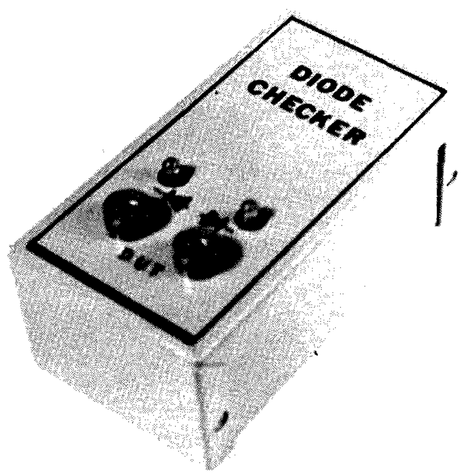
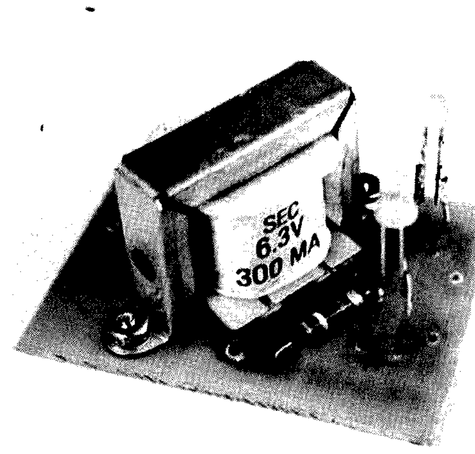


Fig. 3. PC board layout.



Finished, labeled checker.



Assembled circuit board.

these two voltages (say 1.5 and 0.5) from the transformer voltage and dividing by 10 mA:

$$R = \frac{V_{XFMR} - 1.5 - 0.5}{.010}$$

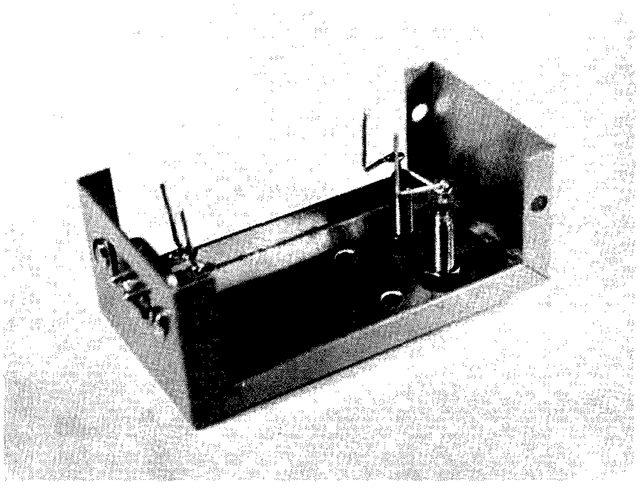
For a 6.3 V ac transformer, the resistor value is 430 Ohms. A 330 or 470 Ohm resistor will do. Its value is not critical.

Construction

The simple circuit lends itself well to point-to-point wiring, which is probably the quickest way to build the checker. If the builder prefers a neater appearance, the printed circuit board layout shown in Fig. 3 can be used. It is easy to duplicate with an etch-resist pen, or, if a professional look is desired, by photographic means. Fig. 2 shows the parts placement for the circuit board, and Fig. 4 shows the matching hole locations for mounting it in a 4 x 2-1/8 x 1-5/8 box. A Radio Shack 6.3 volt transformer, stock number 273-1384, was used for the circuit board layout and hole patterns. No on/off switch is used; the unit is simply plugged in for use. A TV cheater cord plug and socket are used so that the diode checker is easy to store without dangling ac cords everywhere.

Pin jacks, banana jacks, or five-way binding posts can be used for connecting to the diode to be tested. The binding posts allow for a variety of connections to diodes that cannot be brought directly to the checker. Adapters with a V-notch are used so that loose diodes can easily be dropped into place for testing. Fig. 5 shows two easy methods of making such adapters.

The holes should be cut in the box, and it should be painted and labeled to suit the builder's taste. The photographs show how I did it. The current limiting resistor and transformer should be mounted to the circuit board next. The ac plug and pin or banana jacks should then be mounted in the box, with short lengths of wire soldered to them as shown in the photographs. Next, insert the LEDs and bend their leads so that they will not fall



Box with jacks and ac plug ready for circuit board installation.

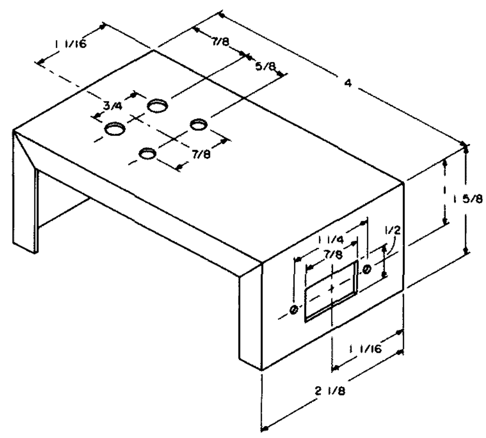


Fig. 4. Hole pattern for a 4 x 2-1/8 x 1-5/8 inch box. Cut holes to fit parts on hand. Holes are centered on centerline of box.

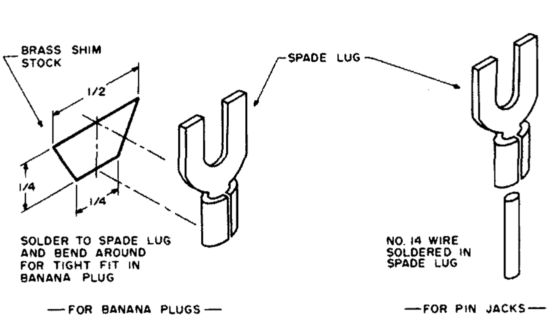
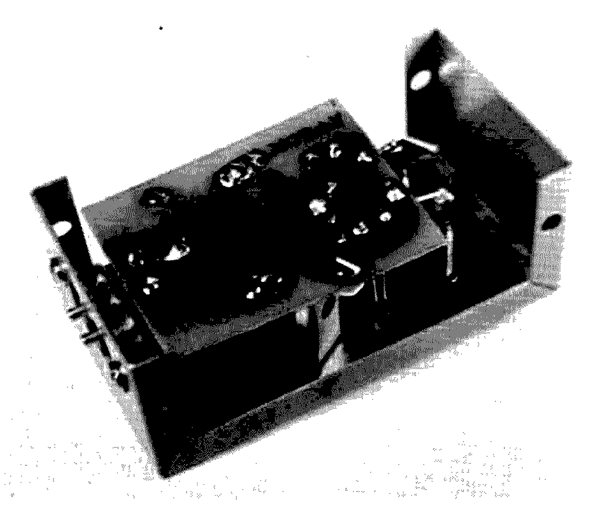
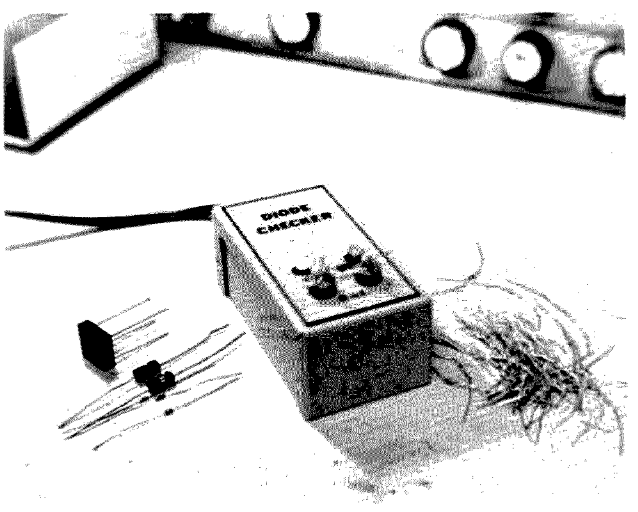


Fig. 5. Adapters.



Box with PC board installed.



Finished diode checker in use.

out. Do not solder them yet. The LED leads must be long enough for the LEDs to protrude through the box, so the builder may have to add short lengths of wire. Now feed the four wires from the ac plug and the jacks through the proper holes in the circuit board, check for proper fit and clearance, and solder the four wires. Position the LEDs and solder them to the circuit board. Put insulation on the inside of the box bottom to prevent any possibility of shorts to the circuit board. Don't forget that it has 117 V ac on it! Make adapters to fit your jacks and you are ready to check out the unit.

Test the checker by applying power to the 117 V ac plug. Neither LED should light. Now put a short circuit across the jack terminals and both LEDs should light. A diode that is known to be good should now be connected across the jack terminals. The LED closest to the diode's cathode should light. Try it both ways to make sure the LEDs are oriented properly.

After building and using this simple diode checker, the owner will find a desire to also know if the diode under test is silicon or germanium. Since a germanium diode will develop about 0.1 volts across itself and a silicon diode about 0.5 volts, it seems that some very simple circuit might be devised that would light an LED if the diode under test were silicon. ■

LETTERS

from page 14

same information. It was natural to turn first to OUR association which should have such information available.

To date, I have never received a reply or any assistance. Only as a last resort did I write *73 . . .* and pronto! You reacted with immediate and successful results.

Thank you again, many times.

Ervin Jackson Jr.
Charlotte NC

Now you know where to turn first, Ervin! – J.M.

CQ SIX

Just a line to let you and your readers know that 6 meter AM is alive and well in Phoenix. Despite ugly rumors and speculation, our group is growing steadily and, with summer skip, widely. We operate two nets on 50.34 MHz – the Arizona Cactus Net on Tuesday at 0200 GMT and the Phoenix VHF Net on Wednesday at 0300 GMT. We have a calling frequency of 50.34 and it is monitored from 1400 GMT to 0500 GMT. We hope that some of your readers will look for us on 6 and relive some of those good old AM days.

Before you mention TVI, I'll say that I have had and continue to have some on 15 meters and on 80 meters too. While TVI is more likely to be a problem on 6 with channel 2, the 3rd harmonic of 21 MHz is right in the middle of channel 3. These problems can and are worked out every day by hams across the country. Nothing can surpass resolve.

For the new operator, this is the only way to get your own phone rig on the air, with a minimum of time, cost, and technical ability. While SSB is the best way to go for reliable communication, it is also the costliest and the more complex. Further, it makes appliance operators out of us, taking away our inventiveness, skill, and that thirst for knowledge. Just try to build as your first rig a home brew SSB rig. Unless you're an engineer, you might just as well pack it away. Six is cheap, it's dirty, and what is more to the point, if we don't use it, we are going to lose it.

This didn't start out to be a sermon, but I've said it and I'll stick by it.

Lawrence Day WB7EAX
Phoenix AZ

BAND PLAN

"Amplitude modulation and sideband can live together on 10 meters if there is sensible band planning," said Norm Lefcourt W6IRT, chairman of the recently created Southern California 10 Meter AM/SSB Band Planning Council. Lefcourt, noting the recent proliferation of conversion plans for CB rigs to 10 meters and the various proposals for channelization of the popular HF band, said unless everybody settles on a single band plan, no one will be able to talk to anyone. "Using crystal controlled transceivers," he continued, "makes the need for a single, widely accepted band mandatory – we have to be able to work each other on common frequencies."

"Some people want frequencies above 29.0 MHz, others are advocating AM frequencies in what has been sideband territory, some want monitoring frequencies at 28.8, and others have suggested using other monitoring freuqencies 5 to 500 kHz away," he said. "It is very confusing."

Council members tentatively approved a "comprehensive band plan" for 10 meters which begins in the sideband portion and ends in that part of the band which is now used by most of the AM operators. "That's very important," said Lefcourt, "because we don't want to exclude anyone." Most commercial CB rigs which have single sideband capability are also able to transmit and receive AM phone signals.

The Council's plan places channel 1 at 28.560, 1.595 MHz above the existing channel 1 on CB radios. The ratio remains constant on each new 10 meter channel, so that channel 23 is 1.595 MHz higher than CB channel 23; new channel 40 also is 1.595 MHz higher than CB channel 40, so the conversion plan will work just as well for 40-channel rigs as it does for 23-channel sets.

"This band plan puts our new channel 4 at 28.6, a commonly used SSB monitoring frequency, and our new channel 20 will fall at 28.8 MHz, the frequency generally used as an AM monitoring channel," said Lefcourt. "Incidentally, with this band plan, channel 40 falls at 29.0 MHz."

The council voted to make public its "tentative list" of 10 meter channels and indicated that a "final recommended list" would be forthcoming after other amateurs from around the country have had a chance to com-

Continued on page 50

David E. Stanfield
3408 Catalina Drive
Atlanta GA 30341

Beat the PC Shortage

-- build (glue) your own!

Between Radio Shack, Lafayette, and Heathkit, there were 37 retail electronics stores in the area, and I couldn't get my hands on a blank PC board larger than 2 by 3 inches. As I required a board at least 6 by 8 inches, my choices in this preposterous situation weren't too attractive. I could abandon the project, wait for the local stores to restock, or try to get some by mail. None of these options appealed to me. I had already spent quite a number of hours laying out the artwork and wanted to get this project wrapped up.

As so often happens, I didn't have a blinding flash of inspiration and suddenly solve this problem. Instead, I waited until a local store finally got some in and then completed my project. But in the back of my mind, I felt a vague sense of frustration. Perhaps it was a sign of advancing paranoia, but I kept wondering when there would be another shortage.

One evening a few months later, I was half following something on television and thumbing through a copy of *The Radio Amateur's Handbook* when I spotted an item that looked interesting. In the section covering construction techniques, they suggested using epoxy to glue strips of copper to an unclad board. The idea was to glue the strips where you wanted conductors. By doing so you could get around having to etch a board.

Things clicked into place, and I immediately figured out the solution to any future shortages of circuit board. After all, if you could epoxy strips of copper to a board, it shouldn't be hard to epoxy an entire sheet of copper and make a real circuit board.

A couple of days later, I had the epoxy, some sheet copper, and a piece of phenolic perfboard. Following instructions, I cleaned the copper and phenolic board, mixed equal amounts of epoxy resin and hardener, and glued the copper to the piece of phenolic. I then placed them under a stack of books and left them overnight. Next morning I took a look at my circuit board and almost went into shock. When I gave the copper a little tug it peeled completely away from the board.

Feeling that I must have done something wrong, I tried again. First, I made sure that room temperature was in the range they recommended. Next, I used more weight to apply more pressure to the pieces while the epoxy was setting. Finally, I doubled the time for the epoxy to set from 12 to 24 hours. When that time had passed, I examined the board. As before, the copper just pulled completely away from the phenolic.

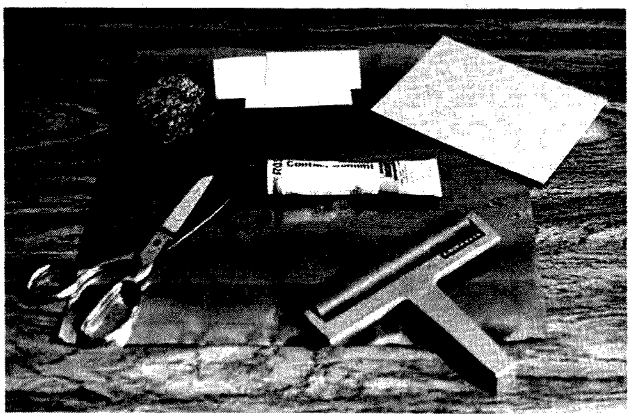


Fig. 1. Tools and materials needed are a pair of scissors, a steel wool soap pad, small pieces of cardboard cut from a filing card, contact cement, a sheet of copper and a phenolic board. The photographic roller is optional.

Fig. 2. Use the soap pad to thoroughly clean the surfaces of both the copper and the phenolic.

Fig. 3. Apply thin, even coats of contact cement to the copper and phenolic using small pieces of cardboard cut from a filing card.

I must admit that I felt foolish. Years of advertising had convinced me that one drop of epoxy will hold anything to any other thing. If there was an outside chance of some combination of materials being beyond the power of epoxy, I seemed to have found it. While many discoveries make you rich and famous, I felt that this wasn't one of them.

At this point I used a little logic and deduced that commercially prepared circuit boards don't grow out of the ground, so there had to be some glue that would work. If I tested every glue I could find, it was probable that one of them would do the job. Dim memories of the thousands of experiments Thomas Edison performed when he was searching for a filament that would work in the electric light gave me inspiration. The saga of San Juan Hill lent me courage, and my local hardware store made a fortune selling me a lot of glue.

I don't intend to bore you with the details of every experiment I tried, but let me tell you about one that almost worked. In their advertisements, they refer to it as "Amazing," "Incredible," "Stronger Than Steel," and "A Space-Age Miracle," Well, it was. And fast. If I applied a drop of it to a piece of copper about an inch square and stuck the copper to a phenolic board, within a couple of seconds it was bonded tight. And once they had bonded, there was no way short of an atomic blast to separate them.

The problem was that when I tried to spread that stuff over a piece of copper larger than one square inch, it started hardening before I could finish spreading it. Once that happened, it wouldn't stick to anything. So if you feel like making some tiny circuit boards, give it a try.

The Solution

Persistence on my part was finally rewarded. When I tried contact cement, everything worked so well that I almost forgot my earlier disappointments. Not only did it do a fine job of bonding copper to the board, but it also withstood prolonged soldering operations from a 140 Watt gun after I had etched out a circuit. And since so many people use contact cement, it's made by several companies, is priced fairly low, and comes in containers ranging from small tubes to five gallon buckets.

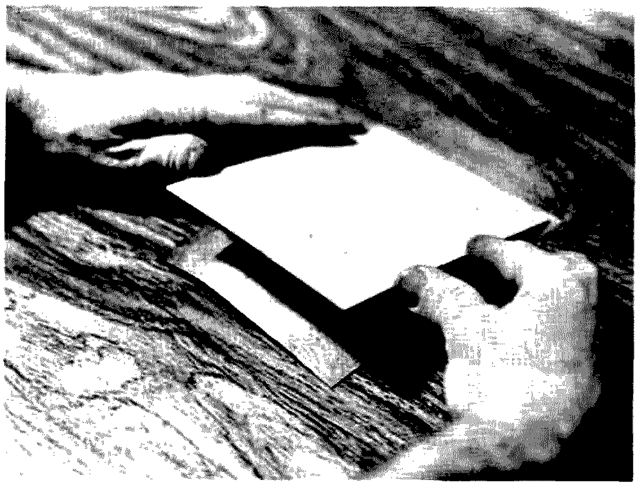


Fig. 4. After allowing the contact cement about ten minutes to dry, carefully align the coated surfaces and press them together.

If you are interested in rolling your own PC boards, let me quickly run through the procedure I use. I think you'll agree it's so simple that you won't have any hesitation about trying it.

The first step is to gather up all of the materials required. These include contact cement, phenolic board, and a sheet of copper. Once you've made these purchases, you will want to round up the simple tools required. These tools are a pair of sharp scissors, a steel wool soap pad, some pieces of thin cardboard cut from a filing card and, if you have one, a photographic roller.

The copper sheets can be found in hobby shops. They are available in several thicknesses, and I strongly recommend that you get the thinnest you can find in order to keep down the time required for etching. You should be able to find contact cement at any hardware store or in the hardware section of most discount stores. Phenolic

Fig. 5. I used a photographic roller to apply even, heavy pressure to the joined pieces, but you can use the palms of your hands.

boards are available at Radio Shack or similar stores. If you want to give it a try, sheets of formica should work very well in place of phenolic. Formica is available in many colors and patterns which could go a long way toward dressing up the average project. And, based on costs per square inch, formica is much cheaper than phenolic.

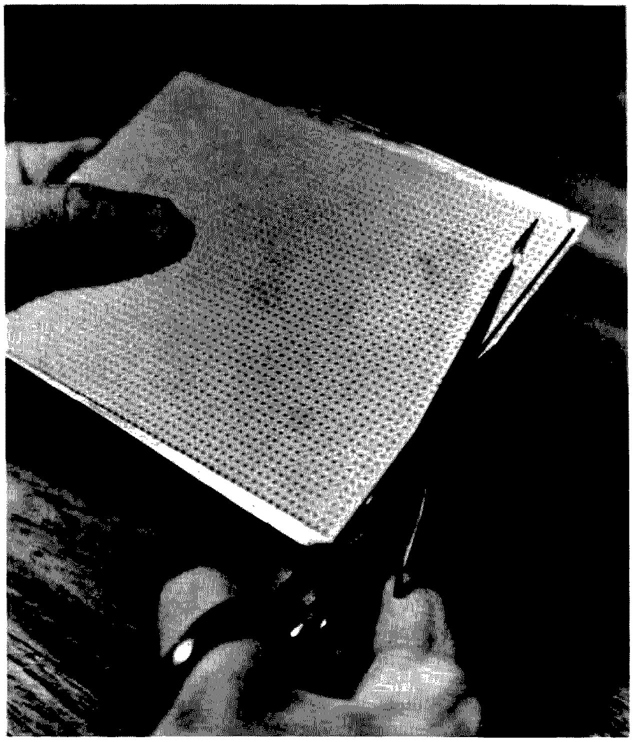


Fig. 6. As your final step, trim away any excess copper with a pair of scissors.

Once you have these materials and tools, begin by using the steel wool soap pad to thoroughly clean both the copper and phenolic on the sides you are going to apply the glue. The copper sheets I bought were coated with a transparent film to keep air from contacting the copper. Since I felt this film might interfere with the bonding process, I removed it with the soap pad. If your copper lacks this coating it will probably be heavily oxidized, which means a good scrubbing will be beneficial.

The copper takes on a highly polished appearance when it is properly cleaned. Once the entire sheet takes on a good shine, rinse it thoroughly and allow it to dry. Giving the phenolic a scrubbing helps to roughen its surface slightly and gets rid of any dirt or oil that might be present. Again, rinse carefully and allow to dry.

After the copper and phenolic are clean and dry, place them on some newspaper and apply the contact cement. Using small pieces of cardboard cut from a filing card, spread the contact cement evenly over the entire surfaces of both the phenolic and the copper. Strive for thin coats and work fairly rapidly.

When both surfaces are properly coated, set them aside and allow them to dry for about ten minutes. Then carefully align the two coated surfaces and join them together. Using either your hands or a roller, apply fairly heavy pressure to the pieces for a few seconds in order to insure good contact between them. Finally, trim away any excess copper with a pair of scissors. ■

LETTERS

from page 46

ment.

Tentative Frequency List

Channel Designation	Frequency
1	28.560
2	28.570
3	28.580
4	28.600
5	28.610
6	28.620
7	28.630
8	28.650
9	28.660
10	28.670
11	28.680
12	28.700
13	28.710
14	28.720
15	28.730
16	28.750
17	28.760
18	28.770
19	28.780
20	28.800
21	28.810
22	28.820
23	28.850

"We want to hear from other hams," said Phil Kogel W6MRQ, "because if they keep sending their thoughts to magazines as letters to the editor, there'll be hundreds of band plans but no real band planning." Kogel asked anyone with comments to send them to him, W6MRQ, 1245 North Laurel Ave., Number 9, West Hollywood CA 90046. "Please send a self-addressed, stamped envelope if you want a reply," he said. "We don't have the funds to mail copies of our final frequency chart to everyone."

John McAulay WA6QPL, a QRP sideband operator, said the council will not advocate exclusive use of any frequency by either AM or SSB. "Normally, SSB is in the low end, AM a couple of hundred kHz higher," he said. "But there is no reason why one operator on SSB shouldn't enter a QSO with another on AM. As long as they can understand each other — that's all that counts."

John English WB6QKF, council vice-chairman, also pointed out that the council is giving some thought to planning a portion of the CW band for Novices. "Right now," he said, "we're thinking about 8 CW channels (28.105, 28.115, 28.125, 28.145, 28.155, 28.165, 28.175, and 28.195) which would put low cost HF gear in the hands of Novice operators who can't afford to spend a lot of money on equipment."

This letter reflects the opinion of the Southern California 10 Meter AM/SSB QRP Band Planning Council. What a title! — J.M.

In your June, 1977, issue, a band plan for CB/10m conversion suggests the use of the OSCAR downlink frequencies. Please! Please! — Don't.

Since you need 230 kHz bandspace, I suggest you add 2.0 MHz to get 28.965-29.255. This band plan will be easy to relate to CB channels using 10 meter spectrum that is less used than others.

Don't forget the 10m Novice (28.1-28.2), the 10m DXer (28.5-28.8), and most of all, OSCAR (29.4-29.55), when preparing a potentially heavily used band plan on 10 meters.

Even so — I would strongly recommend SSB or FM in lieu of AM. If this plan becomes successful, AM will lose in the end anyway.

My conversion of a CB set would consist of:

1. Move frequencies to slot of interest
   a. AM (28.965-29.255) (why hassle the SSB and OSCAR boys?)
   b. FM (28.965-29.255)
   c. SSB (28.665-28.955) (think of the mobile DX work when the band is open)
   d. CW (28.465-29.755)
2. Disable AM modulator
3. Install varactor FM modulator
4. Install FM discriminator (careful use of AM detector will work)

Yes — convert those rigs, but plan the *new use* around *existing use* to add to the hobby.

Bob Winchester W8LSS
Midland MI

CB to 10 meters is great. Past three issues bring this interesting phase of ham radio to the front.

Keep pounding on this, Wayne; this could be the start of something big . . . big as 2m FM repeaters. We hams need to do something with the 10 meter band or it will be given to the CBers.

I have my set all ready for its new crystals and am now putting up a modified CB beam to get active on 10m AM.

Wilbur T. Golson W5CD/4
Panama City Beach FL

Now is the time to get a firm channelized band plan for 10 meters. We have seen two or three frequency plans, and if people use different sets

Continued on page 53

Ralph Tenny
432 Lynn St.
Richardson TX 75080

Identify That Transformer

-- tips for using boat anchors

The experimenter often relies on junk box parts and surplus electronic parts. Many power transformers are marked clearly, but even unmarked transformers are perfectly usable after they have been tested and rated.

Even the completely unmarked transformer will usually offer clues to its design. For example, the ac input leads (primary winding) are usually color-coded black. Other windings probably will be yellow or green. If the transformer has a large number of secondary windings, it may have a high voltage winding color-coded red, and other leads will be yellow, green and brown. If any winding has a center tap, this wire usually is striped in the same color as the winding. For example, a yellow coded winding might have a yellow center tap with a blue stripe.

Fig. 1 shows a transformer as a "Black Box" – a unit with unknown characteristics which must be deduced. Begin by verifying that leads of the same color connect to the same winding and not to another winding. Then, measure the dc resistance of each winding.

At this point, the black box of Fig. 1 has been indentified to the point shown in Fig. 2. The next step is to apply line voltage to the black winding through a 1/8 Ampere slow blow fuse and measure the voltage on the other winding. In this particular example, the ac scale on a VOM showed a no-load output from the secondary winding equal to 12.5 volts. This was measured with 122 volts ac in (line voltage is high in Texas).

The next step is to load the transformer enough to determine a safe power rating. Since the transformer will be used for a dc supply, make a rectifier-filter network as shown in Fig. 3. The capacitor value is not critical so long as the dc ripple under load is no more than 5% (a typical value might be 2000 uF). Remember that the voltage rating for the capacitor must be greater than 1.4 times the no-load transformer output voltage. For the transformer under discussion: 1.4 x 12.6 V dc is the minimum allowable voltage rating.

Determine the current rating of the transformer by applying a dc load to the rectifier-filter network until the ac voltage of the output winding drops by 10%. This dc current rating then can be multiplied by the dc voltage to get a power rating. For the transformer illustrated, a 250 milliamp dc load reduced the 12.5 volt ac (open circuit) to 11.3 volts. With that load, the dc out was .25 A x 11.6 volts = 2.9 Watts. As a final check, weigh the transformer; allow about 1 ounce per Watt of power.

The dc load for the transformer can be power resistors, but the circuit of Fig. 4 is easy to build and is easily variable over a wide range. (Q3 is a power transistor and must be mounted on a heat sink.) Choose R1 with the formula R1 = .6/1 minimum; for 50 mA minimum load, R1 = .6/.05 = 12 Ohms. The upper current limit will be set by the value of R1 and the output voltage of the supply. For a 12 volt supply, the maximum current would be about 1 Ampere.

The final check for any transformer is to operate it with rated load for several hours. If there is any problem with the transformer (shorted turns, etc.) or if the load is too high, the transformer will get hot. In general, transformers run a little warm, but the transformer should not be too hot to touch comfortably. ■

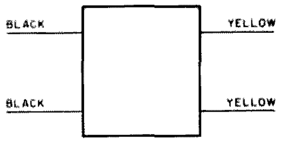


Fig. 1.

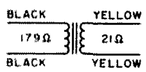


Fig. 2.

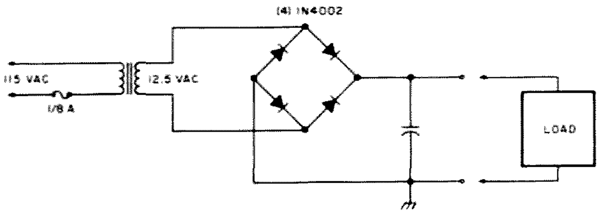


Fig. 3.

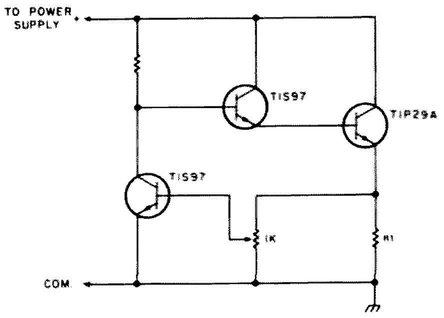


Fig. 4.

William G. Moneysmith W4NFR
109 Cabbel Dr.
Manassas Park VA 22110

Subaudible Tone Encoder

-- access those closed machines

With the ever increasing two meter activity, many repeater owners have chosen to incorporate PL, CG, or QC as a means of accessing their machines. A subaudible tone is required to access and maintain your signal through the repeater. At the repeater site, a subaudible tone decoder is interfaced with the receiver. When a transmitted signal opens up the receiver, a subaudible tone must be present on the incoming audio, so the decoder will close a relay and permit the transmitter to key up and repeat the signal. All individual users must provide a means of generating a specific subaudible tone on their transmitted signal along with their voice audio. There are two main requirements, tone frequency and proper tone deviation of the carrier frequency. Tone frequency is determined by the particular repeater decoder frequency and the deviation level is usually around 350 to 500 Hz.

In areas where many different repeaters are available, it is necessary to have more than just one tone encoder. This article describes a six channel subaudible encoder that works very well. The circuit is laid out on a 1" x 3" PC board. Parts are fairly common to obtain and construction takes about an hour.

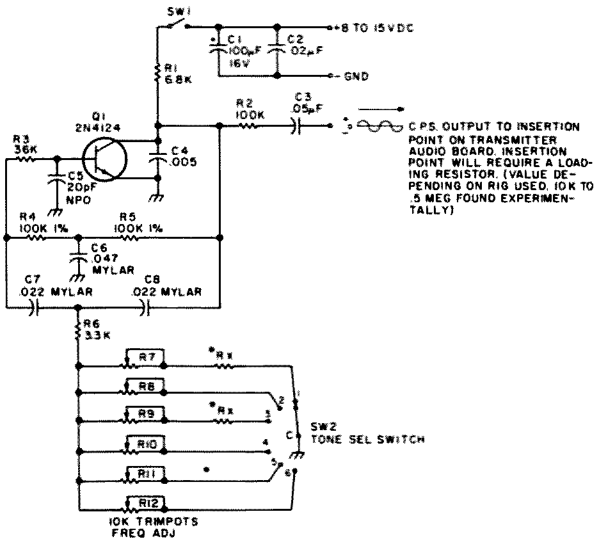


Fig. 1. Subaudible tone encoder.

The basic circuit is a twin T oscillator designed to operate in the subaudible tone range (93 to 170 Hz) for amateur use. It is versatile because the tones are adjustable with 20 turn trimpots. The theory of operation can best be described by saying R4 and R5 and C6 form a low pass type network. C7 and C8 and R6 and R7 form a high pass. As the phase shifts are opposite, there is only one frequency at which the total phase shift from the collector to base is 180 degrees, and oscillation will occur at this frequency. Optimum operation results when C6 is approximately twice the capacitance of C7 and C8, and R6 and R7 have a resistance about 0.1 that of R4 or R5. (R4 = R5) and (C7 = C8). Output is taken off from the collector of Q1 via R2 and C3.

By decreasing R6 and R7, the output tone will go higher. If R6 and R7 are increased, the output frequency will lower. This allows adjustment of oscillator to a precise output frequency, anywhere in the subaudible range.

Frequency is set by feeding the output into a counter. This will get you into the ball park. Adjustment of R7 will bring the encoder to a precise frequency desired. Next, connect the encoder's output through an insertion resistor to an audio injection point on the transmitter audio board. The output of this encoder is quite high (1 volt). An insertion resistor will be required. Values range from 10k to 0.5 megs and is found experimentally and varies between rigs. Choose a value to obtain about 500 Hz of tone deviation. Key up transmitter; "fine" tweak R7 for reliable results with the repeater. Set up each trimpot

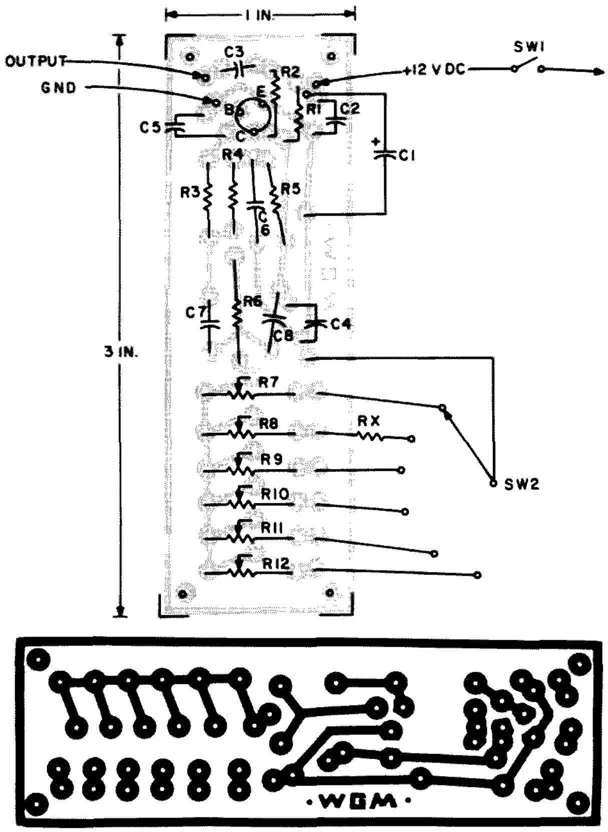


Fig. 2. PC board and component layout.

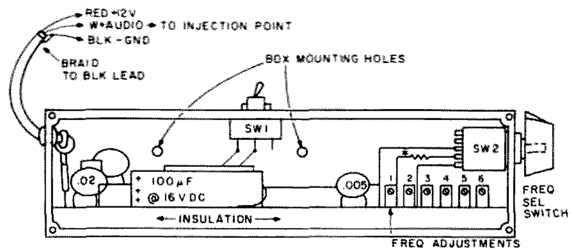


Fig. 3. Suggested layout of board in enclosure.

for a different required tone.

The ability to have six individual tones will probably be a great asset in the near future of repeater users. More and more repeaters are going the subaudible route, because of the FCC monitoring requirement, and the many problems with co-repeater interference. This unit is easy and reasonable to build for around $18. It has been in use for a couple of years with excellent reliability. ■

Tone freq. range		*Rx
93 to 107 Hz	=	12k
98 to 116 Hz	=	8.2k
114 to 170 Hz	=	jumper

Table 1.

Parts List

Q1 = Motorola NPN 2N4124
R1 = 6.8k ± 5% ¼ W
R2 = 100k ± 5% ¼ W
R3 = 36k ± 5% ¼ W
R4, R5 = 100k ± 1% ¼ W
R6 = 3.3k ± 1% ¼ W
R7-R12 = Bourns 20 turn "trimpot" Model 3005P 10k
C1 = 100 uF @ 16V
C2 = .02 uF disc
C3 = .05 uF disc
C4 = .005 uF disc
C5 = 20 uF NPO disc
C6 = .047 uF Mylar
C7, C8 = .022 Mylar
SW1 = Miniature SPDT switch
SW2 = ALCO switch MRA-1-10 1P 10T rotary with knob
Enclosure = Bud Diecast Box (CU-123 1½ x 3-5/8 x 1-7/32)

LETTERS

from page 50

of frequencies, we will have chaos. Rigs will have to be modified to travel from one area to another.

We personally approve of the plan by WA4MFT. We are ready to buy rigs and modify them as soon as a firm set of frequencies can be established.

Ed Johanson K7TEO
Sandy UT
John Dorociak WB7PQI
Layton UT

I am writing about your articles on CB conversions to 10 meters. The Mokan chapter of 10-X International has sponsored our group to increase activity on 10. The whole project was started just before your first article on the subject, and after we had converted several rigs, we found out that you had proposed a different frequency scheme than we had (Murphy's law). We favor a standard scheme that everyone can follow so that when the band opens, we do not cause interference to everyone on the air.

We favor the use of 28.800 MHz because this is the nationwide AM calling frequency and there are several nets, including the 10-X net, on this frequency. We also favor keeping the channels low in frequency. The lower channels can in effect be DX channels, and the upper ones can be for rag chewing. There is also the possibility that many people will use phase locked loop rigs which can be modified to create 70 or more channels. The frequency scheme we propose would allow a PLL rig to have 60 channels and still not interfere with OSCAR satellite operations. Well, here it is — *another frequency scheme*:

Channel	Freq.
1	28.690
2	28.7
3	28.71
4	28.73
5	28.74
6	28.75
7	28.76
8	28.78
9	28.79
10*	28.8
11	28.81
12	28.83
13	28.84
14	28.85
15	28.86
16	28.88
17	28.89
18	28.9
19	28.91
20	28.93
21	28.94
22	28.95
23	28.98
40	29.13

* Universal calling frequency

Jay Sprenkle WBØOUG
Kansas City MO

What's the matter with you people at *73*? I decided to convert a junk CB I picked up into a 10 meter rig; however, after looking at all the 10 meter conversion articles, I was ready to give up. What good is a 10 meter AM rig if I am the only one with that set of frequencies? In all the letters and articles, I think there were nine different band plans, most claiming to be the best.

I would like all the people who have converted CBs and who use 10 meter AM often to drop me a note giving their band plan and most used frequencies. With this data, I will determine the most used plan covering the most popular frequencies and report it to *73*.

Darryl Holman WB9TCY
729 Ziegler Rd.
Madison WI 53714

Well, the CB to 10 plot thickens! The above letters are but a few of the pile received at 73 this month. We need a band plan. I would like to take Darryl up on his suggestion, and gather information from interested converts. If you like, send your comments to me and I'll combine them with information on hand — let's get this thing going. Of course, OSCAR frequencies must be considered in any plan, as several letters indicate. I can see that I'm going to have to fire up my old DX-60 on 10 AM and see what is going on . . . maybe I won't sell the goodie as previously planned! — J.M.

Bob Walker K5UBM
1608 E. Tucker Blvd.
Arlington TX 76010

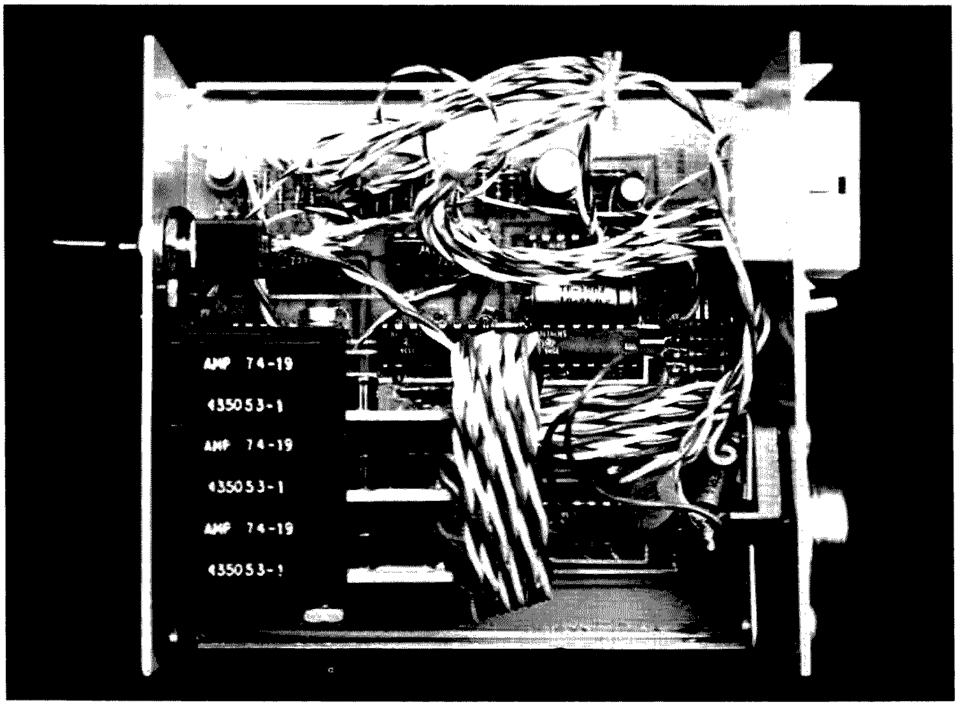
Philip Todd WB5WSG
11456 Dumbarton Dr.
Dallas TX 75228

Build A ComCoder

-- versatility for the IC-22S

One of the most versatile two meter rigs on the market is the Icom 22S PLL synthesized transceiver. With the addition of a device we call the ComCoder, all of the channels that can be programmed into a 22S are available at the flick of three direct reading BCD thumbwheel switches.

Even though several commercial and homemade devices have been developed to increase the programming capacity of the 22S, we feel that the ComCoder is one of the most practical because it is relatively inexpensive, is easy to construct using off-the-shelf components, and is small in size. Moreover, the original 22 positions can still be used, duplex and simplex functions are performed automatically, and the unit can provide a means of remote operation. Perhaps the most significant feature is that any frequency in 15 kHz steps can be dialed in and read out directly on the switch numerals. No codes, charts, or mental calculations are needed. The frequency range covered by the ComCoder on our radios is from 145.340 to 148.215 MHz, in 15 kHz steps. The range below 146.00 MHz may vary from unit to unit. It should be noted that the range above 148.00 MHz is out of the band and should not be used.



Most owners of a 22S who have programmed the matrix board have probably noticed that the board has 23 positions, not just 22! The foresight of Icom in providing the 23rd position along with position 23 on the rotary channel selector switch (first dot past numeral 22) makes addition of the ComCoder or other systems a fairly simple task.

Inside the radio, only one very minor modification is required. Add two diodes, one resistor, a 24-pin accessory socket, and a few wires, and your 22S is ready to accept the ComCoder.

The following steps represent the minimum operations required to make the 22S ready to accept the ComCoder. (We say "minimum" because optional connections such as audio in and output required to remote the entire rig will vary according to the individual's desires.)

1. Remove the standard 9-pin accessory socket and replace it with a 24-pin accessory socket. Icom sells a 24-pin socket complete with bracket that will fit with no modifications to the rig. However, we used a molex #03-06-1241 female and #03-06-1241 male connector. The original bracket with a round hole for the 9-pin socket was carefully filed out into a rectangular shape to accept the 24-pin socket.
2. Disconnect the blue discriminator meter wire from the 9-pin socket, and reconnect it to pin 3 of the 24-pin socket. (See step 4.)
3. Disconnect the ground wire from the 9-pin socket and the board. Reconnect a new ground wire of approximately 20 AWG from the board to pin 4 of the 24-pin

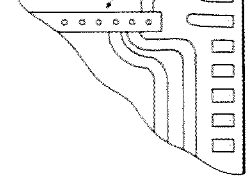
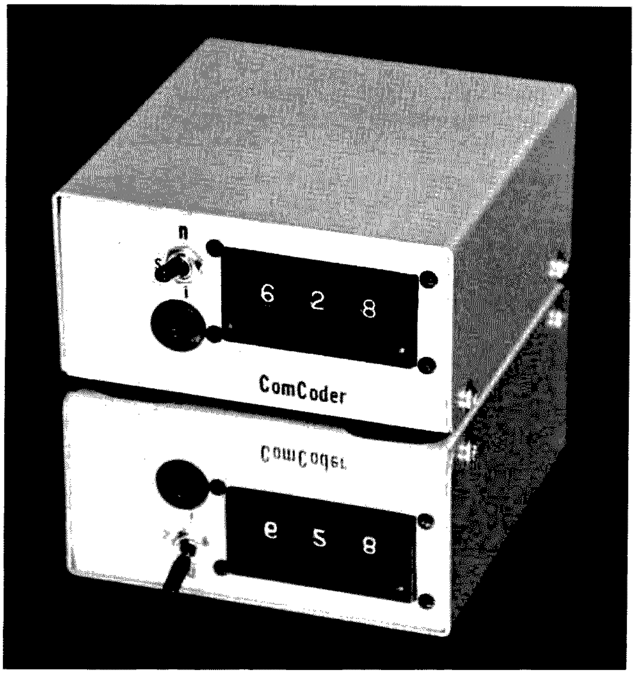
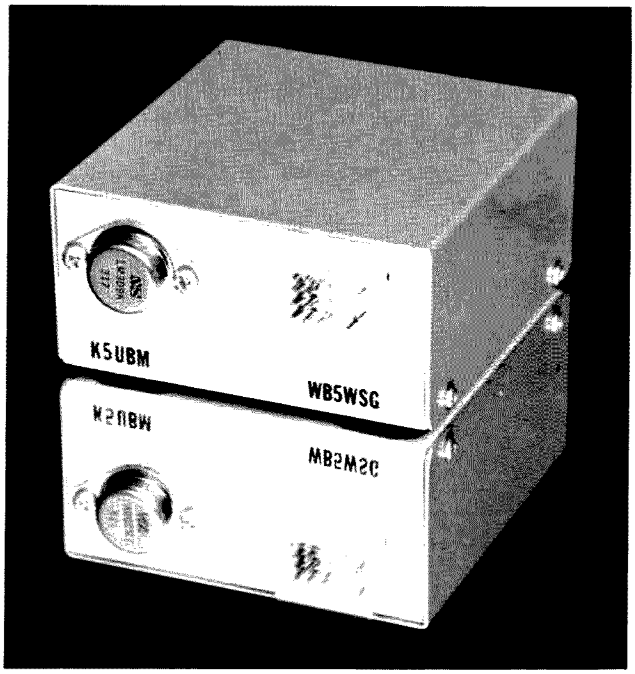


Fig. 1. Bottom of matrix board.





socket. (See step 4.)

4. Disconnect the .01 uF capacitor from the 9-pin socket and reconnect it between pin 3 and pin 4 of the 24-pin socket. This should be done at the same time as steps 2 and 3. We actually used a new capacitor, because it was easier than removing the one from the 9-pin socket.

5. On the bottom side of the matrix board, one strip of copper foil must be separated as shown in Fig. 1, and bridged with a diode. The cathode is placed toward the pin socket. A small triangularly shaped file works well for separating the copper. A diode of the same type used for programming the 22S (1N914) should be used. Cutting the copper at this point is the only real modification required.

6. On the top side of the matrix board, connect a diode to the second pin of the matrix board socket as shown in Fig. 2. This diode should be placed parallel with the end of the board, with the cathode connected to the pin. The other end should be passed through an existing hole in the corner of the board and connected to a wire. This method of installation stabilizes the diode and minimizes the possibility of the leads being broken during other operations. The wire from this diode is the DP line, and connects to pin 13 of the accessory socket. Use the same type of diode as was used in step 5.

7. Connect a 330 Ohm ¼ Watt resistor between the matrix board position 23 common bar, as shown in Fig. 3, and pin 16 of the accessory socket. The end of the resistor should be inserted through an existing hole in the corner of the PC board for stability. The wire from this resistor goes to pin 16 (+ 9 V) of the accessory socket.

8. Connect a wire from the position 23 pad on the bottom of the matrix board, as shown in Fig. 4, to position 23 of the rotary channel selector switch.

9. Install 8 wires from the matrix board channel 23 position locations D7, D6, D5, D4, D3, D2, D1, and D0, as shown in Fig. 3. The wires should connect to the 24-pin accessory socket, as shown in the accessory socket pin assignment (Fig. 5).

10. Connect an 18-20 AWG wire from the top connector (one closest to the squelch control) of the high-off-low switch to pin 2 of the 24-pin accessory socket. This is the 12 volt power wire.

11. Connect a wire from the push-to-talk wire to pin 5 of the accessory socket, as shown in Fig. 6. Connection is recommended at this point, to avoid disassembly of the front of the radio to get to the wire.

The wires connected to

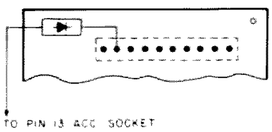


Fig. 2. Top of matrix board.

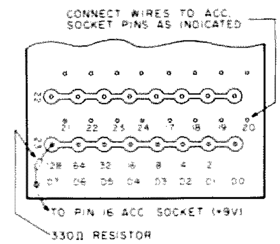


Fig. 3. Top of matrix board.

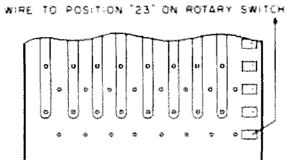
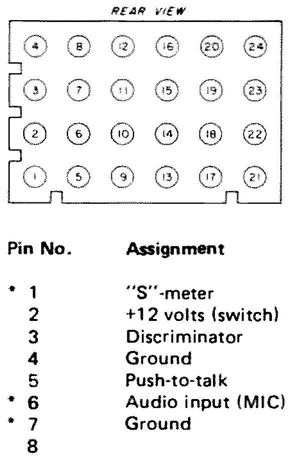


Fig. 4. Bottom of matrix board.



Pin No.	Assignment
* 1	"S"-meter
2	+12 volts (switch)
3	Discriminator
4	Ground
5	Push-to-talk
* 6	Audio input (MIC)
* 7	Ground
8	
* 9	12 V Unswitch
*10	Audio output
11	
12	
13	DP line
*14	Lock lamp
*15	Signal lamp
16	+9 V Pos. 23
17	D3 (Pos. 23)
18	D2 (Pos. 23)
19	D1 (Pos. 23)
20	D0 (Pos. 23)
21	D7 (Pos. 23)
22	D6 (Pos. 23)
23	D5 (Pos. 23)
24	D4 (Pos. 23)

*Fig. 5. Accessory socket pin assignments and connections. Note: Any pin configurations are acceptable, but it is recommended that the above pins be standardized. *Optional connections required only if you desire remote operation.*

the matrix board should be of sufficient length to allow manipulation of the board. After completing the above steps, the radio is ready to accept the ComCoder.

Before you start construction of the ComCoder, you probably will want to know how it works. Fig. 7 shows a block diagram of operation of the system.

In order to understand how the ComCoder works, the programming requirements of the 22S need to be identified. The 22S uses an eight bit binary code to control the phase locked loop (PLL). Normally this code is provided by the diodes in the transceiver and selected by the 23 position switch. A ten position binary coded decimal (BCD) thumbwheel switch produces a code that looks exactly like a binary until the number ten is to be encoded. A binary ten is 1010. A BCD ten is 0001,0000. Therefore, it would take two BCD switches to produce a ten and three to produce a three digit number such as 694.

The range of frequencies that the 22S can be coded for is from 00000000 (which corresponds to a frequency of 144.390 MHz) to 11111111 (which is a frequency of 148.215 MHz). Even though the 22S could be coded for 144.390 MHz, inherent characteristics of the 22S PLL will not let the unit lock up on frequencies in the upper 144 and lower 145 MHz range. Note that only three thumbwheel switches are required. The first two digits (1 and 4) and the 5 showing a 15 kHz are automatic. The 1 and 4 numerals could be painted beside the thumbwheel numerals if desired. The red LED lights to show a 15 kHz split frequency. For instance, when (14) 743 is dialed in, the red LED will light, thus indicating a frequency of 147.435 MHz.

The formula to convert a number such as (14) 6940 to the appropriate binary code is (6940-4390) ÷ 15 = 170. The 170 corresponds to the binary code as shown in the IC-22S owner's manual programming chart. This arithmetic formula required to convert a direct reading number (on the thumbwheels) is solved by the ComCoder. Detailed operation of the ComCoder is as follows:

1. The numbers on the three BCD switches are loaded into the three BCD counters. At the same time, a constant equal to -292(14390/15) is loaded into the binary counters.
2. The oscillator counts down the BCD counter toward zero, while every 15th pulse of the oscillator counts up the binary counter.
3. When the BCD counter reaches zero, 6940 pulses (assuming 14694 has been selected on the switches) have been issued and 462 pulses have been counted into the binary counter. The result of the -292 that was first loaded in and the 462 is 462 - 292 = 170. A pulse is issued to load the latch with this value.
4. The divide by 15 is reset and the process is restarted.

The components not mounted on the circuit board are as follows: capacitors C7 and C6, 5 volt regulator LM309, light emitting diode (15 kHz offset indicator), BCD thumbwheel switches, DPST center off duplex line switch, 1N2069 diode CR13, and the 24-pin plug. The 24-pin plug could be optional. The wiring could be made directly to the components and the circuit board. This is not desirable unless the unit is to operate in a permanent location. Any problems that show up after the unit is operational would probably be the result of a broken wire. Repair would be simplified by having the connecting cable capable of being plugged into the radio and the ComCoder. Also, the use of cables of different lengths for operations such as remote setup in your car and fixed in the house is more practical.

After you have scrounged or bought all of the parts, assembly is as follows:

1. Mount the components on the circuit board. Note that wiring is not critical and that alternate methods other than a printed circuit board could be used. However, in order to make the unit as small and neat as possible (as well as easy to assemble), a printed circuit board is recommended (as shown in the photograph of the inside of the ComCoder).
2. Prepare the housing box to receive the BCD switches, 5 volt regulator, LED, DPST switch, and 24-pin socket. Layout is not critical, but should generally follow that as shown in the photographs. Drill holes for the regulator pins and mounting screws. The pin holes should be approximately ¼ inch in diameter. Drill holes for LED snap mount and DPST switch. Drill starter holes for the BCD switches and 24-pin socket. A hand nibbler was used to complete the rectan-

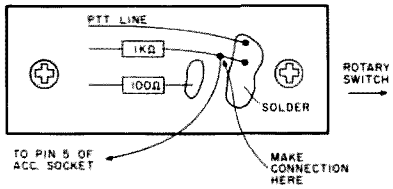


Fig. 6. PTT line connection procedure (located on the back side of the front panel).

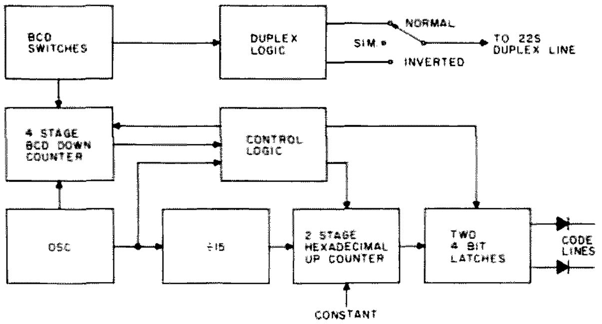


Fig. 7. Block diagram.

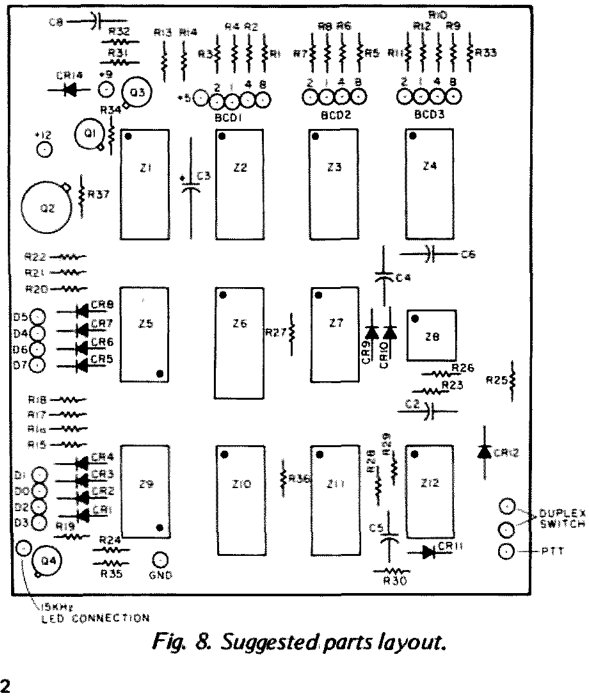


Fig. 8. Suggested parts layout.

gular holes for the BCD switches and 24-pin socket. If a nibbler is not available, the holes could be filled. Note that as shown in the photographs, the switches and LED are over to one side. This will allow the addition of a mike jack for remote operation.

3. Mount components listed in step 2 in their appropriate location. Do not install permanently at this time, because some of the wiring connections are simplified with components not mounted. We used a power transistor socket to mount the 5 volt regulator. This made the task of connecting C1, C7, and the wiring easier. Silicone grease should be used in mounting the regulator, to insure good heat conductivity. Also, if your box is painted, you should scrape the paint beneath the regulator.

4. Install wiring from the BCD switches to the circuit board. We mounted diode CR13 directly to the BCD switch connection points. The connection points are shown on the parts layout drawing (Fig. 8).

5. Install wiring from the PC board, regulator, and DPST switch to the 24-pin socket.

6. Connect the LED to the PC board. We used a snap mount type LED, but almost any type can be used.

7. Mount the PC board inside the housing. Make sure it is well insulated and makes no contact with the box or any other components (see test procedures).

8. Mount all other components permanently (see test procedures).

After completing the above steps, the unit should be ready to operate. However, before you connect the ComCoder to your radio, the following tests are recommended:

1. Measure the resistance from ground to +12 V dc and from ground to +5 V dc, to insure there is not a short.

2. Connect +12 V dc and ground to the unit. Measure +5 V dc. Connect PCB to 5 V dc. The 5 V dc should draw a current of approximately 500 mA.

3. If you have an oscilloscope, insure that the clock is running (555, pin 3).

4. Measure the collector of Q2. The voltage should be less than one volt.

5. Connect 5 V dc to R34, +9 V input to PCB. The collector of Q2 line should go to +12 V dc.

6. Select a 15 kHz frequency. The LED should come on.

7. Select 144.39 and measure each of the code lines. They should all be less than one volt.

8. Select 144.37. The code lines should all measure 12 volts.

9. Connect a 10k Ohm resistor from your meter probe to ground and measure each of the code lines. They should be less than 9.5 volts and greater than 7.5 volts.

10. Set duplex switch on normal. Select 146.34. Center of duplex switch should measure approximately 5 V dc.

11. Ground PTT line voltage should go to less than one volt.

12. Switch to invert. Voltage should go to 9 V dc. Unground PTT line voltage should be less than 1 volt.

13. Select a frequency of 146.52. The duplex line

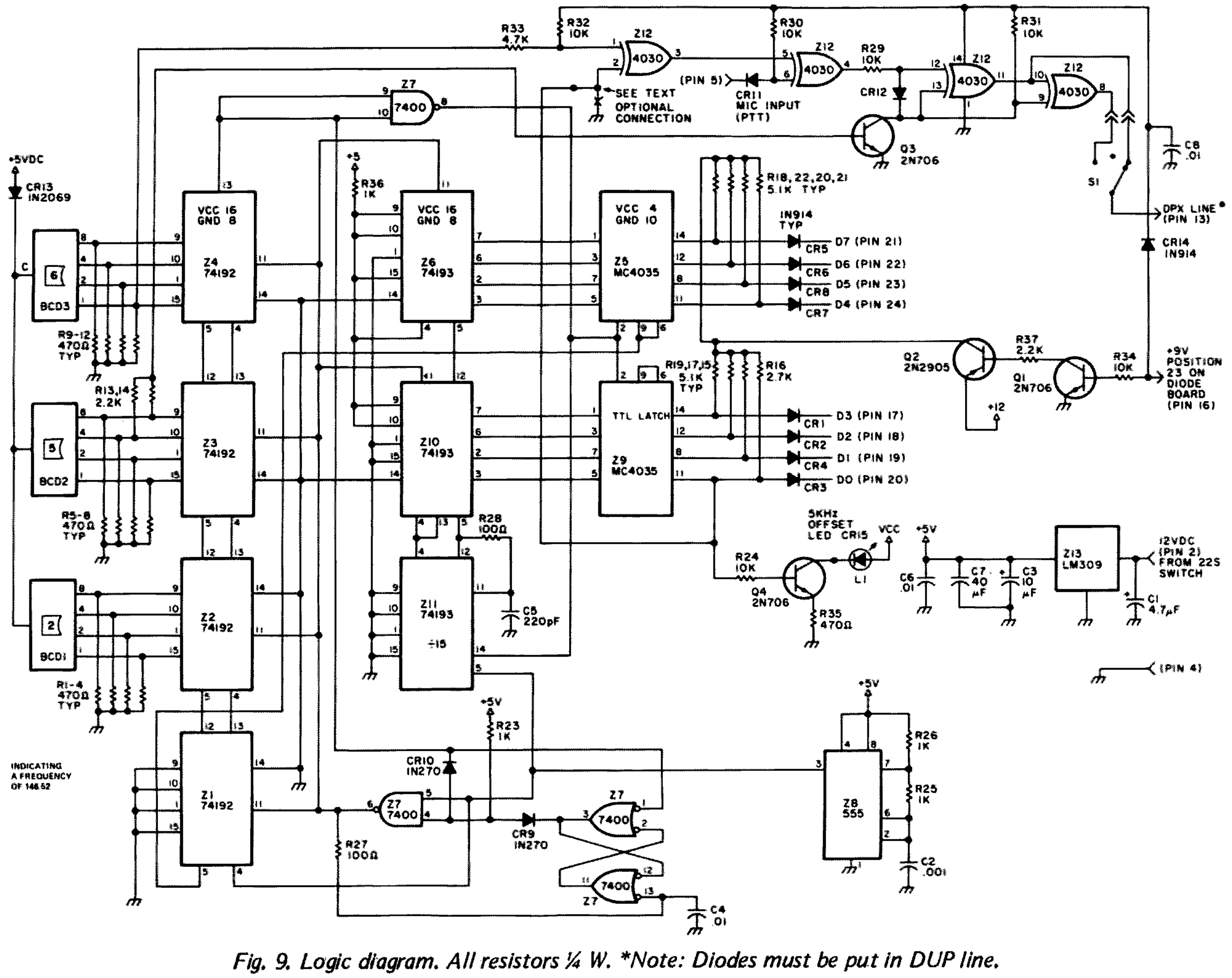


*Fig. 9. Logic diagram. All resistors ¼ W. *Note: Diodes must be put in DUP line.*

should measure less than one volt in all positions of the duplex switch, with the PTT grounded or ungrounded.

14. Select 147.00; voltage should be the opposite of step 10, -12. (Disconnect 5 V dc from R34.)

15. You are now ready to connect the ComCoder to your IC-22S. Caution! Remove power if there are any abnormal sounds or smells, or if lamps dim.

After everything has checked out, undertake the following operating procedures:

1. Connect the ComCoder to the radio via the 24-pin cable assembly.
2. Place the radio duplex switch in the simplex mode.
3. Place the ComCoder switch in the normal position.
4. Place the rotary switch on the radio in position 23 (the first dot past position 22).
5. Dial in the desired frequency on the ComCoder.
6. Turn the power switch on and start working!

Operation In Normal Position

Dialing in a frequency such as 146.280 with the ComCoder function switch in the normal position will cause the system to transmit on 146.280 MHz and receive on 146.880 MHz.

With the function switch still in the normal position, a frequency of 147.180 MHz will cause the system to transmit on 147.780 MHz and receive on 147.180 MHz.

With the function switch still in the normal position, a setting of 146.520 would cause the system to transmit on 146.520 and receive on 146.520.

What all of this means is the frequencies as follows are automatically simplexed: 145.400 to 145.995, 146.400 to 146.985, and 147.405 to 147.990. All others are automatically duplexed either up or down.

Operation In Simplex Position

Any frequency selected receives and transmits on that frequency.

Operation In Inverted Position

Normal duplex operations are reversed. For instance, dialing in 146.280 will cause the system to receive on 146.280 and transmit on 146.880. This mode of operation would be extremely useful for direct communication with other crystal controlled stations in the event of the repeater going down.

The optional connection shown on the schematic diagram at pin 2 of Z12 provides for automatic inversion of the 15 kHz split repeater inputs. This allows 15 kHz repeater operation with the function switch in the normal position.

Generally, all normal operations can be performed with the function switch in the normal position. The simplex and inverted positions are icing on the cake that let you do almost anything.

We hope you have as much fun building and using the ComCoder as we have. We would like to give credit to Gary Todd WB5LIF of Todd Photographics in Sulphur Springs, Texas, for his assistance and efforts in providing the photographs used in this article.

A kit including all electronic components and a double-sided printed circuit board with plated-through holes is available from Bullet Electronics, PO Box 19442, Dallas TX 75219, for $39.95. The kit contains all items required to build a ComCoder except the hardware, box, and switches. For those wanting to scrounge their own parts, a double-sided printed circuit board with plated-through holes is available for $10.50 from Bob Walker, 1608 East Tucker, Arlington TX 76010. On both of the above, add 5% for postage and handling. Texas residents should add 5% sales tax. ■

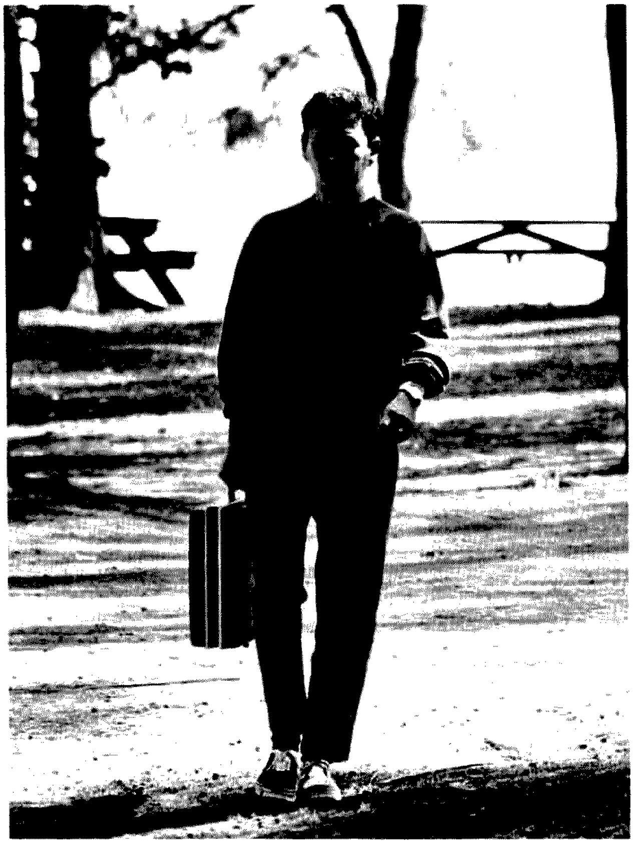
PARTS LIST

Reference Designator	PC Board Description	Value or Type
Q1, Q3, Q4	NPN transistor, silicon, GP	2N706
Q2	PNP transistor, silicon, GP	2N2905
Z1, Z2, Z3, Z4	IC up/down decade counter	74192
Z5, Z9	IC quad latch open collector	MC4035
Z6, Z10, Z11	IC up/down binary counter	74193
Z7	IC quad 2 input NAND gate	7400
Z8	IC timer	555
Z12	IC quad exclusive or, CMOS	4030
R1-R12, R35	Resistor, ¼ Watt	470 Ohm
R13, R14, R37	Resistor, ¼ Watt	2.2k Ohm
R16	Resistor, ¼ Watt	2.7k Ohm
R15, R17-R22	Resistor, ¼ Watt	5.1k Ohm
R23, R25, R26, R36	Resistor, ¼ Watt	1k Ohm
R24, R29-R32, R34	Resistor, ¼ Watt	10k Ohm
R27, R28	Resistor, ¼ Watt	100 Ohm
R33	Resistor, ¼ Watt	4.7k Ohm
CR1-CR8, CR11, CR12, CR14	Silicon diode, GP	1N914
CR9, CR10	Germanium diode, GP	1N270
C2	Capacitor, ceramic	.001 uF
C3	Capacitor, aluminum	10 uF
C4, C6, C8	Capacitor, ceramic	.01 uF
C5	Capacitor, ceramic	220 pF
Z13	3 terminal voltage regulator	LM309
CR13	Diode, silicon, 750 mA	1N2069
C1	Capacitor	4.7 uF
C7	Capacitor	40 uF
CR15	LED	Any type
S1	SPDT with off switch	Any type
BCD1-BCD3	10 position BCD coded thumbwheel switches with zero position open to all contacts	Any type
K1	Socket for LM309	
P1, P2	Molex plug, 24-pin	PO3-06-2241
	Pins for above	02-06-2103
J1	Molex socket, 24-pin	R03-06-1241
	Sockets for above	02-06-1103
	Wire	
	INSIDE RADIO PARTS	
CR1, CR2	Silicon diode, GP	1N914
R1	Resistor, ¼ Watt	330 Ohm
J2	Molex socket, 24-pin	R03-06-1241
	Sockets for above	02-06-1103
	Wire	24 AWG stranded, any type

Attaché Case Portable

-- Bond would like it!

Albert H. Coya N4AL/WB4SCN
1710 SW 83rd Ct.
Miami FL 33155



James Bond and his counterspy gadgetry made the attache' case notorious a decade or so ago. The black vinyl rectangle became a symbol of the super-secret agent. Bond was able to produce weapons and communications devices from his case with the ease of a magician pulling rabbits from his velvet hat.

Usually, the attaché case contained a rapid fire 7 mm machine gun, smoke grenades, plastic explosives, a telescopic blowgun with a provision for darts impregnated in curare, a bottle of champagne and two glasses, and, of course, a two-way radio. With this radio (frequency unknown) and an invisible antenna, he always kept in touch with headquarters in London, even while traveling aboard a dromedary in the Gobi Desert.

Unfortunately, or fortunately, I don't have a license to kill, and my attaché case must be as legal as possible. So I will leave out the explosives, poisoned darts, etc., and will stick to the communications business. My attaché case portable may lack all those lethal weapons, but it contains an efficient and down-to-earth communications system.

As a staff photographer with the *Miami Herald*, I travel throughout the United States and abroad. On short trips I drive, but most of the time I fly. The long hours in a motel waiting for a newsbreak can be shortened if I do some hamming. But I needed to have a compact and portable operation.

I contemplated the need for two possible modes of communication – from a hotel or motel room and from a rented car. To attach the rig to the car, I built a telescopic center-loaded antenna with a gutter clip. To feed the 12 volts from the car battery, I used a long, stranded wire, twelve gauge, coded for polarity, and with heavy-duty battery clips on the end.

The motel operation is a lot simpler. Just be sure to get a room on the top floor. Open one of the back windows, and drop a long, covered wire down to ten to twelve feet above the ground level. Attach the end of the wire to the transmatch, tune the wire to the band of your choice, and you will be talking to the boys back home in no time at all.

In case you can't get a room at the top or it is difficult to drop a wire, the gutter antenna can be clipped to a pipe, the windowsill, etc., and, with the proper band tank coil, you'll go airborne.

For the attache'case operation I chose the Atlas 210X, because of its small size and light weight. I also have an ac power supply and a long wire tuner, compact enough to fit in my case, and coax, wire, pliers, screwdrivers, etc.

Lately I added to this a gel battery, capable of seven Ampere-hours at 12 volts. I use this battery on camping trips and picnics. I have my own private field days and talk to a lot of guys while the

steaks char in the barbecue pit.

On these trips I toss a long, covered wire over the trees and connect the end to the transmatch. On forty meters, stations from all over Florida start popping up. Everybody is interested in my portable operation. The fun starts when they pile up.

The seven Ampere-hour gel battery is compact enough to fit into the attaché case and strong enough for a full morning of rewarding QSOs.

One weekend I took the XYL and my attaché case to Cape Florida State Park, on the south tip of Key Biscayne across the bay from Miami. After biking and swimming, we took our things to a picnic table. While the XYL was preparing the food, I tossed a long wire over the pine trees and connected it to the transmatch. It is a very simple one that was advertised in *73* and sells for less than thirty dollars. Inside the little green box, you will find a toroid coil attached to a ten-position switch and a variable capacitor. Be careful when tuning this toy, because the rf jump can bite your fingers! A neon bulb tells you when the maximum output is obtained.

After installing the gel battery and mike, I started tuning the twenty meter band. It was buzzing like a beehive. At 12:20 pm Miami time, I got my first contact — Hank W3DX in Rockville, Maryland. Hank gave a good report, but he had a sked and had to QSY.

My next contact was a maritime mobile in the Pacific Ocean near Central America. He was calling a W7 station, so our QSO was short.

At 12:50 pm, TG9TG, a Guatemalan station manned by Glen, gave me a 5 by 6 report. Then I tried the forty meter band. Wayne W4JMU was near Jacksonville, Florida. The report was very good. In the low section of the forty meter band, a group of Cuban stations were talking to each other. I called CO2RS in Camaguey, and Ricardo answered my call. We got a nice report from the group, which included one ham working with an AM rig.

Then I switched to the 15 meter band. WA6SKI was on 21.350 MHz in Riverside near Los Angeles. I explained to him that I was having a private field day in Cape Florida. His signal was a solid S9, and he gave me a nice report.

Then the excitement started, when I asked Ray to phone patch my daughter, Susan, who lives in LA with her husband and my only granddaughter, Jenny. It was like a direct pipeline with the West Coast. My XYL had a great time talking with Susan. My daughter couldn't believe that we were sitting there on a picnic table facing the Gulf Stream. In the past, we had spent many hours together in the same spot, when she was in high school.

It was a tremendously satisfying and exciting experience, thanks to the kindness of Ray WA6SKI. I forgot to ask for his QTH to send him my QSL, but, Ray, if you are reading this story, I hope you have a smile and remember this interesting afternoon. ■

New Products

from page 25

For inquiries concerning domestic USA sales of the new series of amateur equipment from Hallicrafters, contact *The Hallicrafters Company, 2501 Arkansas Lane, Grand Prairie TX* 75051, telephone 214-647-9090, telex number 73-2310. Inquiries from other countries will be handled by Hallicrafters International, Inc., at the same Texas address.

FILTER DESIGN MADE EASY

Active Network Design by Claude S. Lindquist is a new 749-page book which describes filter design and applications. It is an invaluable reference for engineers, technicians, and hobbyists who must understand signal processing and filtering, and who must specify, design, or adapt filters for their own uses. A.B. Williams of Coherent Communications Systems says, "It is the most impressive textbook on filters I have ever come across."

The book features standard design curves and tables, practical design examples, numerous problems with selected problem solutions, extensive references, original and unpublished research results, and complete cross-referenced index including applications.

The price is $21.95 prepaid ($23.27 for California orders) or add $1.50 postage and handling for 30 day billing. *Steward & Sons, P.O. Box 15282, Long Beach CA 90815.*

Corrections

In reference to "More Channels for the IC-22S," June, *73*, I would like to point out that the address of Bryant Electronics was in error on my part. Bryant Electronics is alive and well. To all those people who wrote for the boards, and the response was overwhelming, please write to me if you wish the board. To those who received theirs late due to having to have another batch made, accept my apologies. You should have them by now.

Bill Richarz WA4VAF
4124 Colebrook Rd.
Charlotte NC 28215

John Crawford WA4SAM
Box 369
Berryville VA 22611

Build A Beeper Alarm

-- if staying in touch is important

Since the advent of my article, "The Ultimate Alarm II" (*73 Magazine*, June, 1973), there has been much interest in the feature which transmits a tone to a handie-talkie worn on the belt. This lets me know if the alarm is sounding while I am in a location where I can't hear the automobile horns. Moreover, people are impressed that I caught a thief in the act of tampering with my car even though he thought he wasn't setting anything off by climbing through a window. The vehicle described in the above article was broken into a total of 24 times by genuine thieves and, no doubt due to the article, "tested" numerous other times by enterprising individuals at hamfests. One such person jumped violently up and down on the bumper at an ARRL convention, thus destroying .94 talk-in facilities and making me immediately unpopular with several groups.

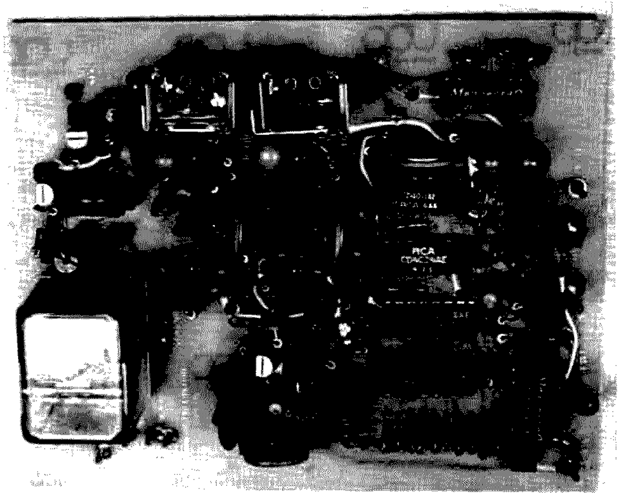
Another problem manifesting itself, and somewhat harder to rectify, was the fact that whenever I was in a theater, during the quietest and most suspenseful part of the picture, my handie-talkie invariably picked up other hams who would choose this time to vent their feelings on the traffic, the world situation, or other nonsense, at full volume and probably directly in front of said theater. This invariably did not sit well with my nearest neighbors or the management, and once, at a posh symphony concert, with the conductor himself. Usually I ended up by turning the receiver off, thus voiding the whole point of the thing.

The HT-220 handie-talkie was bulky, heavy, stretched my pockets on my jacket, and made me look like a plainclothes detective. Something had to be changed.

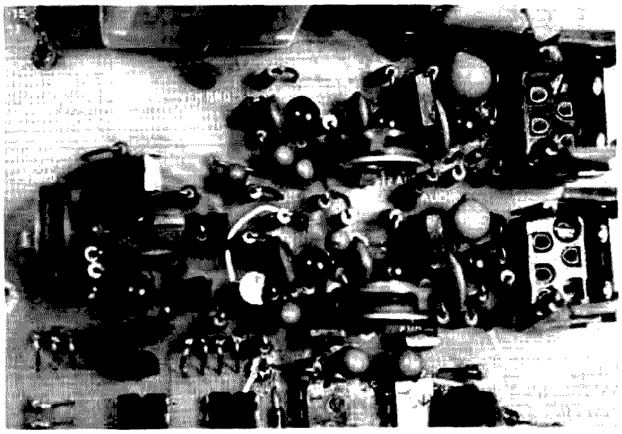
I then noted that at things like concerts or public meetings, no one got particularly upset when a bona fide physician's beeper went off. Here was an Important Person, clearly not a Xerox repairman, and armed with his beeper and a deprecating smile, he usually made his way to an exit with people nodding their approval and falling over one another to give him room.

It became obvious that there seemed to be a difference between physicians and hams.

Recently, feeling somewhat affluent, I purchased a new car and a Motorola Pageboy II (used) with no real idea of what I was going to do with either one. I was,



The completed PC board.



Another view of PC board. The two sockets are for the reeds. The two reed oscillators and the alert (ID) tone oscillator are the portion shown. Above these is the switching and sensor circuitry for the main alarm. Below are the ICs for the logic section.

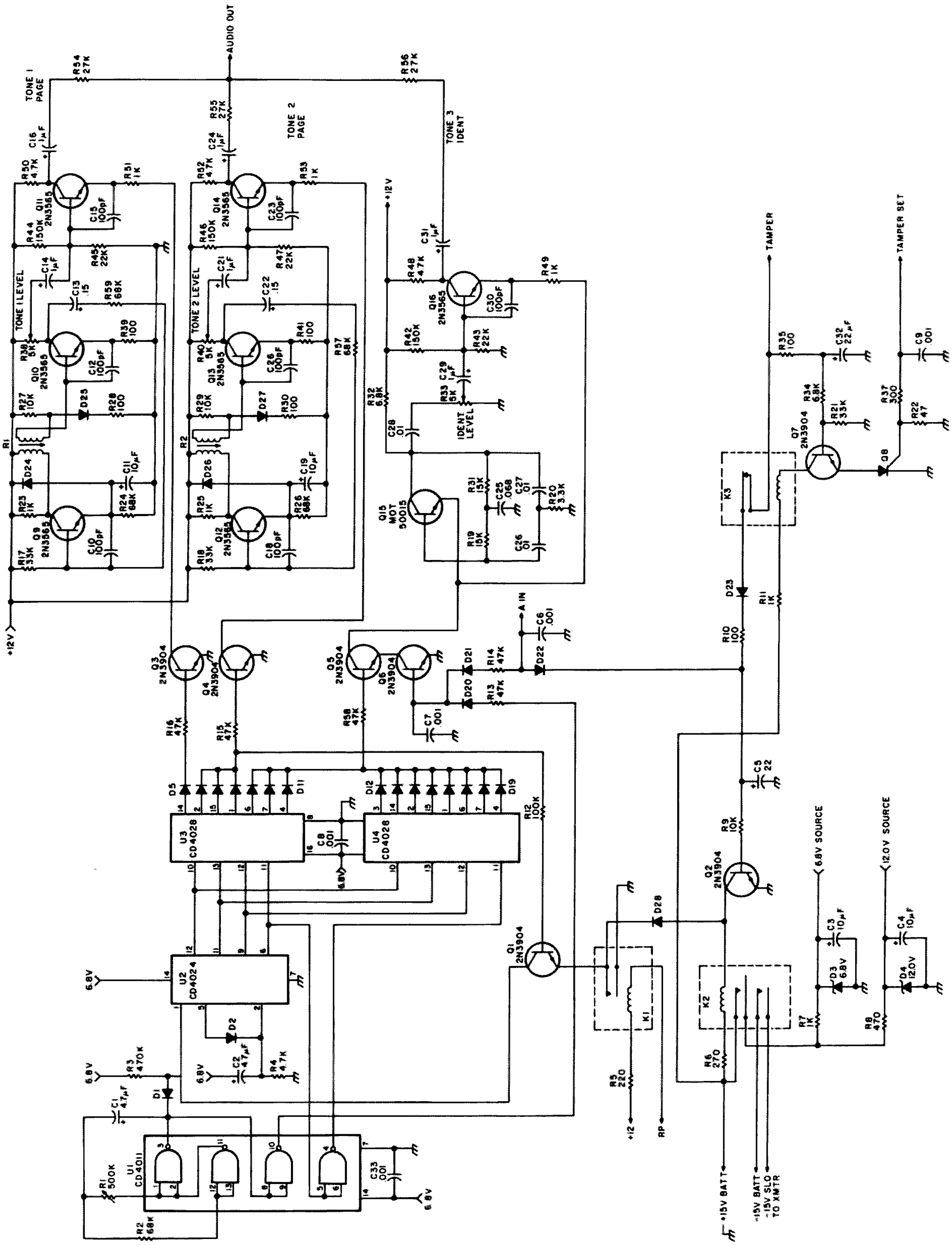


Fig. 1. Radio paging alarm circuit board schematic.

however, determined that anybody who scratched my new car while trying to break in would be dealt with severely. My old car had wear marks all around the various openings from all the attempts made on it. When I sold it, it was depreciated accordingly (should have been cleaned and burned). I, therefore, completely redesigned the alarm system from the collection of several dirty miniboxes full of electromechanical relays to a new integrated unit replete with transmitter, control board, test switches, and all the conceivable input/output combinations I would need.

The new unit provides the appropriate control to energize a 100 Watt elec-

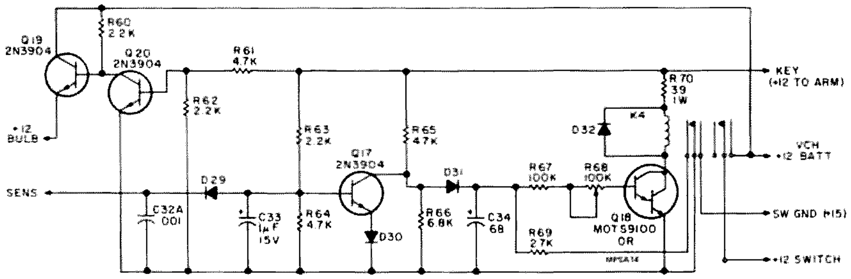


Fig. 2. Alarm switching and control for radio paging alarm.

tronic siren, the vehicle horns, and a 1 Watt transmitter. If tampering occurs, such as a car backing into it or someone attempting to climb inside, jack it up, steal an antenna, etc., a "silent" alarm is activated. This consists of motion sensors which activate a two-tone page and identification signal and a transmitter. The pager receiver is tuned to the same frequency and, with an off-on-off-on tone, indicates the car is probably being, or is about to be, modified in one way or another. Other sensors lie in wait and trigger another input if overt action is taken, such as the hood or doors being opened. The horns and siren then sound, the transmitter comes on, and a steady rather than pulsed tone is heard in the receiver.

The sensors are of many different types and are located throughout the entire car. Motion sensors in the front and rear detect motion of any sort and may be adjusted for various wind pressures and motion levels. Switches in the hood, doors, rear tailgate and crank up window (this is a Chevrolet carry-all) detect the opening of any of these. Vibration sensors on key parts of the auto are activated in case a window is hit or broken and an ultrasonic alarm sender-receiver unit is employed in the rear cargo area in certain instances. Finally, switch mats are used under portions of the carpeting. Should the main battery cable be cut from underneath (no easy feat) in an attempt to defeat the system, another battery used for the transmitter will sound the paging alarm anyway.

The circuit is laid out on a single PC board containing the counters, two-tone page oscillators, ID oscillator, and basic alarm switching circuit. Auxiliary circuits are also included for other functions to be described.

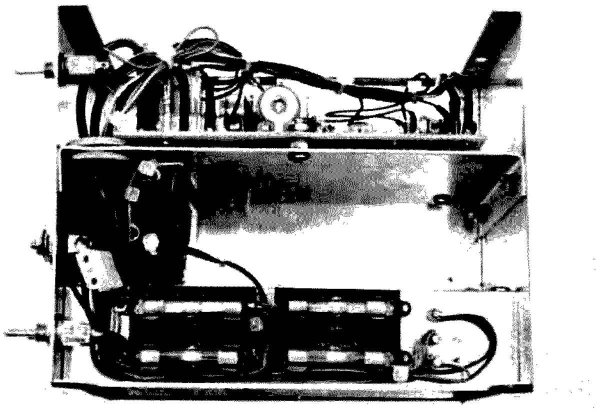
The transmitter is a 1 Watt transistorized unit from a GE Voice Commander II portable unit. I see these at hamfests for about $15.00 quite a bit. The transmitters may be easily removed, leaving only the receiver board audio circuits and case, which may then be sold to firemen, CBers, or monitor buffs for $30.00. The transmitters have a positive ground arrangement, so an auxiliary 15 volt battery, rechargeable and capable of 500 mAh or so, is used. This also drives the counter and tone circuitry to preserve integrity if the main vehicle battery lead is cut.

The antenna is mounted inside a rear window and consists of the solid inner lead of a piece of RG-59 stripped back about 19 inches or so for lowest swr (more on this). Mounted in this manner, it is almost invisible.

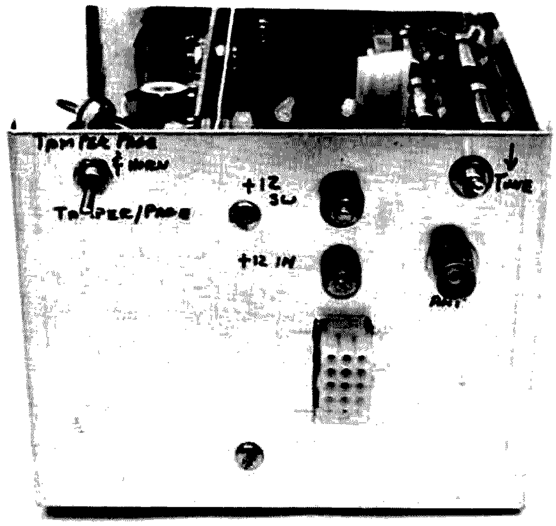
Before describing the circuit operation, it would be best to have an understanding of how a paging receiver works. There are basically two types: tone only, and tone-and-voice. In either case, a receiver is tuned to an operating frequency and will receive all signals transmitted over this frequency. If two sequential audio tones of the proper frequency are transmitted, the pager will emit a beeping tone which stays on for most of the duration of the second page tone. If a tone-and-voice pager is used, the speaker is then turned on and whatever audio is then transmitted will be heard.

My pager is a tone-and-voice Motorola Pageboy II with an "extra loud housing." The housing is a tuned cavity boosting the apparent audio output. Even with the larger dimensions, it is slightly smaller than a pack of cigarettes and fits nicely into a shirt pocket or on the belt.

There are several types available from several sources. A brand new Pageboy II from Motorola costs about $400.00. A used one may be procured for as low as $75.00 and a new charger for $20.00. Meshna advertised older low band units for $30.00. Other types are available from several sources, including hamfests or other surplus dealers. Ideally, you will want a tone-and-voice pager



Top view of alarm box showing parts placement. Top — logic board. Middle — battery compartment with VW relay installed. Bottom — fuses over transmitter compartment. Note sub-chassis bent to fit in box.



Alarm box without battery showing front panel controls and plugs.

utilizing a standard two-tone paging signal. Tone only units will suffice, but with my circuit, you won't be able to use the identification feature for break-in or tamper.

The alarm circuit is shown in Figs. 1 and 2. If the car is rocked or the motion sensors are otherwise put into motion, the tamper input relays a pulsed ground (remember we are using a positive 15 volt vehicle ground) to the base of Q2 through K3. C5 smooths this voltage and, with R9, provides a short delay to keep Q2 turned on. Relay K2 is energized and provides power to the transmitter and logic circuits. With regulated 6.8 volts and 12 volts now available, the CMOS clock provides a square wave to U2 at a rate determined by pot R1 and C1, the rate being adjustable by the pot.

At the same time, R4 and C2 provide an initial reset on U2 so that it starts counting from zero to insure the page tones get sent first, with the identification tone following.

U2 counts each clock pulse, providing a binary count to 16 to the decimal decoders U3 and U4, wired to provide 16 sequential logic ones at their outputs. These are used to turn on Q3, Q4, and Q5 in turn through diode coding. Q5 is clocked by Q4, which turns on and off with clock U1 if the tamper input is enabled. When Q3, Q4, and Q5 turn on, their collectors go low, thus enabling the tone oscillator outputs in turn. Q3 is on for one count and Q4 for 3 counts. These are the paging tone drivers, and, if the clock is made to run at an approximate 1 second rate, the required "on" time of the two tones will be automatically observed because of the diode coding. A pager requires the 1st tone be one second long and the 2nd tone three seconds. Q5 may be pulsed or steadily on, depending on whether the tamper or alarm inputs are enabled. The former is obtained by gating Q5 and Q6 with the clock so that a half second tone is generated. In the latter case, Q6 is turned on independently by the "alarm" input, providing a continuous path for the emitter of Q5. In this way, a continuous identification tone is generated after the fourth count.

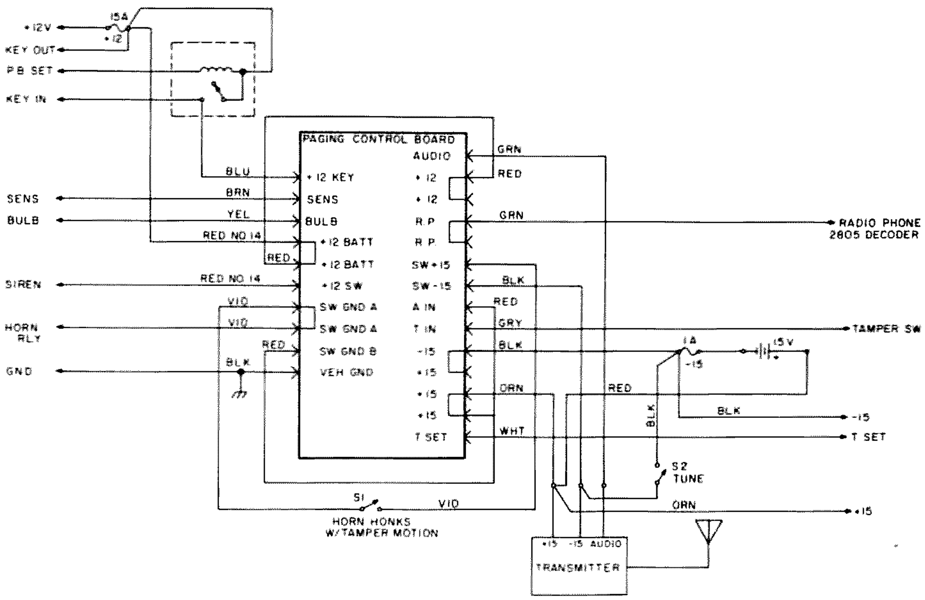
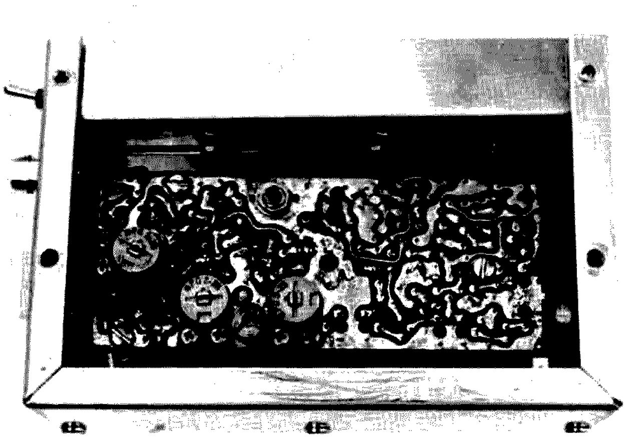


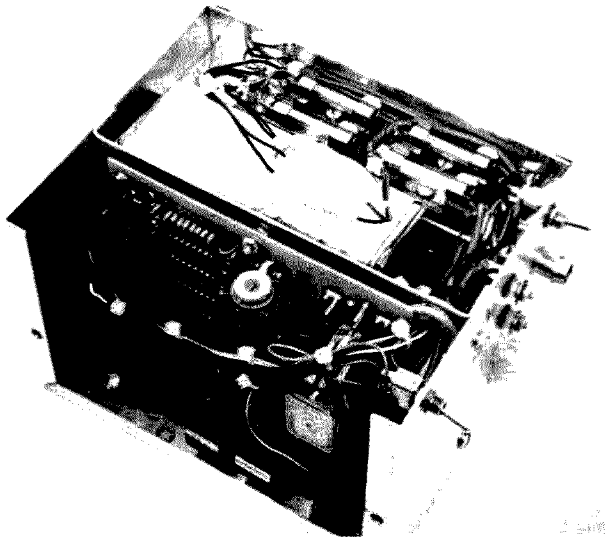
Fig. 3. Main wiring.

The tone encoder circuitry incorporates two reed oscillators and amplifiers for the page tones and one twin T oscillator for the identification tone. The output amplitude of each is fully adjustable for proper insertion to the transmitter. For reasons of frequency stability, reed encoders were used. These are able to withstand the wide temperature extremes found in automobiles without drifting off frequency. The basic design was from one encoder board, socket, and reed purchased from Communications Specialists, Box 153, Brea, California, and adapted for this use.

Since most pagers may come with reeds installed, it will be cheaper to match these reed frequencies to your encoder rather than buy new sets. From name plate information on the pager or the reeds themselves, you can determine the frequencies and order the proper reeds



Side views of alarm showing transmitter board installed.



The completed alarm with battery installed. Note battery plug and method of mounting control board.

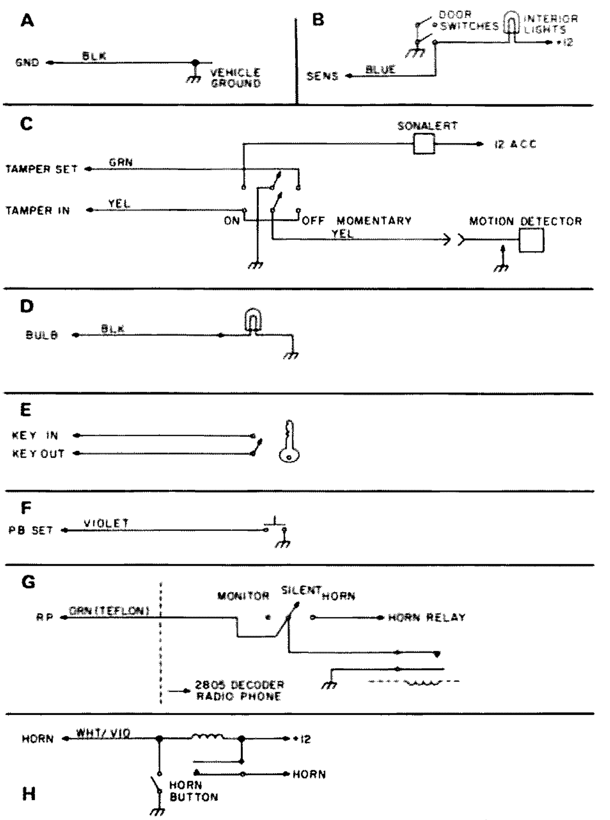


Fig. 4. Interface wiring, alarm to automobile. (c) Tamper set wiring. (d) Status lamp wiring. (e) Keyswitch wiring (operational). (f) Push switch set/reset wiring. (g) Radio page feature.

and sockets. Communications Specialists can supply either reeds, sockets, or complete encoders. If you don't have the reeds installed in the pager, choose any two tones you want or specify you want popular reeds, so that you can get new ones in the future at hamfests or surplus.

Another circuit centered around Q16 allows the tamper sensors to settle down after the car has been driven. Essentially, this circuit disconnects the motion sensors until they have stopped moving to prevent your pager from going wild every time you park your car. If Q8, the SCR, is turned on while the motion sensors are moving, Q7 will conduct through K3, an NC SPST relay in series with the motion sensors. Capacitor C32 smoothes the pulses from the motion detectors and keeps Q7 turned on until the motion has initially stopped. Q7 then turns off, and since there is no longer a load on the SCR, it no longer conducts. With relay coil K3 no longer energized, any further motion now made by the car will not turn Q16 on and will enable the tamper alarm circuitry.

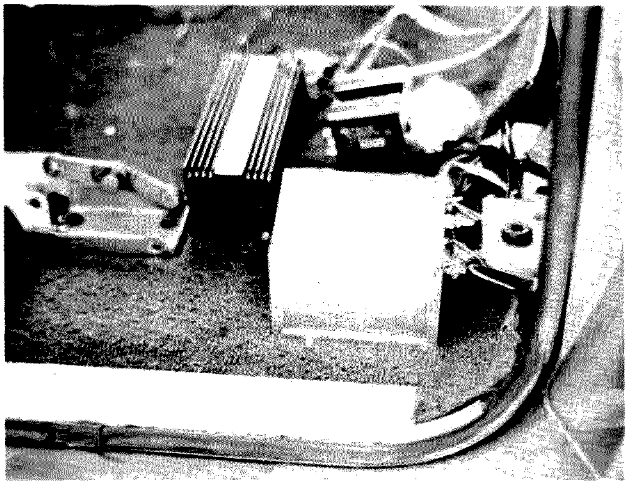
The A input is connected to the output of relay K4 of the alarm circuitry (Fig. 2). When this input is grounded to the vehicle frame, current flows through D22 and R9 to turn Q2 and K2 on. At the same time, current flows through R14 and D21 to Q6, keeping it on so that the identification tone will be steady rather than pulsing.

The vehicle alarm circuit is triggered only when sensors described above are triggered (door switches, mats, vibration sensors, etc.). This circuit is shown in Fig. 2. When the input marked "key" is at +12 volts, Q17 is biased on and grounds the R65-D31 combination which is essentially the base of Q19. If Q17 is turned off by grounding the sensor input momentarily, the collector goes high. Q18 turns on and C34 is charged through R65 and D31. With Q17's collector low again, current flows from C34 into the base of Q19, keeping it on for the length of time determined by R67 and R68. D31 prevents C34 from discharging back to ground through the now "on" Q17.

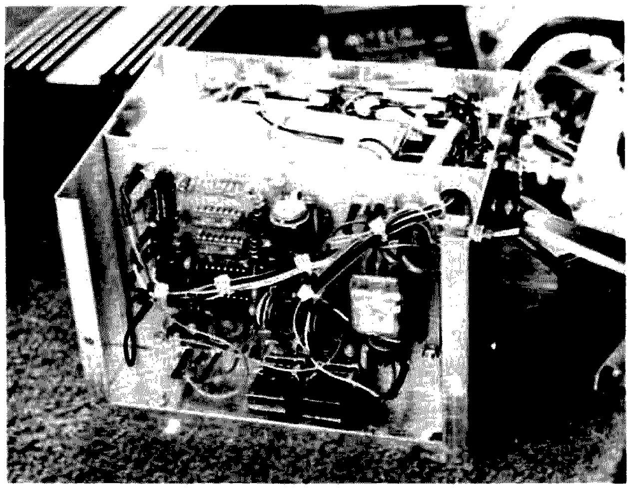
As C34 becomes discharged, Q18 turns off and K4 opens. Since C34 holds a residual charge and will therefore exhibit different time periods if a sensor is again triggered, R69 keeps C34 discharged through K4 while the alarm is off, thereby providing instant reset to whatever time delay has been set (2-3 min.).

K4 provides +12 volt and vehicle ground switching. This is a 4PDT relay rated at 10 Amps. Two sets of contacts are brought out to connectors to provide +12 volts directly to a Federal electronic siren, and two discrete switched grounds are available for the horn relay and the A input to the paging alarm.

Since it was desirable to have easy set/reset capability, a mechanical latching relay is used to arm the system. A push-button sets or resets the alarm and, with no physical switch position to tell if it is set or not, an indicator light is included. When the "key" input is connected through the latching relay to +12 volts, R61 turns on Q20. Initially Q19 is biased on by R60 and passes current to a bulb, keeping it lit. With Q20 on, however, Q19 is turned off and the light goes out,



The completed system installed under rear pull-up seat in car.



Alarm system installed in car, with cover off.

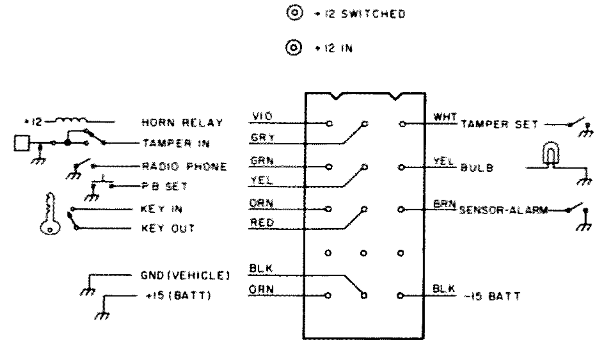
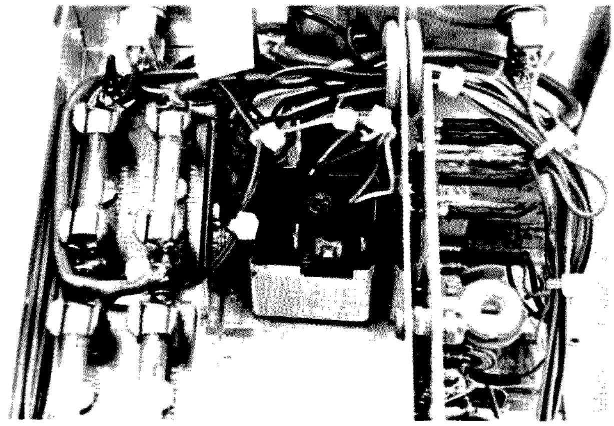


Fig. 5. Connector wiring. Connector as viewed from outside chassis; colors shown in interior wiring. Vehicle wiring color code: green — tamper set: yellow — tamper sensor; blue — sensor; violet — push-button set; white/violet — horn relay; white — headlight relay; black — indicator bulb; orange (teflon) — RCC phone.



Close-up of battery compartment. Note VW relay, 15 conductor plug through to outside, fuses, and logic board mounting.

indicating the alarm is set.

One other circuit is on the board and is a specialized circuit for my own use. With an RCC phone in the car, it has become desirable to have some form of paging occur if someone calls. Since the equipment was present, it seemed easy enough to add a simple circuit to have the alarm call the paging receiver.

When an RCC operator decodes me, a decoder in the RCC radio provides a relay closure to ground. The output of this is tied to isolating relay K1, an SPST relay. This grounds K2, turning on the system and the regular page tones are sent. As explained before, the second page tone sets off the pager receiver's alert tone, which stays on as long as the second tone is transmitted. However, with Q1's emitter grounded by K1, when the base goes high, the collector inhibits the clock input to U2 so that the second page tone will stay on as long as the operator pages me, thereby triggering a continuous alert tone in the pager.

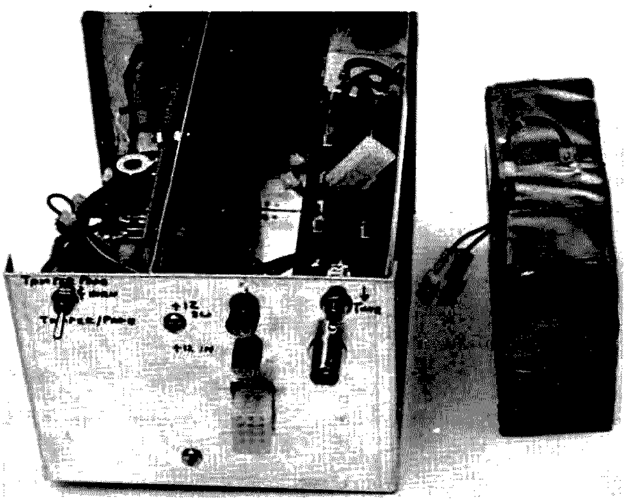
This portion of the circuit is useful if you have RCC or ham decoders, such as touch-tone or PL, which are activated when someone calls you.

We thus have three modes of operation for the paging alarm, identifiable by means of the types of tones out of the pager:

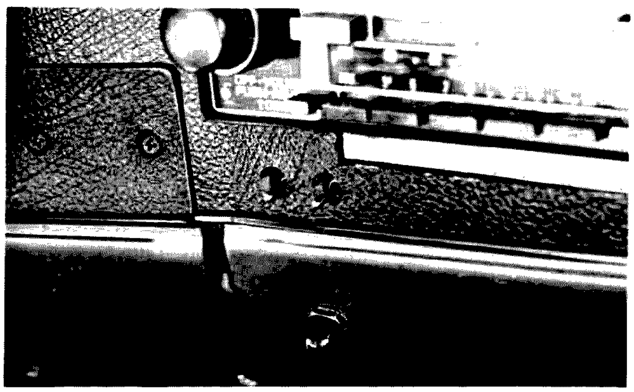
1. A pulsed tone after the alert — Someone is either tampering with the car or an object has hit it, possibly a truck.
2. A steady tone after the alert — Overt action has been taken and entry has been gained, or the above truck totaled your car.
3. A repeating alert signal only — You have just been called on one of the car radios.

Construction was in an LMB 6" x 5" x 4" minibox (#AMC 1007). Two subchassis were bent to fit within the box and used to hold the transmitter and circuit boards (see photos). The battery pack is in between the two. Use was made of Waldom PC card terminals for easy servicing. At each labeled input/output pad, Waldom pins (#R-62-3) were used. The connecting wires had crimp-on sockets (#0206 1103) and were routed to a Waldom plastic 15 circuit connector shell on the outside of the housing, mounted through into the battery compartment. Also located in the battery compartment is the VW headlight dimmer relay (P/N 803941589). This relay is a mechanical latching type so that a single momentary pulse to the coil will turn it on *or* off. One contact goes to the +12 fuse (Fig. 3) and the other goes to the "key in" on the PC board. A hidden push-button switch may then be used to turn the alarm on or off from anywhere outside the car, in addition to having a more cumbersome (and secure) key switch.

Also mounted through into the battery compartment



View of completed unit. Note battery pack and connectors.



The automobile installation. The light is "on" when the alarm is not set. Of the two switches, the left, when pushed down, sets the tamper delay. When in the up position, the tamper alarm is on. The switch on the right controls another circuit in the car.

Fig. 6(a). PC board.

above the Waldom connector shell are two #8 screws with fiber washers to insulate them from the chassis. A solder terminal is under each one. #14 wires are then soldered to these and go to the +12 input fuse and relay K4. These two terminals then pass the heavy current required by the siren.

The battery pack is a 15 volt, 1 Ah array made from 12 commercial 1 Ah 1.25 volt nicad cells. Since these were already available, I wired them together in series and potted them in casting plastic, using an aluminum foil pie pan bent into a mold. These had solder tabs, but the flashlight "C" size will work every well with the plastic battery holders, which may be easily obtained, although they will take up more space.

Other sources of 15 volt batteries are Motorola HT-220 (omni) or HT-200 batteries, usually available for $5.00 from hamfests. A contact arrangement will have to be made up for these. For those of you with Motorola HTs, this is the very thing to use because you can use your HT chargers to keep the batteries up.

The battery ratings should be at least 500 mAh and 1 Ah is best. The larger the battery rating, the more time you can go between charging.

Two switches are mounted on the box. One is S2 (Fig. 3), which allows me to tune the transmitter by turning on the carrier alone. It is an optional feature which is used when parked in crowded public areas, such as a summer bluegrass festival, or ham flea market, where people tend to sit or lean on the cars. If the motion sensor is set off with this switch on, the horn will blow until motion ceases. I had many scratch marks on one car I owned that was usually parked in an area where people used to wait for buses. They wore exposed key rings and would lean back or sit on the car, leaving many deep scratches. It's very hard to sit on the hood of a car when the horn is blowing.

The double-sided PC board has been laid out for small components. Tantalum capacitors were used wherever there was a potential temperature problem (such as in the timing circuits) and also because of their size. CK05 capacitors were used in other locations for bypass and noise padding. Other types can be used, but judiciously, to prevent variation in clock speed, deviation, etc., with temperature. Ceramic disc bypass capacitors can be used if they are the 25 volt size to fit the layout.

After the board has been completed, you will need an audio amplifier and a 10 to 15 volt source to check it out. Begin by setting all controls to their midrange. Attach the hot lead of the amplifier to the point marked "Audio," +15 volts to the "+15" input, and -15 volts to the "-15" input. Also, attach the ground lead of the amplifier to the "-15" input, and connect a clip lead to the +15 volt battery lead.

Using a VOM connected between -15 and the junction of R7 and D3, connect the free end of the clip lead to the "A" input. The VOM should indicate 6 to 7 volts, although higher readings are permissible. Next, move the probe to the junction of R8 and D4 and check for 12 volts here.

At the same time, as you connect the clip lead to the A

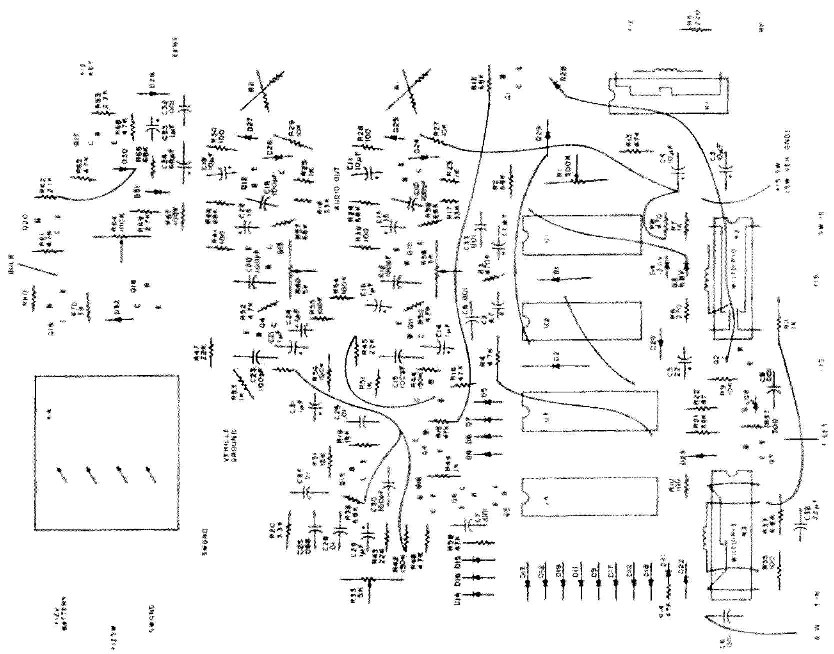


Fig. 6(b). Component layout.

input, you should hear a faint clicking noise from the audio amplifier and, after a short delay, you will hear the page tones followed by a steady alert tone. If this does not happen, the clock may be running too slow. Adjust pot R1, the clock adjustment, to a point at which something starts to happen with the tones.

Move the clip lead from the "A" input to the "T in" input and pulse it at a 2 or 4 pps rate by tapping the clip against the post. The voltage at R7 and D3 should be constant and the paging sequence should start as before. The only difference will be the alert tone, which will be pulsing rather than steady.

Now attach the clip lead to the "T in" post and adjust R1 for a one second 1st page tone or a ½ second on, ½ second off alert tone. Momentarily ground (-15) the "T set" input and insure that the voltage at R7 and D3 goes to zero until you *momentarily* release the clip lead from the "T-in" post. This indicates the tamper delay is working.

After the clock is adjusted and the circuit is performing correctly, check the radio call feature. Connect a clip lead between the "-15" input and "RP" input. Then connect another clip lead between the point marked "+12" (next to the "RP" input) and "+15". You should hear the two page tones; however, the second tone will stay on for as long as you have the clip leads attached.

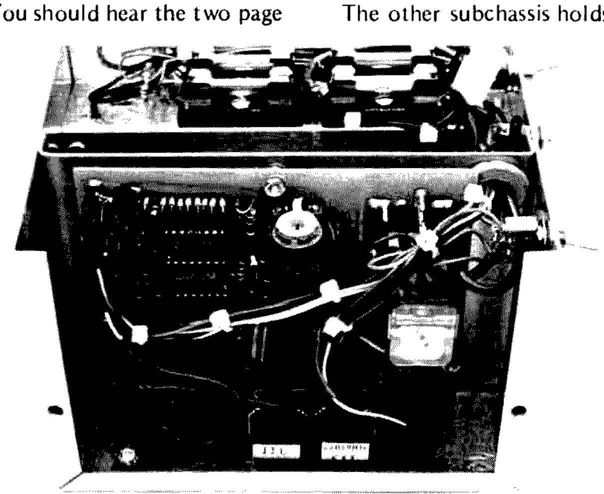
Assembly is simple and straightforward. The minibox bottom is divided into three equal parts by two subchassis bent to fit into the interior. Between the outside of the box and fastened to one subchassis is the control board. A hole punched into this subchassis allows the wires from the various pin connectors to be routed to their various destinations, mostly the 15 pin Waldom connector in the battery compartment.

The other subchassis holds the transmitter board between it and the other side of the minibox. Power and audio is fed to it through two feedthrough capacitors. You will note in the photographs that this subchassis is bent to provide a ledge holding the feedthrough caps and the fuse holders. One set of fuses are spares.

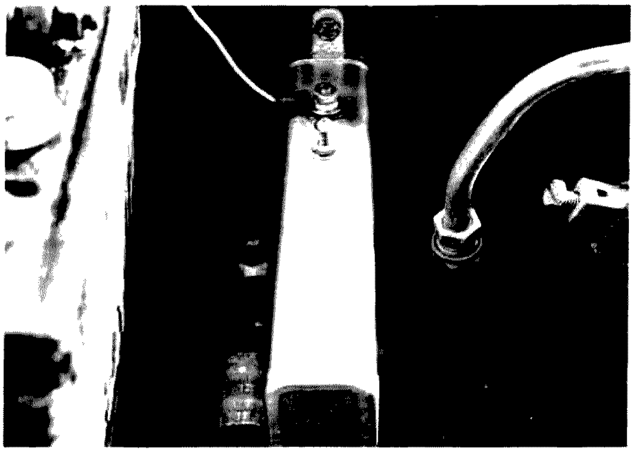
The antenna connector is mounted through to the transmitter compartment and a short piece (about 1/2 inch) of #18 stranded wire attaches to the antenna output of the transmitter board.

The battery compartment in the center holds the VW latching relay as well as the batteries. Depending on the size of the batteries you use, this may be otherwise empty with the batteries external to the box. If 12 "D" or "C" cells are used, the box will have to be larger. Another alternative is to use a large dry 15 volt "electronic equipment" battery, external to the box, making connections through the 15 pin connector.

After completion of the wiring and mechanical assembly, plug in the batteries with the 1 Amp fuse removed. Check with a milliammeter to insure that



View showing subchassis mounting.



One of the tamper sensors mounted in place in the engine compartment.

only a couple of microamps are being drawn with no inputs enabled. If all is well, install the fuses.

Tune the transmitter into a dummy load using the tune switch. At this point, you can check operation of the paging alarm if the pager is close by. About four seconds after connecting a clip lead from the chassis to the "A in" or "T in" inputs, the pager should emit its alert tone and sound the identification tone. If the circuit is left connected, after about 15 seconds the entire cycle will repeat itself.

Adjust the transmitter frequency trimmer to zero on the receiver (or vice versa) and adjust pots R38, R40, and R33 for proper audio. You will want to ideally be at ±5 kHz deviation, but if you don't have a deviation monitor, adjust for as close to the same audio level as a voice transmission and then check with a scope to see that all the tones are roughly the same. After making sure the unit is operational, it may be installed in the car.

A length of RG-58 cable was routed to the rear window and a metal clamp attached to the outer shield at the point where the cable emerged next to the window. The clamp was fastened to the window frame and the solid inner conductor stripped to a length of 20 inches. A piece of 50 lb. test nylon fishline held this wire taut and was routed to a small bracket mounted above the window. Then, with the aid of a through-line wattmeter, the wire was trimmed for lowest swr. The top was formed into a loop and the fishline stretched from there to a small spring fastened to the bracket. This method has kept the wire taut yet allowed for parcels to hit it without breaking the wire.

A key lock switch was installed on the body of the vehicle and is used in high risk areas, where the hidden push-button may not be as secure. The wires to this switch are routed to the 15 pin connector on the alarm chassis. See Fig. 4(e).

A momentary-on push-button switch was mounted in an easy-to-get-to yet unostentatious place on the outside of the car. In low risk areas, this switch is used exclusively as it allows quick and easy setting/unsetting of the alarm without the usual fumbling for the keys. The status bulb is located within the car on the dash. As mentioned before, when it is "on", the alarm is not set, and when it is out, the alarm is set. This prevents an occasional uninterested glance inside by passersby to change to an interested glance when they notice a green light glowing.

The switch for the tamper alarm set/reset function is also on the dashboard. This is a center off DPDT switch with a spring return in one position, and "on" in the other position. Depressing the switch momentarily, then quickly switching to the "on" position sets the tamper delay and readies the circuit so that when all preliminary motion has ceased, any further motion will sound the alarm.

The tamper sensors are made by Empire. Mine were obtained at a discount auto parts store. The term "discount" does not apply here because they cost $10.00 each and consist merely of a flat spring with a weight on one end. The whole thing is mounted in a small enclosure with the spring supported at one end. When the surface to which it is attached is moved, the weight causes a pendulum-like effect and brings the grounded spring into contact with an adjustable screw contact.

One characteristic of the motion is that due to the force against the screw contact, a small secondary or harmonic motion is imparted to the spring. As the car is driven to a halt and the alarm

Parts List — Paging Counter

U1	CD4011
U2	CD4024
U3, U4	CD4028
Q1, Q2, Q3, Q4, Q5, Q6, Q7	NPN 2N3904, HEP S0025, etc.
Q8	SCR 2N5061, HEP R1001, etc.
Q9, Q10, Q11, Q12, Q13, Q14, Q16	NPN 2N3565, HEP S0015, etc.
Q15	NPN S0015 HEP
D1, D2, D5-D28	1N914, 1N4148, etc.
D3	Zener, 6.8 volt, ¼ Watt
D4	Zener, 12.0 volt, ¼ Watt
R1	500k Potentiometer CTS X201R504B or equiv.
R2, R24, R26, R57, R59	68k ¼ Watt 10%
R3	470k ¼ Watt 10%
R4, R48, R50, R52	4.7k ¼ Watt 10%
R5	220 ¼ Watt 10%
R6	270 ¼ Watt 10%
R7, R11, R23, R25, R49, R51, R53	1k ¼ Watt 10%
R8	470 ¼ Watt 10%
R9, R27, R29	10k ¼ Watt 10%
R10, R28, R30, R35, R39, R41	100 ¼ Watt 10%
R12	100k ¼ Watt 10%
R13, R14, R15, R16, R58	47k ¼ Watt 10%
R17, R18, R21	33k ¼ Watt 10%
R19, R31	15k ¼ Watt 10%
R20	3.3k ¼ Watt 10%
R22	47 ¼ Watt 10%
R32, R34	6.8k ¼ Watt 10%
R33, R38, R40	5k Potentiometer, CTS X201R502B
R37	300 ¼ Watt 10%
R42, R44, R46	150k ¼ Watt 10%
R43, R45, R47	22k ¼ Watt 10%
R54, R55, R56, R57	27k ¼ Watt 10%
R36 deleted	
C1, C2	4.7 uF Tantalum electrolytic
C3, C4, C11, C19	10 uF Tantalum electrolytic
C5, C32	22 uF Tantalum electrolytic
C6, C7, C8, C9, C33	.001 Disc or CK05
C10, C12, C15, C18, C20, C23, C30	100 pF Ceramic disc
C13, C22	.1 Ceramic disc
C14, C16, C21, C24, C29, C31	1 uF Tantalum electrolytic
C25	.068 Ceramic disc
C26, C27, C28	.01 Ceramic disc or CK05
K1	SPST-NO DIP relay Magnecraft W107 DIP 5
K2	DPST-NO DIP relay Magnecraft W117 DIP 10
K3	SPST-NC DIP relay Magnecraft W117 DIP 13

set, the motion sensors gradually settle down. At some point, the motion of the spring will stop completely as the forces on it approach 180 degrees, and then it will start up again momentarily. The tamper delay circuitry senses this initial stop and unsets the delay, so that the tamper alarm will sound momentarily when the contacts close again. This is dependent to an extent on the sensitivity of the motion sensor, but serves as a handy check on the operation. Usually you are at your destination by the time the tamper circuitry arms itself, and you can tell if the beeper goes off whether or not you are too far away or if the unit is not working.

Additionally, these motion sensors are affected by temperature. If the sensitivity is set too close and the unit then heats up, such as after driving, it may be closed by the time you drive to your destination. If you then set the tamper delay, it will never release until the car cools off and the contacts release, which could take hours. The short beep you will usually hear is an indication that all is well.

Another check is made when you enter the vehicle. The action of opening a door and sitting on the seat should be enough to set off your beeper and the switch may then be turned off.

If you don't have your beeper with you one day, or other members of your family drive your car, a Sonalert hooked up as shown in Fig. 4(c) will remind them that you are transmitting if it sounds. It's very hard to be in the same car with a working Sonalert, so your transmitter and batteries will be preserved.

The entire alarm box can be mounted anywhere convenient, provided the two switches can be reached with a minimum of trouble. In my Chevrolet "Suburban," it is under the folding rear seat and near the door so that

Parts List — Alarm

Q17, Q19, Q20	2N3904 or equivalent NPN
Q18	MPS-A14 or equivalent Darlington NPN
D29, 30, 31, 32	1N914, 1N4148, etc.
R60, R62, R63	2.2k ¼ Watt 10%
R61, R64, R65	4.7k ¼ Watt 10%
R66	6.8k ¼ Watt 10%
R67	100k ¼ Watt 10%
R68	500k Pot CTS X201R504B
R69	2.7k ¼ Watt 10%
R70	39 1 Watt
K4	4PDT Magnecraft W77CSX-1 or equivalent
C32A	.001 Ceramic disc or CK05
C33	1 uF Tantalum
C34	68 uF Tantalum

servicing is easy and the switches are within easy reach. The individual wires from the mating 15 pin conductor are made up into a harness with wire ties and run to the front of the car, where connections are made to the various devices. With this harness, a #14 gauge wire is also run, which connects to the battery terminal at the starter solenoid. This wire connects to the "+12 input" in the box. Another length of #14 wire goes from the "switched +12" terminal on the box to the power switch on the electronic siren. The function switch on this siren is set to the "yelp" mode.

The transmitter to be used is left up to the user. My version, as said before, uses the GE Voice Commander II board. The VC II or VC III are okay, and HT-200 boards are available at hamfests very inexpensively. If you cannot locate any of these, VHF Engineering sells an inexpensive kit which is 12 volt negative ground. Since it will not work directly with the positive ground arrangement used with the circuit board, a small relay should be used to switch the transmitter on or off by placing the contacts in series with the vehicle battery or an auxiliary 12 volt battery.

The operating frequency of the transmitter and pager must be judiciously chosen. 146.94 is too popular, repeater input frequencies are frowned upon, and use of the commercial bands is a definite no. A choice could be 147.015, 146.475, or any other offbeat frequency. 146.94 was used in my first version with the HT-220 because I didn't want to "waste" a crystal position. When I switched to the pager, I kept this frequency at first; however, at hamfests .94 would be disrupted if someone leaned against the car and, at one, the special .94 repeater covered up my alarm signal completely.

At the time of writing, this new unit has been installed for two years and has exhibited complete reliability. The present car (bought two years ago) has been broken into 8 times. Six times the alarm went off as they opened the doors (I keep them unlocked to prevent breakage). Twice the tamper alarm went off in the middle of the night and as I hurriedly threw my clothes on, the pulsed tone changed to a steady tone and all hell broke loose outside. The thief in these cases had pried open a vent window without trying the door first, rolled the main window down, and opened the door by reaching inside. The motion circuitry detected the break-in and the alarm sensors detected the opening of a door.

Certain tamper signals have also alerted me to the fact that various things were happening. Once I caught a person trying to parallel park in front of me in a space too small for his car. He backed into me and tried to push my car back, a poor thing to do to an automatic transmission left in park. Two children climbing on my car with hard shoes on were asked to get off, and other miscellaneous unintentional nudgings and movements were detected as they happened.

The battery gets charged overnight every two months or so, but rarely needs it. I charge these 1 Ah cells at a steady 100 mA and temporarily use a standby battery for protection.

Another use for a device like this is to build it into a larger chassis with an antenna attached and with built-in motion detectors. The unit is then portable and may be simply placed on the seat or floor of a car, trailer, camper, etc., or hung from the door of a house. On a float, it can function as a wireless swimming pool alarm. Store owners with large, lit signs that get vandalized in the night can put one in the sign. One can be installed in a motorcycle, boat (with different sensors), private plane, etc. Since the pager receiver does not "hear" anything until after the two-tone page signal, it can be left on at all times, even while in the charger, and no irritating chit-chat or interference will ever be apparent. The range of the system is sufficient that a reliable alert will be heard to a radius of at least a mile. ■

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Electronic Systems Corp.
228 Coolidge St.
Jefferson LA 70121

Try Your KIM-1 On RTTY

-- CUL on your computer

KIM-1 is an eight bit microprocessor sold by MOS Technology,[1] which uses the MCS 6502 chip as its central processing unit (CPU). KIM stands for "Keyboard Input Monitor" and describes the software residing in read only memory (ROM) on the two 6530 multipurpose 40 pin chips on the KIM-1 board.

My reason for choosing the KIM-1 was price. The whole KIM computer, with cassette interface, keypad, TTY interface, LED readouts for address and data, costs under $250. For the beginner, there are some "bad" features about it, which I should mention.

To use the KIM-1, you must build your own power supply and cabinet. Also, the user manual and other documentation is oriented more toward the computer prototyper than to the hobbyist. Very few examples are given in the documentation supplied, and the user really has to dig into the machine to get to know it. Software has been very scarce, but, since the KIM-1 users group was formed,[2] more and more software is becoming available.

On the positive side, MOS Technology is making quite an inroad into their own software development. They will soon make a full math package available in ROM, as well as a complete editor-assembler (single pass type) in ROM also. To me, this is what is needed in the industry; by making the "firmware" a permanent part of the "hardware," you do not have to spend a large amount of time and trouble loading programs via cassette (which on KIM operates at about 135 baud).

The two programs included are not original. They are 6502 adaptations of programs which have already been published elsewhere for other type processors.[3,4] To use these programs, it is assumed you have, along with KIM-1, a working CRT terminal with a serial I/O Interface. I use an Infoton BASIC with a full-duplex 20 mA loop hooked to the KIM-1 20 mA loop terminals on the applications connector. I run my terminal at 4800 baud usually.

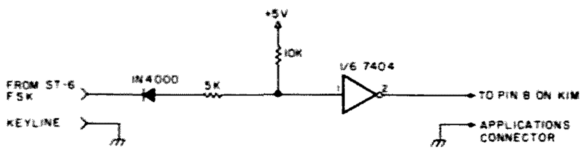

Fig. 1. Interface required to connect ST-6 FSK keyline (or any RS-232C level signal) to KIM-1.

The Baudot Receive Program

The first program was developed out of sheer necessity. Since I am interested in amateur radioteletype (RTTY), I needed a way to quiet things down around the shack while copying press broadcasts and amateur stations. My Model 28 KSR compact is very noisy, and, since KIM-1 and my CRT terminal make no noise, it sure is a lot easier on the nerves.

This is the listing for the Baudot (5 level) receive converter (or monitor), which is in use daily at this station. The FSK converter I use is the ST-6 built from the HAL kit.[5] The output of the ST-6, which I use to feed the computer, is the FSK line output, which is normally used to drive the FSK circuit of the amateur's transmitter. Irv Hoff, who designed the ST-6, in his wisdom chose the computer industry standard RS-232C levels for this output. This means that the output signal jumps in a discrete transition from -12 V to +12 V, which signify mark and space respectively. For more information on RTTY and the equipment you need to get started, see reference 6.

In order to make the ±12 V mark-space levels compatible with the 0 and +5 volt levels needed by KIM-1, you must first construct an "interface." This interface is very simple, and uses only four electronic components. See Fig. 1.

Unlike the KIM-1 monitor, which is completely self-adjusting in regard to baud rate, this monitor requires that you load two values into locations 0274 and 0283 for the various speeds you wish to copy. See Fig. 2. You will notice locations 0227 to 023F were left blank. If you wish to incorporate "unshift on space" in your monitor,

simply insert the unshift on space routine given at the end of the listing in the locations designated (locations 0220 to 022A). You would use the listing without the "unshift on space" for copying weather broadcasts and the listing with "unshift on space" for press and amateur copy.

To use this Baudot monitor, construct the interface and check the output with a voltmeter *before* hooking it up to pin 8 of the applications connector. You can use your receiver calibrator to supply the necessary mark and space signals to the converter, and the output of the interface should be at TTL levels. If you get the correct levels, hook the output of the interface to pin 8 of the applications connector. Next, load the program into the K1M-1 (hopefully via cassette), and make sure you loaded the correct delay constants for the speed you wish to copy from Fig. 2. Remember, most US press broadcasts use 66 wpm, so be sure to change the delay constants. The computer is not as forgiving as the Model 28, which *can* receive 66 wpm RTTY with 60 wpm gears.

CW Transmit Routine

This routine is basically a 6502 version of the program mentioned in reference 4. It really comes in handy on the CW net I check into several times weekly. If you would like to hear a sample of the CW this routine produces, tune in the Liberty Net on 3750 kHz at 8 pm CST on Wednesday and Saturday nights. I have used the same nomenclature used by Sewell, so you should have no trouble following the 6502 algorithm.

Location	60 wpm	66 wpm	75 wpm	100 wpm
0274	0B	0A	08	08
0283	15	14	11	0D

Fig. 2. Delay constants to be loaded into locations 0274 and 0283 for various RTTY speeds.

The most important difference between the 6800 CPU and the 6502 chip is the method used by each for indirect addressing. The 6800 uses a full 16 bit index register, while the 6502 uses two 8 bit index registers. Thus, when crossing a page boundary (256 bytes/page) with the 6502 in the indexed addressing mode, you must use quite a few tricks to keep from putting out an invalid address when on the first byte of the new page. The method I used can be seen at locations 001A through 0021, and 004A through 004F.

The buffer in this routine (ASDRIVER) is 512 bytes long, and includes all of pages 2 and 3 of my unexpanded KIM-1. Thus, since my terminal has 80 characters/line, I can store about 6½ lines of text before overrunning the buffer. 512 bytes will keep you from getting too long-winded. If your KIM is expanded and has more than the 1K of memory mine has, you can be as long-winded as you like. This routine will automatically cross the page boundaries for you (I pity the poor guy on the other end, though).

You must construct an interface from the TTL level output of pin 14 of the applications connector to your transmitter. Since I use the Heath SB-400 which has about +25 V on the CW keyline, this interface is a little more involved than the one for the RTTY interface described above. However, it uses the same 7404 chip as the RTTY interface, and both can be left connected together. See Fig. 3. If your transmitter will not work with this keyer, see the *TTL Cookbook* for other examples or the articles by Hoff in *RTTY Journal.* Don't forget to connect pin 14 of the 7404 chip to +5 volts and pin 7 to ground.

You will note in the comments for location 002B, "Is this a cursor left?" What this means is that my Infoton terminal has a separate cursor control keypad to control the cursor without affecting the display. Infoton uses the hex code "1A" to indicate a cursor left or backspace. Backspace in this routine is used to correct any mistakes while using the buffered routine. You hit backspace (in my case, "cursor left") and

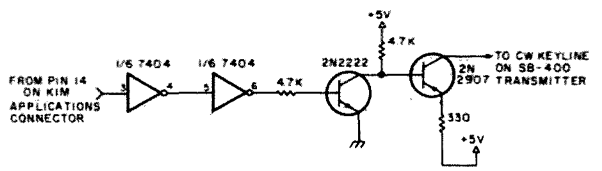

Fig. 3. Interface between KIM-1 and SB-400 transmitter. See text for source of other circuits covering other transmitters.

BAUDOT-ASCII ROUTINE

```
0200  20 40 02  BEGIN    JSR  0240      JUMP TO GETCHB ROUTINE
  03  A6 E1              LDX            LOAD X W/00E1
  05  E0 18              CPX  #$18      IS THIS BAUDOT "FIGS"?
  07  D0 03              BNE  020C      IF NOT, GO TO 020C
  09  4C 15 02           JMP  0215      IF SO, GO TO "FIGS" SUBROUTINE
  0C  BD 90 02  "LTRS"   LDA            LOAD ACC. W/0290 + X, LETTERS
020F  20 A0 1E           JSR  OUTCH     PRINT ASCII CHAR. IN ACC.
  12  4C 00 02           JMP  BEGIN     GET NEXT CHARACTER
  15  BD B0 02  "FIGS"   LDA  02B0+X    LOAD ACC. W/"FIGS" LOOKUP
  18  20 A0 1E           JSR  OUTCH     PRINT ASCII CHAR. IN ACC.
  1B  20 40 02           JSR  GETCHB    GET NEXT BAUDOT CHAR.
  1E  A6 E1              LDX  00E1      LOAD X-POINTER W/00E1
0220  E0 1F              CPX  #$1F      IS THIS  BAUDOT "LETTERS"?
  22  D0 E0              BNE  "FIGS"    IF NOT, GO TO "FIGS"
  24  4C 0C 02           JMP  "LTRS"    JUMP TO 020C

0227 TO 023F  00   THESE LOCATIONS RESERVED FOR UNSHIFT ON SPACE AND OTHER
                   SPECIAL APPLICATIONS.  SEE END OF LISTING FOR UNSHIFT
                   ON SPACE LISTING.

0240  86 E0     GETCHB   STX  TEMP      STORE X TEMPORARILY AT 00E0
  42  A2 05              LDX  #$05      SET UP 5 BIT COUNT
  44  A9 00              LDA  #$00      LOAD ACC. W/$00
  46  8D 01 17           STA  PADD      LOAD $00 INTO 1701 (PADD)
  49  A9 00              LDA  #$80      SET UP PA7 AS INPUT
  4B  2C 00 17           BIT  PA7       TEST PA7 FOR SPACE (START PULSE)
  4E  D0 F9              BNE  0249      IF NOT START PULSE, TRY AGAIN
0250  20 80 02           JSR  DELAY     DELAY ONE PULSE LENGTH
  53  20 71 02           JSR  DEHALF    SAMPLE AT MIDDLE OF PULSE ONE
  56  AD 00 17  GET2     LDA  1700      LOAD ACC. W/INFO AT PAD
  59  29 00              AND  #$80      "AND" ACC W/$80
  5B  46 E1              LSR  CHAR      SHIFT 00E1 RIGHT ONE BIT
  5D  05 E1              ORA  CHAR      "OR" ACC W/00E1
025F  05 E1              STA  CHAR      STORE RESULT AT 00E1
  61  20 80 02           JSR  DELAY     DELAY ONE BIT TIME
  64  CA                 DEX            DECREMENT BIT COUNT BY ONE
  65  D0 EF              BNE  GET2      BRANCH ON X≠0 TO 0256
  67  20 71 02           JSR  DEHALF    DELAY 1/2 BIT TIME
  6A  46 E1              LSR  00E1      SHIFT RIGHT ONE BIT
  6C  46 E1              LSR   "                "
  6E  46 E1              LSR   "                "
0270  60                 RTS            RETURN TO START

0271  05 E2     DEHALF   STA  TEMP      STORE ACC. TEMP. AT 00E2
  73  A9 0B              LDA  #$0B      SET TIMER FOR 11 MS. DELAY
  75  8D 07 17           STA  1707      START TIMER
  78  2C 07 17           BIT  TIMER     IS TIMER FINISHED?
  7B  10 FB              BPL  0278      IF NOT, TRY AGAIN
  7D  A5 E2              LDA  00E2      RESTORE ACCUMULATOR
  7F  60                 RTS            RETURN
0280  85 E2     DELAY    STA  TEMP      STORE ACC. TEMP AT 00E2
  82  A9 15              LDA  #$15      SET TIMER FOR 22 MS. DELAY
  84  8D 07 17           STA  1707      START TIMER
  87  2C 07 17           BIT  TIMER     IS TIMER FINISHED?
  8A  10 FB              BPL  0287      IF NOT, TRY AGAIN
  8C  A5 E2              LDA  00E2      RESTORE ACCUMULATOR
  8E  60                 RTS            RETURN
```

LOOKUP TABLE

```
0290  00 - NOP                   02B0  00 - NOP
  91  45 - E                       B1  33 - 3
  92  0A - LINEFEED                B2  0A - LINEFEED
  93  41 - A                       B3  2D - HYPHEN
  94  20 - SPACE                   B4  20 - SPACE
  95  53 - S                       B5  00 - BELL (NOP)
  96  49 - I                       B6  38 - 8
  97  55 - U                       B7  37 - 7
  98  0D - CARRIAGE RET.           B8  0D - CARRIAGE RET.
  99  44 - D                       B9  24 - $
  9A  52 - R                       BA  34 - 4
  9B  4A - J                       BB  27 - APOSTROPHE
  9C  4E - N                       BC  2C - COMMA
  9D  46 - F                       BD  21 - EXCLAMATION POINT
  9E  43 - C                       BE  3A - COLON
  9F  4B - K                       BF  28 - OPEN PARENTHESIS
02A0  54 - T                     02C0  35 - 5
  A1  5A - Z                       C1  22 - QUOTE
  A2  4C - L                       C2  29 - CLOSE PARENTHESIS
  A3  57 - W                       C3  32 - 2
  A4  48 - H                       C4  23 - #
  A5  59 - Y                       C5  36 - 6
  A6  50 - P                       C6  30 - 0
  A7  51 - Q                       C7  31 - 1
  A8  4F - O                       C8  39 - 9
  A9  42 - B                       C9  3F - ?
  AA  47 - G                       CA  26 - &
  AB  00 - FIGS (NOP)              CB  00 - FIGS (NOP)
  AC  4D - M                       CC  2E - PERIOD
  AD  58 - X                       CD  2F - /
  AE  56 - V                       CE  3B - SEMI-COLON
02AF  00 - LTRS (NOP)            02CF  00 - LTRS (NOP)
```

UNSHIFT ON SPACE ROUTINE

```
0220  E0 04              CPX  #$04      IS THIS A BAUDOT "SPACE"?
  22  F0 E8              BEQ  020C      IF SO, GO TO"LTRS"
  24  E0 1F              CPX  #$1F      IS THIS A BAUDOT "LETTERS"?
  26  D0 ED              BNE  "FIGS"    IF SO, GO TO 0215
0228  4C 0C 02           JMP  "LTRS"    JUMP TO 020C
```

Fig. 4. Special keys used on terminals and their CW equivalents.

!	–	ERROR	....
#	–	SK	...-.-
$	–	AR	.-.-.
&	–	BT	-...-
+	–	KN	-.--.
=	–	AS	.-...

type right over the mistake. Thus the double-decrement of the x-pointer in locations 002F and 0030. If your terminal uses another code for backspace, simply insert it in location 002C. Notice locations 0000 and 0001 in the listing. These are labeled ELSPEED and CHRSPEED. These locations are for timing constants used in the delay routines by the timer, at locations 00CF and 00DF. For normal CW, location 0000 contains the speed you desire (a value of hex 30 = 20 wpm, hex 60 = 10 wpm, etc.), and location 0001 contains the spacing between individual characters, and should contain hex 03 (which means the spacing between characters will be equal to 3 dot lengths). Larger numbers in location 0000 give progressively slower CW speeds, and vice versa. When using the SINGLECH routine, location 0001 should contain hex 01. Notice that the buffered routine starts at location 0005 and the single character routine starts at location 0145. If you desire to switch from one to the other, you must stop KIM. In the KIM-1 user manual, the method for doing this is not made clear. You must load the NMI vector (the vector you get by pushing the stop key on the keypad) into locations 17FA and 17FB. Then, when you push the stop button, the NMI line is brought low and signals an interrupt to the 6502 chip. Internally the 6502 completes its present instruction and jumps to locations 17FA and 17FB for directions on where to go to service the interrupt. The program counter will then address the location contained in 17FA and 17FB. MOS Technology recommends loading 1C00 into this location. But, you must load them in reverse, with the low order byte first. Thus, remember to always load 00 into location 17FA and 1C in location 17FB. This is the first thing you should do when bringing up the computer.

There is another peculiarity of KIM which is not stressed enough in the documentation. This concerns the use of the flag status register at location 00F1 while using the cassette interface. Since the 6502 chip has a decimal mode of arithmetic operation, and since the cassette interface will only work in the binary mode of operation, you must *always* clear the decimal flag before any cassette load or dump operations. Simply load hex 00 into location 00F1 before using the cassette.

To use this CW routine, load your program into the computer, and be sure to load your code speed into locations 0000 and 0001. If you wish to use the buffered output, go to location 0005,

CW OUTPUT ROUTINE

```
ØØØØ   ELSPEED
ØØØ1   CHRSPEED
ØØØ2   HOLDBYTE
ØØØ3   COUNT
ØØØ4   CW POINTER

ØØØ5   A9 Ø1       ASDRIVER    LDA   #$Ø1       PLACE A 1 IN FIRST BIT, TO SET UP
  Ø7   8D Ø1 17                STA   PADD       OUTPUT BIT AT LOC. 17Ø1 (PADD)
  ØA   A9 Ø2                   LDA   #$Ø2       SET UP PAGE 2 TO RECEIVE CW CHARS
  ØC   85 19                   STA              STORE AT ØØ19
  ØE   85 39                   STA              STORE AT ØØ39
ØØ1Ø   85 44                   STA              STORE AT ØØ44
  12   A2 ØØ                   LDX   #$ØØ       SET POINTER (X-INDEX) TO ZERO
  14   2Ø 5A 1E    LOADLOOP    JSR   GETCH      GO TO KIM "GETCH" ROUTINE
  17   9D ØØ Ø2                STA   Ø2ØØ + X   STORE ASCII CHAR. AT Ø2ØØ+X
  1A   EØ FF                   CPX   #$FF       IS PAGE 2 FILLED WITH CHARS?
  1C   DØ Ø4                   BNE   LOC. ØØ22  IF FULL, GO TO ØØ22
  1E   E6 19                   INC   ØØ19       CHANGE 2 AT ØØ19 TO A 3.
ØØ2Ø   E6 39                   INC   ØØ39       CHANGE 2 AT ØØ39 TO A 3.
  22   E8                      INX              INCREMENT THE X-POINTER
  23   C9 Ø3                   CMP   #$Ø3       IS THIS THE STOP BYTE?
  25   FØ 13                   BEQ   NONEED 3   IF A STOP, GO TO LOC. ØØ34
  27   C9 ØA                   CMP   #$ØA       IS THIS AN ASCII "LINEFEED"?
  29   FØ Ø9                   BEQ   SENDIT     IF SO, GO TO LOC. ØØ34
  2B   C9 1A                   CMP   #$1A       IS THIS A "CURSOR LEFT"? (NOTE 1)
  2D   DØ E5                   BNE   LOADLOOP   IF NONE OF ABOVE, GET NEXT CHAR.
  2F   CA                      DEX              IF LAST CHAR WAS A CURSOR LEFT,
ØØ3Ø   CA                      DEX              DECREMENT POINTER TWICE
  31   4C 14 ØØ                JMP   LOADLOOP   GET NEXT CHAR., AND STORE IN BUFF
  34   A9 Ø3       SENDIT      LDA   #$Ø3       PUT STOP BYTE IN ACCUMULATOR
  36   CA                      DEX              SUB. 1 FROM POINTER, FOR LINEFEED
  37   9D ØØ Ø2                STA   Ø2ØØ+X     PLACE STOP AT END OF CHAR. STRING
  3A   A2 ØØ       NONEED3     LDX   #$ØØ       CLEAR X-POINTER
  3C   2Ø 42 ØØ                JSR   CWBUFFER   OUTPUT CHARACTER IN CW
ØØ3F   4C Ø5 ØØ                JMP   ASDRIVER   BEGIN AGAIN

  42   BD ØØ Ø2    CWBUFFER    LDA   Ø2ØØ+X     GET ASCII CHAR. IN BUFFER
  45   C9 Ø3                   CMP   #$Ø3       IS THIS A STOP BYTE?
  47   DØ Ø1                   BNE   CONTINUE   IF NOT STOP, GO TO LOC. ØØ4A
  49   6Ø                      RTS              RETURN TO ØØ3F
  4A   EØ FF       CONTINUE    CPX   #$FF       IS PAGE 2 BUFFER EMPTIED YET?
  4C   DØ Ø2                   BNE   ØØ5Ø       IF NOT, CONTINUE AT ØØ5Ø
  4E   E6 44                   INC   ØØ44       IF PAGE 2 EMPTY, GO TO PAGE 3
ØØ5Ø   E8                      INX              INCREMENT X TO GET NEXT CHAR.
  51   86 Ø4                   STX   CWPOINTER  SAVE X AT LOCATION ØØØ4
  53   2Ø 5B ØØ                JSR   TRANSMIT   BEGIN TRANSMITTING
  56   A6 Ø4                   LDX   CWPOINTER  RETURN POINTER TO X-INDEX
  58   4C 42 ØØ                JMP   CWBUFFER   GET NEXT CHAR. IN BUFFER

ØØ5B   2Ø B6 ØØ    TRANSMIT    JSR   CHARTOCW   CONVERT ASCII CHAR. TO CW
  5E   C9 ØØ                   CMP   #$ØØ       IS THIS A "NULL" CHAR?
ØØ6Ø   DØ Ø7                   BNE   NOTSPACE   IF NOT, GO TO LOC. ØØ69
  62   AØ Ø1                   LDY   #$Ø1       SET NO OF CW ELEMENTS AT ONE
  64   84 Ø3                   STY   COUNT      STORE ELEMENT COUNT AT ØØØ3
  66   4C A1 ØØ                JMP   SPACENT    BYPASS KEY-ON INSTRUCTION
  69   85 Ø2       NOTSPACE    STA   HOLDBYTE   SAVE CW CHAR. AT ØØØ2
  6B   18                      CLC              CLEAR CARRY FLAG  (NOTE 2)
  6C   2A                      ROL              ROTATE CW CHAR. LEFT 1 BIT
  6D   2A                      ROL                        "
  6E   2A                      ROL                        "
  6F   2A                      ROL                        "
ØØ7Ø   29 Ø7                   AND   #$Ø7       SET UP BIT COUNT AT < 7
  72   A8                      TAY              TRANSFER BIT COUNT TO Y-INDEX
  73   A5 Ø2                   LDA   HOLDBYTE   RETURN CW CHAR. TO ACC.
  75   C9 FF                   CMP   #$FF       IS THIS CODE FOR A CW "ERROR"?
  77   DØ Ø9                   BNE   NOTERR     IF NOT, CONTINUE AT ØØ82
  79   A9 ØØ                   LDA   #$ØØ       CLEAR ACC. TO ALL Ø'S
  7B   85 Ø2                   STA   HOLDBYTE   SET HOLDBYTE TO ALL Ø'S
  7D   AØ Ø8                   LDY   #$Ø8       SET ELEMENT COUNT AT 8 BITS
ØØ7F   4C 8C ØØ                JMP   COUNTOK    OUTPUT 8 DITS FOR ERROR
  82   CØ Ø6       NOTERR      CPY   #$Ø6       IS THE BIT COUNT 6?
  84   3Ø Ø6                   BMI   COUNTOK    IF NOT 6, GO TO ØØ8C
  86   98                      TYA              RETURN BIT COUNT TO ACC.
  87   29 Ø6                   AND   #$Ø6       "AND" BIT COUNT IN ACC W/6
  89   A8                      TAY              RETURN BIT COUNT TO Y-INDEX
  8A   A5 Ø2                   LDA   HOLDBYTE   RESTORE CW CHAR. TO ACC.
  8C   84 Ø3       COUNTOK     STY   COUNT      STORE BIT COUNT IN LOC. ØØØ3
  8E   Ø6 Ø2                   ASL   HOLDBYTE   SHIFT LOC. ØØØ2 LEFT 1 BIT
ØØ9Ø   46 Ø2       BITLOOP     LSR   HOLDBYTE   SHIFT LOC. ØØØ2 RIGHT 1 BIT
  92   AØ Ø1                   LDY   #$Ø1       SET WEIGHT FOR DIT IN Y-INDEX
  94   A9 Ø1                   LDA   #$Ø1       LOAD ACC. W/ØØ1
  96   24 Ø2                   BIT   HOLDBYTE   TEST FIRST ELEMENT FOR A DIT
  98   FØ Ø2                   BEQ   SEND       IF IT IS A DIT, GO TO ØØ9C
  9A   AØ Ø3                   LDY   #$Ø3       SET WEIGHT FOR A DAH (3 DITS)
  9C   A9 Ø1       SEND        LDA   #$Ø1       TURN ON KEY BY STORING A 1 IN
ØØ9E   8D ØØ 17                STA   PAD        OUTPUT PORT (17ØØ)
  A1   2Ø CF ØØ    SPACENT     JSR   ELDELAY    GENERATE ELEMENT DELAY
  A4   A9 ØØ                   LDA   #$ØØ       TURN OFF KEY BY LOADING ALL Ø'S
  A6   8D ØØ 17                STA   PAD        IN PAD (17ØØ)
  A9   2Ø DF ØØ                JSR   DELAY 1    DELAY VALUE AT ELSPEED
  AC   C6 Ø3                   DEC   COUNT      GET NEXT ELEMENT IN CHARACTER
  AE   DØ EØ                   BNE   BITLOOP    IF NOT ZERO, GET NEXT BIT (ØØ9Ø)
ØØBØ   A4 Ø1                   LDY   CHRSPEED   SET DELAY FOR A DAH (3 DITS)
  B2   2Ø CF ØØ                JSR   ELDELAY    DELAY A DAH
  B5   6Ø                      RTS   CWBUFFER   GET NEXT CHAR. FROM BUFFER
  B6   29 7F       CHARTOCW    AND   #$7F       STRIP OFF PARITY BIT
  B8   38                      SEC              SET CARRY FLAG TO A 1
  B9   E9 2Ø                   SBC   #$2Ø       SUBTRACT OFFSET OF 32 DECIMAL
  BB   3Ø ØF                   BMI   INVALAS    IF NOT IN TABLE, TO LOC. ØØCC
  BD   C9 3F                   CMP   #$3F       IS THIS LAST CHAR. IN TABLE?
ØØBF   1Ø Ø5                   BPL   NOTFINDAS  YOU USED LOWER CASE LETTERS
```

LOOKUP TABLE

```
Ø1ØØ   ØØ - SPACE                 Ø12Ø   ØØ - NULL
  Ø1   FF - ! (ERROR CODE)          21   42 - A
  Ø2   D2 - "                       22   81 - B
  Ø3   E8 - # (SK)                  23   85 - C
  Ø4   AA - $ (AR)                  24   61 - D
  Ø5   ØØ - NULL                    25   2Ø - E
  Ø6   B1 - & (BT)                  26   84 - F
  Ø7   DE - '                       27   63 - G
  Ø8   ED - (                       28   8Ø - H
  Ø9   ED - )                       29   4Ø - I
  ØA   ØØ - NULL                    2A   8E - J
  ØB   AD - + (KN)                  2B   65 - K
  ØC   F3 - ,                       2C   82 - L
  ØD   E1 - -                       2D   43 - M
  ØE   EA - .                       2E   41 - N
  ØF   A9 - /                       2F   67 - O
Ø11Ø   BF - Ø                     Ø13Ø   86 - P
  11   BE - 1                       31   8B - Q
  12   BC - 2                       32   62 - R
  13   B8 - 3                       33   6Ø - S
  14   BØ - 4                       34   21 - T
  15   AØ - 5                       35   64 - U
  16   A1 - 6                       36   88 - V
  17   A3 - 7                       37   66 - W
  18   A7 - 8                       38   89 - X
  19   AF - 9                       39   8D - Y
  1A   C7 - :                       3A   83 - Z
  1B   D5 - ;                       3B   EO - (
  1C   ØØ - NULL                    3C   ØØ - NULL
  1D   A2 - = (AS)                  3D   ED - )
  1E   ØØ - NULL                    3E   ØØ - NULL
Ø11F   CC - ?                       3F   FF - DEL (ERROR)
```

SINGLE CHARACTER ROUTINE

```
Ø145   A9 Ø1       SINGLECH    LDA   #$Ø1       LOAD ACC. W/ØØ1
  47   8D Ø1 17                STA   PADD       INITIALIZE DATA DIR. REGISTER
  4A   A2 ØØ                   LDX   #$ØØ       CLEAR X-INDEX
  4C   2Ø 5A 1E    SINGLELOOP  JSR   GETCH      JUMP TO KIM "GETCH" ROUTINE
Ø14F   2Ø 5B ØØ                JSR   TRANSMIT   OUTPUT CHARACTER IN ACC.
  52   4C 4C Ø1                JMP   SINGLELOOP GET NEXT CHARACTER AND CONTINUE

ØØC1   A8          GETENTRY    TAY              LOAD POINTER IN Y-INDEX
  C2   B9 ØØ Ø1                LDA   Ø1ØØ+Y     LOAD ACC. W/CW CODE
  C5   6Ø                      RTS              RETURN TO TRANSMIT
  C6   E9 2Ø       NOTFINDAS   SBC   #$2Ø       SUBTRACT DECIMAL 32
  C8   C9 2Ø                   CMP   #$2Ø       IS IT IN TABLE NOW?
  CA   1Ø F5                   BPL   GETENTRY   OK, NOW GO BACK TO TABLE
  CC   A9 ØØ       INVALAS     LDA   #$ØØ       CLEAR ACC.
  CE   6Ø                      RTS              RETURN TO TRANSMIT FOR VALID CHR.

ØØCF   A5 Ø1       ELDELAY     LDA   ELSPEED    LOAD ACC. WITH NO. OF MS. IN ØØØ1
  D1   8D Ø7 17                STA   TIMER      SET TIME TO DIVIDE BY MILLISECS.
  D4   2C Ø7 17                BIT              TEST TIMER FOR MINUS
  D7   1Ø FB                   BPL   ØØD4       IF NOT FINISHED, TRY AGAIN
  D9   88                      DEY              DECREMENT ELEMENT TIMER
  DA   CØ ØØ                   CPY   #$ØØ       IS TIMER FINISHED?
  DC   DØ F1                   BNE   ØØCF       IF NOT, KEEP COUNTING
  DE   6Ø                      RTS              RETURN

  DF   A5 ØØ       DELAY 1     LDA   #$ØØ       LOAD ACC. W/VALUE AT CHRSPEED
ØØE1   8D Ø7 17                STA   +1Ø24      TIMER
  E4   2C Ø7 17                BIT              IS TIMER FINISHED?
  E7   1Ø FB                   BPL              IF NOT, KEEP COUNTING
  E9   6Ø                      RTS              RETURN
```

hit a "G", and type your message (up to 512 characters using the basic KIM). Do *not* hit any line feeds until you are ready to transmit, as this is the character which starts the transmit portion of the program. Let the terminal supply the returns and line feeds. If you make a mistake, hit backspace and type over it. When your message is complete and ready to transmit, simply hit a line feed, and you will hear some mighty fine CW going out. Fig. 4 lists some special keys used for CW characters having no ASCII equivalents.

To use the single character routine, start the program at location 0145. The character you type will be output immediately after each key is hit. This routine is a must for break-in operation.

In summary, both of these routines have been in use for several months at my QTH. I had considered writing a CW receive routine, but, as Wayne Green W2NSD/1 mentioned in his talk at the New Orleans Computerfest, most fists are so bad even the best algorithms cannot copy them unless the sender is using an electronic keyer. And, as he pointed out so well, CW is ten steps backward in technology and will remain so until hams get off their seats and write the FCC demanding the use of ASCII on the ham bands. ■

References

[1] MOS Technology Inc., 950 Rittenhouse Rd., Norristown PA 19401.

[2] *KIM-1 User Notes,* c/o Eric C. Rehnke, PO Box 33077, N. Royalton OH 44133.

[3] Borgerson, "Baudot to ASCII," *73 Magazine,* Nov. 1976, p. 172.

[4] Sewell, "If Only Sam Morse Could See Us Now," *Byte Magazine,* October 1976, p. 42.

[5] Hoff, "ST-6 Solid State Demodulator," *RTTY Journal,* Sept. 1970.

[6] Green, "RTTY Handbook," *73 Magazine,* Peterborough NH 03458, $5.95.

[7] Simpson, "A Date With Kim," *Byte Magazine,* May 1976. This article gives a complete description of the KIM-1 computer.

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S.D. Sales Z-80 Review

-- quality at a good price

With the price of hobby computer equipment going from expensive to overpriced and, lately, to outrageous, I have been home brewing most of my computer equipment. This makes it more affordable, as the price of the components plus the cost of a wire-wrap Altair S-100 card is usually a small fraction of the price of the equivalent kit. I have designed and built a complete Altair S-100 bus computer for about $100-150 less CPU card. This computer has all the panel functions of a commercial machine, such as the IMSAI, and performs equally. It was originally designed to use the somewhat obsolete 8080 CPU card that was removed from my other computer when I changed over to a Z-80. However, as anyone who has ever used both chips can tell you, once you have used a Z-80 you will not be able to tolerate the poor instruction set and processing inefficiency of the 8080. About that time I saw an ad for the $149.95 Z-80 CPU card from S.D. Sales. It was fantastic and was at a price that was less than my first Z-80 card cost to build. Of course, the price of the Z-80 had dropped somewhat since I built my first card, but the price was still around the current cost of parts to build a card, so I ordered one.

Having built several microcomputer kits, and lived with poor documentation, poor quality boards, idiotic designs that were very hard to change, etc., I didn't really know what to expect at such a low price. But, past experience with S. D. Sales on parts orders had shown me that they were reputable, quick, and generally offered a good value with prime quality parts. This still did not completely prepare me for the surprise that I got when I opened the package.

The PC board was one of the best quality boards I have ever seen. Fully solder masked, high quality plating, plated through holes ... everything! The design was really superb – two 5 V regulators with heat sinks (most CPUs really need two as the current required for all the buffers really heats up one), heavy power buses with a fantastic ground plane, silver mica caps, precut, preformed resistors (most resistors and caps were precut, preformed, and ready to insert in the PC board), a very thick book on the design, software, and hardware differences between the Z-80 and 8080, complete instructions for assembly, and a Z-80 manual. The ICs were all prime quality with very recent date codes. All of the component values (part numbers) were screened exceptionally clearly on the component side of the board, and the IC numbers and component numbers are still visible after installing sockets (there were sockets provided for everything) and components.

The actual assembly of the board was one of the easiest and quickest assemblies of PC boards I've ever done. The instructions were excellent, and the preformed leads and clear screening made everything fall together. One or two resistor locations were somewhat obscure, as they did not wind up in the general numeric order of most of the parts and required a little searching. But there were only a couple of these, and they were solved after a few seconds of searching.

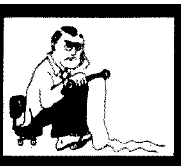
I popped the board into the computer and powered it up. Everything worked beautifully, the first time, and with no problems. I did have to make one minor modification to my VDM board (involving the bending of one pin on an IC) before I could initialize the screen. This was mentioned in the Z-80 manual that S. D. Sales provides (the kit manual), but I wanted to try it first to see if it was really necessary. They also mention a few modifications and changes (all very minor) to other boards to get them to work with the Z-80. This is necessary in the case of the VDM because of the timing difference between the Z-80 and 8080 (the Z-80 is in most cases faster). However, it works fine, and it was really thoughtful of S. D. Sales to point all of these differences out. (This is an example of the thorough and complete attention to detail and documentation that is typical of everything involved with the kit.) It is one of the truly fantastic bargains still available on the hobby microcomputer market today.

Speaking of fantastic bargains, S. D. Sales also makes a 4K low power memory board for the Altair S-100 bus that is an equal bargain, in that it has the same quality parts, is

equally well documented, easy to build, and costs less than the components to wire-wrap one. This is another well-designed, well-implemented piece of hardware. The board uses 4 regulators and runs very cool. Fast memory chips and good design allow super fast board access time. (The board has no provisions for wait states but works perfectly with a Z-80 CPU running at almost 3 MHz, which is far in excess of specs.) There are sockets for everything. Run to the nearest phone and order a dozen or so right away, before they come to their senses and raise the price to what it should be. At $89.95 you are robbing them blind.

The combination of the CPU and memory gives you the basis for a really super home brew computer with the addition of a panel, backplane and power supply. This will give you a complete machine, with a Z-80, 16K of reliable, low power STATIC memory, and full I/O for about the cost of a bare IMSAI or the same with video output capability for the cost (or slightly less) of an Altair (the case, panel, 8080 CPU and power supply and nothing else).

In case this review seems too good to be true, you might remember the early days of *73* when I used to review ham radio equipment. I never was overly kind to a manufacturer that didn't deserve it and told it like it was. I still feel the same today, and with the abundance of shoddy, overpriced computer equipment on the market (as well as a lot of very good equipment), these product reviews are an important guide as to what to buy or avoid. However, they should also be a useful guide, if honestly written, as to what is good and what is really a fantastic bargain. These boards from S. D. Sales definitely qualify for the category of fantastic bargain. ■



NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 15

been involved with, right from the start.

The above is not intended as bragging; it is to put what I am about to write into perspective. Note that there is no one involved with the ARRL or any other ham magazine with even a fraction of this background. I have been at the heart of amateur radio for a long time now, and I think I understand how the pieces of the puzzle fit together.

THE OVERALL PICTURE

Before we can adequately tackle an immediate problem, it is helpful to step back and take a long look at the whole situation. This keeps us from being too confused by the trees to see the forest.

Amateur radio exists because international allocations of frequencies have been set aside for it by the International Telecommunications Union (ITU), an international organizer of all radio frequencies and wire communications. The United States is a member nation of the ITU and has agreed to abide by the rules which this body makes.

At each ITU frequency conference, amateur radio has lost frequencies. Old-timers remember when 20 meters went from 14 to 15 MHz and 40 meters from 7 to 8 MHz, etc.

1947 – ATLANTIC CITY

At this ITU conference, the major European nations got together with the U.S. and screwed the smaller nations of the world out of major portions of the shortwave bands. Radio was still primitive in many of the smaller countries, and their representatives didn't realize how the world would change in the next few years. The ITU at this time was firmly under the control of the U.S.

1959 – GENEVA

When this ITU conference came along, I had been editor of *CQ Magazine* for four years. I was selected by the State Department as one of the official representatives of amateur radio, along with Huntoon of the ARRL. I had visited the ITU the previous year and gotten the inside story on what was in store for amateur radio at the '59 frequency conference . . . and it was a truly alarming story. When I found out what the positions were of some of the supposed "friendly" countries, I called the general manager of the ARRL, Budlong, and offered to put aside any differences between the two magazines in order to present a united front. Budlong, in blunt four letter words, said he didn't need any help from anyone. He personally had been running amateur radio for years and he would continue to run it . . . so go to hell.

When I arrived at Geneva a short while before the ITU conference was to begin, I was issued a five foot shelf of position papers to wade through. Each of the countries at the conference had proposed substantial changes in the frequency allocations in the 3-30 MHz band.

As I read through the positions of the various countries, I found that the predictions of the ITU hams had been, if anything, far too optimistic. Virtually every country proposed serious cuts in the ham bands . . . some in favor of shortwave broadcasting, some for mobile services, some for short range commercial services, etc. For example, the Wireless Institute of Australia is one of the world's more vocal ham groups, with considerable strength in their country . . . yet the official position of Australia was to cut all ham bands down to 50 kHz width!

If that sounds drastic, our good Asian friends in India officially proposed that all ham bands be cut to 20 kHz – worldwide – and they seemed to have a good deal of support from several smaller countries.

The mood of the hams at Geneva was glum. True, the official U.S. position was to back the present ham allocations and ask for no changes. But when I took the other delegates on the U.S. team out to breakfast, lunch, dinner, coffee, etc., I found that in virtually all cases, their confidential instructions were to reflect any losses to their service to the nearest ham band. In other words, if they lost 50 kHz of allocation, it would be taken from a ham band to give them back the lost 50 kHz. This is how the 14,350 to 14,400 segment of 20 meters was lost in 1947.

The more foreign delegates I talked with, the more the conference looked like it would turn out to be a slaughter for amateur radio. Budlong was there, but he was asleep much of the time. Huntoon was all tied up with entertaining visiting ARRL dignitaries and acting as secretary for a few committees.

The U.S. strategy was to try to get all frequency allocations in the 3-30 MHz segment postponed until the next ITU general meeting, scheduled for around 1969. This would pull the fat out of the fire on a lot of the shortwave allocations where the U.S. had a disproportionate share. The U.S.

Continued on page 174

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San Jose CA 95124

Title Your Pix With A Micro

-- a useful SSTV accessory

Upon the successful completion of my SSTV picture generator program[1], I decided my next logical applications program would be one to title SSTV pictures. This project was selected since a majority of the programming was already written and debugged in my previous project. To accomplish this task, another piece of equipment was required. This piece of equipment is an SSTV scan converter. This equipment is quite interesting because it takes normal TV from a fast scan camera and converts it directly to SSTV. Since the TV is digitized in the process, it is quite easy to mix computer-generated video with the camera video.

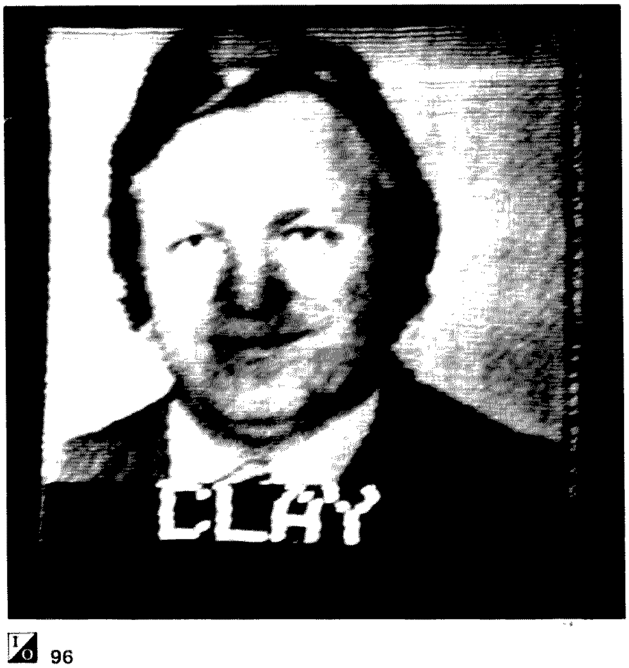
Prior to any system layout or programming, I decided upon a few ground rules which would affect the total project. These rules were:

1. The entire program must be coresident in the SWTPC memory with my SSTV generator program in 8K memory.
2. Little or no hardware interface would be required.
3. An MXV 200 Scan Converter would be used to generate the SSTV.[2]

The selection of the MXV 200 Scan Converter was an obvious one — I had one in the shack. But even beyond that, it is the only scan converter available with pins on the main connector to pick up sync pulses and locations to mix the digital video. Other units could be adapted to this application (e.g., the Robot 400[3]).

As with my previous programming projects, the first steps required were to determine detailed programming specifications and then to draw flowcharts. Additionally, I decided to use a structured programming approach and modularize the program for ease in writing, debugging and making future changes.

For anyone attempting such a project, this is an absolute necessity. As a result of these steps, I had the program totally operational in three weeks. Try and accomplish the same project in hardware logic design in such a time frame! This point demonstrates how powerful microprocessors are, and how easily the SWTPC 6800 System can be programmed.



MXV 200 Scan Converter

A fast scan camera is connected directly to the unit as shown in Fig. 1. The first stage is used to shape the signal, and, in the second stage, the sync pulses are stripped from the fast scan video. The fast scan sync pulses are used to clock the 1K shift register memory and to generate the slow scan sync. The shift register memory is then loaded at a slow scan rate into a digital-to-analog converter and then into a slow scan modulator. The important concept which is required for the whole thing to work is to slave the microprocessor to the scan converter. This was accomplished by attaching the horizontal and vertical sync signals to the SWTPC 6800 Peripheral Interface Adapter (PIA) input port (pins 1 and 2). The output from the SWTPC 6800 was taken from two pins of the output PIA port (pins 4 and 5). Two pins were required for output, one for background and the other for character dots. The whole setup is shown in Fig. 2.

The Software

The programming routines

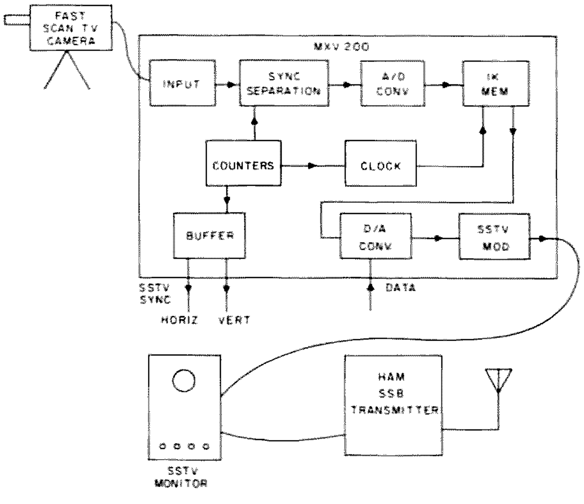


Fig. 1. MXV 200 Scan Converter block diagram.

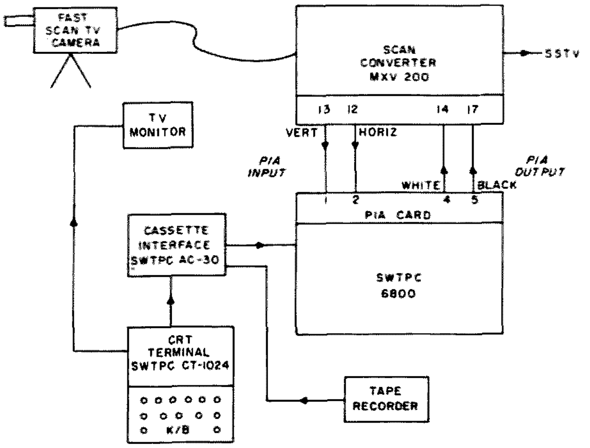


Fig. 2. Scan converter/computer interface.

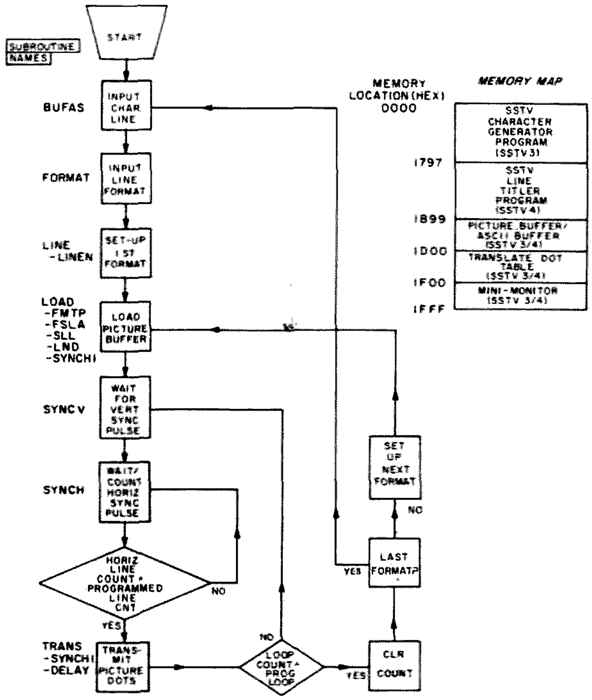


Fig. 3. Main line program.

used to generate the picture dots are similar to those used in my previous article. Therefore I will not discuss them in this article.

However, I will discuss the algorithms I used for picture sync and other significant changes. I will first start by listing a few of the features of the titler program.

1. The titler program mixes up to 10 lines of SWTPC 6800 generated characters with SSTV scan converter generated pictures.
2. The SWTPC 6800 computer connects directly to the MXV 200 and Robot 400 without a hardware interface.
3. Ten different titles can be stored in the SWTPC 6800 System's memory.
4. Titler program can place 1 line of 9 SSTV characters on any one of 9 locations of the SSTV picture.
5. Titler program can mix up to ten different formats which consist of picture loop/number/line.
6. Program includes a mini-monitor which allows the user to select the titler or generator program.
7. The mini-monitor allows the user to select either 50 or 60 Hz SSTV with the generator program.
8. The mini-monitor allows the user to select either white characters on a black background or black characters on a white background.

Fig. 3 shows the main line flow of the titler program along with the subroutine names and a memory map. The SYNCV and SYNCH subroutines are two of the most important routines and function as follows:

1. The program senses the PIA, bit 1 or 2, and waits for it to go positive.
2. When the pulse goes positive, the program then waits for the bit to go to ground and then branches out of the routine.

As you can see, all that is now required is to count the horizontal sync pulses and, when the preprogrammed value matches the actual count, a line of slow scan characters are inserted into an SSTV picture.

The TRANS subroutine functions like the SSTV generator program. Fig. 4 contains a flowchart of this routine along with the memory counter locations used for storage of the various program constants.

The loading of the picture dots is similar to the generator program with one major exception — the picture dots are loaded immediately after the transmission of a titler line or prior to the start of the program. These are convenient times to perform operations of this type, since the computer would only be waiting for sync pulses.

Fig. 5 shows how the character dots are loaded into the picture dot buffer. The picture buffer consists of 126

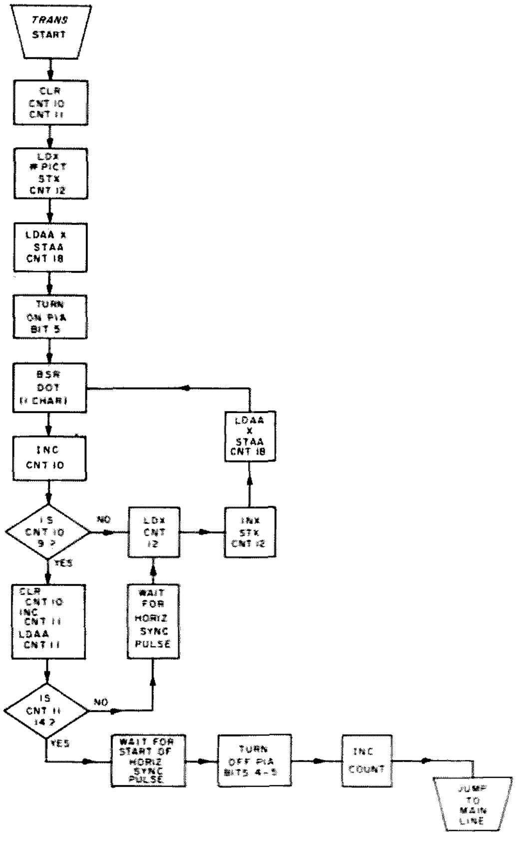


Fig. 4. Transmit picture line of 9 characters. COUNT = actual count of numbers of transmits. CNT 18 = temp. byte storage for picture dots. CNT 10 = character count. CNT 11 = Number of horizontal scan lines transmitted. CNT 12 = temp. storage for index register. PICT = address of picture dots in memory.

SSTV TITLER PROGRAM

```
Machine
Address
1790 00 00 00 00 00 00 00 CE 1B 4D BD E0 7E 8D 4C 7D
17A0 17 EA 27 F3 CE 1B 70 BD E0 7E BD 18 87 BD 19 11
17B0 BD 19 A1 BD 1A 82 BD 1A 94 B6 1A 93 F6 19 0D 11
17C0 26 F4 7F 1A 93 7E 1A AE B6 1A AD F6 19 0C 11 27
17D0 02 20 E0 7F 1A AD B6 19 10 F6 18 84 11 27 05 BD
17E0 19 1C 20 CC 7E 1F 50 00 00 00 00 7F 17 EA 5F BD
17F0 E1 AC B7 17 E9 84 F0 81 30 27 04 7C 17 EA 39 B6
1800 17 E9 84 0F CE 18 2A 81 00 27 12 FF 17 E7 BD 1A
1810 18 4A 81 00 27 03 20 F3 39 FE 17 E7 5F BD E1 AC
1820 A7 00 08 5C C1 09 27 F0 20 F3 00 00 00 00 00 00
1830 00 00 00 00 00 00 00 00 00 00 00 80 00 00 00 00
1840 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1850 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1860 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1870 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1880 00 00 00 00 00 00 00 7F 18 84 7F 18 85 CE 18 ED
1890 8D 3E 8D 48 F6 18 85 C1 01 27 34 A7 00 08 8D 30
18A0 8D 3A F6 18 85 C1 01 27 26 A7 00 08 BD E1 AC B7
18B0 18 86 8D 28 F6 18 85 C1 01 27 14 A7 00 08 7C 18
18C0 84 F6 18 84 C1 0A 27 07 86 20 BD E1 D1 20 C1 39
18D0 BD E1 AC B7 18 86 86 2F BD E1 D1 39 F6 18 86 C4
18E0 F0 C1 30 26 04 86 18 86 39 7C 18 85 39 00 00 00
18F0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1900 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1910 00 7F 19 10 7F 1A 93 CE 18 ED 20 03 FE 19 0E A6
1920 00 84 0F B7 19 0C 08 A6 00 B7 19 0B 08 A6 00 B7
1930 19 0D 08 FF 19 0E 8D 04 7C 19 10 39 B6 19 0D 81
1940 31 27 20 81 32 27 22 81 33 27 24 81 34 27 26 81
1950 35 27 28 81 36 27 2A 81 37 27 2C 81 38 27 2E 81
1960 39 27 30 86 01 B7 19 0D 39 86 0F B7 19 0D 39 86
1970 19 B7 19 0D 39 86 27 B7 19 0D 39 86 35 B7 19 0D
1980 39 86 47 B7 19 0D 39 86 55 B7 19 0D 39 86 69 B7
1990 19 0D 39 86 71 B7 19 0D 39 00 00 00 00 00 00 00
19A0 00 7F 19 9E CE 1B 9A FF 19 9F 8D 4D FE 19 9C A6
19B0 00 B7 19 99 8D 72 BD 1A 52 BD 1A 5F BD 1A 52 BD
19C0 1A 64 BD 1A 52 BD 1A 69 BD 1A 52 BD 1A 6E BD 1A
19D0 52 BD 1A 73 8D 7C BD 1A 78 8D 77 BD 1A 7D 7C 19
19E0 9E B6 19 9E 81 09 27 10 FE 19 9F 08 FF 19 9F FE
19F0 19 9C 08 FF 19 9C 20 B7 39 B6 19 0B 84 0F CE 18
1A00 2A 81 00 27 0F FF 17 E7 8D 0E FE 17 E7 4A 81 00
1A10 27 02 20 F4 FF 19 9C 39 FE 17 E7 5F 08 5C C1 09
1A20 27 02 20 F8 FF 17 E7 39 B6 19 99 84 3F CE 1D 00
1A30 B7 1A 34 E6 00 B6 19 99 84 40 81 40 27 0A F7 1A
1A40 43 CE 1E 00 FF 19 9A 39 F7 1A 4D CE 1D 00 FF 19
1A50 9A 39 FE 19 9A A6 00 08 FF 19 9A FE 19 9F 39 A7
1A60 00 A7 09 39 A7 12 A7 1B 39 A7 24 A7 2D 39 A7 36
1A70 A7 3F 39 A7 48 A7 51 39 A7 5A A7 63 39 A7 6C A7
1A80 75 39 B6 80 1E 81 FD 27 02 20 F7 B6 80 1E 81 FD
1A90 27 F9 39 00 B6 80 1E 81 FB 27 02 20 F7 B6 80 1E
1AA0 81 FB 27 F9 7C 1A 93 39 00 00 00 00 00 00 7F 1A
1AB0 A9 7F 1A AA CE 1B 9A FF 1A AB A6 00 B7 1A A8 86
1AC0 20 B7 80 1C 8D 3C 7C 1A A9 B6 1A A9 81 09 27 0E
1AD0 FE 1A AB 08 FF 1A AB A6 00 B7 1A A8 20 E6 7F 1A
1AE0 A9 7C 1A AA B6 1A AA 81 0E 27 04 8D 4F 20 E1 B6
1AF0 80 1E 81 FB 27 02 20 F7 4F B7 80 1C 7C 1A AD 7E
1B00 17 C8 5F B6 1A A8 49 B7 1A A8 25 0E 86 20 B7 80
1B10 1C 8D 1E 5C C1 05 27 10 20 E9 86 10 B7 80 1C 8D
1B20 10 5C C1 05 27 02 20 DB 86 20 B7 80 1C 8D 02 39
1B30 50 B6 1B 30 4A 81 00 27 02 20 F9 39 B6 80 1E 81
1B40 FB 27 02 20 F7 B6 80 1E 81 FB 27 F9 39 10 16 4C
1B50 4F 41 44 20 42 55 46 46 45 52 53 20 30 2D 39 0A
1B60 0D 20 42 31 20 20 20 35 20 20 20 39 0D 0A 3F 04
1B70 10 16 4C 4F 41 44 20 4C 4F 4F 50 2D 50 49 43 54
1B80 55 52 45 2D 4C 49 4E 45 0A 0D 31 30 20 45 4E 54
1B90 52 59 53 20 4D 41 58 0A 0D 04 00 00 00 00 00 00
```

TRANSLATE/DOT TABLE

```
Machine
Address
1D00 40 47 4E 55 5C 63 6A 71 78 7F 86 8D 94 9B A2 A9
1D10 B0 B7 BE C5 CC D3 DA E1 E8 EF F6 40 40 40 40 40
1D20 04 5F 66 6D 74 7B 82 89 90 97 9E A5 04 04 58 0B
1D30 12 19 20 27 2E 35 3C 43 4A 51 04 04 04 04 04 04
1D40 00 00 20 50 88 00 00 20 50 88 88 F8 88 88 F0 88
1D50 88 F0 88 88 F0 F0 88 80 80 80 88 F0 F0 88 88 88
1D60 88 88 F0 F8 80 80 F0 80 80 F8 F8 80 80 F0 80 80
1D70 80 78 80 80 80 98 88 78 88 88 88 F8 88 88 88 70
1D80 20 20 20 20 20 70 08 08 08 08 08 88 70 88 90 A0
1D90 C0 A0 90 88 80 80 80 80 80 80 F8 88 D8 A8 A8 88
1DA0 88 88 88 88 C8 A8 98 88 88 70 88 88 88 88 88 70
1DB0 F0 88 88 F0 80 80 80 70 88 88 88 A8 90 68 F0 88
1DC0 88 70 A0 90 88 70 88 80 70 08 88 70 F8 20 20 20
1DD0 20 20 20 88 88 88 88 88 88 70 88 88 88 88 88 50
1DE0 20 88 88 88 A8 A8 D8 88 88 88 50 20 50 88 88 88
1DF0 88 50 20 20 20 20 F8 08 08 20 40 80 F8 F8 F8 F8
1E00 F8 F8 F8 F8 00 02 00 00 00 00 00 00 08 10 20 40
1E10 80 00 70 88 98 A8 C8 88 70 20 60 20 20 20 20 70
1E20 70 88 08 30 40 80 F8 F8 08 10 30 08 88 70 10 30
1E30 50 90 F8 10 10 F8 80 F0 08 08 88 70 38 40 80 70
1E40 88 88 70 F8 08 10 20 40 40 40 70 88 88 70 88 88
1E50 70 70 88 88 78 08 10 E0 00 00 00 00 00 00 20 00
1E60 38 00 20 00 F8 00 20 20 20 20 20 20 20 00 00 00
1E70 F8 00 00 00 00 F8 20 F8 20 F8 00 08 10 20 40 80
1E80 78 00 A8 50 A8 50 A8 50 A8 00 C0 30 08 30 C0 00
1E90 20 50 A8 20 20 20 20 50 00 F8 88 88 88 F8 00 00
1EA0 00 38 20 20 20 00 00 00 70 20 20 20 00 00 00 00
```

MINI-MONITOR PROGRAM

```
Machine
Address
1F00 CE 1F 79 BD E0 7E 20 02 6E 00 BD E1 AC 81 31 27
1F10 16 81 32 27 17 81 33 27 24 81 34 27 29 81 35 27
1F20 2E 81 36 27 37 20 E3 CE 00 00 20 DC 4F B7 80 1F
1F30 B7 80 1E 86 04 B7 80 1F CE 17 97 20 CB CE 02 E3
1F40 86 80 A7 00 20 BA CE 02 E3 86 70 A7 00 20 B1 86
1F50 20 8D 16 86 10 CE 1B 1B A7 00 20 A4 86 10 8D 09
1F60 86 20 CE 1B 1B A7 00 20 97 CE 1A C0 A7 00 CE 1B
1F70 0D A7 00 CE 1B 29 A7 00 39 10 16 53 45 4C 45 43
1F80 54 20 50 52 4F 47 52 41 4D 0A 0D 31 2E 20 54 52
1F90 41 4E 53 4D 49 54 20 53 53 54 56 0A 0D 32 2E 20
1FA0 54 49 54 4C 45 20 53 53 54 56 0A 0D 33 2E 20 36
1FB0 30 20 48 5A 20 53 53 54 56 0A 0D 34 2E 20 35 30
1FC0 20 48 5A 20 53 53 54 56 0A 0D 35 2E 20 42 4C 41
1FD0 43 4B 20 4F 4E 20 57 48 49 54 45 20 54 49 54 4C
1FE0 45 53 0A 0D 36 2E 20 57 48 49 54 45 20 4F 4E 20
1FF0 42 4C 41 43 4B 20 54 49 54 4C 45 53 0A 0D 3F 04
```

Program A. Object listings for SSTV titler program.

bytes of data formatted as shown in Table 1.

Each of the 9 bytes of picture data is duplicated for each scan line. Since the characters were formed by a 5 x 7 dot matrix, the total number of scan lines is 2 x 7 = 14, and the total number of bytes is 9 x 14 = 126. The picture dots are loaded from the same dot and translate table contained in the generator program. This table is also listed for ease in program entry (see Program A).

Well, you now have a good idea of how the program works. Let's discuss how to use the program.

Operating The Program

After you load the program into memory, you should first set locations A048 and A049 to the start address of the program 1F00. When you type G, the TV monitor screen will be filled with a menu of the program options. If you plan to also use the generator program with the mini-monitor, one programming change should be made at locations 0355-6. The address of 0000 should be changed to 1F000. This will cause the generator program to branch back to the mini-monitor program after the characters are transmitted.

When the titler program is first executed, a menu will appear on the TV screen which will allow you to select a few program options. Photo 1 shows the mini-monitor menu. A brief description of each option follows:

1. Transmit SSTV. This option will cause the program to jump to the character generator program. If the previous change was made (address 355), the program would return to the mini-monitor when completed.
2. Title SSTV. This option selects the titler program. When the option is completed, control will be returned to the mini-monitor.
3. 60 or 50 Hz SSTV. This option modifies the program delay constants in the generator program at location 02E3.
4. Black on white titles. When selected, this option will place black letters on a white background. Four program constants are changed in the titler program. This is the normal condition when the program is first loaded. Normally character data is on PIA bit 4 and background is on bit 5.
5. White on black titles. When selected, this routine produces white letters on a black background in the titler program. The same four program constants are changed, character data is now on bit 5, and background is on bit 4.

Let's assume that you have selected the titler program option. The first instructions

you see on the screen are shown in Photo 2. This routine is asking for an entry into the ASCII buffers of 9 characters. Ten buffers can be loaded (0-9). When you place an ASCII letter under the letter B, the program will then jump to the next routine.

The next routine is shown in Photo 3. This routine sets up the picture titles to be placed on the SSTV screen. The entry is formatted by the program in the order LOOP/PICTURE/LINE.

Up to ten of the above formats can be entered and the whole process will be terminated at the end of the tenth format, or when an ASCII letter is typed.

The following is a description of each format term:

1. Loop entry. Reply should be 1 to 9. This entry controls the number of SSTV frames which will contain the picture title you select. If you reply with a zero, 255 loops will be assumed. In order to recover from this condition, you must put a 00 in COUNT at location 1AAD, or wait for 34 minutes of SSTV (255 frames).
2. Picture entry. This number corresponds to the picture buffer previously loaded. The reply should be 0 to 9.
3. Line entry. This reply selects the SSTV scan line at which the title will start. The reply should be 1 to 9. The following is a list of reply versus scan line:

Line no.	Scan Line
0 or 1	1
2	15
3	25
4	39
5	53
6	71
7	85
8	105
9	113

This concludes the description of how to use the program. Next, we'll discuss how to interface the SWTPC 6800 to the scan converters.

Interface Considerations

As I stated earlier, the

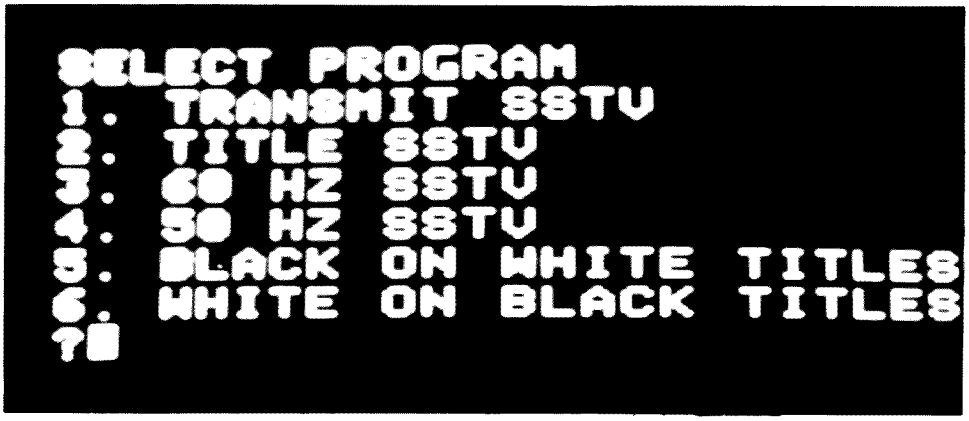


Photo 1. Mini-monitor routines.

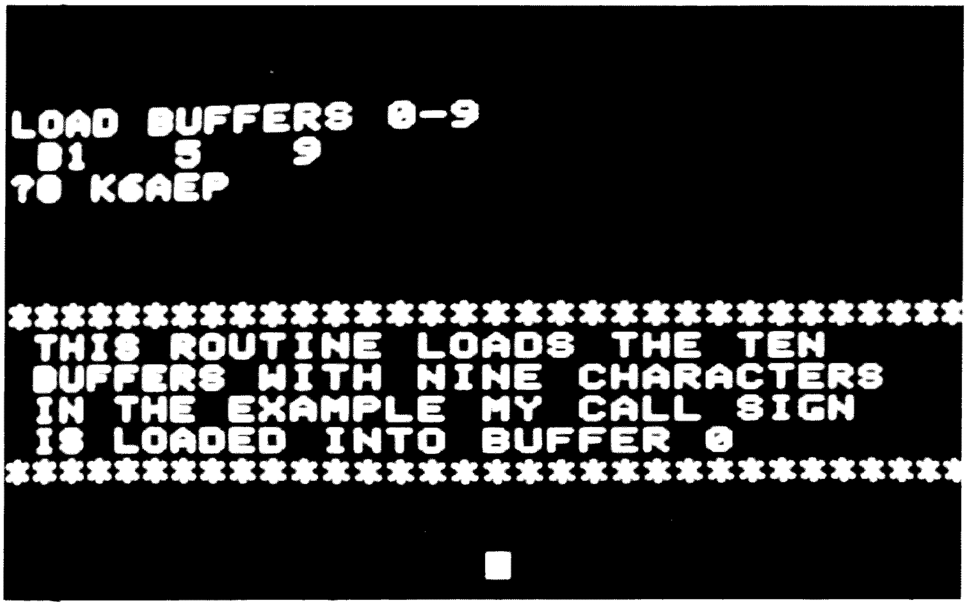


Photo 2. Titler program option.

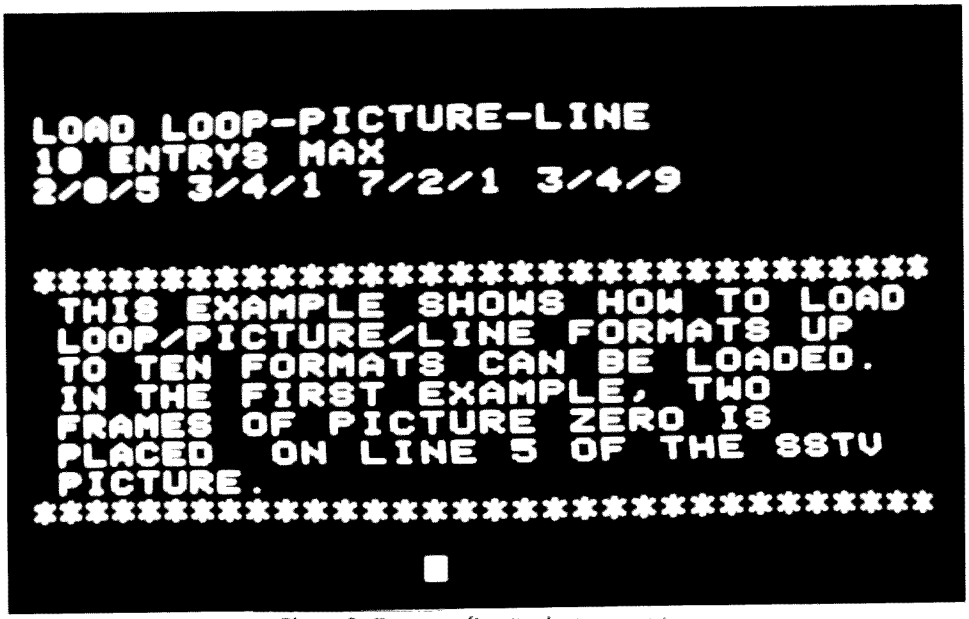


Photo 3. Entering (loading) picture titles.

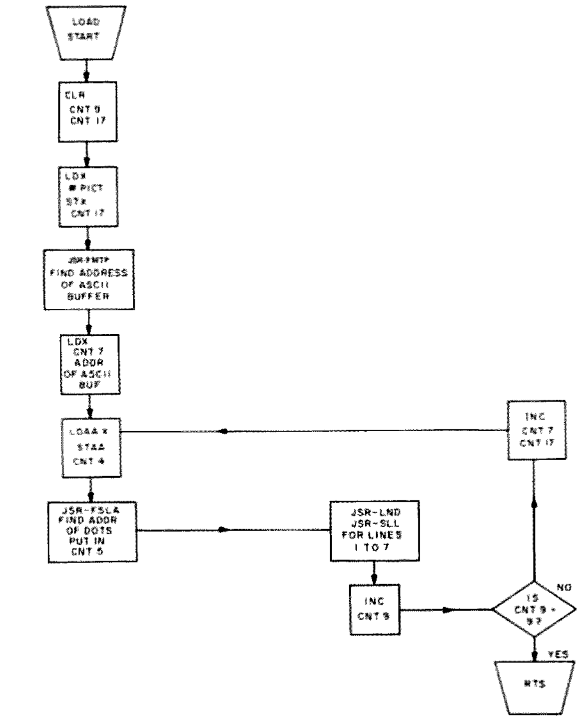


Fig. 5. Load character dots in picture. Memory counters: CNT 4 = ASCII character byte. CNT 5 = address of picture dots. CNT 7 = address of ASCII buffer. CNT 9 = character count. CNT 17 = address in picture buffer for dots.

Character Position (bytes)

location									
1B9A	1	2	3	4	5	6	7	8	9
1BA3	1	2	3	4	5	6	7	8	9

Table 1.

Unit	Signal	PIA Bit	Location
MXV 200	Vert Sync	input 1	pin 13
	Horiz Sync	input 2	pin 12
	White Cont	output 4	pin 14
	Black Cont	output 5	pin 17
Robot 400	Vert Sync	input 1	U44 pin 1
	Horiz Sync	input 2	U44 pin 2
	White Cont	output 4	U54 pin 1
	Black Cont	output 5	memory rev switch (S1)

Table 2.

MXV 200 is the easiest unit to interface to since all the correct signals are on the main connector. Table 2 lists the interconnection to both scan converters mentioned earlier.

The Robot 400 interface requires some additional comments from those listed in Table 2. The white control is obtained by removing U54 (74LS175) from its socket and bending pin 1 up. When installed on the board, a fine wire, #30, should be connected to a free pin on the main connector and then interfaced to the computer. The black control is not available on the circuit board. However, pin 5 of S1 (memory reverse switch) can be used. Remove the wire from +5 volts on pin 5 of switch S1 and connect PIA bit 5 to it through a spare pin on the main connector. You may have to experiment somewhat in this area since I do not have a Robot 400 to attach to. You may have to experiment with the program constants to achieve the correct picture polarity. The program constants are located at locations 1BØD, 1B1B, and 1B29. These constants will have to be changed also in the mini-monitor.

If you decide to write about any questions, please include a self-addressed stamped envelope for my return answer.

This completes the functional description, operation and computer interface. I think a few words should be said regarding the SWTPC computer in general. The titler program assumes that MIKBUG is used and the following routines are used: E1D1 – Output one ASCII character; E1AC – Input one ASCII character; EØ7E – Output a character string.

Other system requirements are:

1. The output PIA address is side A at location 7, address 801C.
2. The input PIA is side B address 801E. Prior to execution of the program, the PIA is initialized by the mini-monitor. If the user does not use the mini-monitor, the PIA must be conditioned in a similar manner for the PIA to function properly.
3. The SWTPC 6800 must have at least 8K of memory.

I would like to thank Mike Tallent W6MXV for his technical guidance with this project. Additionally, I would like to thank Clarence Munsey K6IV for his help in providing data on the interfacing to the Robot 400. ■

References

[1] "SSTV Meets the SWTPC 6800," June 1977, *73 Magazine*, C.W. Abrams K6AEP.

[2] MXV 200 Scan Converter Unit can be obtained from Mike Tallent W6MXV in kit or PC board alone, $35.00, contact Mike Tallent W6MXV, 6941 Lenwood Way, San Jose CA 95120.

[3] Robot 400 Scan Converter, Robot Research Inc., 7591 Convoy Court, San Diego CA 92111.

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Mastering Network Operations

-- everything you need to know!

Across the amateur bands there are many nets . . . the rag chewers net, the old-timers net, YL net, and a host of others too numerous to describe. Some of these "networks" have an official purpose; others may exist for club activities or just friendly chitchat. It is through this article that I hope to open some eyes, so to speak, into network operations, especially for those who misuse our net frequencies and/or have little understanding of the system. Many newcomers don't understand the networks as related to amateur radio, so it seems appropriate to begin by answering a frequently asked question:

What Is a Network?

Start by imagining a large circle which represents all amateurs on a certain frequency. A point in the center of this circle is the control station. This station asks for check-ins from hams within the circle and logs them, stating whether they have traffic or are standing by. One by one he takes in call letters, and each station checked in establishes a tie or a communication bond with the net control. You can see that after a while a large net will form, which is actually many stations tied to a central point, or the control station.

But what some hams don't understand is how important nets can be to the amateur fraternity. Take, for instance, military servicemen overseas who want to communicate with their loved ones back home. Without amateur nets, finding a particular city might be a long, tedious job. The same applies to maritime mobiles, aeronautical mobiles, and persons with urgent medical or priority traffic who may very well have short time limits.

Unless you're very lucky, finding a certain area may take hours, even with a crowded band! Going through a network can cut that down to just a few minutes.

How, Then, Can I Get Involved In Net Operations?

Becoming an active part of a network is not hard. The best place to start might be either the maritime mobile net or the intercontinental traffic net which meet every day on 14.313 MHz. Come there and you can count on good advice about network operations from a real down to business net. Just listen for a while. Then, when you feel you're ready, jump in head first.

But That's the Easy Part!

Order is needed for the proper functioning of a network. It would be absurd to operate without a control station or rules. Networks need not only members and traffic to handle, but also the smoothness and order that rules and regulations provide.

There are too many guys that leave cooperation up to the control. They figure, "Oh well, it's his job to keep order." Ridiculous, isn't it? On that basis, the net control spends half his time screaming for quiet so the net can operate. If you hear someone using improper procedures or causing interference, why not move him off frequency and politely explain the rules to him?

So, you see, being a net member means more than checking in every once in a while and handling traffic. Each member should realize the purpose of the net and accordingly try to keep and enforce the rules. FCC chairman Richard Wiley told me in a recent interview that he considers amateurs "self-policing." On the average, I'm sure that's true. But the networks on 14.313 can be a pretty poor example of this! Just tune in some afternoon and grab an earful of unmodulated carriers, endless chains of CQs, and ear-splitting splatter from stations on nearby frequencies. You'll be lucky to hear the net control . . . and not only that, but the net control will be lucky to hear you!

On that note, I would like to present a network "primer for misunderstood procedures" which, I hope, will help get the garbage off the nets.

Checking In

Sounds simple, doesn't it? The misuse of this maneuver is so incredible it might even qualify for a round or two in Ripley's.

Very basically, the check-in is a method used to enter a net. But before you rush right into a network, take the time to listen a few minutes. This enables you to catch up with the control and follow what he is doing. Then if you wish to check in, listen for the controller's signal. He'll call for check-ins when the way is clear for more stations. Do not take it upon yourself to check in. It only interferes with the process of handling traffic. Also, there may be special check-in calls, such as, "Check-ins, maritime mobiles only!" This means the controller only wants check-ins from maritime mobiles and for all others to stand by.

After waiting for the controller's signal, quickly and clearly give him your callsign, always remembering to keep it short and sweet. The control has no time to listen to inane chatter (such as your name, what the weather is like, your rig, and so on).

After you transmit your callsign, the control will respond in some way or another. If no response is given, wait again for a check-in signal and try once more. Depending on your output power and location with respect to the net control, it may take several tries before he acknowledges. In any case, the control usually responds by repeating your callsign and then either asking for further check-ins or telling you to "call your traffic" right away. When you're asked to call your traffic, don't rattle on! Just simply let the controller know who or where you wish to communicate with. (If you have no traffic, just say you're standing by.) Control may now do any one of a number of things. For example, WB4EZM checks in and is looking for Los Angeles. Net control may tell him to call Los Angeles, or do the calling himself. If there is a Los Angeles station already on frequency, control will hook WB4EZM and L.A.

together, and they will decide what frequency to move to. Suppose there is no Los Angeles station on the frequency. Then control will ask WB4EZM if he would like to have his traffic listed. If the reply is "yes," then WB4EZM remains on frequency in hopes that L.A. will come up soon. If the reply is "no," then the traffic is scratched from the controller's list and WB4EZM goes elsewhere.

Checking into a net is one of the easiest things in the world. But some guys don't get the picture.

In fact, the only person on a net to use the term "check-in" should be the controller, with the exception of stations with life-and-death, priority, or short-time traffic. But for most cases, don't call us, baby, we'll call you!!!

The Contact

Another one of those simple but misunderstood terms. Contact means that your station is on frequency and you would like to contact him. For instance, WB4EZM tunes into the net and hears Los Angeles check in and stand by on the frequency. At a convenient break in the controller's transmissions, WB4EZM says "contact," and he is hooked up with L.A. accordingly. Remember: Use "contact" only when you know for sure that the station you want is on frequency. Some hams use "contact" as a means of getting into a net, because the controller will usually respond to it immediately. They'll call for a station that isn't there and then say, "Oh, well, I thought I heard him!" This practice is unfair, and now many net controls will refuse to list these stations.

The Recheck

Not many problems with this one. It means, "I have moved off frequency with a station and contact was not established." In this case, the net control would ask you to call your station again and, if you receive no reply, give you the option of waiting on the frequency in case he returns or another station in the same area pops up. Losing a station could have been caused by heavy QRM, QRN, or otherwise nasty band conditions. So, you see, a net not only provides a method of linking stations, but also a way of re-linking them if they don't hook up.

The Checkback

Easy to understand, but consistently confused with the recheck. Checkback means, "I have moved off frequency with a station. Contact was established, the traffic passed, and I would now like to check back into the network." The misuse of this term is pure laziness. Recheck is used for checkback, and vice versa, which leads the net control off track. Understanding net language is a necessity!

The Check-out

Rarely used, but nevertheless existent. Looking at it tells you the meaning: simply, "I wanna get the heck outa here." Although a polite way of leaving a net, its rare use stems from it almost being a time-waster. As a net control, I can honestly say that the absence of this term hasn't hampered operations. If you're not there, you're not there!

Relays

Without relay stations, efficiency would be greatly reduced. At the QTH here in northern Virginia, I am totally unable to copy ones, twos, some threes, a few fours, eights, and nines. Skip conditions just won't allow it on 20 meters during the daylight hours. Therefore, I need stations to pick up those I cannot copy . . . relay stations. For example, I would use a station in Florida to receive traffic from up north and pass it along to me. Networks require the cooperation and patience of all their members to coordinate relay activities. But that isn't the only use for relays. Many times a station will try to break the net because he cannot hear the net control.

If you hear someone needing a relay, you can be the one to help. First, make sure the net control can hear you. You'll know whether or not he can from previous conversations. Next, ask the breaking station to stand by. Then at an appropriate break in the controller's transmissions, transmit "relay." If control acknowledges, he will tell you to pick up the traffic from the station unable to copy him. One word of warning: Many net controllers will refuse to list stations who break the net and are able to copy control.

Courtesy To the Net Control

A controller has an incredible chore coordinating some 50 to 100 (or more) stations. And the only reward is the satisfaction of running a good, smooth net. Efficient operation requires the help of all members. Don't leave it all up to the control. Here are some good guidelines to follow:

1. Politely ask all stations operating in the immediate vicinity of the net frequency to move elsewhere. If someone won't move, don't get nasty about it, just leave them be, and eventually they'll go away.
2. Aid the net control as a relay station, whenever possible.
3. Follow net procedures to the letter, and explain the rules to those who don't.
4. Become active! Use that phone patch where it is most needed!

The Three Cs

Well, here it is! The grand finale, and maybe you've already guessed my point. It's called the three Cs of network operation:

1. Courtesy – Always be courteous to the net control,

fellow members, and everyone else in the amateur society. Where does everyone else fit in? Just take a look . . . when you ask a station to move away from the net frequency, do it politely! Don't give the attitude that the nets want to take over everything within 5 kHz of the net frequency. Simply explain that the net needs breathing room to operate properly. Networks are a service, not a burden.

2. Cooperation – Try to get along well with the controller and follow the rules. If you check into a net, say you're standing by and mention you have a phone patch. The net control could throw anything your way! Be prepared to help out in any way possible, whether it's acting as a relay or handling traffic.

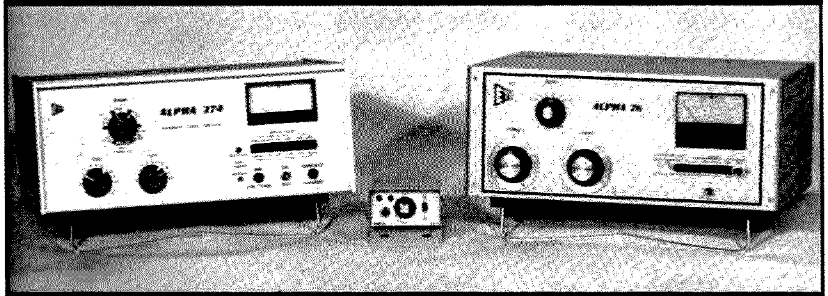
3. Commitment – Commit yourself to a net. It doesn't have to be every day. It can even be once a week! Nets need stations to handle traffic. Wouldn't it be great if you could check into a net, ask for a particular city or state, and hook up immediately? This is entirely possible if more people who have the time would at least monitor the nets for possible traffic!

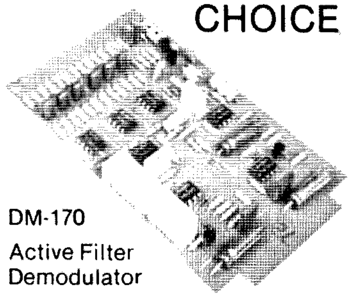
I certainly hope you won't take this article lightly. Get in there! Find a net! Do your part! Here's a good way to get started:

The Maritime Mobile Service Net
14.313 kHz (20 meters)
7 days a week, starting around 1700 GMT.

The Intercontinental Traffic Net
14.313 kHz (20 meters)
7 days a week, with two operation times:
1. Morning – from band opening to around noon. Eastern time.
2. Evening – following maritime mobile net and continuing to band closing.

Note: Sometimes the IC net will not operate on Sundays. ■





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Try A Trapped Dipole

-- save copper and coax!

Often the need arises for a permanent low cost antenna. A dipole or inverted vee is a good choice. They are easy to install and cheap to build. One of the disadvantages of such antennas is that they are only usable on a single band, unless they are fed with an open feedline and an antenna tuner.

Most traps used in amateur radio multiband antennas are made of a lumped inductance and capacitance in parallel. I tried to overcome this.

By placing a trap 32 feet 6 inches from the feedpoint, a current maximum will occur at 7200 kHz. With the correct wire length on the outside end of the trap, the antenna can also show current maximum at the feedpoint for 3900 kHz. In both cases, the dipole functions as a halfwave dipole.

Why not add another antenna under the existing 80 and 40 meter wire, fed at the same feedpoint, with another trap tuned for 21300 kHz? An outside wire of the correct length will give current maximum on 80, 40, 20 and 15 meters, all functioning as a halfwave dipole.

With the help of my XYL, I came up with this antenna. The information for construction follows. I hope it will do as well for you as mine does for me!

The dimensions given here are resonant at 3.9 MHz, 7.2 MHz, 14.3 MHz and 21.3 MHz. For 40 meters it's 160 turns, for 15 meters, 55 turns. Number 12 magnet wire is wound on a 1/2 inch rod, close wound. The coil is removed from the 1/2 inch rod and placed inside the 1/2 inch PVC pipe.

The PVC pipe is cut to 18 inches for 40 meters, 10 inches for 15 meters. The PVC is then placed inside the 7/8 inch ID, 1 inch OD aluminum tube. The aluminum is cut to 16-1/2 inches for 40 meters, 8-1/2 inches for 15 meters.

Drill a hole in the center (ends) of eight 1/2 inch PVC caps, and mount stainless steel eye bolts on them. (Cut off the eye bolts as short as possible, so they will not go into the PVC tube.) Now drill a hole to fit the #12 magnet wire below the eye bolt in each end cap. See Fig. 4.

Cement one end cap onto the PVC tube after bringing the end of the coil wire through the small hole. Secure a tin solder lug on one end of the aluminum tube, as shown in Fig. 3, with a pop rivet or small screw. Do not use aluminum or copper for the solder lug. Slide the aluminum tube over the PVC with the solder lug end first, and solder a jumper from the lug to the coil wire as close to the PVC cap as possible.

You are now ready to tune the traps. The traps were adjusted to frequency through the use of a grid-dip meter (checking on a receiver for accuracy). The coil can be changed quite easily if an extra turn or two is put on for adjusting purposes. The coil can also be wound with spacing and compressed or extended to get the traps exactly on frequency. Tune to 7.2 on 40 meters. Tune to 21.3 on 15 meters.

After the tuning is completed, the end cap can be cemented on. The two wires sticking out of the end caps are to be soldered to the antenna wires.

My antenna is supported in the center about 32 feet high and 10 feet at the ends. I show an swr of 1.2 to 1 on 3.9, 1.3 to 1 on 7.2, 1.3 to 1 on 14.3 and 1.2 to 1 on 21.3. The CW bands can be worked with the swr less than 2 to 1 on all CW bands.

The overall length is 106 feet, and it can be installed as an inverted vee in a lot less than 90 feet. ■

Parts List

PVC cement
8 1/2" PVC caps
56" of 1/2" PVC pipe
1 balun, 1:1
4 ceramic insulators
135' of antenna wire
50" of 1" aluminum tubing (a discarded lawn chair will do)
80' of #12 magnet wire

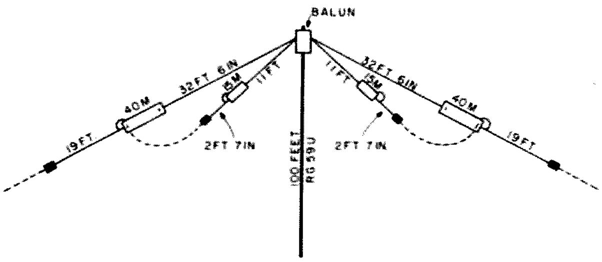

Fig. 1.

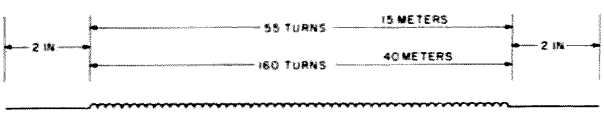

Fig. 2. Don't forget to leave 2" on each end of each coil.

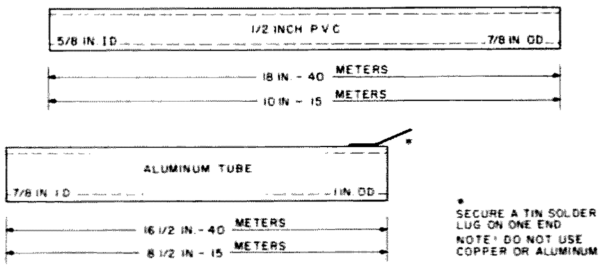

Fig. 3.

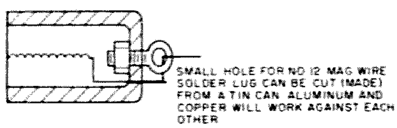

Fig. 4. The coil will expand to make a nice fit inside the PVC tube. The aluminum fits snugly over the PVC, and the cap rims help hold the aluminum tube in place. It all makes a very nice looking assembly.

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Liberate Your Wilson HT

-- who needs nicads?

I am sure that many hams will agree with me that the Wilson HTs are among the best buys on the market. Their performance/price ratio is significantly greater than that of many other units intended for the same purpose. There are, however, several features which those other units offer which the Wilson could benefit by, and one of the most valuable is the ability to operate from a power supply other than the self-contained nicads.

As a ham with a large investment in low band equipment and getting deeply involved in slow scan (more money), I cannot afford both a base and a portable/mobile 2 meter rig and must make my Wilson perform both functions. Since I'm a rag chewer by nature and the Wilson's nicads are useful only until their charge gives out, the ability to operate my HT from an external dc power supply became a necessity if I were to be able to remain on the air for any extended period of time.

While it is possible to access the battery pack through the fitting at the top of the rig (only when the unit is turned on), this is both physically inconvenient and electrically unsound. There had to be another way.

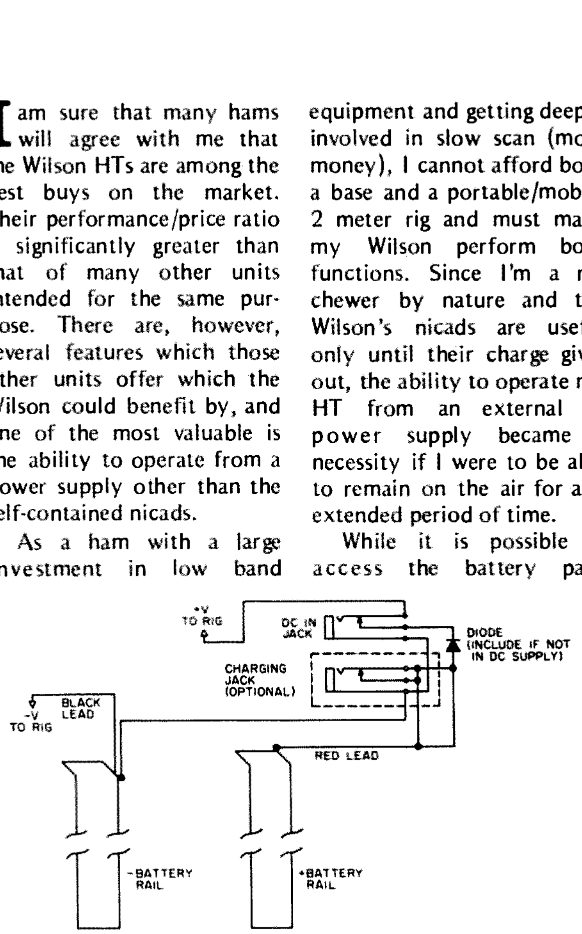

Fig. 1. Rear view of front half of Wilson case (not to scale).

One solution to my predicament was proposed by a friend who owns two battery trays for his own Wilson. He has taken the second tray (*sans* batteries), drilled a small hole in its base, and connected wires to the internal rails which normally carry power from the batteries to the electronics. Outside his Wilson, these wires are attached to a suitable dc supply, and he is in business.

With all due respect, I find several drawbacks to this system. First, when you want to switch from the nicads to external power, it is necessary to remove the one battery tray and insert the other. This can be somewhat inconvenient if you are in a big hurry or want to travel light.

Second, with those wires coming out of the bottom of the rig, its equilibrium becomes rather unstable and, while I know from experience that the Wilson is capable of sustaining a fall of reasonable distance, I prefer to verify this knowledge as infrequently as possible. The only safe way of using this arrangement is with the rig lying on its back — somehow inelegant as well as inconvenient. Consequently, I tried a different approach.

I went about adding external dc capability to my Wilson by installing a jack in the side of the transceiver. The wiring is such that, normally, the rig functions as usual from the internal nicads. When the plug from the power supply is inserted, however, the batteries are disconnected from the rest of the rig, and dc from the outside world flows directly into the Wilson. An obvious advantage of this setup is that you never have to fuss with, or even consider, a second battery tray. A less obvious advantage is that while you are running the HT from outside power, you can be charging its batteries at the same time. More about the use of a second jack for charging purposes later.

Installation of the jack(s) is easy — all you really require is the nerve to puncture the hide of the HT. By no means should the hole be made with a drill — one slip or ill-timed sneeze could wreak havoc with the rig and your wallet! Instead, start the hole with a pencil tip soldering iron and go only far enough to just begin to penetrate the inside wall of the case. The hole may then be enlarged with a tapered reamer until it is the right size to snugly accommodate the jack. It may take several days to work up the courage to do this, but it's worth working up to and once you've done it, you'll find it hard to resist doing it again.

The jack I used is an enclosed miniature 1/8" normally-closed phone type

(Radio Shack 274-296). Properly located, two of these will fit comfortably within the Wilson. The obvious — and probably only — place to install the jack is on the right-hand side of the unit (as seen from the front) in the front half just above the battery pack.

There is plenty of room if you pay attention to one or two details. Allowance should be made to clear the channel selector switch which will be just above the jack, and to clear the metal brace which, it would appear, serves to keep you from crushing the HT in your grip if you squeeze the PTT lever too enthusiastically. Careful planning will enable you to pinpoint the correct spot.

In working on my rig, I tread a little too cautiously and placed the dc jack a bit on the low side, probably because I was trying to avoid conflict with the trimpot for my touchtone pad. Even so, I still have room for the addition of a charging jack, so, being forewarned, you should have no difficulties at all.

The unswitched terminal of the dc jack (see Fig. 1) is connected to the ground rail (black wire) of the battery tray slide. The hot lead (red, from the other rail) is broken and connected across the other two terminals of the jack. The battery side of this red lead should be connected to the switched terminal. This way the internal current flow will be normal when no plug is inserted, but insertion of the dc plug will break the battery line and allow current from the external supply through the rig's electronic innards.

Similarly, a second jack, for battery charging from the outside, may be installed ahead of the first and wired the same way. Normally, the HT will operate as usual, but with a plug inserted in the charger jack, the batteries will be placed in parallel with the charger. While it is not recommended that the Wilson be operated from its, or any other, battery charger, with this arrangement is is possible to charge the batteries while operating from the external dc supply at the same time.

Incidentally, the power supply which I use was adapted from the one detailed by WA8WVF in the September, 1976, issue of *73*. My supply uses smaller power tab type transistors, available from Radio Shack (276-636), which seem to function very comfortably at the level required by the Wilson.

An out-of-tolerance 15 V zener together with a diode in the line (for both slight voltage dropping and *reverse polarity protection;* install such a diode at the jack if your power supply doesn't incorporate one, to save your nicads unnecessary grief) feed my Wilson about half a volt more than it normally gets from its battery pack, and the rig has been operating very happily and successfully in this fashion for a number of months.

My thanks to W2YHX and WA2UAQ for their inspiration and urging on to better things, and best of luck to you in making this simple, but extremely worthwhile, modification. ■

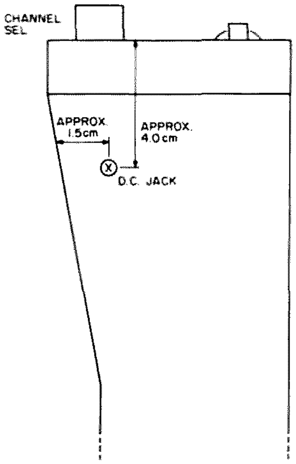

Fig. 2. Right side of Wilson 1402-SM showing approximate location of dc jack (not to scale).

Novice Antenna Specials

-- tips for that first antenna

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When a Novice receives his first license and is ready to get on the air, there comes the final portion of the volunteer examiner's responsibility which many either fail to realize or completely forget. Here is a newly-licensed individual whose knowledge of amateur radio is largely theoretical – one for whom the minor technicalities of getting on the air can present a major stumbling block unless that individual who got him into this in the first place is still with him, ready to help him over the few pitfalls in the process of getting started.

To the newly-licensed Novice, especially if he is a young person, the task of erecting his first antenna can be a formidable one. Then, if he makes one small mistake here or there, mistakes that the books don't always warn him against, he may be in for disappointment and discouragement. This article, then, is written with the beginner in mind, in hopes that it might help him to do the job right and start him out with an antenna that will properly introduce him to a truly rewarding hobby.

It's not nice to fool Mother Nature. She has her rules which, if obeyed, will serve you well and, if ignored, will trip you up. An antenna is a piece of equipment all in itself. It must change the alternating currents generated by your transmitter into radio waves; it must change radio waves into alternating currents from which the receiver can then recover the intelligence. So long as the rules are met, you can make your antenna any way you like.

In part, the rules are: The antenna must run in a straight, or nearly straight, line. It *must* be resonant. It should be suspended as high above the ground as possible, and as clear as possible of substantially large, grounded objects. While there are many antennas that are exceptions to these rules, they apply to any kinds of antennas that are relatively easy to install and tune.

What Kind of Antenna Do You Want?

The vast majority of antennas used by amateurs transmitting on Novice frequencies are distributed through two classes: dipoles and endfed wires.

The Dipole

A dipole is made of two pieces of wire, strung end-to-end, with the coax feedline connected in the center. The overall length of the combined two pieces of wire must be one half wavelength. The exact size may vary with the kind of wire you use, the height of the antenna above the ground, the conductivity of the ground in your location, and a few other things. Here are some sizes that will get you into the right ball park. (Note: these values are aimed at the centers of the Novice bands.)

80 meters	**125' 7"**
40 meters	**65' 5½"**
15 meters	**22' 1½"**
10 meters	**16' 7½"**

It is best if the antenna is run in a straight line, although some small amount of angle between the two halves can be tolerated. If you run the two halves side-by-side, as

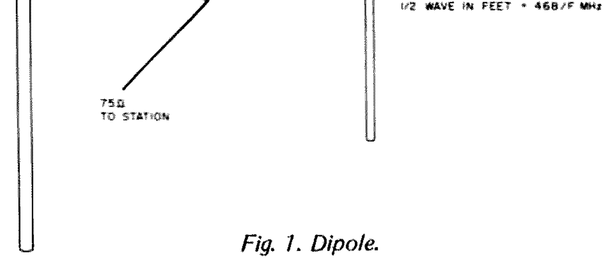

Fig. 1. Dipole.

one Novice almost did, it simply won't work! Support your wires with any strong insulating cord from trees, poles, buildings, or whatever happens to be handy. Fasten the cords to the antenna with glass, plastic, or ceramic insulators. In the center, use another insulator similar to those used at the ends.

Feed a dipole with 75 Ohm coaxial line. Type RG-59/U is adequate. You can use RG-11/U also, but it's bulky and expensive. Wrap the coax around the center insulator, tape it in place, and connect the conductors, one to each antenna wire.

The Inverted Vee

The inverted vee is a variation of the dipole that has provided excellent results for a great many hams. Unlike the dipole, the inverted vee is supported in the center, with the ends staked in place close to the ground. At this point, I will caution you to have the ends of the wires high enough that your neighborhood kid can't reach them. Otherwise, he'll be sure to grab them when you're transmitting, to the tune of a couple of thousand volts.

The angle between the two halves of an inverted vee should be between 90° and 120° for best results. The vee form factor changes the length needed to resonate your antenna. Here are the total lengths required for the Novice bands:

80 meters	124' 7"
40 meters	64' 11"
15 meters	21' 11"
10 meters	16' 6"

The inverted vee should be fed with 50 Ohm coax. Use type RG-58/U. RG-8/U can also be used, but it is more bulky and expensive.

The Endfed Wire

The endfed wire is the simplest of the antennas to erect, and can be the answer if your shack is on an upper floor. However, it requires a tuner, and can be a stinker to tune up for the first time. Also, if it isn't tuned up right, it can produce stray rf voltages floating around your shack and showing up where least welcome.

The length of an endfed wire is the most tolerant of mistakes (among the three antennas discussed here). In fact, an experienced amateur can load up almost any random length of wire. Since it is brought directly to your shack, there is no feedline as such. The tuner can be connected to the antenna with either 50 or 75 Ohm coax, but not both.

For a tuner, you can use the "Lunch Box" tuner described in the November/December, 1975, issue of *73*.

Bring the coax from your antenna, or tuner, through a coaxial lightning arrester, a low pass filter (if you use one), and a reflected power meter to the antenna relay or transceiver. Bring a wire from the lightning arrester, and a wire from each piece of equipment, to a common terminal in your shack, which will be your prime ground terminal. Don't depend on the shield in the coax for this connection. Run a heavy conductor from your prime ground terminal to your final earth-ground connection (a water pipe, driven rod, or several square feet of buried screen). A good ground is essential for the best operation of your station.

How to Tune Your Antenna

Generally, most antennas will work OK if cut from the basic antenna formulas, or if cut carefully to the sizes given in the preceding paragraphs. Once in a while you will find one needs further matching. We call the process "pruning." If the reflected power meter indicates a standing wave ratio of 2 or higher, you should prune the antenna. If the swr is 1.5 or less, leave it alone. Between 1.5 and 2, it's your decision.

It's a good idea to secure the help of an experienced amateur if you prune your antenna. With a little care and

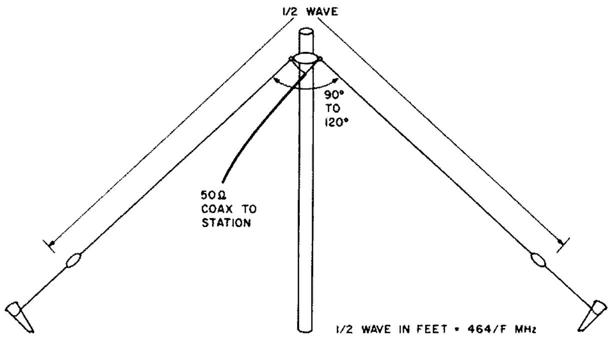

Fig. 2. Inverted vee.

common sense, however, you can do it yourself, and there's no time like the present to learn. You will need a grid dip meter. This can be borrowed from a local ham, if you can locate one, or it can often be located through a ham club. You will also need a receiver with a fairly accurate dial. *Never* depend on the dial calibrations of a grid dip meter unless it comes from a commercial lab. Even then be ready to question it.

The swr of the antenna can give you some idea which way you will have to go. If it is lowest at the high end of the band, the antenna is too short; if it is lowest at the low end of the band, the antenna is too long. To find out exactly how much to change the length, you must find out just where the antenna is resonant. That's where the grid dipper comes in.

Let's first consider the process of pruning a dipole. Support the dipole, stretched out in a straight line, at a height where you can easily reach it. Remove the coax and short the two halves together. Hold the grid dip meter with the coil just touching, but not making electrical contact with, the center of the antenna wire. Very slowly tune the grid dip meter through the suspected resonant frequency of the antenna. You will notice a pronounced dip in the meter reading. The bottom of this dip is at the resonant frequency of the antenna. Slowly move the coil away from the antenna, tuning back and forth over the resonant frequency until the dip is barely noticeable. When the meter reads at the lowest point, it is tuned to the antenna's resonant frequency. Now tune your receiver until you zero-beat the meter's oscillation, and read the frequency from the receiver's dial.

If you are checking an inverted vee, leave it in place and connect a turn or two of wire across the end of the coax. Couple the coil of the grid dip meter into this link, and spot the resonant frequency as in the preceding paragraph.

Once you have the resonant frequency spotted, you're almost there. Now you must adjust the antenna length to make it resonant where you want it. If the resonant frequency is too high, the antenna must be lengthened; if it is too low, the antenna must be shortened. Just how much depends on how far off the antenna's frequency is from where you want it. Find the *difference* between the antenna's resonant frequency and the center frequency of the band you are using. Multiply that difference by the factor given below:

80 meters	0.4
40 meters	0.11
15 meters	0.01
10 meters	0.007

The result is the amount, in inches, that must be taken from or added to your antenna. Remove or add exactly half this amount to each half of the antenna, and recheck swr. If you did it right, you

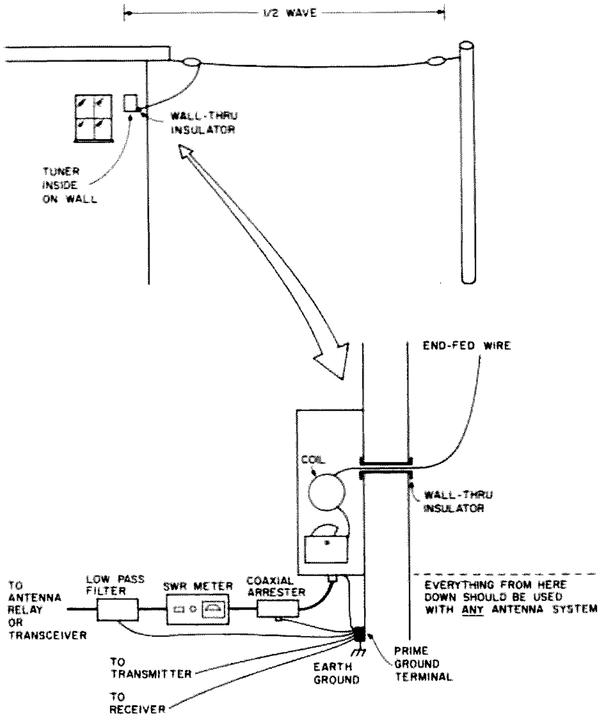

Fig. 3. Endfed wire.

will find a tremendous improvement.

Example: Charlie Brown finds his antenna is actually resonant at 6575 kHz. He wants it resonant at 7125 kHz. 7125 - 6575 = 550. 550 x 0.11 = 60.5. Charlie cuts 30¼ inches from each half of his antenna, and it will resonate at 7125. The discrepancy has been exaggerated to better illustrate the principle.

Example: Linus finds his antenna is resonant at 3875 kHz, and he wants it at 3725. 3875 - 3725 = 150. 150 x 0.4 = 60. He adds 30 inches to each half of his antenna, and it's resonant at 3725. Again, the amount of difference shown is more than you're likely to come up against.

Tuning An Endfed Antenna

There isn't much need to adjust the length of an endfed antenna, since the tuner makes up for that. If you've never done it before, you may want to tune your transmitter into a dummy load first. This isn't absolutely necessary, however. A grid dip meter can help, but you can get by without it. If you don't have something to read swr, get it.

With a grid dip meter:

Connect the antenna to the tuner, disconnect the transmitter, and short the coax connector. Set the grid dip meter to the center of the band you are using, spotting the frequency on your receiver. Couple the grid dip meter into the tuner and adjust the capacitor until you get an indication on the meter. If the meter seems to be approaching an indication with the tuner capacitor fully meshed, add a turn to the tuner coil. If the meter seems to be approaching an indication with the tuner capacitor all the way out, remove a turn from the tuner coil.

Without a grid dip meter, or after finding resonance with a grid dip meter:

Reduce the drive level in your transmitter as far as you can and still get rf out. (At this point it helps if the transmitter has already been tuned into a 50 Ohm dummy load.) Set the swr meter for reflected power. Tune the capacitor in the tuner for a dip in swr. If it seems to be approaching a dip with the capacitor all the way in, turn off the transmitter and add a turn to the tuner coil. If it seems to be approaching a dip with the capacitor all the way out, turn off the transmitter and remove a turn from the tuner coil. *Never* touch the coil while the transmitter is operating, unless you get the jollies by being tickled with a few thousand volts of rf.

Once the tuner is resonated, increase the drive in your transmitter and retune for a dip in swr. You may notice that you don't necessarily get the maximum forward drive at the same point where you get minimum swr. Redip the plate tuning of the transmitter, and you're ready to go. With subsequent changes in frequency, simply touch the tuner capacitor for minimum swr. It takes a bit of practice to get used to handling endfed antennas, but those who have mastered the art swear by them.

Having resonated an antenna, the next step is multiband operation. With dipoles or inverted vees, there's nothing at all wrong with connecting several antennas to one piece of coax. They do become trickier to tune, however.

Trap antennas simply utilize the frequency selection characteristics of parallel wavetraps to provide an end of the antenna for one frequency while letting others go on to the ends of the wire. These can be resonated in the same manner as dipoles or inverted vees, remembering that the higher frequency portion, in the middle, must be resonated first, then the lower portion at the ends.

The techniques outlined here have been very basic — old hat to most amateurs, but I hope the Novice reader may find this article useful in getting over that all-important hurdle and getting on the air.

Good luck, and welcome to ham radio! ■

Sound Operated Relay

-- for the ultimate security system

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There are numerous occasions when it would be nice to have a relay circuit that could be conveniently triggered by sound. Applications include automatic recording of the output of a monitor receiver that is not equipped with a COR circuit, automatic recording of data from any audio link, design of VOX circuits for RM or home brew sideband equipment — in short, lots of possibilities. In most of these applications, it would also be nice to have an adjustable time delay so that once triggered, the control circuit would remain actuated for a set period in the absence of further input, thus saving wear and tear on the recorder when monitoring a channel where rapid callbacks could be expected, where data dropouts might occur, or in a VOX circuit where we would want to avoid cycling the relay during momentary speech pauses. A great many of the circuits that can accomplish the relay/time delay function have several drawbacks, including undue circuit complexity or unwanted variation in the time delay. While looking through application notes for the versatile Signetics NE-555 timer IC[1], I realized that this chip could be very effectively put to use in a VOX circuit, something which is probably done every day in industry, but an application which is little used in amateur designs.

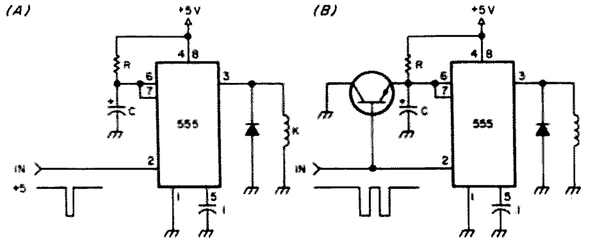

Fig. 1. Basic timer circuits for the NE-555. (a) Shows the basic timer. A momentary LOW at pin 2 causes the 5 volt reed relay (K) to pull in for a time period equal to 1.1RC. This circuit cannot be triggered again until the timing cycle is completed. (b) Shows the addition of a PNP transistor that permits the circuit to be continuously triggered during a timing cycle. As long as the input lows continue to arrive within the timing period (again 1.1RC), the relay will remain in the pulled-in condition. The relay will only drop out if a period of 1.1RC elapses between pulses.

A basic NE-555 timer circuit is shown in Fig. 1. If the input is momentarily pulled low, the timer will pull in the reed relay for a period determined by R and C in the timer circuit. The relay pull-in time can be computed from the formula $t = 1.1$ RC. If we use a 100k resistor for R and a 47 mF capacitor for C, the relay would pull in for $1.1\ (1\text{x}10^5)\ (4.7\text{x}10^{-5})$ or approximately 5.2 seconds. By itself, this circuit is not ideal for VOX, for it is not possible to retrigger the circuit until the timing cycle has been completed. By adding a simple PNP transistor, as shown in Fig. 1(b), it is possible to retrigger it. This circuit is widely used as a missing pulse detector, for the output will remain high (relay pulled in) as long as trigger pulses continue to arrive. Used as a missing pulse detector, one would normally set the timer for a period slightly longer than the expected interval between pulses. As long as the pulses arrive on schedule, the timer is repetitively triggered, but it will drop out as soon as a pulse is missing from the input train. This circuit configuration can easily be used in a VOX mode, for if we can pull the input low with peaks in an audio waveform, the relay will close and remain closed as long as there is audio input. When the input audio ceases, the relay will drop out after a time period determined by the RC formula noted earlier.

All that is required to convert the missing pulse detector to an audio triggered circuit is the addition of a single transistor as noted in Fig. 2. If this transistor conducts, it will trigger the timer. By adjusting the 10k input pot to just short of the point where the timer is triggered — in other words, biasing the transistor to just short of the point where it is ready to take off — a very small audio voltage on the input will trigger the timer and keep the relay in as long as the audio signal is present. The circuit is more than sensitive enough to respond to a signal tapped off the speaker leads of a monitor receiver, keyer, intercom, or what have you. Obviously, if you want to use the relay with a monitor receiver, the receiver should be equipped with a squelch circuit, other-

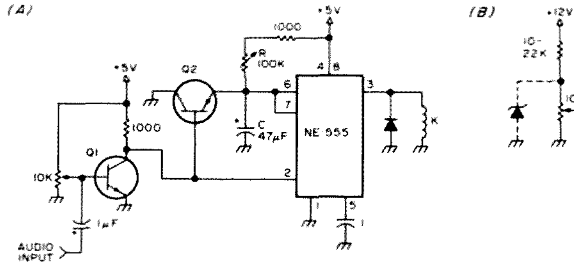

Fig. 2. (a) The basic audio operated relay. Q1 is any general purpose NPN transistor, while Q2 is an equally non-critical PNP unit. The 10k input pot is adjusted (starting with 0 V on the base of Q1) to a point just short of where Q1 turns "ON" as indicated by K pulling in. The closer the bias is set to this point, the less audio voltage at the input required to trigger the circuit. K is any 5 V reed relay. With the values shown for R (100k pot) and C (47 mF/20 V tantalum capacitor), timing values from .05 to slightly over 5 seconds can be achieved. In practice, timing below approximately 0.25-0.5 seconds is impractical as the relay will cycle between syllables. Values in excess of 5 seconds can be obtained simply by increasing the values of R and C. (b) Shows the addition of a 22k series resistor to the 10k input pot if a 12 V supply is used. If voltage fluctuations are expected on the supply line, a 4-6 V 1 W zener can be added as shown. Adjust the value of the series resistor in this case to provide the proper regulated voltage at the top of the input pot with the expected supply variations. The timer will function quite well at 12 V if a suitable 12 V reed relay is used at K. The diode across the relay coil simply provides surge protection from the back EMF developed across the relay coil and any general purpose 1 A diode rated at 50 or more volts may be used.

wise the background noise will trigger the relay just as effectively as the voice signals or data we wish to record. The attack time of the circuit is limited only by the pull-in time of the relay, which is very short in the case of typical reed relays. The timer will operate quite nicely at 12 volts, but in this case it is wise to include a series resistor at the top of the input pot shown in Fig. 2(b) to keep the base voltage to Q1 at a safe level. The timer will retain its accuracy with very wide swings in supply voltage, but since the bias level is critical for Q, it would be wise to include a 4-6 V zener on the input pot to stabilize the bias voltage in a mobile installation or situations where an unregulated supply voltage is used. The chip will handle virtually any reed relays at 5 or 12 volts, but if you should require a larger relay in your application, you should consider using the reed relay to trigger the larger unit or interfacing a transistor at the timer output to pull in a conventional open frame or plug-in relay.

The handful of parts used in the circuit are easily assembled on a small piece of perfboard and component placing is non-critical. This circuit has been used in a variety of applications in my own shack, including making tapes from the weather satellite receiver, logging calls on local "experimenter" simplex channels, automatically recording weather alerts, and in a variety of system control applications. It works like a charm despite the minimal component investment! ■

Reference

[1] Haney, L. M. (Ed.), 1973, *Calectro Digital Handbook*, G.C. Electronics, Rockford, Ill., 63 p.

Traffic Handling Explained

-- a lost art?

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Brooklyn NY 11236

I am sure that many of you have heard the terms ARPSC, AREC, and NTS. I am sure that you were as equally confused with those terms as you were with these: public service, traffic handling, emergency communications.

"What are they talking about?" you have probably asked yourself more than once, but probably gave up trying to understand soon after.

I am going to explain those terms and the ideas behind them, with the hope that it will cause you to take an interest and pursue that interest.

The National Traffic System (NTS) and the Amateur Radio Emergency Corps (AREC) are actually the Amateur Radio Public Service Corps (ARPSC) divided into two parts: an emergency division (AREC) and a traffic division (NTS). The AREC is usually dormant during normal times (no emergency), whereas NTS is always active. This does not mean, however, that the AREC is not ready. It's standing by, to be activated in an emergency.

Since my main objective is to get you into traffic handling, I will try to give you as complete a background of NTS that is possible without getting too technical.

The NTS is a major network composed of many smaller, interdependent networks (nets, for short). These smaller nets are categorized (from biggest to smallest) as local nets, section nets, region nets, and area nets.

The purpose of NTS is to handle third party traffic during normal times and, ultimately, to pass emergency traffic during emergencies. By passing traffic, we not only perform a public service, but we also train for the times when there can't be any mistakes, those life and death situations that we call emergencies.

You say you don't know what third party traffic is? You may think of third party traffic as any communication (phone patches, radiograms, etc.) transmitted via amateur radio for a third party (someone other than yourself). The bulk of the traffic handled on NTS are "radiograms." These radiograms (written messages in a standard form) may be relayed to their destination by way of the National Traffic System.

Let's see how NTS "gets you there" (your message, I mean).

Let's assume that you are living in New York City. Your neighbor wants to send birthday greetings to her Aunt Enna in Los Angeles, California. Here's how your message gets to California: First, you must put the message in the ARRL's standard amateur message form (a minor and simple technicality). Next thing you would do is check into your section net, which is, in this case, the New York City-Long Island Section Net (NLI). A section net is composed of people from their respective ARRL section (NLI in this case). If you have any traffic whose destination is within the section, it can be passed directly on your section net.

Since your message is for California, and not within the NLI section, it must be taken to another net – a region net. A region net is composed of representatives from each of the respective section nets of that region. (By the way, this representative is called a liaison, and is the person who brings all the outgoing traffic of one net to another net.)

Since the NLI section is part of the second region, all the traffic coming from this net must go to the second region net (2RN). The liaison appointed for that night will take your message from you, and then check into 2RN with that same message.

There are four liaisons who check into the second region net, one from the New York State Section Net (NYS), one from the New Jersey Section Net (NJN), one from NLI (the one that you check into), and a station that will go to the Eastern Area Net. Now . . . if there is any traffic for any of the sections in the second region, it can be passed directly on this net. For example: The NYS liaison has one message for New Jersey. The liaison from NJN will take this message. He will take it back with him to his section net, when he checks in later, to be delivered to the proper town.

If there is any traffic whose destination is not within the region, it must be taken to yet another net, the Eastern Area Net (EAN). Such is the case with your message. Your message is for

California, and that is certainly not part of the second region. There will be a liaison at the second region net who will take your traffic to the Eastern Area Net.

If you can see the pattern now, you will note that California is not part of the EAN either, but must be sent to the Pacific Area Net (PAN).

When the liaison with your traffic checks into EAN, he will relay the message to an operator in the TransContinental Corps (TCC). TCC is the organization that relays messages to and fro between PAN, CAN, and EAN – Pacific, Central, and Eastern Area Nets respectively. The message will then be sent by way of TCC to the PAN. Your message then undergoes the previous processes in the reverse order: From PAN (an area net), to the sixth region net (a region net), to the appropriate California section net.

The people who check into this section net are people from all over the section. A station in Los Angeles will check in and take your traffic. This station would then deliver your message to your neighbor's Aunt Enna by telephone and/or mail. He will usually take the time to explain how the message got there, so as not to baffle its recipient.

That is how your traffic gets from place to place within the National Traffic System. Would you believe that this usually takes place within about three hours?

There are three major purposes (in my eye) of NTS and traffic handling: public service, emergency communications, and fun.

Most non-hams have a dim view of amateur radio because their only experience with radio has been that of TVI and RFI. Handling their traffic shows them that ham radio has a purpose, and can be useful to them. I used to have a problem with my neighbor, but once I started handling her traffic, she never mentioned anything again!

Knowing how nets operate and how you yourself must act on a net increases NTS's effectiveness during emergencies. We are not usually so lucky: Many inexperienced people check into nets (wanting to help, of course), but usually decrease the net's efficiency because of this inexperience. A well-trained amateur is NTS's biggest asset.

Traffic handling is fun. I cannot actually pinpoint the reason, but once I started, I was hooked.

By this time, I am sure that many of you would like to know more.

The first net that you can actually check into is the section net; it is unwise to check into a higher net if you lack the proper experience. The section net is, as I said before, composed of people from your respective ARRL section. Most section nets have a roster of about 30 people, but this usually depends on what the ham population is in that area. You realize, of course, that it is a rare occasion when more than half the net's membership checks in on any given night (this is especially true on CW nets). A section net with a roster of thirty will usually average six to twelve check-ins per night.

ARRL Operating Form #9 gives you the standard amateur message format. On the opposite side are Q signals and abbreviations for traffic net use.

AMATEUR MESSAGE FORM

Every message originated and handled should contain the following component parts in the order given.

I PREAMBLE
- *a.* Number (begin with 1 each month or year)
- *b.* Precedence (R, Q, P or EMERGENCY)
- *c.* Handling instructions (optional, see text)
- *d.* Station of Origin (first amateur handler)
- *e.* Check (number of words/groups in text only)
- *f.* Place of Origin (not necessarily location of station of origin)
- *g.* Time Filed (optional with originating station)
- *h.* Date (must agree with date of time filed)

II ADDRESS (as complete as possible, include zip code and telephone number)

III TEXT (limit to 25 words or less, if possible)

IV SIGNATURE

CW MESSAGE EXAMPLE

I NR 1 R HXA W1AW 8 NEWINGTON CONN 1930Z July 1
a b c d e f g h

II DONALD R SMITH $\overline{AA}$
164 EAST SIXTH AVE $\overline{AA}$
NORTH RIVER CITY MO 00789 $\overline{AA}$
FONE 733 3967 $\overline{BT}$

III HAPPY BIRTHDAY X SEE YOU SOON X LOVE $\overline{BT}$

IV DIANA $\overline{AR}$

CW. Note that X, when used in the text as punctuation, counts as a word. The prosign $\overline{AA}$ separates the parts of the address, $\overline{BT}$ separates the address from the text and the text from the signature. $\overline{AR}$ marks end of message; this is followed by B if there is another message to follow, by N if this is the only or last message. It is customary to copy the preamble, parts of the address, text and signature on separate lines.

RTTY: Same as cw procedure above, except (1) use extra space between parts of address, instead of $\overline{AA}$; (2) omit cw procedure sign $\overline{BT}$ to separate text from address and signature, using line spaces instead; (3) add a CFM line under the signature, consisting of all names, numerals and unusual words in the message in the order transmitted.

PHONE: In general, use *prowords* in place of procedural signals or *prosigns*. The above message on phone would go something like this: "*Message Follows* Number one, routine, HX Alpha, W1AW, *check* eight, Newington, Connecticut, one eight thuhree zero zulu, July one, *to* Donald *Initial* R Smith, *Figures* one six fower, East Sixth Avenue, North River City, Missouri zero zero seven eight nine, Fone sev-ven thuhree thuhree, thuhree niyen six eight. *Break* Happy Birthday X-ray see you soon X-ray love *Break* Diana, *End of Message, Over*." Speak in measured tones, emphasizing every syllable. Spell out phonetically all difficult or unusual words, but do *not* spell out common ones.

PRECEDENCES

The precedence will follow the message number. For example, on cw 207R or 207 EMERGENCY. On phone, "Two Zero Seven, Routine (or Emergency)."

EMERGENCY – Any message having life and death urgency to any person or group of persons, which is transmitted by amateur radio in the absence of regular commercial facilities. This includes official messages of welfare agencies during emergencies requesting supplies, materials or instructions vital to relief of stricken populace in emergency areas. During normal times, it will be *very rare*. On cw, this designation will *always* be spelled out. When in doubt, do *not* use it.

PRIORITY – Important messages having a specific time limit. Official messages not covered in the "Emergency" category. Press dispatches and other emergency-related traffic not of the utmost urgency. Notification of death or injury in a disaster area, personal or official. Use the abbreviation P on cw.

INQUIRY – Messages pertaining to the health or welfare of persons in a disaster should carry this precedence, which is abbreviated to Q on cw. These messages are handled *after* PRIORITY traffic but before ROUTINE.

ROUTINE – Most traffic in normal times will bear this designation. In disaster situations, traffic labeled "Routine" (R on cw) should be handled *last*, or not at all when circuits are busy with emergency, priority or inquiry traffic. Most traffic handled on amateur circuits in normal times will fall in this category.

Handling Instructions

HXA – (Followed by number.) Collect landline delivery authorized by addressee within .... miles. (If no number, authorization is unlimited.)
HXB – (Followed by number.) Cancel message if not delivered within .... hours of filing time; service originating station.)
HXC – Report date and time of delivery (TOD) to originating station.
HXD – Report to originating station the identity of station from which received, plus date and time. Report identity of station to which relayed, plus date and time, or if delivered report date, time and method of delivery.
HXE – Delivering station get reply from addressee, originate message back.
HXF – (Followed by number.) Hold delivery until .... (date).
HXG – Delivery by mail or landline toll call not required. If toll or other expense involved, cancel message and service originating station.

This prosign (when used) will be inserted in the message preamble before the station of origin, thus: NR 207 R HXA50 W1AW 12 .... (etc.). If more than one HX prosign is used, they can be combined if no numbers are to be inserted, otherwise the HX should be repeated, thus: NR 207 R HXAC W1AW .... (etc.), but: NR 207 R HXA50 HXC W1AW .... (etc.). On phone, use phonetics for the letter or letters following the HX, to insure accuracy.

OPAID 9 81075 — ARRL, 225 Main St., Newington, CT 06111

ARRL QN SIGNALS FOR CW NET USE

QNA*	Answer in prearranged order.
QNB*	Act as relay Between.....and.....
QNC	All net stations Copy. I have a message for all net stations.
QND*	Net is Directed (controlled by net control station).
QNE*	Entire net stand by.
QNF	Net is Free (not controlled).
QNG	Take over as net control station.
QNH	Your net frequency is High.
QNI	Net stations report In.* I am reporting into the net. (Follow with a list of traffic or QRU.)
QNJ	Can you copy me? Can you copy.....?
QNK*	Transmit messages for.....to.....
QNL	Your net frequency is Low.
QNM*	You are QRMing the net. Stand by.
QNN	Net control station is..... What station has net control?
QNO	Station is leaving the net.
QNP	Unable to copy you. Unable to copy.....
QNQ*	Move frequency to.....and wait for.....to finish handling traffic. Then send him traffic for.....
QNR*	Answer.....and Receive traffic.
QNS	Following Stations are in the net.* (Follow with list.) Request list of stations in the net.
QNT	I request permission to leave the net for.....minutes.
QNU*	The net has traffic for you. Stand by.
QNV*	Establish contact with.....on this frequency. If successful, move to.....and send him traffic for.....
QNW	How do I route messages for.....?
QNX	You are excused from the net.* Request to be excused from the net.
QNY*	Shift to another frequency (or to.....kHz) to clear traffic with.....
QNZ	Zero beat your signal with mine.

*For use only by the Net Control Station.

Notes on Use of QN Signals

The QN signals listed above are special ARRL signals for use in amateur cw nets *only*. They are not for use in casual amateur conversation. Other meanings that may be used in other services do not apply. Do not use QN signals on phone nets. *Say it with words.* QN signals need not be followed by a question mark, even though the meaning may be interrogatory.

INTERNATIONAL Q SIGNALS

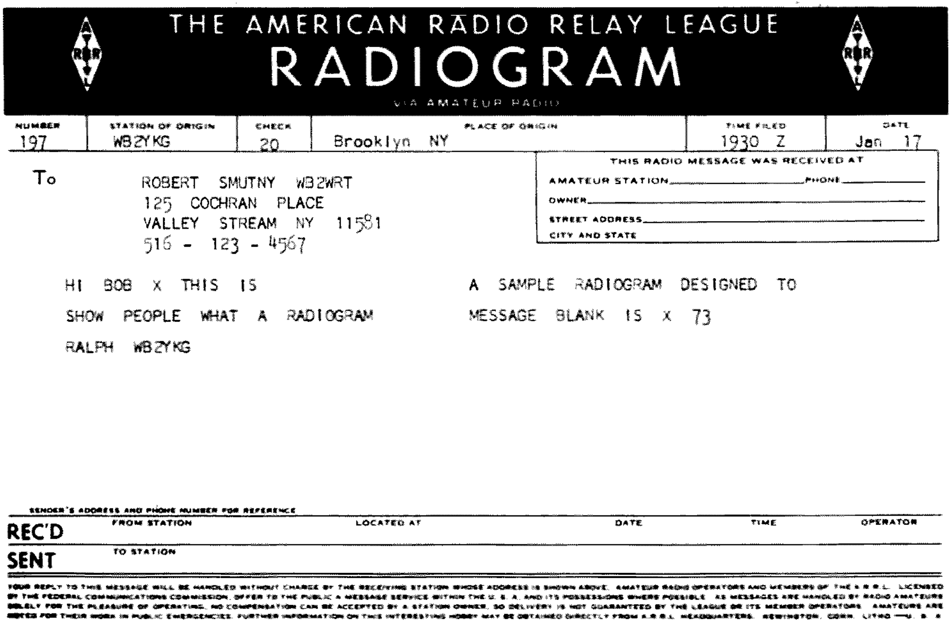
A Q signal followed by a ? asks a question. A Q signal without the ? answers the question affirmatively, unless otherwise indicated. See the ARRL *Handbook* and *Operating an Amateur Radio Station* for an expanded list.

QRA	What is the name of your station?
QRG	What's my exact frequency?
QRH	Does my frequency vary?
QRI	How is my tone? (1-3)
QRK	What is my signal intelligibility? (1-5)
QRL	Are you busy?
QRM	Is my transmission being interfered with?
QRN	Are you troubled by static?
QRO	Shall I increase transmitter power?
QRP	Shall I decrease transmitter power?
QRQ	Shall I send faster?
QRS	Shall I send slower?
QRT	Shall I stop sending?
QRU	Have you anything for me? (Answer in negative.)
QRV	Are you ready?
QRW	Shall I tell.....you're calling him?
QRX	When will you call again?
QRZ	Who is calling me?
QSA	What is my signal strength? (1-5)
QSB	Are my signals fading?
QSD	Are my signals mutilated?
QSG	Shall I send.....messages at a time?
QSK	Can you work breakin?
QSL	Can you acknowledge receipt?
QSM	Shall I repeat the last message sent?
QSO	Can you communicate with.....direct?
QSP	Will you relay to.....?
QSV	Shall I send a series of V's?
QSW	Will you transmit on.....?
QSX	Will you listen for.....on.....?
QSY	Shall I change frequency?
QSZ	Shall I send each word/group more than once? (Answer, send twice or.....)
QTA	Shall I cancel number.....?
QTB	Do you agree with my word count? (Answer negative.)
QTC	How many messages have you to send?
QTH	What is your location?
QTR	What is your time?
QTV	Shall I stand guard for you.....?
QTX	Will you keep your station open for further communication with me?
QUA	Have you news of.....?

ABBREVIATIONS, PROSIGNS, PROWORDS

CW	PHONE (meaning or purpose, exception obvious)
$\overline{AA}$	(Separation between parts of address or signature.)
AA	All after (used to get fills).
AB	All before (used to get fills).
ADEE	Addressee (name of person to whom message addressed).
ADR	Address (second part of message).
$\overline{AR}$	End of message (end of record copy).
ARL	(Used with "check," indicates use of ARRL numbered message in text.)
$\overline{AS}$	Stand by; wait.
B	More (another message to follow).
BK	Break; break me; break-in. (interrupt transmission on cw. Quick check on phone.)
$\overline{BT}$	Separation (break) between address and text; between text and signature.
C	Correct; yes
CFM	Confirm. (Check me on this.)
CK	Check
DE	From; this is (preceding identification).
FONE	Phone; telephone.
$\overline{HH}$	(Error in sending. Transmission continues with last word correctly sent.)

CW	PHONE (meaning or purpose, exception obvious)
HX	(Handling instructions. Optional part of preamble.)
....	Initial(s). Single letter(s) to follow
$\overline{IMI}$	Repeat; I say again. (Difficult or unusual words or groups.)
K	Go ahead; over; reply expected. (Invitation to transmit.)
N	Negative, incorrect; no more. (No more messages to follow.)
NR	Number. (Message follows.)
PBL	Preamble (first part of message)
....	Read back. (Repeat as received.)
R	Roger, point. (Received; decimal point.)
SIG	Signed; signature (last part of message).
$\overline{SK}$	Out; clear (end of communication, no reply expected)
TU	Thank you.
WA	Word after (used to get fills)
WB	Word before (used to get fills).
....	Speak slower.
....	Speak faster.


THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM
VIA AMATEUR RADIO

NUMBER	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE
197	WB2YKG	20	Brooklyn NY	1930 Z	Jan 17

To ROBERT SMUTNY WB2WRT
125 COCHRAN PLACE
VALLEY STREAM NY 11581
516 - 123 - 4567

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION ______ PHONE ______
OWNER ______
STREET ADDRESS ______
CITY AND STATE ______

HI BOB X THIS IS A SAMPLE RADIOGRAM DESIGNED TO
SHOW PEOPLE WHAT A RADIOGRAM MESSAGE BLANK IS X 73
RALPH WB2YKG

SENDER'S ADDRESS AND PHONE NUMBER FOR REFERENCE

	FROM STATION	LOCATED AT	DATE	TIME	OPERATOR
REC'D					
SENT	TO STATION				

A radiogram message blank. Although not necessary for handling traffic, they do give your messages a "spiffy" look.

If you are in the dark as to what net meets in your area, you might send for the ARRL Net Directory (an SASE will bring a quick response). This lists all NTS nets, as well as other nets which do not have traffic handling as their main purpose. The net directory will help you find any NTS net. They are listed by state and frequency as well as by the net's name.

Most section CW nets meet anywhere from 6 pm and later (usually) and are almost exclusively on 80 meters. The phone nets, however, are of different case. They usually meet during the day or in the late afternoon. The area phone nets usually meet on 40 meters (for obvious reasons).

There are generally three types of traffic nets: CW nets, phone nets, RTTY nets. All are quite useful, but for different purposes. RTTY comes in handy when you have to handle bulk traffic, that is, many messages all at once. Tape operation gives this advantage. Unfortunately, there are very, very few RTTY nets in NTS. Phone nets, as well as RTTY nets, are mainly for those who are experienced in traffic handling. CW nets are of two kinds: high speed and slow speed. The high speed net usually operates at a speed of approximately 18 wpm and is usually composed of experienced traffic handlers.

A very valuable net to those beginning in traffic handling is the slow speed net. The slow speed net serves many purposes. One of its greatest purposes is to train inexperienced rookies and turn them into veteran traffic handlers. This net is for making mistakes and no one will look down on you for making them. (Don't get me wrong. I am not saying that high speed nets are for the experienced and that slow speed nets are for the inexperienced only. This would be terrible. The inexperienced must learn through the help and examples set by the experienced. Believe me, everyone is usually willing to help.)

The slow speed net used to mainly train Novices, Generals, etc., but now with the new regulations, even Technicians can check into slow speed nets. Take my word, traffic handling will increase your code speed by plenty, and if you're a Tech or Novice who wants to upgrade, it will help a lot!

In time, if you become deeply involved in traffic handling, you may find your name printed in *QST* on the Public Service Honor Roll and Brass Pounder's League. But don't think that your name has to be there to be important. The fact is that every single person is important whether he passes thousands of messages or just one. Remember that without all the little people, the big people would have no one to relay their traffic to! No man is unimportant in NTS! No man is all-important, either. It's one big team doing a public service.

Traffic handling is surely something worth looking into. Not only can you perform a public service, you can also better yourself in one way or another as well. Don't think that you cannot be used if you don't have traffic; that's not true. NTS needs stations *from* everywhere to take traffic *to* everywhere. There is nothing preventing anyone from turning on his rig and checking into NTS. ■

The Third Hand

-- how many times?

Harry J. Miller
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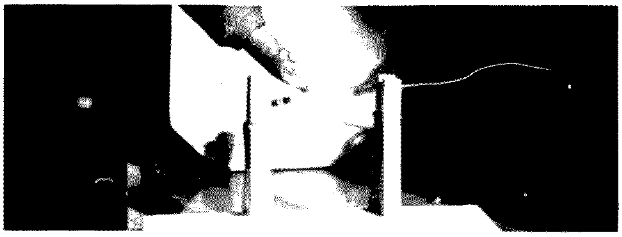
When you're soldering small components, it can be a job to hold them, the soldering iron or gun, and the solder. The easy way is with a vise made with two spring-type clothespins.

Cut one leg shorter than the other, and then use small brads to nail the longer ends to the side of a small wood block. Place the item within the jaws of the two clothespins while you solder. ■



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Vehicle Security Systems

-- protect your rig

The theft of radio equipment and other such valuables from vehicles is a current problem that is getting more serious with every passing day. We are all concerned with this problem, and rightly so, because if someone's vehicle hasn't already been burglarized, the odds are that sooner or later it will. That may be a pessimistic statement, but we may as well face facts: More mobile ham rigs are being stolen today than were stolen a few years ago before the rise in popularity of CB radios. The reason, as we are all aware, is that ham rigs are sometimes mistaken for CB rigs and are ripped off just the same.

As a result of this problem, many hams are taking preventive measures to protect their valuable property. Some of these measures include engraving driver's license numbers both outside and inside the unit and installing a quick disconnect mount to allow the rig to be easily removed and stored in the trunk. In addition, borrowing an idea from the CB market, there are a few swivel antenna mounts on the market that allow VHF antennas to be folded into the trunk along with the transceiver.

These measures are worthwhile, but we can always go one step further and include some type of security system as additional insurance against unwanted intrusion. Granted, if someone wants to break into a vehicle, nothing can really prevent him. However, if a security system in the vehicle goes off making some loud noises, most rip-off artists will usually run for cover, particularly if the attempted burglary is in an area where an alarm will draw a lot of attention, such as parking lots and busy streets.

The subject of building an electronic security system is not necessarily a new one, but there are new and unique ways such a system can be designed and built. This article describes a solid state security system designed around simple CMOS NOR gates for the ultimate in flexibility and reliability.

General Requirements of a Security System

Most of the commercial intrusion alarms on the market today generally fall into one of two categories:
1. Inexpensive alarms with an external key switch and no time delays, and
2. More expensive "electronic" alarms with exit/entry time delays and no external key switch.

The first (which I will refer to as key switch alarms), while being low in cost, are sometimes ineffective because of the visible external key switch which tips off the rip-off artist. He will usually do one of two things. He will reach under the battery compartment from beneath the vehicle and cut the battery cable, which disables the alarm. Or he can break the window, climb in, and make off with your rig without opening the door or setting off the alarm.

On the other extreme, the electronic systems with exit and entry delays have no visible key switch to tip off the burglar. This type is usually very effective because of the element of surprise,

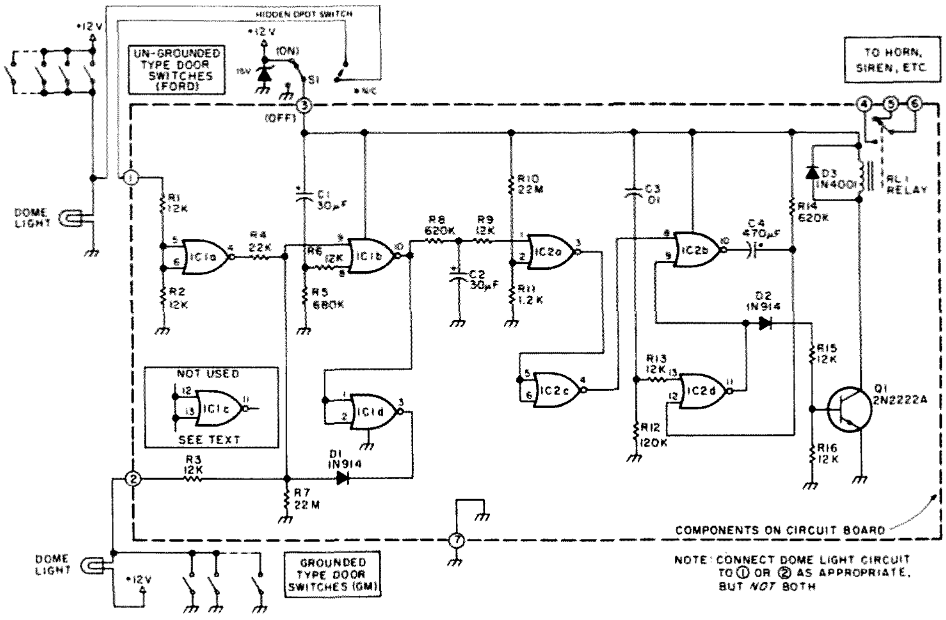


Fig. 1. Schematic diagram.

but can be expensive to purchase. In fact, the high cost of some of these sophisticated alarms has kept many hams from having the kind of protection they really need.

One solution to this problem is to build your own electronic system, thus keeping the cost low and protection high. Some of the features that an electronic alarm system should have are as follows:

1. Be able to operate over a wide voltage range and withstand the harsh electrical environment of a car's electrical system.
2. Exit and entry time delays to eliminate the need for an external key switch. The alarm is to be activated from within the car, before leaving.
3. To comply with the laws in some states, the alarm should have an automatic shut-off feature to turn the alarm (horn, siren, etc.) off after five minutes of sounding.
4. There should be negligible power drain on the battery until the alarm is triggered by an intruder.
5. The alarm should be easy to build and install, in addition to being low in cost.
6. Once the alarm is triggered, the operation sequence should be automatic and not affected by subsequent opening or closing of doors.

The alarm described in this article meets the above requirements and uses only two CMOS integrated circuits.

How It Works

Referring to the diagram shown in Fig. 1, the heart of the alarm system is comprised of two CMOS CD4001 2-input quad NOR gates which provide the switching logic for the system. These devices can operate over a wide voltage range (+5 V to +15 V) and are ideal for automotive applications.

The first CD4001 provides the sensor interface, latching circuitry and exit/entry time delays. The second CD4001 provides the output (through a transistor relay switch), as well as an automatic shutdown time delay for the sounding device.

Two types of sensor inputs are provided: one for ungrounded door dome light switches usually found in Fords, and one for the grounded type door switches such as in General Motors cars. When the hidden switch within the vehicle is switched on, C1 begins charging through a 680k resistor to ground. However, until C1 is fully charged (about 15-20 seconds), pin 8 of IC1b is at a high logic state. Since the output of a NOR gate is low if either or both inputs are high, the output of IC1b will remain low for the duration of C1 charging and regardless of whether the door switches are opened or closed.

However, once C1 is fully charged, pin 8 of IC1b is low, and opening a door will cause pin 9 of IC1b to also become low. When this occurs, the output of IC1b becomes high and two additional things happen. C2 begins charging through the 680k (R8) resistor connected to the output (pin 10) of IC1b. This begins the entry time delay sequence. Also, since both input pins (1 and 2) of IC1d are also connected to pin 10 of IC1b, the output of IC1d (pin 3) switches to a low state, effectively grounding the cathode end of diode D1. When this happens, the input of IC1b is latched to a low state and will remain that way until the alarm is reset with the hidden switch. The alarm sequence will continue regardless of any subsequent

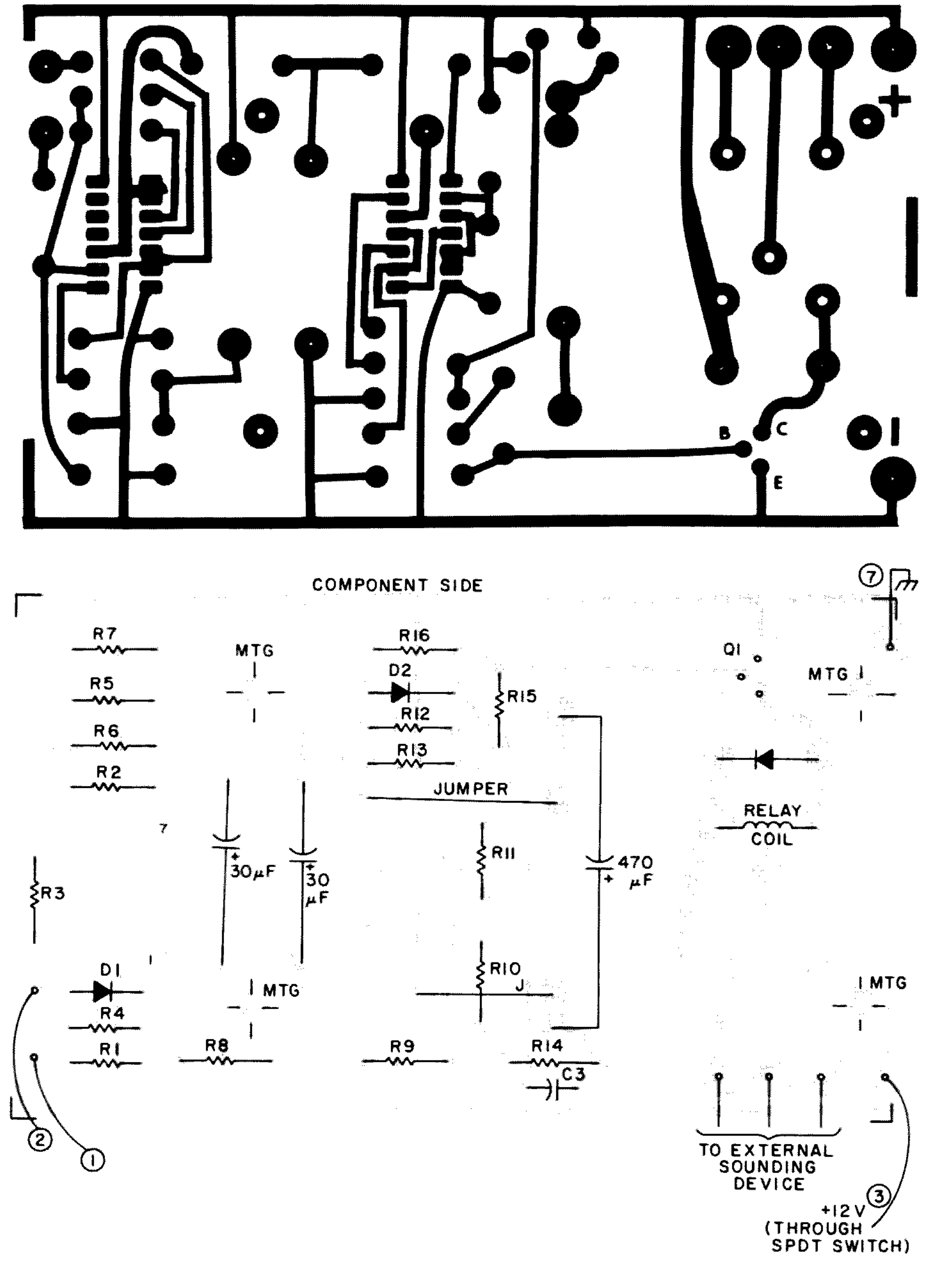
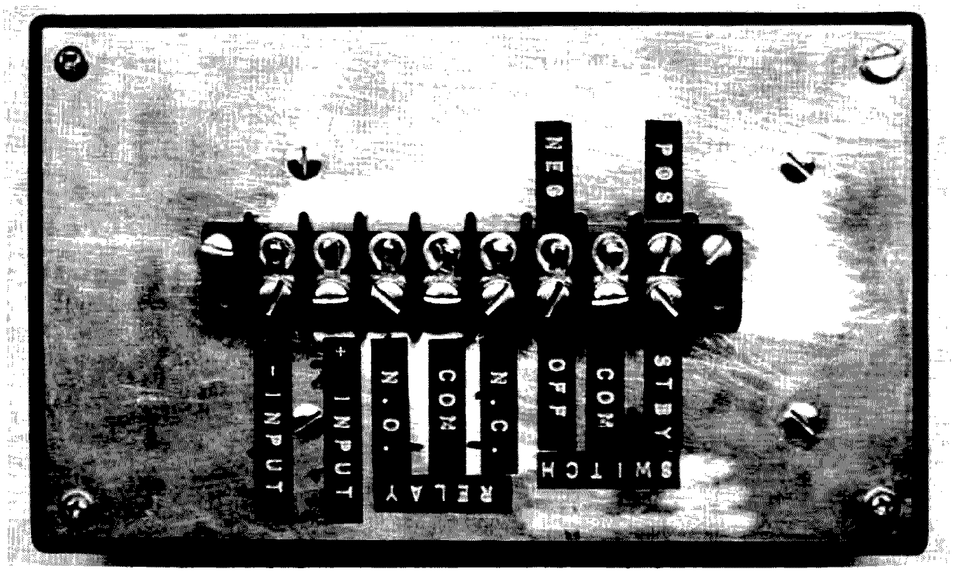


Fig. 2. Printed circuit board layout.



Front view of the security system control unit showing the eight-terminal barrier strip for external connections. Note that one row of screws has been removed and a small hole drilled through each terminal opening into the box. Leads were then brought through these access holes and soldered to small solder lugs for attachment to the remaining screws.

closing or opening of doors or sensors.

If the hidden switch is not reached in time (15-20 seconds), IC2d turns on the relay through Q1. This turns on the alarm sounding device, which remains on for the duration of the charging of C4 (approximately 4 to 5 minutes).

Construction Details

The security system may be built in a 6-1/4" x 3-3/4" x 2" plastic instrument available from most electronics parts suppliers. The layout is not particularly critical. Fig. 2 is an example of a typical PC layout for the circuit. The layout will easily fit into the above plastic case. Actually, the entire unit could be constructed much smaller than the example in this article by redesigning the PC layout for a more compact arrangement.

Although the circuit described works exceptionally well with the relay shown, you may want to substitute a 2N3055 power switching transistor in place of the relay. This will make the unit completely solid state and able to switch a load greater than the 3 Amps limitation of the relay contacts. With a slight redesign of the circuit board, the 2N3055 could be mounted in the same area previously occupied by the relay. If anyone is interested in this feature, drop me a self-addressed stamped envelope, and I'll send you a schematic diagram of the circuit.

If the actual load of the alarm sounding device is greater than 3 Amps, and you want to build the alarm with the internal relay, just use its contacts to control a heavy-duty relay at the load. In this way, the amount of current to be switched is limited only to the rating of the contacts at the source.

The printed circuit is etched from a 3" x 5" phenolic or epoxy glass blank, using standard practices. It [illegible] strongly recommended [illegible] IC sockets or molex pins [illegible] used for the two ICs. The obvious reason for this is to allow replacement of the ICs (and also to protect the sensitive input terminals from static electric charges during soldering).

Checkout and Installation

After the circuit board has been etched and wired, it's time for the initial checkout. First check out all connections, and, when you are satisfied there are no wiring errors, insert the CD4001s, avoiding any hand contact with their input pins. Then apply power to the circuit (-V to pin 7 and +V to pin 3 on the external terminal strip, temporarily eliminating the hidden SPDT switch to be used in the actual installation).

Next, with an ohmmeter, check the relay contacts. Pins 5 and 6 should indicate a closed circuit, and pins 6 and 4 should indicate an open circuit. After the initial entry delay period, use a jumper wire to momentarily connect input pin 1 to +V. This should start the alarm sequence, and after 20-30 seconds, you should hear the relay operate. Check the contacts with your ohmmeter. Pins 4 and 6 should remain closed for about 4-5 minutes and then reopen.

Next, remove power and short pin 3 to ground to

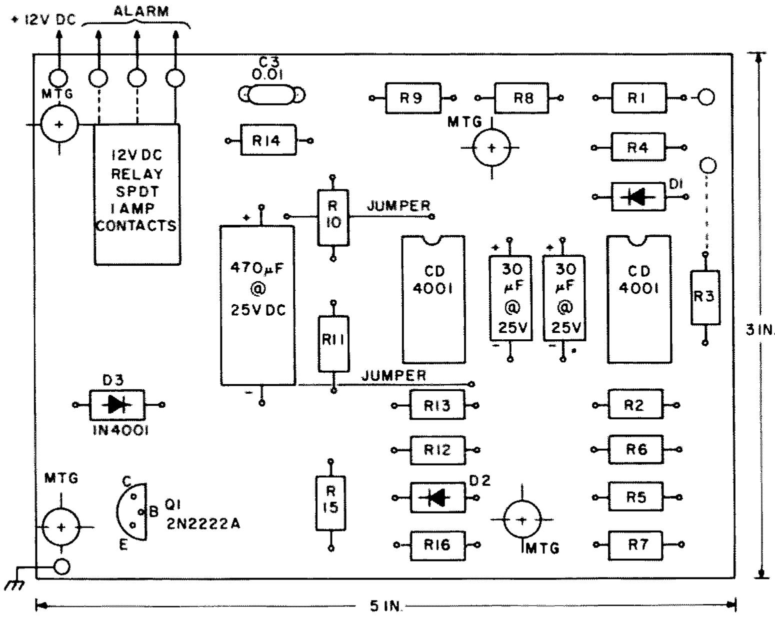


Fig. 3. Component placement.

discharge the electrolytics. This would be accomplished automatically when the unit is operated with the hidden SPDT switch (see the schematic diagram). Then restore power and wait for the initial exit time delay to reset. Repeat the previous check for input pin 3, but in this case momentarily connect the jumper from pin 3 to ground. After the entry time delay cycle completes, the output contacts of the relay should close and remain closed for 4-5 minutes. This completes the initial checkout and the unit is ready for installation into your car.

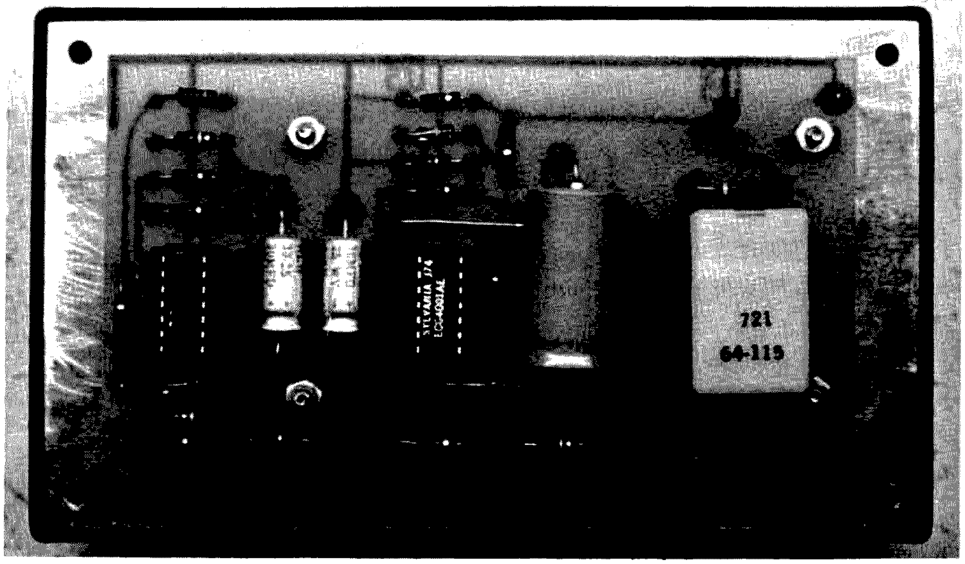
External connections are made through the barrier terminal strip as shown in Fig. 4. Power for the unit is derived from the car's fuse block, from a terminal that is not switched by the ignition switch.

The actual location for the unit may be anywhere in the vehicle that is away from view and preferably not easily reached. Also, the hidden switch should be installed at a convenient location that is not obvious to an intruder. The only remaining connection to be made is to the dome light circuit. Depending on your particular car, this connection may be to input pin 1 or 2 but not both. If your car uses ungrounded door switches, the connection will be to pin 1. (Note that this connection should be on the load side of the switch as shown on the schematic.) On the other hand, if your car uses grounded type door switches, input pin 2 should be used.

To complete the installation, you may want to add door switches to the two rear doors, trunk, and hood for total protection. As before, match the new door switches to your existing door switches and connect to the appropriate input terminal.

This security system should provide years of troublefree operation, and hopefully will someday foil the plans of any would-be intruder. If it prevents an unauthorized entry on just one occasion, it will have more than paid for itself. In fact, the cost to build this system is so reasonable that you may want to build another for your home, apartment or camper. Power drain is so negligible that it can be operated from lantern batteries for years. Just use NC magnetic reed switches in series from +V to the input of the unused IC1c. Then connect the output of this IC1c to input terminal 1 on the circuit board. As long as all switches are closed, the inputs are high and the output of IC1c is low. If a door is opened, the output of IC1c goes high and the normal alarm sequence is started.

As you can see, this circuit is very versatile and may be adapted to just about any alarm application. ■



This photograph shows a top view of the PC board with the components in place. External connections are made to the board through the terminal strip on the opposite side of the aluminum panel.

References

1. "20 Easy-To-Build COSMOS Burglar Alarms – Part 2," ***Radio-Electronics***, R.M. Marston, May, 1975, page 48.

Parts List

C1, C2	30 uF @ 25 volts electrolytic
C3	0.01 F bypass
C4	470 uF @ 25 volts electrolytic
D1, D2	1N914
D3	1N4001, 1A @ 1000 volts PIV
IC1, IC2	CD4001AE quad 2-input NOR gate
Q1	2N2222A NPN transistor

All resistors are ¼ Watt, 10%

R1, R2, R3, R6, R9, R13, R15, R16	12,000 Ohms
R4	22,000 Ohms
R5	680,000 Ohms
R8, R14	620,000 Ohms
R7, R10	22 megohms
R11	1200 Ohms
R12	120,000 Ohms

RL-1 SPDT relay with a 12 volt coil (Burstein-Applebee stock number 19A1823-3)
Misc IC sockets, plastic instrument case, terminal strip, circuit board

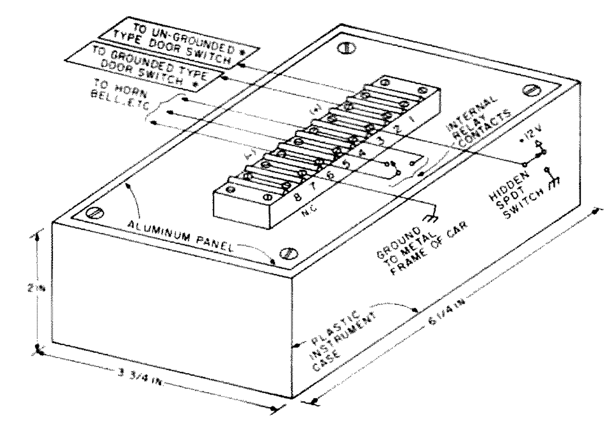


*Fig. 4. External connections (not to scale). *Connect terminal 1 or 2, but not both, to the appropriate door switch (1 for ungrounded and 2 for grounded type switches).*

One Cent Channels for the IC-22S

-- inflation fighter!

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Waneta Edgett WA2HGQ
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Frequency Hex	490=8C	147.000=AE	147.510=D0
	505=8D	015=AF	525=D1
146.010=6C	520=8E	147.030=B0	540=D2
025=6D	535=8F	045=B1	555=D3
040=6E	146.550=90	060=B2	570=D4
055=6F	565=91	075=B3	585=D5
146.070=70	580=92	090=B4	600=D6
085=71	595=93	105=B5	615=D7
100=72	610=94	120=B6	630=D8
115=73	625=95	135=B7	645=D9
130=74	640=96	150=B8	660=DA
145=75	655=97	165=B9	675=DB
160=76	670=98	180=BA	690=DC
175=77	685=99	195=BB	705=DD
190=78	700=9A	210=BC	720=DE
205=79	715=9B	225=BD	735=DF
220=7A	730=9C	240=BE	147.750=E0
235=7B	745=9D	255=BF	765=E1
250=7C	760=9E	147.270=C0	780=E2
265=7D	775=9F	285=C1	795=E3
280=7E	146.790=A0	300=C2	810=E4
295=7F	805=A1	315=C3	825=E5
146.310=80	820=A2	330=C4	840=E6
325=81	835=A3	345=C5	855=E7
340=82	850=A4	360=C6	870=E8
355=83	865=A5	375=C7	885=E9
370=84	880=A6	390=C8	900=EA
385=85	895=A7	405=C9	915=EB
400=86	910=A8	420=CA	930=EC
415=87	925=A9	435=CB	945=ED
430=88	940=AA	450=CC	960=EE
445=89	955=AB	465=CD	975=EF
460=8A	970=AC	480=CE	147.990=F0
475=8B	146.985=AD	495=CF	

Fig. 1. Hexadecimal for IC-22S.

The recent arrival of Icom's new IC-22S has completely changed the 2 meter FM transceiver market. The most noted change is the decrease in cost, for a unit which has the features of a synthesizer. The IC-22S only requires you to program a diode matrix board for the common frequencies that you will be using with the 22 selector positions. This makes for very convenient operation, with an even greater advantage over a regular synthesized unit while in mobile use. We have been able to create the best of the crystal controlled rigs and the synthesized units, with a slight modification of the 22S.

The modification, which should cost only a little over $2.00, simply consists of making use of the 23rd position of the selector switch, with the addition of a miniature 8 position DIP switch. This will allow for programming this position at any time, for any unusual frequency that you desire, at any standard 15 kHz spacing. The location that was picked to mount the 8 position DIP switch was on the underside of the radio, between the matrix board and the front panel. This allows minimum wire length, convenience of operation, and very little modification to the unit.

The first item that is required is a small piece of vector or printed circuit board, approximately 1 3/8" by 1", to mount the switch on. The best source of this material might be one of your surplus computer boards from which you have removed a 16 pin integrated circuit. Due to the limited mounting space, this makes for an easier installation than using an IC socket and associated hardware.

Simply drill two #39 holes in the rear lip of the front panel to secure the printed circuit board. The right side of this PC material should be aligned with the position 19 of the matrix board to allow for ample mounting space. The first hole has already been drilled through the plastic portion, so it is only necessary to complete the hole through the metal portion. The second hole is drilled about 7/8" to the left. Countersink these holes to allow for installation of 2 #3 flat machine screws. Another piece of PC board material, 1-3/8" by 3/8", should be cut and drilled to be used as a shim (between the front panel lip and the PC material, which will have the switch mounted later). This will make the top of the switch block even with the cabinet cover assembly after it is reinstalled.

It will be necessary to cut a slot with the dimensions 5/16" by 7/8" parallel to the front of this cover to allow for activating the switches after the cover is reinstalled. Viewing this cover from the front of the rig, the slot should be located 9/16" from the front and 1½" from the right side. The next step is to

modify the matrix board by drilling 8 #60 holes in the right end of the matrix board, just to the left of the D0 through D7 markings on the board, making sure that they do not make contact with any of the conductive copper on the board. This will allow for the insertion of 8 diodes which will later be connected to a cable assembly, which will be connected to the 8 slide switches.

Mount the mini DIP switch to the PC board. Install 8 diodes with the anode end going through the new holes just drilled in the matrix board. Assemble a 3" 8 wire cable, using stranded wire to avoid breakage. It is best to use a color coded arrangement, as you will need to keep the wires in order for wiring into the switches. If coded wire is not available, it would be advisable to run one wire at a time, starting with diode D0 going to the right-hand-most switch. Continue in sequence until all positions are wired. The next modification is to run a wire from the unused 23rd position of the selector switch to a common point of all of the 8 slide switches. Test for broken connections and solder bridges. Mount the matrix board and the switch unit with the necessary screws.

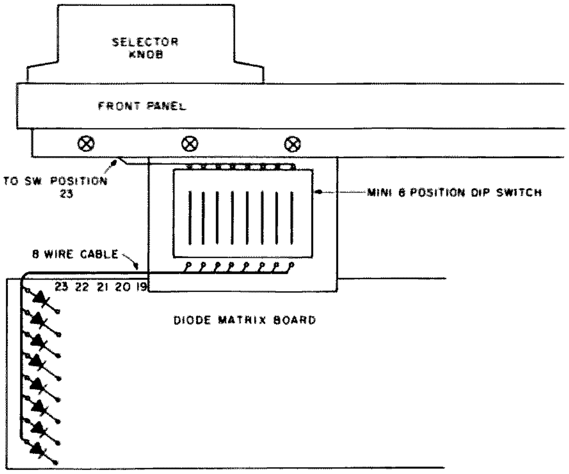

Fig. 2.

A note should be made at this time on the actual programming of the switches. Anyone who is familiar with the hexadecimal system will have no problem in remembering how to program the unit. The layout is two hex bytes as follows: 00 to FF, which you can lay out as 8421 8421. An example: To program 146.55, you would need hex 90, or 1001 0000 in the switches from left to right. As another example, 146.94 would equal hex AA, or 1010 1010 in the switches. After learning a couple of these reference frequencies, simply remember that each value of hex one equals a change of 15 kHz.

Another modification that can be done is use the small version of the hex (base 16) thumbwheel switches and mount 2 of them in the cover near the speaker, as there is sufficient room at that point. Others have run a cable to the accessory plug and used an external switch assembly. You could also use the octal thumbwheel switches, which are easier to obtain, but 3 are needed. Some people find it more confusing using the octal system, as it is more difficult to remember the frequencies.

Any of the above provides for a very practical synthesized unit at a reasonable cost. ■

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The Missing Length

-- phantom IC-22S channel

Even in an area where repeaters are few and far between, such as Maine, it was easy to fill all 22 channels of the Icom 22S. When you start adding area repeater frequencies, a few essential simplex channels, and attempt to cover yourself for those trips to other locations, it is very easy to run out of available channels and wish you had "just one more."

While recently pondering the replacement of the final in my Icom only two days out of warranty, I noticed that the 22 channel diode matrix board had positions for *23* channels. On closer inspection it became apparent that the 23rd channel on the matrix board was not a mistake, but a bona fide operable set of holes which I could program to get that extra channel.

There was no wire connected to the 23rd position on the matrix, so I quickly scrutinized the rotary channel selector and found that one pin following channel 22 was empty. At this point it crossed my mind that this could be a trap — there must have been some reason why Icom did not wire in the 23rd channel, and I was overlooking something very obvious. I have been known to do that once or twice. Thinking that the unused connection might be grounded or in some other way be unusable, I checked the unused pin and several other connection points for anything that looked the least bit unusual. Nothing found.

Finally throwing caution to the wind and dedicated to making some mistake, I ran a small gauge wire from the 23rd row on the diode matrix to the empty pin on the rotary switch. Success! Now, when I select the dot following channel 22, I have access to yet another essential frequency. Frankly, I have no idea why Icom deleted channel 23 when building the 22S, but as long as I am able to expand my capabilities, I'm happy.

Now, if I had just one more channel . . . ■

73 Magazine *Staff*

Design A Circuit Designer!

-- with special plug-in boards

Many amateurs are aware by now of the component plug-in boards that allow the test assembly of a circuit without soldering. These boards are produced by a number of manufacturers and utilized as the heart of various "circuit designer" pieces of equipment.

This article describes the use of such boards in a circuitry "test bed" configuration that is particularly well-suited to use by radio amateurs. The test bed contains many features found in the more elaborate, and expensive, "circuit designer" pieces of equipment. But the cost can be kept low, with the main cost being that only for the main plug-in component boards. Also, some measurements were made on the boards which might be of interest to amateurs who want to experiment with rf as well as with audio circuits.

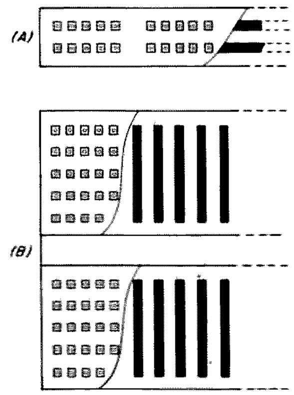

Fig. 1. This drawing shows how the internal metal binding strips are used to interconnect the component plug-in tie points on a bus strip (a) and a circuit socket (b).

For those not acquainted with the plug-in boards, their basic makeup is shown in Fig. 1. Two basic boards are available – a circuit socket board and a bus strip board. Both come in various lengths. The circuit board has five tie points, which are all interconnected vertically on either side of a gap in the middle of the board. The gap is spaced so an IC or transistor can straddle it and plug directly into the board. The bus strip boards have two rows of interconnected tie points running horizontally, but grouped in clusters of 5 tie points each. One can, if desired, break the interconnection of the groups of 5 tie points running horizontally so as to produce 4 rows of tie points. Or, one can isolate one or more clusters of tie points and permanently connect them to input/output devices. Other components such as resistors and capacitors plug directly into the boards, and interconnections are made with #22 hookup wire plugged into the boards.

Complete, rather elaborate radio receivers have been test-built using enough of these boards, but for the average amateur who builds a multiple transistor/IC amplifier, keyer, filter, speech processing device, etc., 3 boards only will suffice. The boards used in the example for this article are the Continental Specialties QT-595 circuit board, which is 6½ inches long and sells for $12.50, and two matching QT-59B bus strips, which sell for $2.50 each.

The boards are placed on top and towards one side of a 7" x 11" x 2" chassis. There is about 5/16" spacing between the circuit boards and the bus strips, but this is just an arbitrary spacing. The rest of the chassis has mounted on it various connectors for input/output connections, power supplies for linear and TTL ICs, metering provisions, and a built-in loudspeaker. Also, room has been left to the left of the circuit board to include a built-in rf or af signal generator for a really complete "circuit designer" configuration.

By carefully examining the arrangement shown in Fig. 2, one can envision how the various terminal posts and connectors are arranged. This arrangement is a matter of personal preference, of course, but the arrangement shown has proved to be very convenient. Basically, two input and two output BNC sockets are used, and wired to binding posts near the circuit board. Two grounding binding posts are on either side of the circuit board near the lower bus strip. The -V binding post is centered below the lower bus strip. The two meter binding posts are to the left of the meter, and next to them are two more posts – one for a fixed +5 volt output and the other for the +V output. PL-59 type jacks are associated with the loudspeaker and with one input binding post for the quick connection of microphones and headphones using PL-59 plugs.

Three power supplies are available in the unit, but only *one* transformer, a 24 volt CT unit, is used. The 5 volt supply is regulated with an LM309K. The +V and -V supplies are regulated by zener diodes in a conventional regulator circuit. Either ±6 or ±12 volt outputs can be switch-selected. All the components for the power supply, except the transformer, are assembled on a piece of perforated board stock and mounted in any convenient location inside the chassis.

The circuit and bus strip boards come with a paper backing. If this is removed, one can readily see, for instance, how the tie points are interconnected on the bus strips and how they may be further broken down if desired. Since the circuit board would be used for rf circuit testing, it was thought best to better insulate the boards from the chassis. If available, the best thing would be to replace the paper backing with teflon tape. But embossing tape of the Dymo variety will also work fine.

Audio circuits and digital circuits can be pretty well "wired up" (that is, plugged into the circuit), as shown on

a schematic. The bus strip boards are used to run the ground, +V, and -V lines around the top and bottom of the circuit board. Rf circuits require a little more care in layout, since one must keep in mind the stray capacitances that exist around the boards. Bypassing can also be a problem, since it must be made with leads as short as possible to be effective. As regards stray capacitances, measurements showed the average insulated binding post will show about 7 pF to ground. A bus strip run (10 of the 5 clustered tie points) will show about 20 pF to ground. One of the 5 vertical tie points (on either side of the center channel of the circuit board) will show 2-3 pF to ground. Parallel running tie point clusters on the circuit board show about 2 pF between them. All these values are not too bad and can be lived with for many HF circuits, although VHF circuits would generally be impossible to lay out. A greater problem with rf circuits is good bypassing. The solution to this might lie with placing a number of miniature ground lugs in the space between the bus strips and circuit board, and placing bypass capacitors between the circuit board tie points and the ground lugs as necessary for any given circuit.

Two banana plug sockets are installed below the lower bus strip on either side of the -V terminal. These are for the mounting of a plug in the front panel. The panel is not shown, but it is just a flat piece of aluminum stock drilled/punched randomly with cutouts to accommodate switches and potentiometers of various sizes.

In any case, for someone who likes to do any sort of circuit experimenting, the plug-in boards are highly recommended. Parts can be reused many times and one avoids those soldered-up, three dimensional, experimental lash-ups which look like modern art gone astray. ■

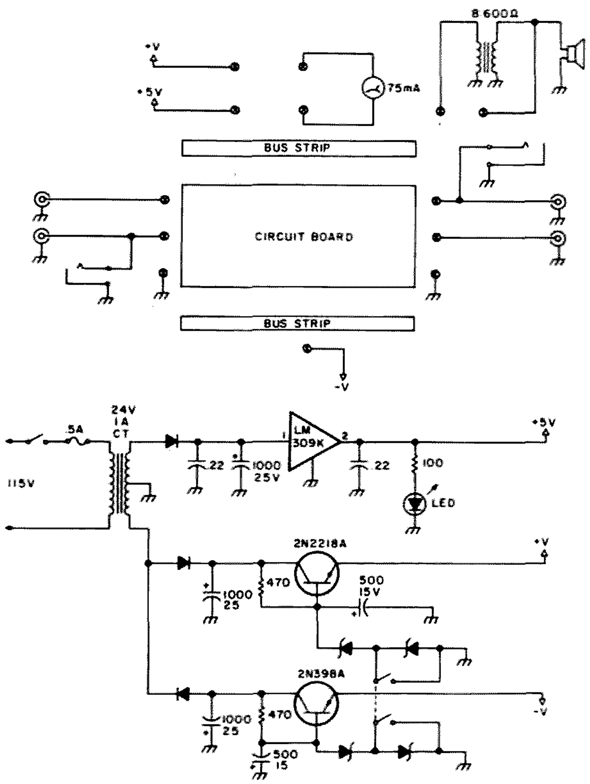

Fig. 2. Arrangement of the binding posts around the plug-in boards and the triple voltage power supply. The zeners are 6.2 volt types. By shorting out the lower zener, a selectable output of ±6 or ±12 volts is obtained.

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Sensitive Meters Saved

A simple overvoltage protection circuit can be built to not only protect a milliammeter (used as a voltmeter with a series resistor), but also provide a visual indication of the fact that the meter is in the "off scale" region.

For normal operation, Z1 (a 10 volt zener) has less than 10 volts across it, and R1 and R2 (in series) simply function as a 20 volt meter multiplier for the 0-1 mA meter. When E1 gets to 20 volts, Z1 conducts and turns on Q1, which draws current through R3 and the LED. The LED gives a visual indication of the overvoltage condition.

The zener Z1 is one of a series of Motorola diodes that have particularly sharp knees at low current. Other zeners will work, of course, but the demarcation between "normal" and "overvoltage" will be less well defined. The values of R1, R2, R3 and the breakdown voltage of Z1 may be changed to suit one's particular voltage range. ■

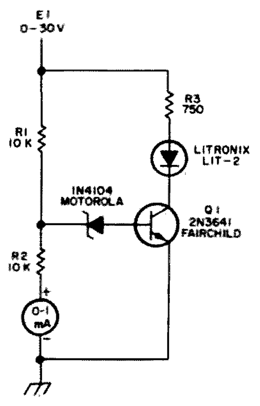

Fig. 1.

73 Magazine Staff

Big Bust In Amarillo

-- bootlegger nabbed!

Do not pass "GO." Do not collect $200. In fact, Jim Krueger, go directly to jail.

It may sound like a game of Monopoly, but, in Amarillo, Texas, it was more like cops and robbers on July 7, 1977. Four hams nailed James Krueger, infamous haunter of repeaters and county jails from coast to coast. Krueger, known by more than a dozen different aliases and a number of bootlegged or "borrowed" calls, is now held on a federal charge, without bond, in the Potter County Jail, as a result of the actions of Joe Bethancourt WA7TUM/5, his wife, Mary Alice, Jim Wilhite W5RXC, Scott McDowell WB5JJN, Joe Cowen WA5TUM, and his fiancée, Malinda Lyles.

Cowen, president of the Amarillo Repeater Society, and McDowell, repeater trustee, along with society technical committee heads, Wilhite and Bethancourt, had been on Krueger's trail at various times since he first appeared in the Amarillo area a year ago. Then he was using a legitimate call, WB9MRA, which he "stole" from a duly licensed Indiana ham.

But three weeks of bogus operation in June and July using a nonexistent call, WD7AAB, finally led to his arrest. It had been a game of hide and seek with DF loops, but quick-triggered Krueger was always on the move and kept his transmissions short. Most Amarillo amateurs played the game of chatting with Krueger, knowing all along that the committee of four was out chasing him.

Hams had first become suspicious of Krueger a year ago because of his unorthodox repeater habits – "WB9MRA, requests the patch" – at which time he would key up the touchtone autopatch access.

His old, white school bus, laden with CB slogans, antennas, and advertising for CB repair, was seen by Cowen last year, before it was known that he was illegally using another amateur's call. But Krueger became wise to the situation and disappeared last summer, before he could be apprehended.

During summer months, Krueger travels Interstate 40, working truck stops. This year he was recognized, by the unmistakable Indiana twang of his voice and his well-known repeater habits, even though he was using the new call. One call to the FCC established that it was a fictitious set of numbers and letters. WD7AAB just didn't exist. A vehicle similar to his was spotted briefly by another local ham, John Gifford W5SYB, who immediately contacted Cowen. Cowen later saw the bus in the parking lot of a movie theater in Amarillo.

"I had gone to see 'Star Wars,' but I never made it," he said. Cowen and his fiancée, Malinda, saw a crowd in front of the theater and learned a projector had broken and was being repaired.

"That discouraged us," he said, "and I started to drive away, and Malinda saw the bus." It was vacant and parked. But, it was the same bus driven in Amarillo last year by Krueger.

Cowen called the other three hams, by telephone, from a nearby store, knowing that Krueger carried a pocket scanner. McDowell, a dispatcher for the Texas Department of Public Safety, put local highway patrolmen on standby, and joined the stakeout crew – Cowen, Bethancourt, Wilhite, Miss Lyles, and three vehicles fitted with UHF gear on a commercial frequency for coordination without detection.

The stakeout started at 6:50 pm, and, finally at about 10:45 pm, Krueger came out of the theater and entered the bus. Before his exit, the hams, knowing from past experience that the bus had equipment to monitor 2 meter and law enforcement frequencies, had set up a communications system using Bethancourt's wife, Mary Alice, who was at home.

"We used the UHF gear to communicate with Mary Alice," Cowen said. "Then she'd talk to DPS holding on an open phone line."

Officers then made arrangements to stop the bus on Interstate 40, after it was trailed in James Bond fashion throughout the city by the four hams coordinating through Mrs. Bethancourt.

"We were just plain lucky," Cowen said, "that it turned out that Krueger was wanted by the FBI for unlawful flight to avoid prosecution, a fact that could not be confirmed until officers had learned his date of birth from the 'driver's license check stop' made by the highway patrolman.

"We knew that he was arrested in Indiana last year and jailed for dealing in stolen CB equipment," Cowen added, "and this year we got highway patrol cooperation because the registration tag on the bus did not fit the vehicle, according to information Scott McDowell was able to get out of Arizona, its state of registry."

Because of the mismatch of license tag to bus, Texas troopers had "just cause" to stop the thing and investigate.

"We hoped that some of the CB radios, or perhaps the Icom 2 meter gear he was using, would turn out to be stolen," Cowen said. "We had

tried last year and this year to get the FCC Field Enforcement Team interested. It seems that they could not have cared less, and we knew if we were to get Krueger off the air, it would have to be done on other charges, due to the lack of interest demonstrated by the FCC and the American Radio Relay League.

"I wrote the ARRL and the FCC last year about Krueger, and so did the legitimate holder of WB9MRA. As far as I know, neither of us even got an answer. I know I didn't," emphasized Cowen.

"However," Cowen stressed, "I think we may get some action this year from the FCC, for I hand-carried a written request to the FCC to investigate the situation to Texas Congressman Jack Hightower. We have tape recorded evidence against Krueger, and, by his own admission to the highway patrolman who stopped him and asked to see his amateur radio license, we know he is not a ham.

Ham hunters who nailed bootlegging operator James Krueger are (left to right) Joe Cowen WA5TUM, Malinda Lyles, Mary Alice Bethancourt, and Joe Bethancourt WA7TUM/5. Kneeling are (left) Jim Wilhite W5RXC and (right) Scott McDowell WB5JJN. Hams and two of their ladies are shown around a Dodge Ramcharger, one of the vehicles used to track the bootlegger, who is now in jail awaiting federal prosecution.

"Even the FBI has egg on its face after this deal," Cowen added. "Scott McDowell also phoned the local FBI Resident Agent to tell him that we were staking out Krueger, because he was in violation of federal law due to his illegal amateur radio operation. That agent didn't have much to say when he was phoned again later the same evening by Scott to inform him that he should appear at the Amarillo DPS office to pick up his prisoner. The agent was completely uninterested in Krueger when we wanted him for violation of communication laws, but his interest picked up somewhat when he learned that we apprehended a fugitive under federal warrant."

"Some of the radios in the bus have had serial numbers ground off, and it is my understanding that checks are being made on all confiscated equipment," Cowen said.

"We realize that Amarillo is a long haul from the nearest FCC office," he added, "but we feel that this case warrants further investigation, so hams will never again be bothered by James Krueger. We know the FCC is on our side, but at some point it is necessary to either enforce the rules we have or forget them altogether. If we forget them, however, then we have lost amateur radio to the money-hungry EIA, with its lucrative CB industry, and the amateur frequencies will rot away to the tripe now found on 11 meters. I hate to see this happen, but we hams are powerless, it seems, to legally enforce the rules, and, without the FCC's help, we are completely vulnerable to any CB freak who has the bread to buy a radio. If Krueger had not been wanted on other charges, I'm afraid he'd still be on 2 meters." ■

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Right Way, Wrong Way, Navy Way

-- or the 73 way

Learning the code can be approached in a systematic and rewarding way. Like the title suggests, there is a right way to go about it and there is a wrong way. And when you are finished arguing about these, there's the Navy way.

As for my credentials, I attended the Naval Radio Communications School some years ago, and there in the short period of three months became a "35-word-per-minute man." Subsequently, on board ship and with a year of radio watches behind me, I copied "px" (press wireless) with ease at 50 wpm while covering the International Calling Frequency with the other ear. No one, of course, writes with a stick (pencil) at that speed. We learned to copy the code directly onto a typewriter with a special telegraphic keyboard with almost identical upper and lower cases.

There are other ways of communicating intelligence by code. I learned land line telegraphy and blinking light as well. Land line takes a somewhat different code, the true Morse code, which is an alphanumerical setup, with five clicks for a "p" and spaces between the elements of a few characters. It is received with a sounder, a clicker instead of the beeper that hams are familiar with. Another code method is machine tracing of the impulses on a strip of paper (either by offset or broken trace) and then sight reading the result like an old 1929 Wall Street tycoon with his ticker tape.

The ham type code is known as the International Morse alphabet, adapted from the true Morse, the better to hear the beeping sounds from a radio receiver with.

Some persons have a knack for the code, like a drummer has rhythm. Others will never learn it, like some people can't carry a tune in a satchel. There is a psychological synapse in the brain that can distinguish the difference between a short beep and a longer beep, which we shall henceforth call "dit" and "dah," respectively. Some people's heredity simply did not include the required synapse, and to these a dit is exactly as long as a dah and spaces between do not exist. The good code man finds this hard to believe, because code comes so easily for him, but the poor guy whom nature forgot can well believe it. More about this aspiring ham later.

The Navy taught its operators to send with a hand key. "Bugs" were verboten until we could handle 18 wpm with the hand key with ease. We had to take a test before a gimlet eyed old shipboard operator before we got our "bug ticket." The test was first on our hand-key sending ability and, secondly, on our ease and familiarity with the semi-automatic T. L. McElroy Vibroplex, the bug. There was good reason for all this caution — listen to any code ham band, and you'll see why. The lives of many good men depended on the accuracy of sending and receiving the code on board ship. There was no phone wireless at one time, remember? And even when it first came into shipboard use, phone was far from dependable. Navy operators were taught to send clearly, at a speed no greater than could be received by the operator at the other end. Demerit points were accumulated for repeating portions of messages, for corrections, etc. The idea was to send so clearly and distinctly that the receiving operator got a perfect message the first time.

When I took my ham exam, some years after leaving the Navy, I petitioned the FCC examiner to use the typewriter instead of a pencil for receiving. He, though surprised and not quite sure the regulations permitted, agreed. He had a code sending machine that he used for making the test as fair as possible which he could set at any speed up to umpteen wpm. After I had done the required minimum speed test with obvious ease and accuracy, he asked me if I'd care to boost the rate. He advanced the speed about 10 wpm each minute, and at 55 wpm I began to make errors and to falter. That was the first time I knew with accuracy, after all my years of shipboard operating, just what my code ceiling was. Needless to say, I passed my ham ticket code exam the first time and, later, the ARRL 35 wpm certificate as well, thanks to Uncle Sam's Navy. I mention this for good reason.

There is an aspect of learning to send and receive the code that resembles a stairway landing: plateaus. You begin with individual characters and advance to recognition of character combinations. This recognition is at first a conscious act. You strive to make sense from the sounds and silences, and suddenly sense comes through. Instead of "dit dah stands for A," you suddenly recognize that "dit dah *is* A." There is a very important difference here, make no mistake about it! Then when you drop the "is" and *dit dah becomes A in truth within your consciousness,* you have ceased to translate, and are "thinking in code." That's important! It's the whole ball of wax.

I don't mean to make it all sound easy. Learning the code takes a lot of application of the seat of the pants to the chair, hard work and perseverance. You are learning a new language, just as surely as though you were studying Spanish, German, or Parsi. If you would study the science of communication, try Norbert Weiner's *Cybernetics.* You'll come out a better all around ham for having tackled it.

I contend that most of the trouble people have learning to send and receive code is with the teacher, yourself included when self-taught. Vital to your success is a positive mental attitude. One of the first mistakes every teacher makes is to teach you the code alphabet. Don't do it! At least, don't do it that way.

Get hold of a first grade reader and start at page one, letter one, word one. Each letter you don't know the Morse character for, look it up on a handy chart, and convert it to the phonetic: "B" = *dah dit dit dit.* Say it out loud: *dah dit dit dit.* Hear it. Send it on your hand key (stay away from semiautomatics and automatics until you can send fast and comfortably well with the hand key.) Do not, ever, say: *dash dot dot dot.* That is not what you hear coming out of the speaker. You are learning to recognize code by sound, not sight (at this point at any rate).

By taking the letters as they come in a child's reader, you will be learning the code as it was meant to be learned by the inventor who was a much smarter man that he is generally given credit for. Note that the most frequently used letter in the English alphabet is "E". Note its counterpart in Morse: *dit.* Yes, he did take frequency of letters into consideration, and the International Morse improved upon this somewhat. And that's the way you should learn to recognize the Morse language, most frequently used letters first. You won't have to worry about how often you have to refer to the code chart – your natural laziness will soon commit the letters and their Morse counterparts to memory rather than go through the extra work of referring to the chart each time! It will come surprisingly naturally if you simply do it the Navy Way!

Now as you become better and better acquainted with the sounds, and the sounds become the letters, a point will be reached when you will suddenly find yourself recognizing two and three letter combinations. They will sound like a new Morse character that isn't in the alphabet: *dah, ditty ditty, dit*: the. The silences will take their places in the character if you are being careful not to slur in your sending and are making each character distinctly and with its spaces where they are intended and the length they are intended to have. You will be developing your ear, and you will be walking on the second plateau before you even realize it was a struggle to get there!

So you keep on going, and, after you have gone completely through the primer reader, do it again and then a third time. Now you will probably be ready to take on a standard book, say a radio theory handbook, or a page of *73 Magazine.* Don't skip over the numerals. You've got to learn them now, and they are no more difficult than the letters. Do them the same way, by referring to the chart when you hit one you don't quite remember. Get with it and before long you will recognize a series of two and three letter words all as one character! You will have reached the leading edge of the third plateau. Keep pushing, keep practicing, and you'll be walking on third level with ease before you realize it was a tough nut to crack. When you do, you'll be receiving 15 wpm or better!

After that it's practice, practice, practice. There's another plateau at about 25 wpm, and another around 35 to 40. Once these humps are cleared and become comfortable, copying behind begins to sneak up on you, and your elation will know no bounds. Your code will have become a second language, just as surely as Hindi, Chinese or Russian. I once shared the radio shack with a guy who copied from 20 to 30 words behind! You can't possibly keep up with individual characters at that speed. The reason has to do with learning to type and its distinctive plateaus, word-combinations, etc.

There is a way of sending Morse with a hand key that is unbeatable for clarity and ease. You can send all day without getting tired if you will learn this method from the beginning: Raise your wrist slightly with each downward motion of the hand on the key, like Liberace on the piano only not quite so carried away. Don't grasp the key with a death grip; treat it reverently, lightly, caressingly. That way your muscles will remain almost relaxed. (Yes, I know that raising your wrist feels absolutely wrong at first. But persevere, and you'll never regret it.)

It takes a lot of hard work and determination to master the code, but I am certain that too many potentially good hams make a hard, hard, bitter job out of it when really it's not that hard at all. It's simply a matter of starting out on the right foot – wups! Careful! You'll be accused soon enough of sending with your left foot!

And when you've been at it for a few years, and the birds and bedsprings begin talking to you in Morse, it's time for a vacation into the phone bands! Many a crack Navy op ended his radio career in a padded cell – there's a certain hazard attached to daily, year in and year out high speed code work.

What's tops in speed? Well, there's another little quirk of the human grey matter that blends a rhythm into a solid roar above a certain threshold. Even the best signalman begins to lose his differentiation of blinking lights at about 12 to 15 wpm. If he didn't he'd never be able to appreciate the movies or television. Same thing with code by ear. After some level around 50 to 75 wpm, individuals will find it's time to let the computer handle it.

There are dozens of little hints and kinks that can be passed along by old radio ops. For instance, you've got to push yourself to copy at a speed faster than is comfortable for you at any given time in your learning period. If you don't, you'll top out at a very low speed. It also means that you have to expect to make errors. Don't sweat it; let the errors fall where they may as you are climbing the speed ladder. When you have reached the level beyond which you don't feel the effort is worth the use to which you'll put the ability gained thereby, settle down at that speed and begin to perfect your accuracy. Keep away from swinging your sending. Another hint – if you make a mistake, don't go back over it. Keep on going with what you are copying. Trying to correct an error only causes you to miss what's coming. After you have learned to

copy behind the signal, there's plenty of time to correct minor errors.

Another hint – learn to receive on a typewriter, right from the beginning. There's a much better linkup between the code, your brain, and a typewriter key than between the brain and a pencil.

And after all this, if you try and try and pretty soon six months rolls around (at 2 hours a day) and you haven't passed 5 wpm, ask for help from a psychologist. It's just possible you are one of the unfortunate few whose synapses never quite got together for that particular mental function. Then do some letter writing. Petition the FCC to let such bona fide proven-by-a-psychologist handicapped persons pass the test by reading written dot dashes from a moving tape. Because, chances are, even though you can't hear the difference in character lengths, if you are sighted you can learn to read the difference as fast as you and I can read this printed page! Having known guys who could, whose job was to handle the automatic code printer in the radio shack, I'd say we have reached a point in our ham evolution where there's room for this particular exception.

Therefore, let nothing you dismay. You, too, can learn the code. As long as the majority of hams persist in maintaining the code test requirement for licensing, go along with them and show them you've got what it takes to pass their silly old test. And who knows, maybe it's not so silly after all? Suppose, for instance, you were suddenly stranded on a desert island, and all you had to signal for help with was a simple, keyed transistor oscillator you whipped together out of a pocket radio? Once you learn the code, you'll be surprised at how much fun you can have with it, and, at infrequent times, how *valuable* it is to you! ■

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Living With the Family Ham

-- planning births, etc.

In many situations a ham marries a non-ham. Realizing that there is a scarcity of information available on how to cope as a non-ham in a ham world, I have compiled the following information dedicated to greater harmony in the lives of hams and their spouses.

1. Do learn the radio vocabulary.
– PTT and CW are not real estate agencies.
– XYL is not the abbreviation for xylophone.
– 73s and 88s are not just lock combinations.
– DX is not just a brand of gasoline.

2. Remain calm while as many as 5 antennas are installed on the roof. Describing to a stranger that you live in the house with 5 antennas leaves less chance for misunderstanding than describing a house with blue shutters.

3. Don't panic when the utility room gets transformed into a ham shack.

4. Plan to serve meals at times that do not interfere with radio nets.

5. If possible, try to schedule the birth of children in midweek so as not to interfere with hamfests.

6. Don't get upset if your spouse cannot coordinate 2 articles of clothing in the closet, but he is able to spot a new transceiver in a store window from across the street.

7. Don't get alarmed if the side is cut out of the broom closet to make way for a transceiver installation.

8. Even if they do just look like funny post cards to you, do not throw away QSL cards.

9. Do your homework. Have ready for curious friends and grocery bag boys at a moment's notice clear and logical answers to the following questions:
 a. Why do you have those funny license plates on your car?
 b. What kind of CB is that?
 c. Can you hear police calls on that?
 d. How far away can you talk to people?
 e. Can you talk to my friend in Guatemala (or Peru, or Liberia, etc.)?

10. Learn to reassure the neighbors when they ask if being a MARS member means you report the activities of the neighbors to the FBI.

11. If possible, study radio code and theory for your own license. Never under any circumstances comment that the code sounds to you like a confused woodpecker.

12. Relax and enjoy the benefits of your spouse's hobby. It does, after all, keep him (or her) home much more and is usually less dangerous than auto racing or scuba diving.

After almost 6 years of marriage to a ham, I took the test. In October, 1976, I was licensed as WA4WZL. ■

Add Jazz To Your Tempo

-- with a few simple mods

Ronald R. Groshans WB8ZBJ
PO Box 727
Niles MI 49120

Microphone with clip installed.

I have been an amateur radio operator for about a year and have had to start on a financial shoestring. My first piece of equipment was a Tempo fmh HT. As my only means of communicating with my fellow hams, the HT went a lot of places with me. I soon discovered that the handie-talkie was not so handy as it was on the road. I tried hooking a carrying strap to the two provided eyelets, and this, too, proved unsatisfactory. I then put on my thinking cap in earnest.

I knew Motorola made a wide variety of HTs. I dug out my Motorola wish book (commonly called a catalog) and started my search for a better means of carrying my HT.

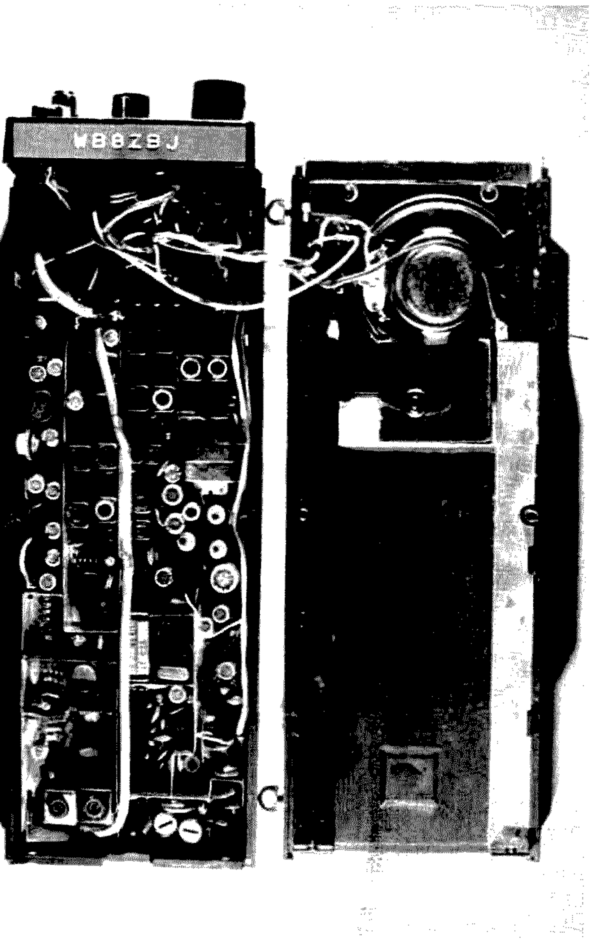
I discovered that there were two ways available to carry an HT in comfort. One way was by means of a case which attached to the belt. To use the HT one simply lifted it out of the case. Second was by means of a belt clip, the belt clip being permanently affixed to the unit. This second method I liked for two reasons; one, it was more secure, and, two, it turned out to be less expensive.

Having solved the problem of how to carry my HT, I started to work on the idea of a hand-held microphone accessory. This turned out to be more time-consuming than the belt clip. Therefore, since it would take time to work everything out on my microphone accessory, I decided to go ahead and put the belt clip on.

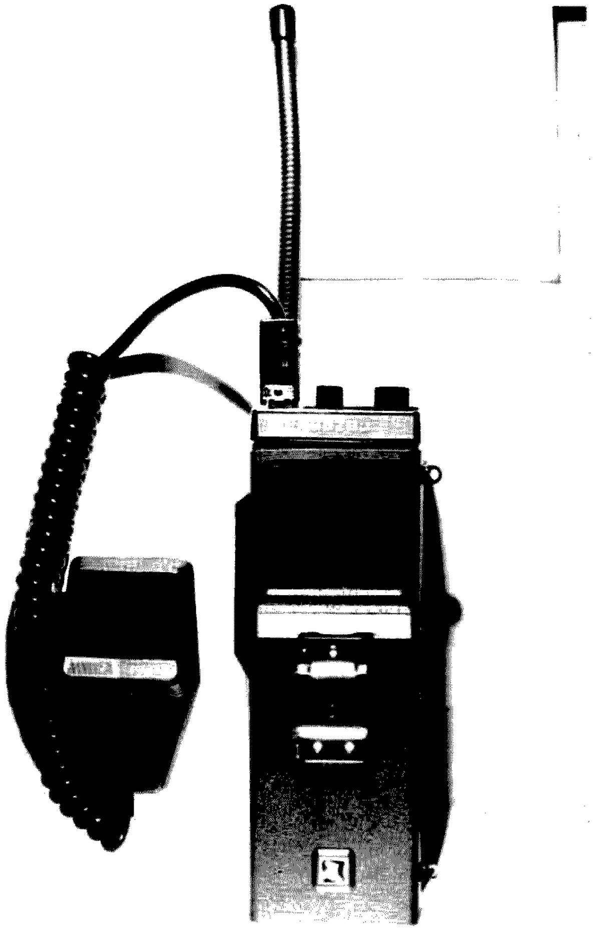
I went to a local Motorola parts sales and repair dealer and ordered what I needed. I placed an order for one belt clip, one fiber adhesive insulator, two screws, and one metal backing plate. The entire order came to a whopping grand total of $3.67. The Motorola dealer did not happen to have these parts on hand, but ordered them for me. I had them in just about a week.

Now the hard part. I found a microphone with no problem. That was the easiest of this group of parts to find. I had a microphone, but I needed a means to connect it. After many long hours of searching, I settled on a connector made by ITT. A five piece connector system costs $4.88.

After comparing the schematics for both the



The inside of the Tempo after modification.



The Tempo fmh after modification.

microphone and the HT, I discovered that the microphone switch alone would not handle the switching chores in the HT. Now here was a real problem. How does one get a manual slide switch to function from a remote hand-held microphone? I instantly thought of a relay operated switch. But most relays I had seen were way too big to fit into the limited space of the HT. Now I really had a problem, one that could kill this whole modification.

I dug into my parts catalogs and, after making a molehill out of a mountain, I found just what the doctor ordered. I found two Magnecraft relays that would work perfectly. Yes, I said two relays. Magnecraft manufactures all sizes of relays, and these two relays are the size of an integrated circuit, one DPDT and the other an SPST. These two parts were the second most expensive items after the microphone. They cost a total of $20.00 but are worth the cost for their size alone.

After waiting for four weeks for the relays and connectors, I could now go to the workbench. To start with, you need a small container to put the screws in. These are small screws and easy to lose. It is so hard to find a good screw – once you have one, you hate to lose it.

The first step involved the removal of all case parts. Then, taking the top plate and removing the useless meter, I inscribed the outline of the connector and filed the hole to fit. I found that I had to bend the tabs down on the connector in order for the connector to fit. To secure the connector, I liberally applied a plastic cement (commonly used to build plastic models). Setting this aside to dry, I then went to work on the circuit board.

For working on the circuit board you need to get out your surgeon's cap, gown, and mask as well as your trusty scalpel. The first step here was to locate both the B+ connections and the antenna switch-over. Once locating these, I was ready to start the operation. My assistant handed me the soldering iron, and we were off. I removed the meter connections first. Then, with the scalpel, I made an incision to sever the printed circuit between the points where the

Parts List

Motorola Parts				
1-84206D81	clip	$ 3.50	Req'd.	1
14-82643E25	insulator	$ .03		1
3-136666	screw	$ .04 ea.		2
64-82043D01	plate	$ .10		1
Magnecraft Parts				
W171DIP-14	SPST @ 12 V	$ 5.00	Req'd	1
W172DIP-19	DPDT @ 12 V	$14.95		1
ITT Parts				
DE-9P		$ 1.48	Req'd	1
DE-9S		$ 2.02		1
DE-110963-1		$ 1.33		1
Radio Shack Parts				
21-923	microphone clip	$ 1.29	Req'd	1
Mura Microphone	DX-120	$29.95	Req'd	1

antenna was switched (3 places) and the B+ switching (3 places).

Then turning the patient over, I inserted the DPDT relay on top of the existing slide switch with a little glue. I also adhered the SPST relay to the back of the unit's internal microphone. (Note: As the position indicators are hard to see once the relays have been glued down, it is recommended that a spot of white paint be placed on the underside for easy identification.)

The glue takes some hours to dry, so I left the patient under the anesthetic and went to the microphone. I soldered the wires to the connector and bent the tabs down, then put the plastic clip on. I was careful to write down which pin got which color wire. This done, I went to lunch. I returned after supper to finish, making the connection to the relays and the circuit boards. (Be sure that shielded wire is used in the antenna connections.)

Depending upon how you wish the unit to function, you may wire it so that it will work either with or without the external mike. However, I have rarely used mine without the external microphone. I find it to be much more convenient with the microphone. If you wish only operation with the external microphone, you may omit the SPST relay and simply disconnect the internal microphone.

Next I placed a Realistic microphone holder on the front of the unit by just peeling off the adhesive protector and pressing the holder into place. One thing about that Realistic microphone holder is that if you have a touchtone pad on the front of your unit, you can put the holder on a leather strap and slide it on your belt.

This group of modifications may be used on other HTs as well. ■

Interested In Television?

-- how to get started

Dr. Ralph E. Taggart WB8DQT
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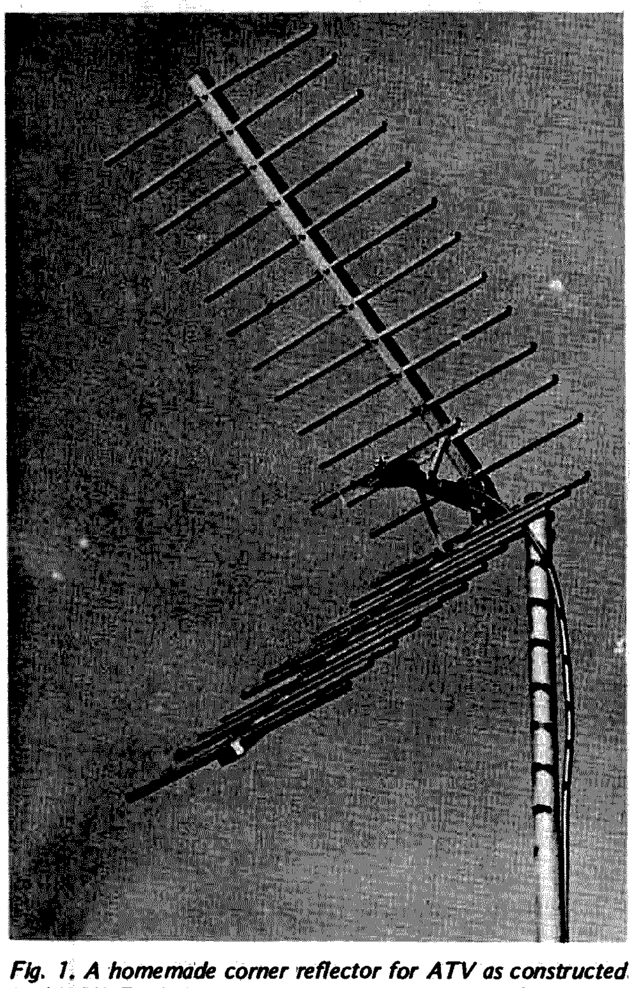


Fig. 1. A homemade corner reflector for ATV as constructed by WB8JXF. Maximum gain with such arrays is in the order of 10-12 dB, depending largely on the size of the reflector and its angle. This gain is easily realized, the antenna is simple to construct and match, and the array has a wide frontal lobe making aiming noncritical. These features make the corner reflector an ideal candidate for home construction where adequate facilities for precision antenna work are not available.

There is little doubt that ATV holds a fascination for many operators. If articles in the literature for the last few years are any indication, we well may be entering a modest growth phase for this fascinating mode. ATV, because of the incredibly wideband nature of the signals, is completely different from other modes with which amateurs are familiar, and even considerable experience in VHF and UHF is not sufficient to predict the requirements for a useful system. Quality results over a given path are not nearly so easy to achieve as some might suggest. Getting sufficiently good results to sustain local interest is a matter of being willing to invest a certain minimum amount of effort in setting up a quality system, and this is largely a matter of paying attention to innumerable details.

WB8JXF and myself have devoted a considerable period of time to developing the guidelines for an ATV system that would provide the kind of performance that would encourage others to give the mode a try. Some of the things we have discovered run counter to conventional wisdom, as expressed in many articles on the subject, but we have taken the trouble to document all aspects of system performance. If you follow some of our recommendations, you can expect to have the same level of system performance.

It is all too easy to quote results that can be obtained under particularly favorable conditions of location, terrain, or band conditions. Our approach has been extremely conservative, for it is the average performance level that must bear the brunt of day-to-day operations. You will occasionally be able to do considerably better when conditions permit, but our approach will be to pitch the system in terms of what you can expect in the way of performance whenever you turn the equipment on!

If you have been thinking about trying ATV, why not read on and see what you can accomplish? If you are giving serious consideration to ATV, and there is no present activity in your area, you should convert at least one other station. A working operation over a reasonable path is usually a prerequisite for interesting still other operators.

System requirements are largely related to the range involved in the specific path you wish to cover. Functionally, requirements break down into a few general range categories:

1. Less than 5 miles. In this category it is usually possible to achieve true "line of sight" conditions. If this is the case, it is possible to get by with low power or relatively simple converters or antennas.
2. 5-10 miles. About 10 Watts average power output is required in this category, assuming that quality antennas and converters are employed. If not, still higher power will be needed.
3. 10-20 miles. 10-100 Watts power output will be required for this distance, depending largely on the remaining system elements and the

terrain along the intended path.

4. 20+ miles. Regular work over extended paths will require good antennas and converters and a power output of 100 to 1000 Watts depending upon the path. Even the best of stations will have difficulty maintaining quality pictures out beyond 40 miles.

Note particularly that these categories are based on normal band conditions. Real DX of up to a hundred miles or more will be a rare event, usually coupled with excellent band conditions. The quality of such long haul pictures is such that they are acceptable primarily because they are DX. To sustain a local level of ATV activity requires consistent coverage over a much smaller area with pictures of consistently good quality. The purpose of this article will be to describe the requirements for the various system elements to achieve this end. Those elements include the antenna system, the receiving converter, the basic ATV exciter, high power options, and the matter of voice transmission along with the pictures. We will discuss each of these separately, but you should keep in mind that the results you achieve will depend on the quality achieved with each link in the system at both ends of the circuit. The pictures that are possible over a given path will be critically dependent on the weakest link in your system, and the gradual increase in coverage is largely a matter of optimizing each element of the total ATV system.

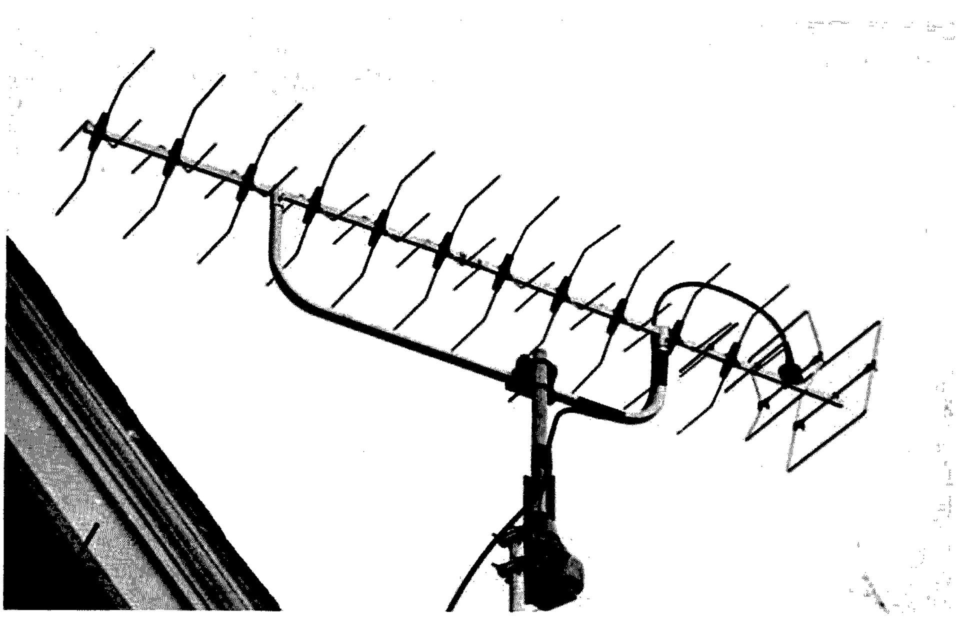


Fig. 2. The MBM48/70 antenna in use at the author's QTH. This antenna exhibits 17.3 dBi of gain and is essentially flat across the entire 420-450 MHz band. The driven element and reflector look somewhat like a combination of a quad and skeleton slot with two conventional directors transitioning into a series of cross-shaped elements each of which consists of four half-wave elements. Despite its unusual geometry, the antenna really performs as indicated by the specifications certified by the British Aerial Standards Commission and verified by our own tests. Like most high gain arrays, this one is extremely sharp in terms of pattern and is definitely not suitable for round tables, although it cannot be beaten for long haul point-to-point work.

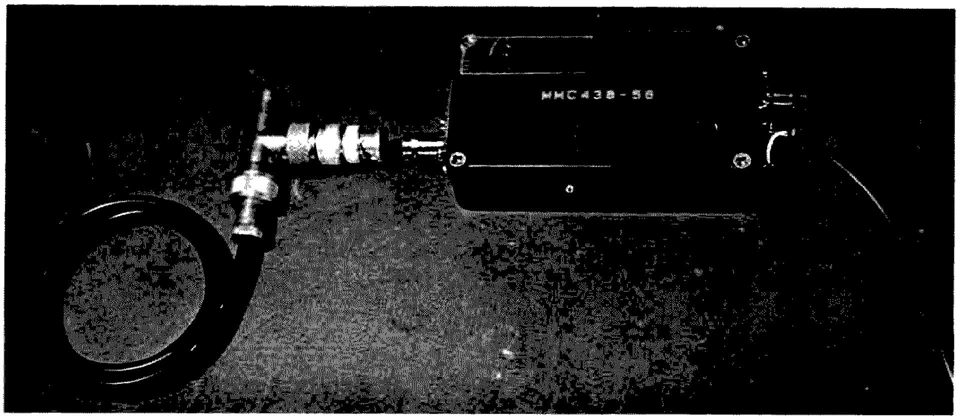


Fig. 3. One of the modified MMC 432/28 converters (MMC 438/56) used in our system. The photograph also shows the 1/4 wave stub for channel 6 which is used to remove a spurious mixer product between channel 6 and 23 in our area as described in the text. The use of such modern crystal controlled converters results in considerably better system performance than can be obtained with converted UHF TV tuners and outboard preamplifiers.

Antennas

The keys to success here are gain and bandwidth. Unless you just want to work down the block, you should not consider anything less than 10 dB, and you should try for all the gain you can get. Yagi arrays are out for ATV, primarily due to their limited bandwidth. Commercial antennas are cut for the wrong parts of the band and even a home brew antenna cut for your operating frequency will noticeably restrict the resolution of the pictures.

The simplest antenna that will do a reliable job is a corner reflector such as the one illustrated in Fig. 1. Such antennas are easy to construct,[1] are sufficiently broadband for TV use and are not critical to aim. About 10 dB gain is what can be expected. Several commercial antennas are designed to cover the entire 420-450 MHz band and thus can be used not only for TV, but for other modes as well. Table 1 summarizes some of these antennas. The KLM models are well thought of in ATV circles, although we have not used them. Our favorite is the MBM48/70 from J. Beam of Great Britain. This antenna is flat across the entire band yet packs a respectable 17 dB of gain into quite a compact package. This antenna, illustrated in Fig. 2 and marketed

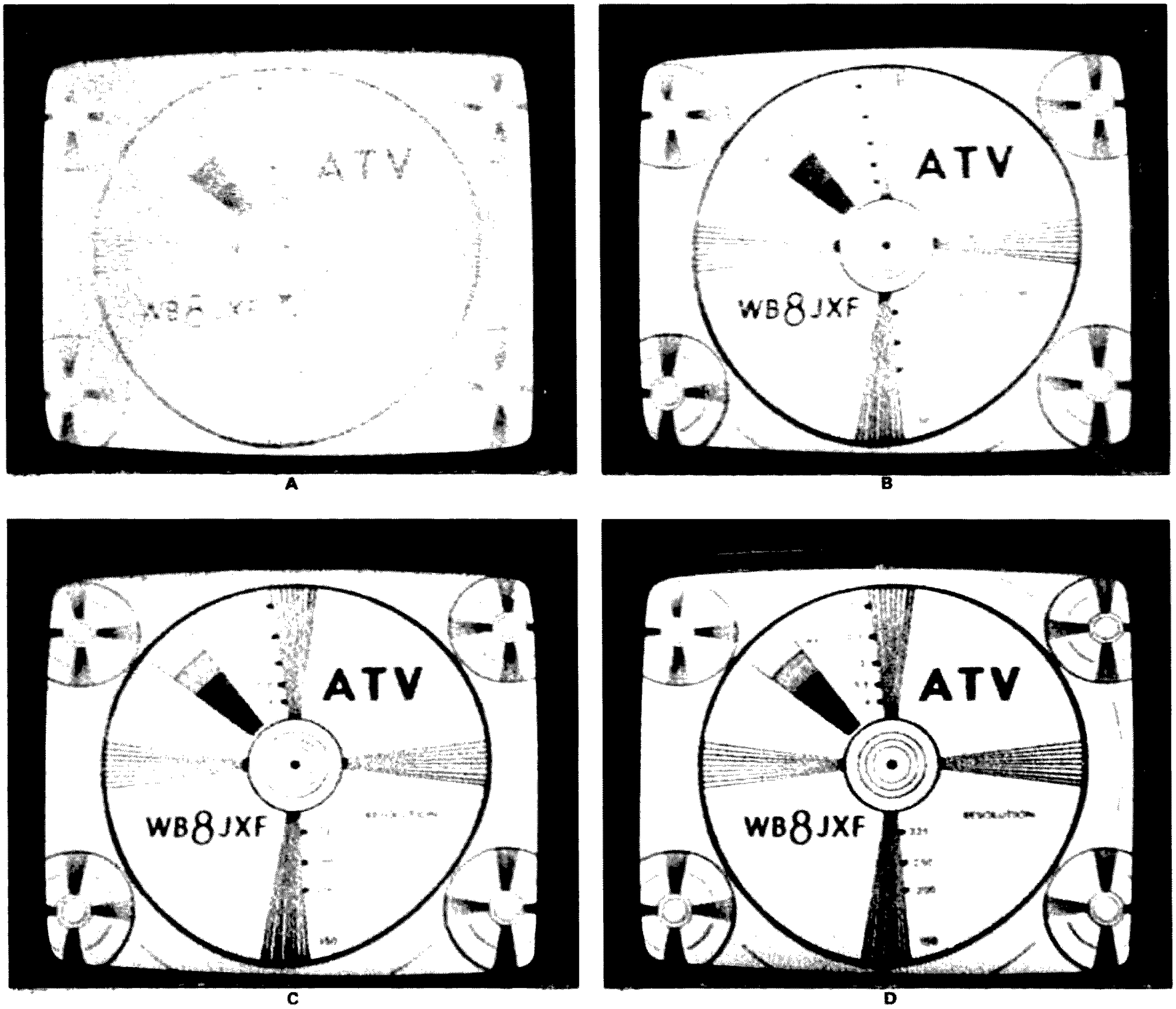
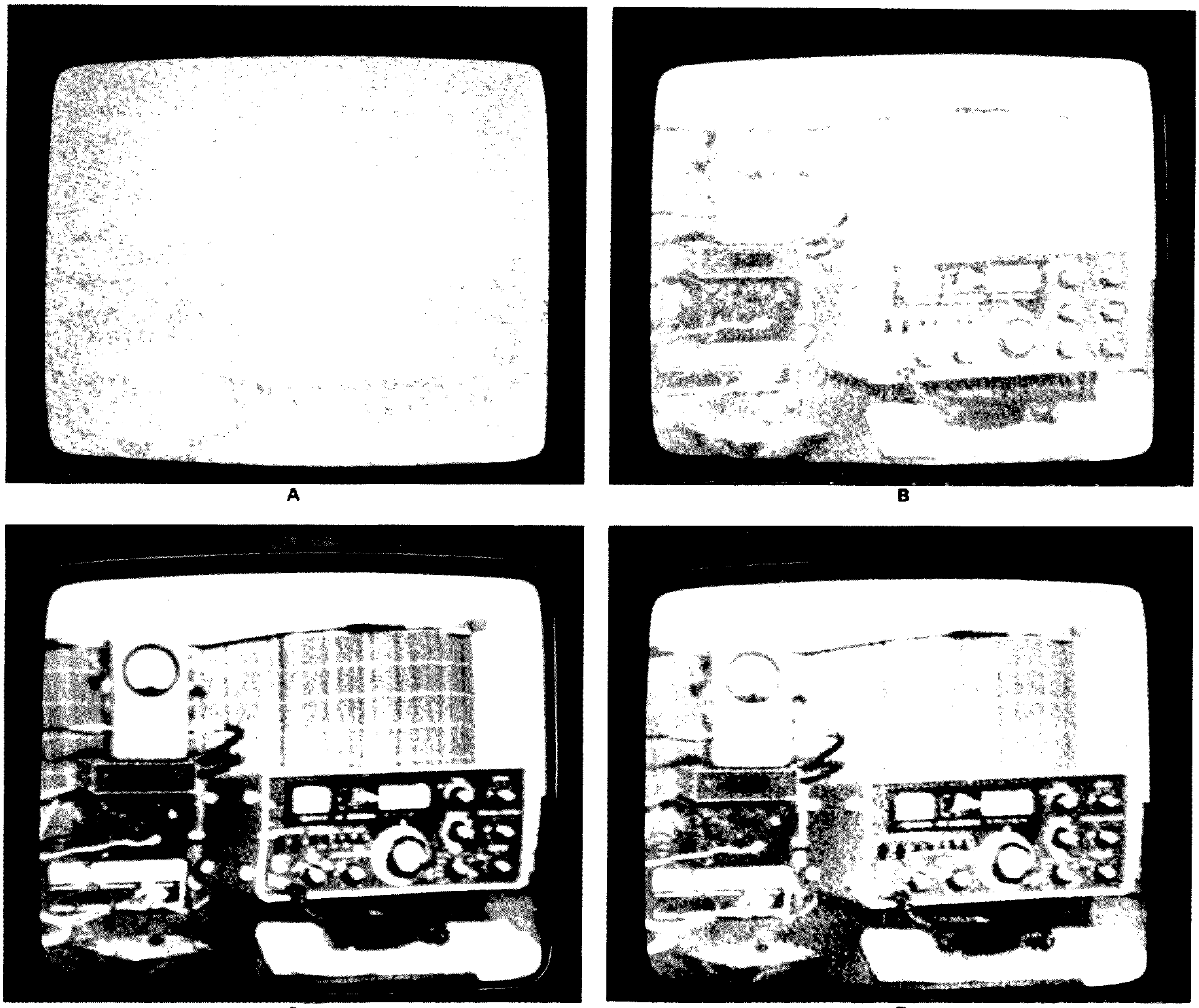


Fig. 4. Test transmission sequence from WB8JFX as received by the author using the MMC 438/56 converter. Antennas are those illustrated in Figs. 1 and 2, with 10 feet of antenna height at the transmitting end and 25 feet at the receiving end. The path is 8 miles over rolling low hills. Power levels are 10 Watts (A), 15 Watts (B), 20 Watts (C), and 30 Watts (D) average output. The important fact here is not the absolute power versus path length, for we have now reached the point where 5 Watts average power does as well over this path as 20-25 Watts in this test (by simply raising the antenna at WB8JXF's end). What is significant is the pronounced threshold effect for video signals. Even 1.5 dB additional system gain (B) will produce a surprisingly good picture; 3 dB is even better, as is 4.5 dB (D). Once you can see any video at all, a comparatively small increase in system gain at any point will give you a working operation. The other side of the coin is that if you are near the threshold, a similar small loss in system gain can ruin otherwise acceptable pictures! The proverbial "snow-free" pictures require at least 20 dB additional gain above the threshold, and you are not likely to get such pictures without line of sight conditions.

by Spectrum International, certainly has not received the attention that it merits based on performance.

Polarization is completely noncritical as long as it is matched at both ends of the circuit. You will probably be best off deciding between vertical or horizontal based on what other modes you might wish to play with on the band in addition to your TV activity. Height and location of the antenna are prime factors, however, and care should be excercised to insure minimum run of transmission line to the station. The antenna should certainly clear local obstructions, and height gain increases nicely up to about 50 feet. Above this the increase in height gain is usually counteracted by increased line losses, so super high antenna systems are really far from desirable.

There is considerable mystique about transmission lines for VHF and UHF work these days, and the feeling is that everyone should be using some form of hardline. Extensive measurements we have performed regarding direct line losses and system performance indicate that for runs of up to 50 feet there is little to be gained by going to the more expensive hardline. Use a good brand name RG-8 type foam cable, and you will do just fine. This does not mean you should use CB type cables. These have low braid density, and the braid is rarely tinned or plated — both factors leading to excessive line losses. Short runs around the shack can be handled with RG-58 foam



A B C D

Fig. 5. A test transmission sequence similar to that of Fig. 4, except that power levels of 5 Watts (A), 10 Watts (B), 15 Watts (C), and 20 Watts (D) are shown. Again, the pronounced threshold effect over a signal range of 3-6 dB above visibility is clearly evident.

with good results up to power levels of 50 Watts or so. Higher power levels will cause noticeable line heating with 58 foam and you will have to go to the larger cable sizes.

Equally misleading are some of the opinions circulating about connectors. Most serious UHF operators use type N connectors for larger cable sizes, dropping to BNCs for RG-58 cable due to the impedance bumps caused when the typical UHF series connectors (SO-239, PL-259) are used. Although such impedance bumps are real, they will not result in noticeable degradation in system performance if the venerable UHF connectors are installed properly. The newer solderless PL-259 connectors are ideal for use with RG-59 foam cables and are far less tedious to install than a BNC.

TR relays are a continuing problem. If you look at the astronomical cost of such relays these days, you would assume that they must perform. The sad fact is that the relays available to amateurs generally perform very poorly at this frequency and are a major source of lost power in transmitting and disappearing signals on receive. The only suitable route we have found is to

Model	Source	Gain	Length	Price
420-470-14	KLM	13.7 dBi	5 feet	$21.95
420-450-27	KLM	16.7 dBi	10 feet	$39.95
1:1 balun for above	KLM			$19.95
MBM48/70	Spectrum International	17.3 dBi	6.5 feet	$51.75

Table 1. Antennas suitable for use on ATV. Listed prices do not include postage. KLM Electronics is located at 17025 Laurel Road, Morgan Hill CA 95037. Spectrum International is located at Box 1084C, Concord MA 01742. The KLM antennas require the listed 1:1 balun, while the MBM48/70 can be fed directly with 50 Ohm cable. Stacked pairs or quad arrays may be employed for an additional 3 or 6 dB gain. KLM makes a variety of 2 and 4 port power dividers that vastly simplify the proper phasing and matching of larger arrays. A major advantage of these wideband antennas is that they are equally effective for other modes anywhere in the band.

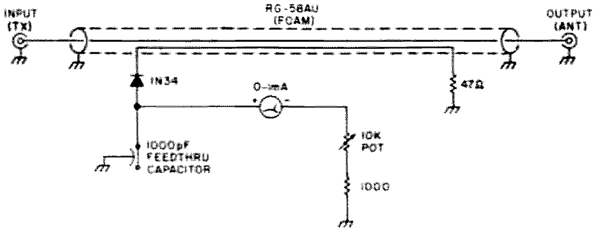


Fig. 6. In-line power output meter suitable for use on any VHF band. The coupling loop is a length of #24 enamel wire threaded under the shield of the braid of a length of RG-58 foam coax. Input and output connectors may be SO-239 bulkhead connectors but matching hoods (Amphenol 83-765) should be used to minimize the impedance anomalies at the connectors (see Fig. 7). Lead lengths for the terminating resistor (47 Ohms) and the 1N34 diode should be kept to a minimum. The diode is bypassed using a 1000 pF feedthrough capacitor. A button mica capacitor may be substituted but a conventional disc capacitor is unsuitable. The meter may be calibrated using a Bird or similar in-line wattmeter, with the 10k pot used to establish the desired full scale deflection.

shop the surplus outlets for military relays designed for use in the high UHF and low microwave region (like about 1 GHz). In any case, avoid 110 V relays, as these seem to have a tendency toward overheating coils and less than perfect performance.

Converters

A great deal of thought went into the subject of suitable converters. The conventional approach is to use a padded UHF tuner, usually with a quality preamp to compensate for the poor sensitivity of the tuner.[2] There are several objections to this approach. First of all, even the best of the outboard tuners employ passive diode mixers. This results in a mixer noise figure of 10-15 dB. A good preamp will have low noise and a gain of perhaps 20 dB. This gain is not sufficient to overcome the mixer losses and still set the system noise figure. The result is a higher system noise figure and a system loss of at least 10 dB compared to a system employing a low noise active mixer. The preamp does improve things considerably but you have not optimized either system gain or noise figure. The tunable feature of these converters was useful in the old days when self-excited transmitters might be operating anywhere in the band (or out of it on occasion), but is of marginal utility today when transmitters should be crystal controlled. The tunable converter is really only useful over a few megahertz if the preamp is peaked for maximum performance in any case. You can go to a broadbanded preamp but this will cost in terms of both gain and noise figure.

The answer, of course, is to go to a conventional crystal controlled converter of the same type that would be employed for work at 432. The converter we use is manufactured by Microwave Modules of Great Britain and is marketed in this country by Spectrum International and others. The basic MMC 432/28 converter is designed for 432 input and 28 MHz output and costs $65. For an additional $20, SI will peak the front end to your video frequency, install a crystal to bring you out on any low VHF channel (we use channel 2), and repeak the i-f output circuits. Thus for $85 you get a converter with a 6 MHz front end, a 3.5 dB noise figure and a total of 25 dB of conversion gain! This is cost competitive with the tuner-preamp approach if you tally up the cost of all the components of the latter system, and will outperform the latter in terms of both system gain and noise figure. Other converter manufacturers (Vanguard, Janel, etc.) will do similar jobs, or you can build any of the modern converters in the literature, making appropriate changes in the crystal frequency, LO, and i-f output circuits. The fine tuning control of the TV set will swing you several MHz, permitting the signal to be centered as desired in the i-f passband of the TV set.

My own modified MMC 432 converter is shown in Fig. 3. We adopted a video frequency of 437.25 MHz for a very practical reason. Most converter manufacturers offer 432 units with 50 MHz i-f output as an option. If 432 comes out at 50.00 MHz, then 437.25 will come out at 55.25 MHz, which just happens to be the video carrier frequency for channel 2! Thus a crystal for 6 meter output can be used, saving the long wait for a special crystal order. The only additional modifications to the converter involve a retuning of the i-f output coil for 55-60 MHz and repeaking the front end for the video frequency. Spectrum International labeled this version the MMC 438/56 and can deliver within a few days.

Fig. 3 also shows a fix for another kind of problem which you may encounter. In our area we have two powerful TV stations — one on channel 6 (video frequency of 83.25 MHz) and the other on channel 23 (video frequency of 525.25 MHz). Given our i-f, one of the many possible spurious mixer products falls right in our video window. Channel 6 is about 1 mile from WB8JXF's location, while channel 23 is less than 2 miles distant. He was faced with a very strong spurious signal while, even though I was about 9 miles from either station, I had a moderately strong image. After far too many evenings waiting for one or the other station to sign so we could get on with our tests, we decided to solve the problem. One solution would be a strip-line or coaxial filter in the input line to the converter, but I decided to try a simpler solution first. A coaxial T connector was mounted at the converter input with a quarter wavelength of coax (electrical length) cut for channel 6 on one arm, with the antenna lead on the other. This stub had no effect on reception at 437.25 but completely removed the spurious signal. WB8JXF tried the same trick, and it worked perfectly despite the very high signal levels at his location. In-line filters may be required for some types of interference due to front end overloading, but if one of the offending components is on a VHF frequency this simpler approach may work equally well.

Converted TV tuners do have one major use — they are so insensitive (without a preamp) that they let you monitor your picture when operating at moderately high power levels. Simply pad down the LO in the UHF tuner of your set, and you will have that capability. Direct monitoring with the high performance converter is not really feasible as it will overload with outputs over a few Watts.

Another factor worth mentioning is the TV set used as the i-f. It makes little sense to use a junker from the back room of the local service shops when modern sensitive sets are available for so little. If you get one with a power transformer (not a hot chassis), it can even be converted for use as a video monitor. I use a Sony TV-770 with excellent results ($139.95 at a discount store), but many other types are suitable and cost even less.

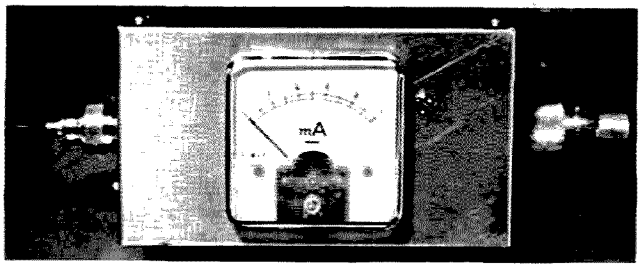
ATV Power Levels

Before discussing specific transmitter options we should have a realistic chat about power. The power requirements for ATV are directly

related to the path you intend to cover. The wideband nature of TV, coupled with the performance of rf amps and the agc threshold of the TV set, results in a very pronounced threshold effect over any given path. Over a distance of up to a few miles a low powered transmitter (@ 1 Watt) will yield acceptable results provided line of sight conditions exist. The latter condition is increasingly unlikely as the path is stretched out, and it is amazing how fast the video signal disappears despite the fact that QRP voice communication is possible over the same path.

Power output is a difficult question to address in the case of TV since there are several reference levels that can be used, including peak power, black level, and average power output level. Peak power is equivalent to the power output of a properly set up transmitter-modulator combination during sync pulse intervals. An in-line wattmeter such as a Bird will measure peak power only when the camera is switched out of the modulator input. Let us say that the transmitter will grind out 10 Watts under such conditions. Provided things are set up properly, if the camera is switched in but the lens is capped we should get an approximation of the black level output. This should be about 75% of peak output or 7.5 Watts. If we uncap the lens on an average scene we would get an average power output reading typical of what would be obtained under normal operations. This average level should run about 50% of peak output, or about 5 Watts. The average power percentage (relative to peak) will obviously vary considerably with the subject but it is a convenient reference, and, unless otherwise noted, all test results will be quoted as average power output.

Fig. 4 shows one path test between WB8JXF and myself at various average power output levels. Both of us are above average terrain and about 8 miles apart, with the intervening path consisting of gently rolling hills. Total system antenna gain is 27 dB (10 dB + 17 dB). Several intervening hills do not permit line of sight conditions at the antenna heights used in this and the following test. The first picture (10 Watts) is just at the threshold of visibility. Since the basic modulated exciter is running about 1 Watt output, additional system gain of 10 dB is required to reach the threshold of visibility. Note, however, that comparatively little additional gain is required to boost the picture from the threshold level to a point where it is quite acceptable. Referenced to the threshold, an additional 1.5 dB (15 Watts), 3 dB (20 Watts), and 4.5 dB (30 Watts) result in progressively better pictures. Depending upon your tolerance for snow, anywhere between 3 and 6 dB of additional gain will certainly produce acceptable pictures. Once you have boosted the signal to the point where it can be seen at the other end, comparatively little additional gain is needed to make the path usable. WB8JXF's antenna (a 10 dB corner reflector) was only 10 feet high for this test. Raising his antenna from 10 to 20 feet produces about 5 dB increase due to height gain, which means that pictures at the 10 Watt level would now be equivalent to those at 30 Watts with the previous antenna height. Note that all that is required is that the total system be increased by 3-6 dB, which can be achieved by any combination of factors at either end of the circuit. Conversely, a similar small drop in gain can have disastrous consequences if you are near the threshold in terms of system performance. Even over our short path it is easy to document small changes in path loss when operating at the 5-10 Watt average power output level.



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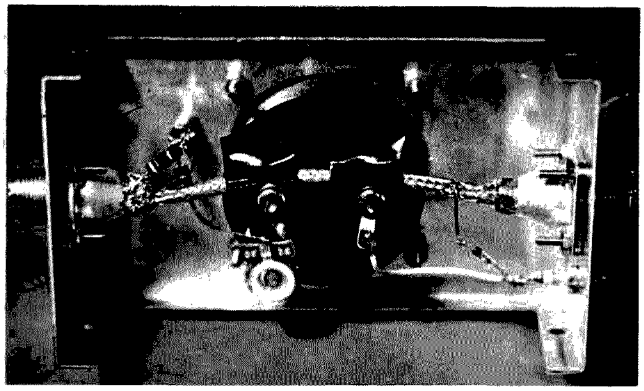


B

Fig. 7. External (A) and internal (B) views of the in-line power meter shown in Fig. 6. The meter is kept in the transmitter line at all times to monitor power output.

The changes amount to no more than 3 dB fluctuations in path loss, but if you want acceptable performance every evening you must incorporate that 3 dB as a buffer in the form of additional system gain.

Fig. 5 shows a similar test sequence, only this time the threshold was at 5 Watts average with power increments of 10, 15, and 20 Watts shown for comparison. This series, showing some of the station equipment, also shows the Bird wattmeter used to monitor power output — you are not getting estimates based on guesses from a #47 lamp!

There is no doubt that the most effective means of monitoring power output in the 420-450 MHz band is a Bird wattmeter with a suitable set of slugs for the power levels you wish to use. It is highly doubtful that without the use of WB8JXF's Bird we would now be sending pictures back and forth. The problem is of course that the little devils are expensive and, although it is usually possible to borrow one for a short time to tune up a transmitter or check the antenna system, what is needed is an inexpensive yet reasonably accurate means of monitoring power output so that one needn't be afraid to tinker with the transmitter. The ever popular VHF Monomatch[1] works well for the lower VHF bands, but is more critical in layout to get a good null when used at 432. Numerous descriptions of more elegant directional couplers are available, but these are tedious to construct. It is possible to effectively modify the basic monomatch concept, however, if all we are interested in is measuring forward power. Such an approach is illustrated in schematic form in Fig. 6 and with photos in Fig. 7. This basic unit will effectively monitor power output up to about 100 Watts. If you run higher power, you can go to RG-8 foam cable and a shorter pickup loop. The internal pot can be set for full-scale deflection at any desired power level down to less than 1 Watt. Calibration is best accomplished using a Bird or

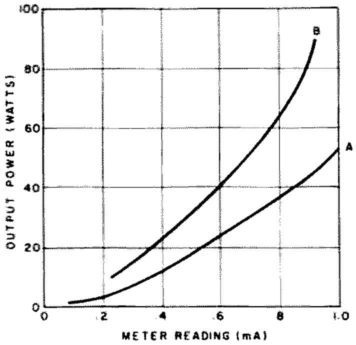


Fig. 8. Calibration curve for the author's in-line power meter. Curve A is for 432 MHz and curve B is for the two meter band. Provided the antenna system exhibits a low swr, once you have calibrated your meter you can reliably use it for power output measurements. The calibration curves will differ for each instrument, so there is no way to avoid the task of calibration if you want it to be useful.

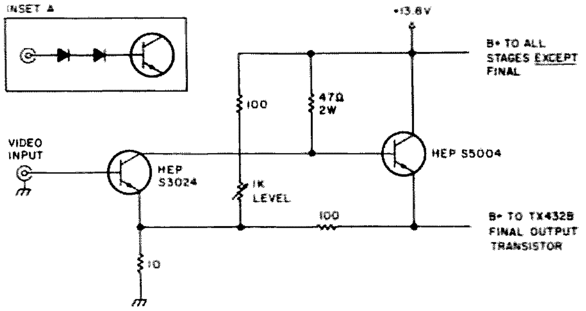


Fig. 9. Video modulator, designed by WB8JXF, for the TX-432B transmitter strip. Unless otherwise noted, fixed resistors are 1/2 Watt units. The 1k level control can be a 1/4 Watt PC pot mounted on the modulator board, or it can be a conventional panel mount control. Since it is usually not adjusted following setup, it is perhaps best to mount it internally to prevent tinkering. No heat sinks are required for use with the TX-432, but, if other transmitters are to be modulated (the modulator will sink up to 1/2 Amp), they may be required. Some tube-type cameras have a dc component in their output that will alter the bias on the input transistor. This can be eliminated by adding silicon diodes in series with the input (inset A) until the modulator provides proper video swing. 1N914 or other small signal diodes are fine here. No diodes will be required with solid state cameras. No terminating resistor is required at the input, as this function is taken care of by the input transistor itself. Several features contribute to the excellent performance of the modulator, including the use of high frequency transistors and the incorporation of dc coupling throughout.

similar unit for setup. A good 50 Ohm load is required, but this is easy at 432 – simply use 50-100 feet of RG-58/U (the older the better) terminated with a 50 Ohm resistor. Using the Bird as a reference, set the transmitter for the desired peak value (50 Watts for example) and then insert the meter into the line (starting with the pot at the maximum resistance setting). The pot is then advanced until full-scale meter deflection is obtained. Now reduce the transmitter power in steps (40, 30, 20 and 10 Watts for example), comparing the meter reading with the power as indicated by the Bird wattmeter. The meter may be used in several power ranges by switching in different pots with each range being calibrated as indicated. The adjustment pots should be internal to eliminate the urge to tinker with them and thus throw off your careful calibration at some later time. You can then use your meter readings to prepare a calibration curve. An example of such a curve is shown in Fig. 8. As long as you are working into a reasonable load (low swr) you will be able to estimate your power output quite nicely anywhere in the band. The meter can also be calibrated for other bands, but in that case you leave the pots as set for 432 and simply tabulate power output against the meter readings. The fixed geometry of the pickup loop causes the instrument to be less sensitive at lower frequencies, as shown by the two meter curve included in Fig. 8.

See how interesting it is to read all the articles in *73* each month! Even if you never intend to operate TV, you now have a reference for a simple and cheap instrument (less than $20) for keeping track of your power output in any mode on any VHF band.

Transmitters

There are many approaches that can be taken to arrive at a suitable transmitting system. One of the more common procedures is the modification of a commercial transmitter strip obtained on the surplus market. Some of these modulate quite easily with adequate bandwidth (RCA "Carfone" and G.E. "Prog Line"), while others are more difficult to use (Motorola T44). The primary advantage of this approach is that you have a well engineered transmitter operating at moderate power levels. The disadvantages are the bulky power supplies and the fact that replacement tubes are getting harder to find at reasonable prices. Both JXF and myself decided to opt for a more modern approach, starting with a basic crystal controlled solid state exciter. The one we use is the TX-432B from VHF Engineering (see ads in *73*). The kit for this strip costs $39.95, and one approach to using it as a TV transmitter is described in "Simple Amateur TV Transmitter."[3] The strip is constructed following the kit instructions, with the single modification involving re-orienting a single RFC so that B+ for the final can be brought out on a single land without using additional components. Attachment of the output coax to the board is critical for maximum output and stability. Short exposed leads are a must, and I achieved a 30% boost in output power by soldering the flange of a BNC connector directly to the foil groundplane with the center pin going directly to the rf output pin on the board. The object is to tune the exciter for maximum stable output into a 50 Ohm load. The final will take off on its own at certain tuning settings, and you should pull the crystal to check for this possibility when you think it is tuned up. You will get between 1 and 1.5 Watts output at 13.8 V, depending upon your specific output transistor. If you are getting much more output, you should suspect self-oscillation. The transmitter strip is quite clean when properly tuned. Heat sinks are provided for the driver and final output transistors, but, in both versions we have built, the pre-driver has run uncomfortably warm, requiring an additional heat sink.

Reference 3 describes a video modulator for the exciter, but another circuit, designed by WB8JXF, is shown in Fig. 9. This modulator is essentially noncritical in terms of parts placement and lead length to the transmitter board, and has more than adequate bandwidth for use of an aural subcarrier audio system (more on that later). With the camera connected to the modulator, the level pot should be adjusted for a

power output of approximately 50% of what you obtain with the camera disconnected. The camera should be set up on a properly lighted subject for this step. Final setting of the level control can be optimized while watching the picture. At one extreme the video will "white out" with very little power output from the strip, while at the other extreme you will have plenty of contrast but the picture will become unstable as you gradually eliminate the sync threshold. With normal video input the output will be 50% of peak, rising to about 75% if the lens is capped. Some older tube-type cameras have a dc component in the output signal, which will mess up the bias on the input transistor or the modulator. This problem can be eliminated by adding one or more silicon diodes in series with the input to the base until you have knocked the dc component down to the point where you get good video swing. An old Dage camera I used required three such diodes in series. No diodes will be required for solid state cameras. Fig. 10 shows a photograph of my own exciter and video modulator.

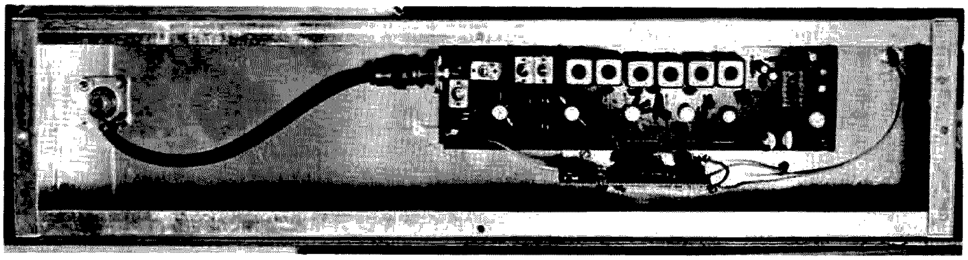


Fig. 10. The basic exciter and video modulator used in our ATV operations. In the author's version, shown here, the transmitter strip is mounted on standoffs with the modulator board mounted vertically next to the exciter strip. An extra large chassis was used, because I initially thought I would mount a power amplifier along with the exciter, but later decided to keep the exciter as an independent unit for demonstrations and portable work. A socket was used for the audio IC on the transmitter strip, but the IC is removed because the modulator is not being used at the present time. The additional heat sink added to one of the driver transistors (third from the left) shows clearly. A BNC connector is used to couple the rf off the board because this resulted in approximately 30% more power output than simply attaching the coax directly to the output pins.

When properly set up, the modulated exciter puts out a very nice picture that is limited in resolution only by the camera you employ. The main difficulty is that it simply does not have enough power to carry very far. I can shoot a nice picture around town (WB8JXF could do the same except that he doesn't live in a town!), but the picture quality drops off due to snow within a few miles. With everything optimized over the 8 mile path between us, we can exchange barely recognizable pictures with the basic exciter. The answer of course is higher power, and here WB8JXF and I took different routes, mostly to see what could be accomplished with various approaches.

The route I took involved the use of the Motorola MHW-710 power module as a linear amplifier. Reference 3 describes this as a "1 Watt in, 10 Watts out" module, but, as we shall see, this is not strictly correct. Two versions of the module are of interest to amateurs, depending upon your video frequency. The MHW-710-1 covers 400-440 MHz without tuning and the MHW-710-2 does the same over a 440-470 MHz frequency range. Both cost $41.50 and are available from Motorola distributors across the country. The module is basically an IC that requires very few additional components to do its job. Fig. 11 shows the schematic of my power amplifier using this module. A photo of the module and associated components is shown in Fig. 12. The module is one of the easiest-to-use rf components I have ever come across, and the amplifier is simplicity personified. The whole thing is constructed in a small aluminum chassis using a piece of double-sided glass board to provide for short ground returns. The board is mounted to the inner surface of the chassis with several screws and the input connector, to assure that the inner copper surface is actually at ground potential. A cutout in the board is provided so that the module can be mounted directly to the metal chassis, with thermal grease applied between the metal IC ground slab and the chassis surface. A large heat sink is mounted on the other side of the chassis, secured by the same screws that mount the IC. Use thermal grease at the interface between the heat sink and the chassis to assure good heat transfer. The amplifier is unconditionally stable if the exposed ends of the coax cables are kept very short — particularly the output line. Subminiature RG-174 is used to minimize lead stress on the module. Grounded IC pins, coax shields, and the grounded side of the bypass capacitors are soldered directly to the copper ground plane. A power supply capable of delivering at least 4 Amps at

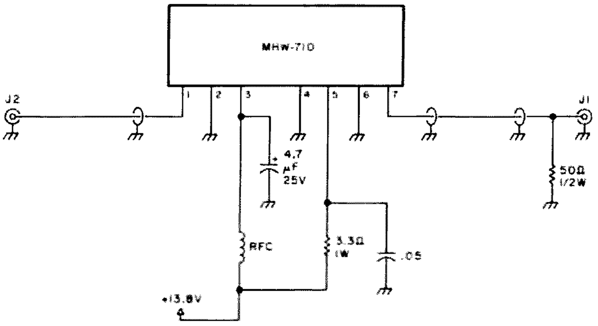


Fig. 11. Schematic for the circuit utilizing the Motorola MHW-710 power module in linear TV service. J1 is a Switchcraft 3501 FR phono jack. Interconnection to the module is made with a short lengths of RG-174 coax. A piece of double-sided circuit board with a cutout to accommodate the module (Fig. 12) permits short ground leads for input and output coax, bypass capacitors, and the grounded pins of the module. The schematic shows the IC pins as viewed from the top of the module. The metal slab of the module should be mounted directly to the aluminum chassis using thermal grease, with the heat sink mounted on the other side of the chassis in a similar manner. J2 is an SO-239 connector interconnected to the module with another short length of RG-174. Small coax is used to minimize lead stress on the module. Output lead length (exposed center conductor and shield at both ends of the output coax) should be kept to an absolute minimum. J1 is connected to the exciter by 50 feet of RG-174. This length is gradually trimmed until the proper drive level is obtained as outlined in the text. RFC — 8 turns #22 enamel on a 1 megohm 1 Watt resistor.

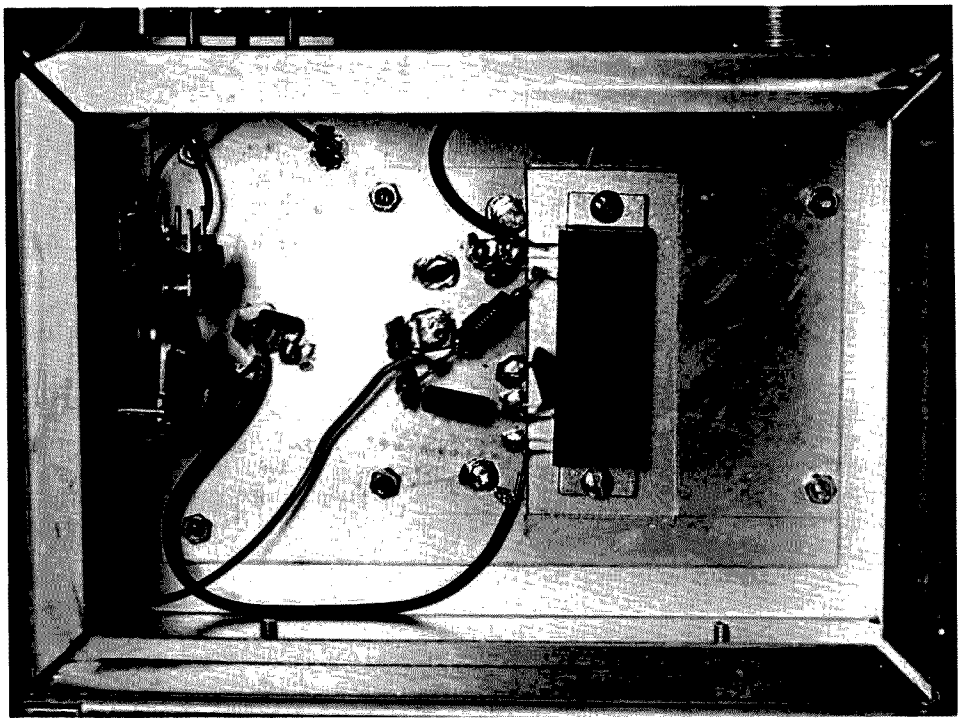


Fig. 12. Under-chassis view of the MHW-710 power amplifier circuit. A piece of double-sided glass PC board is mounted on the inside of the chassis surface to provide for direct ground returns for the power module pins, bypass capacitors, and the coax shields. This board is secured to the chassis with several screws and the input connector. A cutout in the board permits the metal mounting slab of the IC to be grounded directly to the aluminum chassis. Thermal grease is used to provide thermal coupling between the IC and the chassis. A large heat sink is mounted on the outside of the chassis, secured by the same screws used to mount the power module. Thermal grease should also be used in mounting the heat sink. Mounted in this fashion, the amplifier can run continuously at peak output (15 Watts) without overheating. The amplifier is unconditionally stable provided the free ends of the output coax are kept to an absolute minimum. The relay used to switch power to the amplifier during transmit is just visible to the left. Ideally the amplifier should work into a load with an swr of less than 2:1. I have made a few mistakes in this regard, and the module still works, but extended operation at full power into a large mismatch will probably do you in eventually.

13.8 V will be required, as the chip draws almost 40 Watts average input under modulation.

If driven directly by the modulated exciter, the module will put out almost 20 Watts, but very little modulation will be evident. Only 50 mW average drive is actually required, and the chip simply isn't linear when driven by 1 Watt from the exciter. The module performs excellently under modulation if we drop the drive level to the proper value, but we do not want to alter the tuning or voltage on the exciter, because this will alter its characteristics when modulated and will require that it be reset up if operated independently. Major changes in load will also have an adverse effect on picture quality. The answer turns out to be the use of a moderate length of RG-174 coax for coupling between the exciter and the module. This small coax is very lossy at this frequency and will drop the power to the module very smoothly while maintaining the proper 50 Ohm load on the exciter. Start with 50 feet of this cable (it's only \$.08 per foot). With no camera connected to the modulator, gradually prune the coax while watching the power output from the amplifier. Slow down when you get to 10 Watts and begin checking with the camera to be sure that black level and average output are tracking at 75% and 50% respectively. The module will not stay linear beyond 15 Watts peak, and I play it safe by stopping at 13 Watts. If you push for the last possible Watt, you will start infringing on the sync threshold, which will hurt your weak signal performance even if it is not noticeable in close. If you trim off a little too much coax, it's hard to put it back together, but you can recover by compensating with slight adjustment of the level control on the exciter. You should try to get it right using just the coax, however, for then you will have the exciter set up properly if you want to use it independently. Fig. 13 is a photograph of the complete transmitter, showing the coaxial coupling and the heat sink on the power amplifier. The result is a solid state ATV transmitter that performs as well as a converted surplus strip and which can be built for \$100-130, including packaging.

The basic ATV transmitter just described puts out enough power to function well over normal paths of 10-12 miles, and it can also be used to drive an amplifier in the 50-100 Watt class. There are several ways to go in getting to this latter power level. If you want to stay in the solid state business, there are a number of solid state linears which will do the job nicely. KLM makes two amplifiers that will do the job. Their PA10-35CL (\$139.95) will put out 35-40 Watts (average) when driven by the basic transmitter, and the PA10-70CL (\$245.95) will deliver about 70 Watts under the same conditions. VHF Engineering has recently announced the introduction of a similar series of amplifiers. Both companies, and others as well, are tooling up for amplifiers that will deliver comparable outputs when driven by the basic TX-432B exciter, but amplifiers with 35-70 or more Watts out with 1-2 Watts of drive are expensive. Costwise, it is far cheaper to incorporate the MHW-710 module to get enough drive to use one of the less expensive 10 Watt input amplifiers. All of these amplifiers require a regulated high current supply. (The PA10-35 draws 6 Amps and the PA10-70 requires 18 Amps.) So some pretty hefty power supplies are in order. Many manufacturers are marketing supplies for use with solid state HF transceivers in the 200 Watt range, but check the specs carefully if you plan to avoid the hassle of building a supply. Many of the HF supplies are rated for SSB service, and it is the continuous ratings that you should heed in making a selection.

Solid state linears with

their requirements for massive power supplies make it reasonable to consider tube-type amplifiers for more power output, as suitable supplies are readily available and often cost less than a low voltage supply required for comparable output with a solid state linear. WB8JXF went this route using the basic TX-432B exciter described earlier. One of the nicest amplifiers for outputs in the 30-100 Watt range is the cavity configuration using a 4CX250 described in the *The Radio Amateur's VHF Manual*.[4] This amplifier will deliver 30-40 Watts (average) on an 800 volt transceiver power supply and can push up to close to 100 Watts average at maximum rated voltage. Do not attempt to drive such an amplifier directly with the TX-432B exciter. WB8JXF did and lost the output transistor. It seems that the 250 tube series develops rather high rf grid voltages (a fact not mentioned enough in the literature), and the poor 2N5913 in the output of the exciter is only rated at 14 V on the collector! WB8JXF employs a 2C39 in grounded grid as a buffer between the exciter and the cavity, with excellent results. The 2C39 is set up to provide very little gain, and functions primarily to protect the exciter from the ravenous grid circuit of the cavity. Power output of the MHW-710 is more than adequate to drive such a cavity using lossy coupling, thus protecting the power module. If there is sufficient demand, WB8JXF could undoubtedly be persuaded to document his power train, which not only works well, but also employs some rather interesting ideas on coupling the exciter, 2C39, and cavity amplifier. If you want to go the limit on power, then the K2RIW kilowatt[5] is probably the best route.

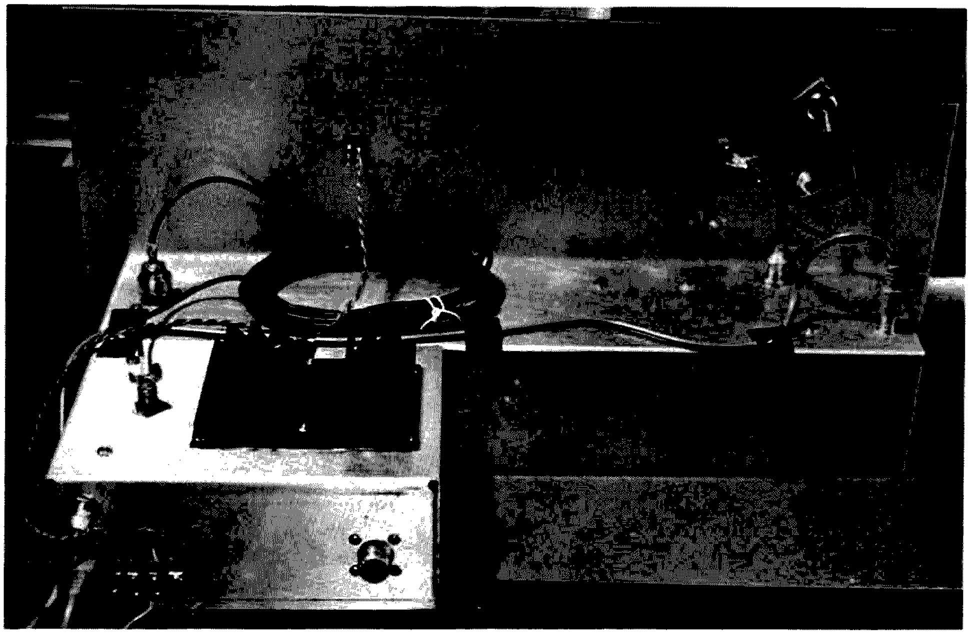


Fig. 13. Rear view of the complete basic ATV transmitter using the TX-432B exciter and video modulator (long chassis) and the MHW-710 power module (short chassis). The heat sink on the latter is visible, as is the coiled length of RG-174 used to drop the exciter power output to the proper drive level for the power amplifier. The front panel holds the TR switch, camera input and monitor output jacks, and video switch. The vacant space in the collection of boxes is for the cavity final (4CX250) which is presently under construction. An oversize panel is used to allow for metering and control hardware for this amplifier. 13.8 V comes into the power amplifier compartment and is jumpered over to the exciter. This permits power to be applied separately to the exciter if desired, with the latter connected directly to the antenna.

You will note that our system philosophy has involved the use of a well set up exciter with linear amplifiers to get to the desired power output level. You will occasionally read that such strings of linears result in a loss of picture resolution. This simply is not so if the stages are tuned properly. The linear approach does have the advantage that the power train can be broken down to any useful intermediate power level for demonstrations and such – something that is not possible with a modulated final. When we are talking about high powered tube finals, linears would appear to present a problem with power output, since maximum efficiency with AM linears is limited to about 35%. An interesting fact discovered in our tests is that excellent video quality can be obtained in class B. The finals can thus be biased AB1 for local work and easily shifted to class B for really long haul schedules. The only effect of the latter operating conditions is a very slight compression of the grey scale, which actually may improve subjective picture quality under conditions of high noise. The effect is hardly noticeable locally, but you can always shift back to AB1 for color or other critical applications. Given the flexibility of linear power trains, this approach seems to us to be better than grid modulation of the final, for there is little or no difference in effective power output at any given input when the power difference could actually make or break a contact. For those who might doubt, the test photographs of Figs. 4 and 5 were made with the cavity final operating in class B!

Sound

There are many ways to handle the matter of sound to go along with the pictures. The easiest way is, in our opinion, the best. It involves using your existing phone equipment on another VHF band (2 meters is ideal). This gives you a reliable audio link that is so essential in setting up a system and permits voice communication without firing up the video gear. Another substantial advantage of this approach is that your audio commentary will receive maximum exposure and perhaps get you some new converts. If you put the voice up with the video signal, no one but your cronies will hear and you cut your chances of snagging new converts.

Another approach is to simultaneously FM modulate the exciter, recovering the audio on a separate FM receiver tuned to the carrier frequency. This is easy with the TX432B exciter since there is an FM modulator already on the board, but it is hard to keep sync buzz out of the receiver, particularly in the case of a signal that does not limit fully during video modulation.

Audio in conjunction with the TV receiver can be

accomplished in two ways. The first is the use of an aural subcarrier unit in which a voice modulated 4.5 MHz oscillator (FM) is mixed with the video at the input to the modulator of the TV transmitter. This results in two FM sidebands 4.5 MHz from the video signal. The upper one is demodulated as sound in the TV set. Several problems are associated with this method. First, the video amp must be flat to 4.5 MHz (the one in Fig. 5 is) to pass the FM subcarrier. The more power you apply in the subcarrier, the more you take from the picture signal, so compromise is required. The subcarrier unit must be designed so that it does not load the modulator input if a loss of resolution is to be avoided. A nice subcarrier circuit is described in "Practical Ideas for the ATV Enthusiast."[6] The most elegant approach is to use another FM transmitter 4.5 MHz above your video carrier frequency. The most effective sound level is achieved with an output level from the voice transmitter of 1/3 to 1/2 of the average video output. This ratio is in terms of the effective radiated power, so the antenna gain for the voice transmitter should be taken into consideration. Simple yagi arrays are fine here since the voice signal is narrowband.

Summary

This article has covered a lot of ground in attempting to document an effective ATV system. The system outlines provided are realistic, and if you are interested in trying ATV you can implement them with expectations of success. If you are within line of sight of an ATV repeater, you can undoubtedly get by with far less in the way of equipment, but our approach has been oriented toward point to point service. When band conditions are good, you will get even exceptional results with a given power level, but you will have assembled the station with a realistic idea of what you can accomplish at any time.

I first got into ATV when virtually every item of equipment had to be built from scratch, and when you were done the technology was such that you occasionally wondered if it was worth the effort. Today the effort and costs are actually less than they used to be, and there is no comparison in terms of the results you can achieve.

ATV is a fascinating aspect of our hobby. You will have to tinker to optimize the system, but there is lots of room for real experimentation. The biggest stumbling block is simply getting an effective two-way operation going. I think we have developed some workable guidelines to make that task easier.

Once you are on you can branch out in any direction – color, Pong, microprocessors via ATV time-sharing – you name it. The name of the game is both fun and a little education. If you do give it a try, you will not only enjoy demonstrating your efforts, but will also have accomplished something far more in the traditions of amateur radio then simply playing with store-bought goodies. For about what it would cost for a fancy FM toy, you can come up and join the video freaks for some real pioneering – why not give it your best shot?! ■

References

[1] *The Radio Amateur's VHF Manual,* ARRL, Newington CT (any edition).

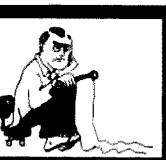
[2] Brown, B., "Amateur TV Receiving System," *73,* June, 1976.

[3] Brown, B., "Simple Amateur TV Transmitter," *73,* June, 1976.

[4] *The Radio Amateur's VHF Manual,* ARRL, Newington CT, 2nd edition, p. 257.

[5] Knadle, "A Strip-line Kilowatt Amplifier for 432 MHz," ***QST,*** April and May, 1972.

[6] O'Hara, T. R., "Practical Ideas for the ATV Enthusiast, Part II," ***QST,*** February, 1975.



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NEVER SAY DIE

EDITORIAL BY WAYNE GREEN

from page 95

delegates found little enthusiasm for this move with the other countries, and head counts of the countries indicated that we were very far short of the needed majority.

On the opening day of the conference, the U.S. managed to get the Netherlands to start things off by proposing the 3-30 MHz postponement, sort of in the hopes that it wouldn't look as if the U.S. was pushing for it, and thus when it was defeated, it would not be a U.S. defeat. The entire assembly of the plenipotentiary meeting was thunderstruck when the Soviet Union rose and seconded the Netherlands motion. With a large number of small nations in the U.S.S.R. pocket, the motion was carried and amateur radio was saved until the next conference.

How did this happen? It was a pure fluke. Khrushchev had just visited the U.S. and been most cordially welcomed by Ike. When he returned home, he wanted to make sure that his good feelings toward the U.S. were reflected, and it happened that the first opportunity to show friendship between the U.S.S.R. and the U.S. came at this ITU meeting in Geneva. When you consider that not long after this Gary Powers was shot down and the U.S.S.R. mood changed, you can appreciate how we lucked out.

1964 – THE ITU

As more and more of the emerging nations joined the ITU, the balance of power changed from the U.S./ European block to the third world. The American Secretary General of the ITU was voted out and replaced by an Ethiopian. The American who really ran the ITU was fired and the whole place changed to reflect the new African/Asian influence.

After the Ethiopian Secretary General, they voted in one from India, with the second man in command from Australia. Remember, if you will, the 20 kHz ham band proposal of India and the 50 kHz proposal of Australia. Amateur radio no longer had good friends in high places.

1966 – I TRAVEL

With a possible frequency conference scheduled for 1969, it seemed like time to take stock. I decided to take a trip around the world and visit some of the countries that would be deciding the future of the ham bands at the ITU. My trip took me to Kenya, Uganda, Tanzania, Ethiopia, Sudan, Egypt, Lebanon, Syria, Iraq, Iran, Afghanistan, India, Nepal, Burma, Thailand, Singapore, Australia, New Zealand, New Caledonia, Fiji Islands, Western Samoa, American Samoa, Tahiti, and back to the U.S. I DXpeditioned from 15 of the countries, working tens of thousands of amateurs as I traveled.

In each country, I got together with the national amateur radio society of that country or with the local amateurs where there was no significant society. In several, I visited the ministers of communications to explain the importance of amateur radio to them and their countries.

One of the results of this trip was the development of the concept of having ham ambassadors visit smaller countries to point out the benefits to them of encouraging amateur radio. This was written up in my November, 1966, editorial in *73 Magazine* . . . written while I was in Sydney, Australia.

While in Ethiopia, I got together with the ex-Secretary General of the ITU and explained amateur radio to him. He had very little background in it and became most enthusiastic when I pointed out the benefits to emerging nations of the hobby. I showed him how people could be encouraged to learn electronics and communications on their own time and pretty much at their own expense, and thus become a very valuable resource for the country . . . technicians and engineers. He suggested that I should get together with the current Secretary General of the ITU when I was in India, and he helped arrange a meeting.

In Delhi, I did meet with the Secretary General and discussed the importance of amateur radio to emerging nations with him. I pointed out that small country students normally think in terms of being lawyers, doctors, or civil servants, and the concept of an engineering career is lost. With amateur radio as an impetus, many of the students would want to try for technical school training and the country would benefit greatly.

Communications is the basis for growth of any civilization, and when a country has to import everything electrical and electronic, including technicians at $200 a day from Sweden or Switzerland, they are able to buy very little in the way of telephone systems and radio communications. With local technicians, they would be able to buy much more.

The Secretary General was enthusiastic when I suggested that I could provide a sample set of amateur radio regulations for the ITU to make available and recommend to smaller

Continued on page 177

Simple Electronic Siren

-- it's loud!

Ray Megirian K4DHC
606 SE 6th Avenue
Deerfield Beach FL 33441

"Whatcha makin' Dad?"

"A microcomputer, son."

"What's it do?"

"Well, when it is finished, I hope to program it so it will run my rig. Every fifteen minutes it will initiate a receiver scan of all the ham bands to search for rare DX. If a rare callsign is recognized, it will tune up the transmitter, select the best antenna, call the station, and sound an alarm so I can take over. It will also make out a QSL card and record the contact for my log."

"Oh."

"Why don't you go next door and play with Buddy so I can get this thing finished. It's costing me a bunch and I don't want to make any mistakes in the wiring."

"Yeah, ok. His dad just made Buddy a turn signal for his bike. He makes a lot of neat things for Buddy. He's real smart. See you later, Pop."

Then it hits you. Is it really that long since you were pouring sand into a length of copper tubing so you could bend it into a tank coil for that super new 5 meter modulated oscillator? And it can't possibly be so many years since you thrilled to the sound of Big Ben on 49 meters with a one-lunger on a cigar box chassis. Transistors? Who needed 'em! Your vacuum tube superregen ran on 6 volts with the grids reversed. Remember? Ah, those were the fun years.

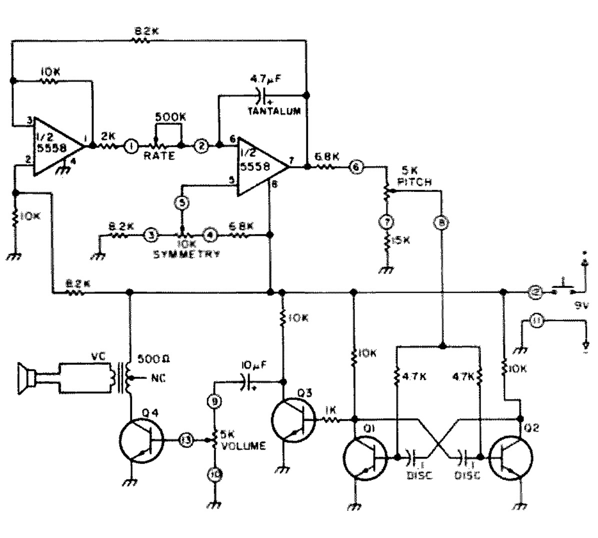

Fig. 1. Schematic for the electronic siren. The circled numbers correspond to numbered pads on the printed circuit board.

An Electronic Siren

Well, here is a fun thing you can build in a couple of hours that is guaranteed to make you a hero in the eyes of any youngster and just possibly the envy of your neighbors. What I'm selling is an electronic siren. Not a new idea by any means, but this one has enough operating controls to make it particularly appealing. The circuit is self-starting, simple, and runs on standard 9 volt radio batteries. Drain is low enough so you won't have to make a trip to the drug store every day for fresh batteries. You can vary the repetition rate from a long wail to a rapid warble, control the volume from soft to annoying, vary the pitch and the symmetry.

The circuit, as shown in Fig. 1, makes use of a type 5558 dual op amp and 4 NPN transistors as the active elements. The IC is used to generate a triangle wave much as any basic function generator. This triangle can be distorted by means of the symmetry control to form either a fast rise or a slow rise sawtooth. This signal is applied as base bias to the astable multivibrator formed by Q1 and Q2. As the level of the triangle or sawtooth rises and falls, the charging time for the cross-coupling capacitors varies and causes a change in multivibrator frequency. Output is taken from one side of the multivibrator and squared up by direct-coupled amplifier Q3. The audio output stage, Q4, is pulsed on and off by the square waves and provides plenty of noise with little expenditure of battery power.

The siren contains about 5 dollars worth of parts. Depending on the cost for an enclosure, the total outlay shouldn't exceed 10 bucks. All resistors are ¼ Watt. The output transformer isn't critical. I used a 500 Ohm to voice coil type with PC leads for use with the board layout shown in Fig. 2. The tran-

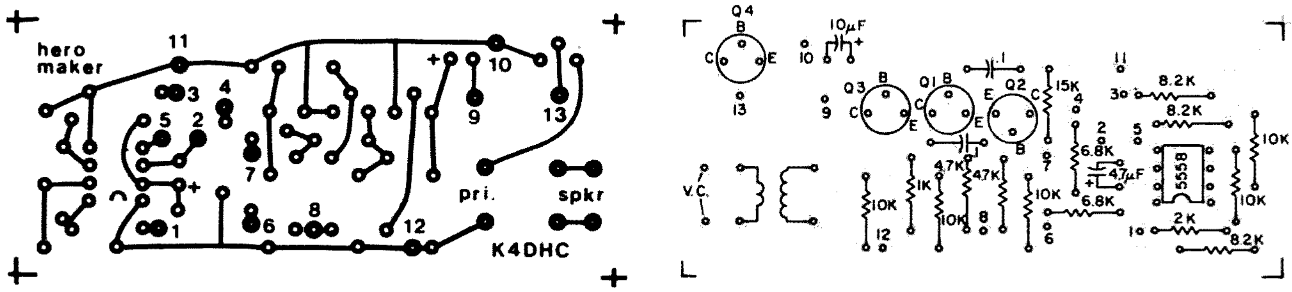

Fig. 2. PC pattern and parts placement for the Hero Maker.

sistors are NPN silicon units. Mine were house-numbered cheapies in TO-18 cans which I picked up years ago. The .1 uF capacitors are 50 volt discs. The 10 uF coupling capacitor in the audio section is an electrolytic. The 4.7 uF capacitor used in the integrator section of the triangle generator should be a tantalum unit for best results. I used a small dipped tantalum which fits the board layout. An axial lead type may be used by mounting it hairpin fashion. The operating switch can be either a push-button or a toggle switch to allow hands-off operation when used on a bicycle.

Operation of the controls and their effect on the siren sounds will become apparent after a few minutes of use. The symmetry control is the only one whose purpose may elude you at first. The complete cycle consists of an audio tone which starts at a low frequency and rises to a high point before retracing its way back to the starting frequency. If the symmetry control is set at one end of its range, the rising wail of the siren can be stretched out to occupy the greatest portion of the cycle time or the falling wail can be made longer with the control at the other extreme. Somewhere in between, a symmetrical triangle is generated and the rise and fall portions of the siren sound will be equally long. The pitch control varies the actual range of frequencies covered in one complete cycle and the rate pot controls the number of complete cycles per unit of time.

Most of the common siren sounds can be imitated with this toy and it will furnish hours of amusement for the youngsters, provided your nerves hold out. If the kids do mount these on bicycles, it might be worth a little extra effort to make them removable. One of our neighbors' boys had his bicycle ripped off less than 12 hours after installing one of these sirens. It makes the prize just that much more enticing to a thief.

So there it is; your golden opportunity to be a hero. Why not put digital readouts, microprocessors, RAMs and ROMs out of your mind for a couple of hours while you build something just for the fun of it. Have a ball! ■

EDITORIAL BY WAYNE GREEN

from page 174

countries.

Upon returning from the three month trip around the world, I found the magazine in dire straits . . . a month behind in production and almost bankrupt. I had to get things in hand and work hard for several months before I could get to the substantial job of writing a set of international amateur radio regulations. I was partly done with them when I read in the newspapers that the Secretary General had suddenly died. Well, so much for that project.

1969 – ITU

I visited the ITU in Geneva at every opportunity to keep in touch with what was going on under the surface. While the African/Asian countries were strong enough to influence the vote of the ITU on many matters, they were not well enough organized to force a general meeting to change the shortwave frequency allocations. The European nations were so far able to block every attempt at frequency talks.

1971 – ITU

With the African nations growing stronger, a satellite frequency conference was called for 1971 and the U.S. participated, with the ARRL representing amateurs worldwide. The ARRL went into the conference with 237,254.77 MHz of satellite frequencies allocated to amateur radio. They came out with 7.5 MHz . . . and only 3 MHz of that above 150 MHz! Thus they managed to lose 237,247.27 MHz of the amateur satellite allocation.

This loss was duly reported in *QST*, with the explanation that the conference might have gone better if they had done their homework. If they had done as I suggested in my November, 1966, editorial, and sent ham representatives to visit the foreign countries to make them aware of the benefits of amateur radio to them, we might have thousands of megahertz of satellite frequencies today. They found many of the ITU delegates did not understand amateur radio and few had any knowledge of how it might benefit them.

Satellites were still pretty new in 1971, so the impact of the loss was not generally recognized. Now, as we think in terms of satellite communications as a way for amateurs of all countries of the world to get together via synchronous satellites, we are beginning to appreciate what has been lost . . . and lost forever.

1979 – ITU

The next conference is scheduled for 1979, and there is no indication that it will be anything but a replay of the 1959 situation, only without the U.S.S.R. to pull our fat out of the fire. There will be even more pressure for eliminating the shortwave ham bands, and fewer friends to try to hold them for us.

The ARRL has been generating a smoke screen of proposals for new shortwave ham bands, none of which has been seriously accepted by even the U.S. delegation.

Do we yet have ham ambassadors visiting the third world countries to sell them on the value of amateur radio to their countries? You know the answer to that . . . no.

1970 – JORDAN

While visiting Jordan and operating JY1 from the Royal Palace, I talked with His Majesty King Hussein about my plan for encouraging amateur radio in emerging nations as a way to get technically enthusiastic students who would then opt for engineering careers. Hussein asked me to explain the plan to his government, which I did . . . and it was put into action, despite a fierce civil war between Jordan and the resident Palestinians which began only a few days after I left.

I returned again to Jordan in 1973 and found that there were active ham clubs in every major city in Jordan, with over 500 licensed amateurs. The rules and regulations were essentially those I had prepared for them and sent over shortly after my return to the U.S. in 1970. As a result of the large number of technically interested youths in Jordan, the government was thinking in terms of setting up a radio crystal manufacturing plant and a small plant for making VHF transceivers. These would have been totally impossible projects just three years before.

In Jordan, the King supplied ham stations to each of the youth clubs and sent one man around to conduct code and theory classes. It worked.

The growth of amateur radio before the ARRL pushed through their "incentive licensing" plans was 11% per year. If the League had not insisted on trying to force amateurs to get higher class licenses by taking frequencies away from them if they did not, we might have seen amateur growth continuing at that level, and we might have about 1,250,000 amateurs today. With numbers like that, we would not be having to worry about losing 220 MHz and other UHF bands.

Continued on page 181

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Digital To Audio Decoder

-- for the blind operator

About a year ago, I had an accident involving an exploding car battery whose shrapnel left me blind in one eye. As the anniversary of this unfortunate event passed me by, I got to thinking about how lucky I am to be blessed with sight and about those hams not so blessed. I thought how difficult it would be to do something most of us take for granted, like reading a frequency counter or a digital voltmeter.

So here is a device which overcomes one of the many difficulties experienced by a blind person involved in any phase of electronics. In essence, it converts a binary coded decimal input, from any suitable piece of digital test gear, into a sequence of different tones — ten tones representing the numbers zero to nine, and the length of the sequence equal to the number of digits displayed, plus a sign indicator, if desired.

Photo 1. Digital to audio decoder and Heathkit IB1100 frequency counter.

Theory

Some readers unfamiliar with logic design may have a little trouble wading through the audio decoder's workings, while others of you have probably spent the last ten minutes exploring the schematic and now understand its working better than I do.

Perhaps the best place to start is with the sequence generator consisting of IC5, IC6, and IC7. IC5 is a familiar 555 timer connected for astable operation, which means that it generates sharp edged pulses, about twice a second as determined by time constant R10-C1. IC6, a decade counter, advances one count as the 555's output swings low. When the counter counts to nine, the next pulse resets its count to zero.

The count output, at terminals 1A, 2B, 4C, and 8D, is fed into IC7, which converts the 7490's BCD output to a one out of ten output. To clarify this a bit, suppose the 7490's outputs were 1A=0, 2B=1, 4C=1, 8D=0. This is the same as one 2 plus one 4, which is 6. Now only one of the 7442's ten outputs is activated. Output six drops to zero. When another pulse arrives from the 555, the 7490 will now store a "seven" and the 7442's output seven will be a zero. The rest (including six) will be a one. So only one output is low at a time, and every tenth pulse starts the sequence over.

The sequencer drives the digit scanners IC1-IC3, aided by inverters in IC8. (An inverter changes a zero to a one and vice versa.) The idea is to look at one digit at a time and convert its number into a corresponding tone and then move on to the next digit and repeat the process. But I'm getting a little ahead of the story here; first the right digit has to be selected. The NAND gates in IC1, IC2, and IC3 are of the open collector variety. They provide one of two output states, much as a conventional NAND, but, instead of ones and zeroes, these put out high impedances instead of ones and zeroes as in the regular NANDs. *Caution:* These are 7401s or 7403s but *not* 7400s. The inputs to these open collector gates allow us to: 1) pass data from the data input terminals to the output terminals; and 2) make the gate outputs look like they are open switches. As long as we apply a data pass signal to only one of several gates whose outputs are tied together, the others look like they aren't there! The job of the sequencer, then, is to apply a "one" pass command to only those four gates that are the input path for the digit we want. Since the data is inverted by the digit scanners, IC4 reinverts the data to its proper form. Four gates must be used at a time, because it takes four bits to represent a number from zero to nine.

At this point, the four outputs of IC4 first mimic the 100s place of the connected digital test equipment,

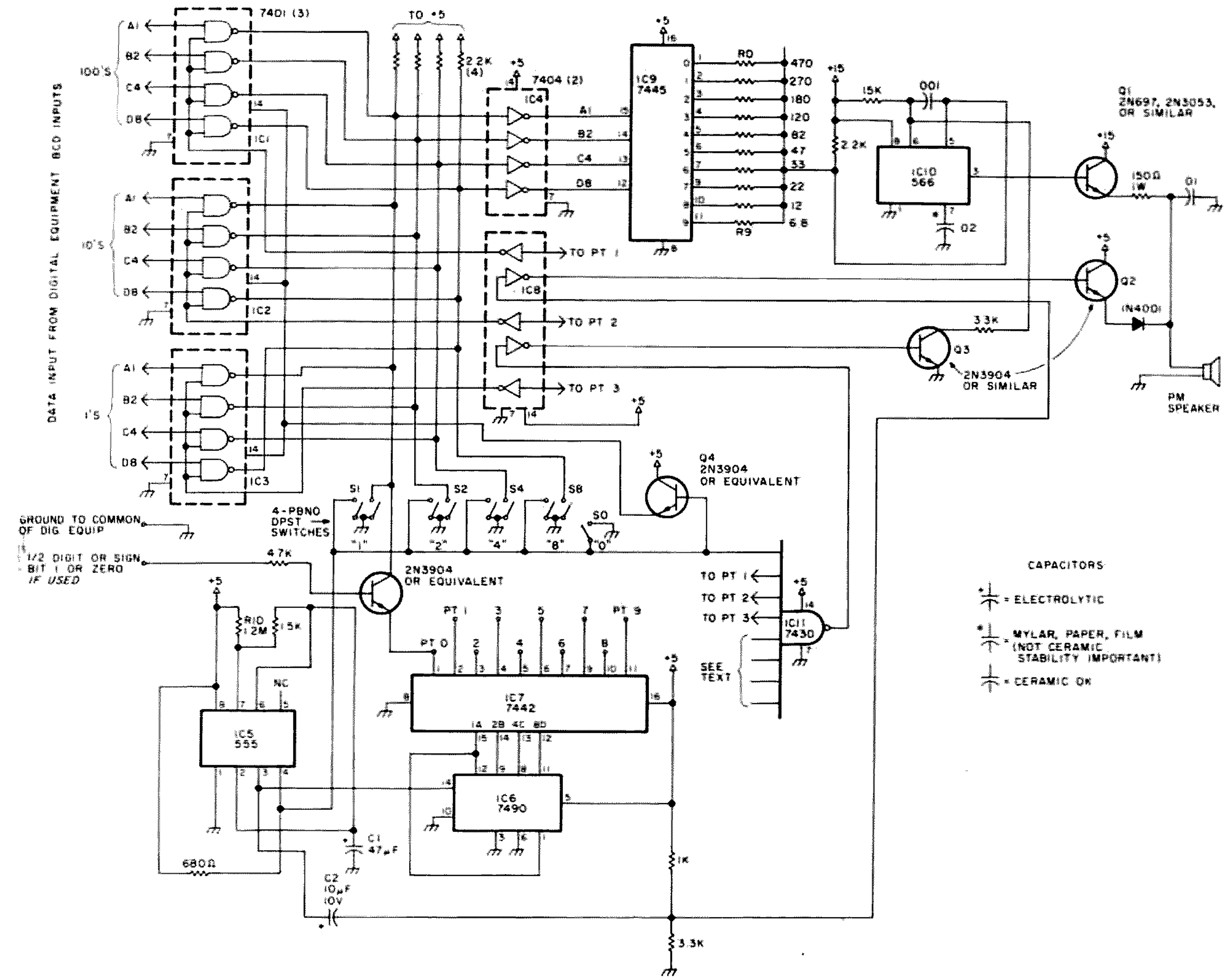


Fig. 1. Schematic of 3½-digit digital to audio decoder. Resistors should all be ¼ W ±10% or better, unless noted. If not specified, values are given in kΩ, i.e., 470 = 470k.

then the 10s place, and finally the 1s place, as the sequencer steps from 1 to 2 to 3. You may wonder what sequencer position zero does. It is the sign bit, in case you wish to connect the audio decoder to a digital VOM with this feature, or use it to indicate overrange on a counter as I did.

IC4's output feeds IC9, which is another BCD, to one out of ten decoders, as we talked about in the sequencer. It has one important difference though: Its outputs are open collector, just like the digit scanner gates. So once again, only the corresponding output of IC9 will be brought low for any given input number. This switches a different resistor into the voltage controlled oscillator circuit, IC10, which in turn causes it to see a different voltage and generate a different tone. I set up the resistors to provide an increasing tone for increasing numbers. The resistors could be selected to play musical notes. Q1 merely amplifies the tone to drive a speaker.

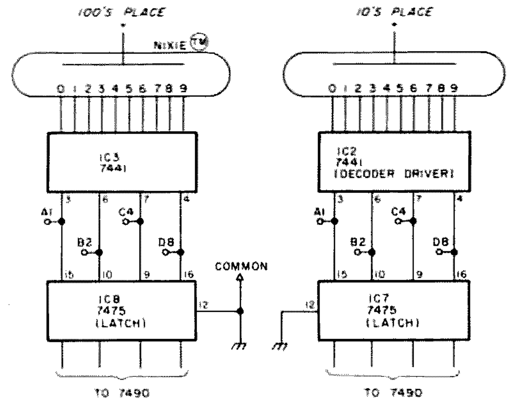


Fig. 2. Partial schematic of Heathkit IB1100 frequency counter showing where to connect inputs from audio decoder.

Optional Features

C2, Q2, and associated

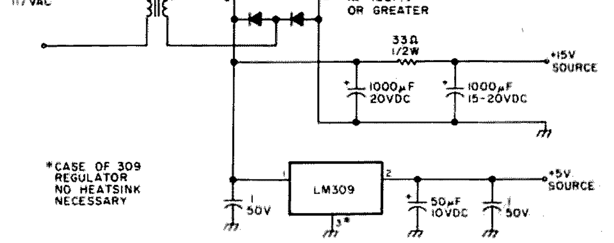


Fig. 3. 117 V ac input power supply for digital to audio decoder.

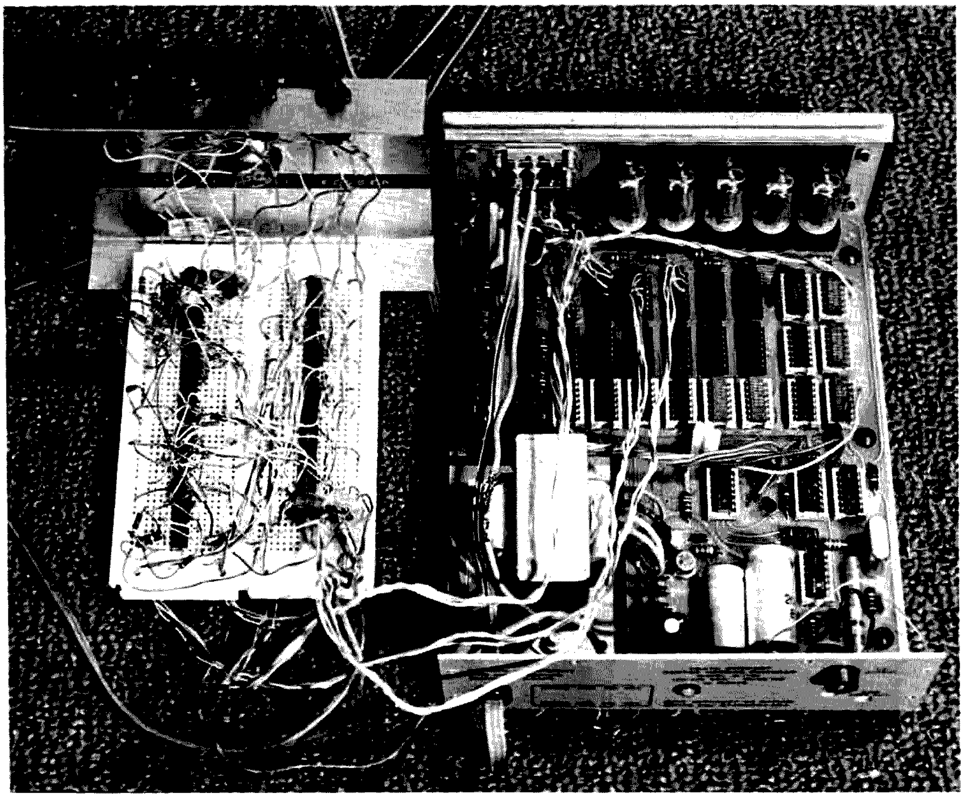


Photo 2. Audio decoder shown connected to Heathkit counter.

parts cause the speaker to emit a click every time the sequencer steps, thus announcing a new digit and serving as an audible "pilot light." IC11 and Q3 eliminate the zero tone, which you hear when the sequencer is stepping through unused outputs.

Speaking of unused outputs, enough are available to allow easy expansion up to eight digits, if desired. All you need to do is buy a few more 16¢ open collector NAND gates (7401s or 7403s), and string their outputs together in parallel with IC1, IC2, and IC3. Then duplicate the enabling circuitry used for IC1, IC2, and IC3, using the unused inverters in IC4 and IC8. Connect the inputs of these inverters to sequence generator point 4, point 5 and so on, depending upon how many additional digits you want. Remember, though, that these added digits are less significant than the first three, so connect the biggest place digit (100s, 1000s, 10,000s, etc.) to IC1. This ease of adding (or subtracting) digits is why I used lowly old open collector logic, as opposed to fancier data multiplexers. Be sure to connect all *used* sequence generator output points to an input of IC11, the 8 input NAND. Doing this allows the vco to turn on for all the digits you want. Unused IC11 gate inputs should be tied to +5 V (same as a "1" in TTL).

My last "optional" feature is probably not so optional. It gives the blind user the ability to hear what a number sounds like just by pushing the right combination of switches S1 through S8. For example, a "9" can be heard by pushing S1 and S8 simultaneously, or a "4" by pushing S4 alone. Pushing any of these buttons does a few other things, too. First, it removes power from IC1 through IC3, making all their outputs open up, allowing the pushed buttons to enter the desired number independently of the numbers being entered from the digital test instrument. Second, it brings one input of IC11 low, allowing the vco to function, so the tone can be heard. Finally, it stops the 555 timer from pulsing to allow hearing the tone alone. The switch marked S0 allows hearing the zero tone.

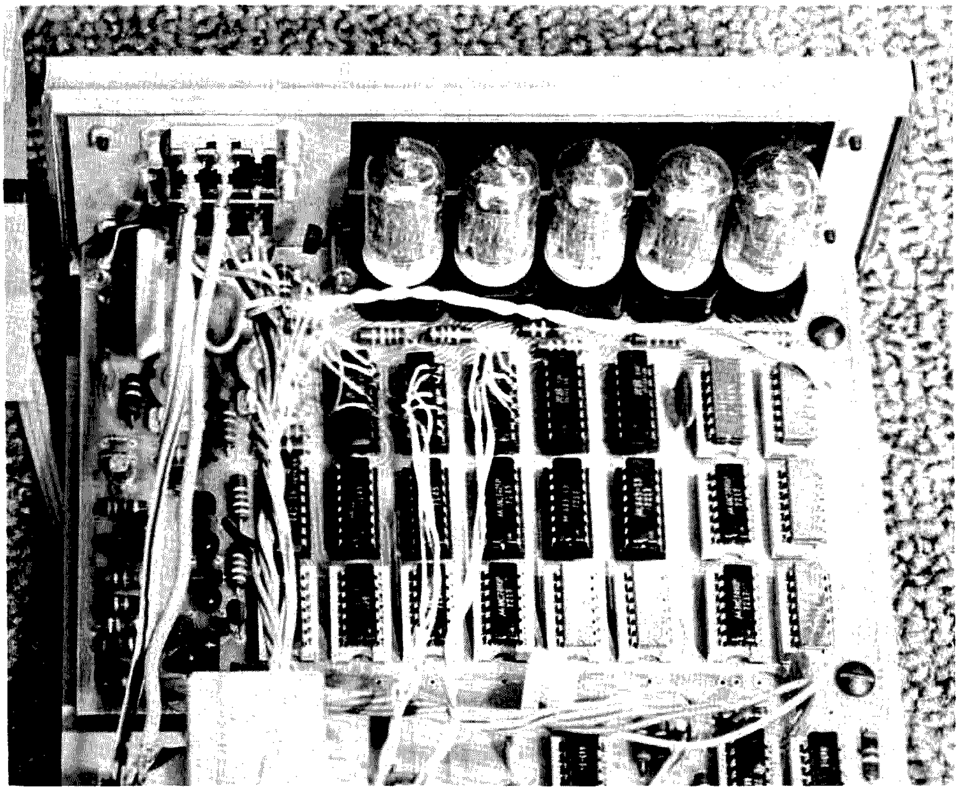


Fig. 3. 117 V ac input power supply for digital to audio decoder.

Interfacing

As it sits, this digital to audio decoder will not easily connect to every piece of digital test equipment, but it can be done! If the piece of test gear has an output connector labeled "BCD output," you're in. Most Heath frequency counters are usable, but you must solder to the circuit board. Connect the audio encoder's BCD inputs to test equipment's data latch outputs. Fig. 2 and Photo 3 show how this is accomplished for a Heath IB1100 frequency counter.

Construction

In that only eleven ICs and a few other parts are used, I don't think a printed circuit board is worthwhile. As to the mechanical details, like switch placement, I strongly urge you to talk it over with the person for which the audio decoder is intended.

As to operation, what can I really add? I went through most of it in the theory and optional features sections. When power is first applied, you should hear a clock every ½ second from the speaker, three tones after a few clicks, and then the same set of tones provided the numbers on the DVOM, counter, or whatever haven't changed. If you are in a hurry to try it out, as I was, you can take the 100s, 10s, and 1s input lines A1, B2, C4, and D8 and tie some high and some low. Be careful, though, not to exceed 9 on any digit, or the results could be a bit confusing to say the least!

Although there may not be anything in it for you, except satisfaction, please don't look at this as "just another project." Look at it in the light of letting a blind person see some of the numbers we take for granted. Build one for a friend. ■

EDITORIAL BY WAYNE GREEN

from page 177

MY PREDICTION

From everything that I can see so far, I would suggest that amateur radio in the 1980s may be almost entirely a VHF affair, with 50 MHz and 144 MHz as our major bands. I suspect that Cowan and S-9 may win the day with a CB band on 220 MHz, since hams seem to be doing very little to stop him. This is the chap who publishes *CQ Magazine*.

Without any satellite bands to mention, and without long-range communications, the whole fabric of amateur radio will change. About half of the active amateurs are already on two meters . . . now the other half will either join them or try stamp collecting . . . or computers.

IT IS NOT TOO LATE

Since most of the ITU countries have not yet formulated their positions on the shortwave bands, we still have some time, if we hurry, for ham ambassadors to lobby for our hobby. Members of the QCWA would seem to be ideal ham ambassadors. These are the people who made amateur radio what it is today and it would seem to rest in their hands to make amateur radio whatever it is going to be tomorrow.

The QCWA member amateurs include a great number of the pioneers and innovators — people with the drive and enthusiasm to get things done. It is not surprising to find that many of these same people have become top men in the electronics industry. As part of their work, many of these men travel quite a bit and have good opportunities to see the heads of foreign countries and put in a good word, or perhaps a few thousand good words, for amateur radio. A little side trip to see the king or president of a country will not generally hurt business, if I may be guilty of understatement.

No other group has such an elite membership as QCWA — just the type of people who could get an entry to a king and who would be able to sell the concept of amateur radio benefitting the country. Even if the ARRL wanted to spend money on such a project rather than their new million dollar wing of headquarters, they have no one of any stature to send out. Since QCWA members are already traveling, with their businesses paying the bills, there would be no cost to anyone for ambassadors.

QCWA members who are interested in the project should drop me a line and get a copy of a newsletter called "Amateur Radio, the Key to the Growth of a Country." There isn't much time to lose . . . unless you are a confirmed UHF addict and could care less about the low bands.

THE RADIO SHACK COMPUTER

"Most impressive" is my verdict on this one. When you see it and have a chance to try it out, you'll find it difficult not to like. They have packed a lot into what looks much like just a keyboard — it's the complete computer, with a Z-80 microprocessor, BASIC language on a ROM so it is right there ready to use as soon as you turn on the power, plus enough memory to tackle most things you might want to do. There is also the cassette interface system so all you have to do is plug in any ordinary cassette recorder to save and reload programs or data.

There are three sockets on the back panel of the computer — one for the monitor TV set, one for the little power supply which comes with it, and one for the cassette recorder.

The price for this? $400 for the computer, and $600 for the complete package of computer, TV monitor, and cassette recorder. Is it a coincidence that this is the same price as the PET?

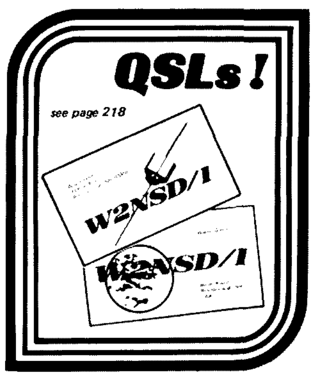
Radio Shack's complete TRS-80 Microcomputer System, consisting of a 53-key professional-type keyboard and microcomputer plus regulated power supply, computer-controlled data cassette recorder, and 12" video display monitor, is suitable for business, educational, and home applications. Available exclusively from Radio Shack stores and dealers, nationwide, for $599.95.

Since I needed a computer system as a prop for a TV commercial I was making to advertise Computermania, I borrowed the computer and took it down to the TV station. Readers around the Boston area may have seen me operating it on the commercial, programming it to print out a short message for Computermania. The gist of the commercial was that here is a computer which would have cost over a million dollars just about ten years ago . . . now you can buy one for $400 . . . perhaps it is time to look into microcomputers for your business.

It's a very good-looking set and it worked like a charm.

It will be a while before production is up to full scale on this new system, so check into the larger Radio Shack stores from time to time. The first few production runs may go almost entirely by mail order, so you may have to buy one just to try it out . . . or at least keep an eye on your friends in case they buy one.

The BASIC which comes with the system is an abbreviated version in 4K of ROM. They are working on a more expanded version and that will probably accompany their disk system which is scheduled for December. Yep, disks are coming . . . starting with single density single side, about 90K of storage. You can be sure this will grow to double density, double sides, etc.



George R. Allen W1HCI
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Windsor CT 06095

Synthesize Yourself!

-- practical experiments

Synthesizers are here to stay. Synthesizers are used in amateur and commercial transmitters, receivers, audio frequency generators, test equipment, and a multitude of devices for a large variety of purposes. They are used in applications that require the generation of a large number of frequencies.

Prior to the invention of the digital integrated circuit, synthesizers were few and far between. The technology was known, but the necessary fundamental building blocks were not readily available. Synthesizers were used, but they were cumbersome due to the large number of components required, and of course they were expensive to build and maintain. It wasn't until the advent of digital integrated circuits that synthesizers came into vogue because of the fact that digital ICs combined a large number of functions into a simple package. The "new" synthesizers are simple to construct, use few parts, and can by built inexpensively.

This article discusses the current generation of frequency synthesizers and provides an overview of the operation of the three common types of synthesizers in use today: the oscillator-mixer synthesizer, the period synthesizer, and the phase locked loop synthesizer. The greater portion of this article is devoted to the popular and versatile synthesizer, the phase locked loop, commonly known as the PLL synthesizer.

This article also describes simple synthesizer circuits and simple experiments using PLLs.

Those experimenters who are already experienced with synthesizers will notice that various topics have been glossed over or omitted in total. Those who have never worked with synthesizers should be able to read this article and make the simple circuits work.

Synthesis

Synthesis, by definition, is

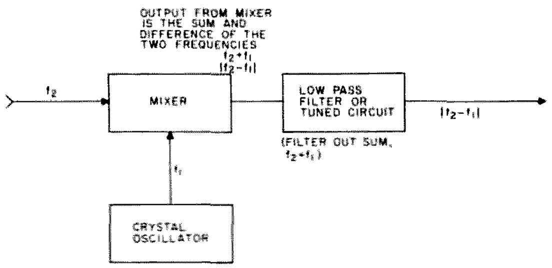


Fig. 1. Receiver mixer.

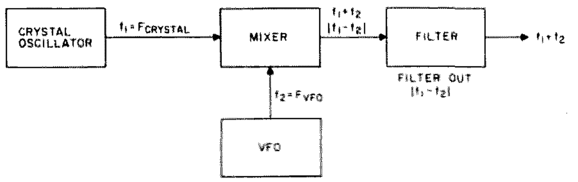
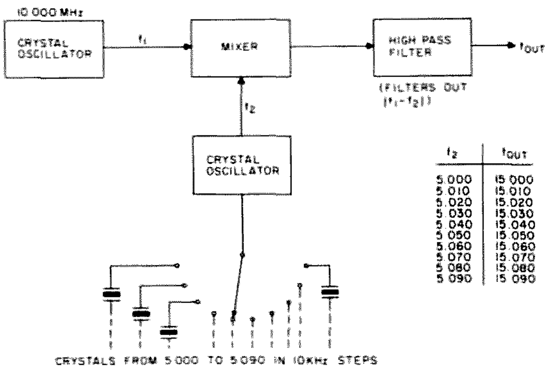
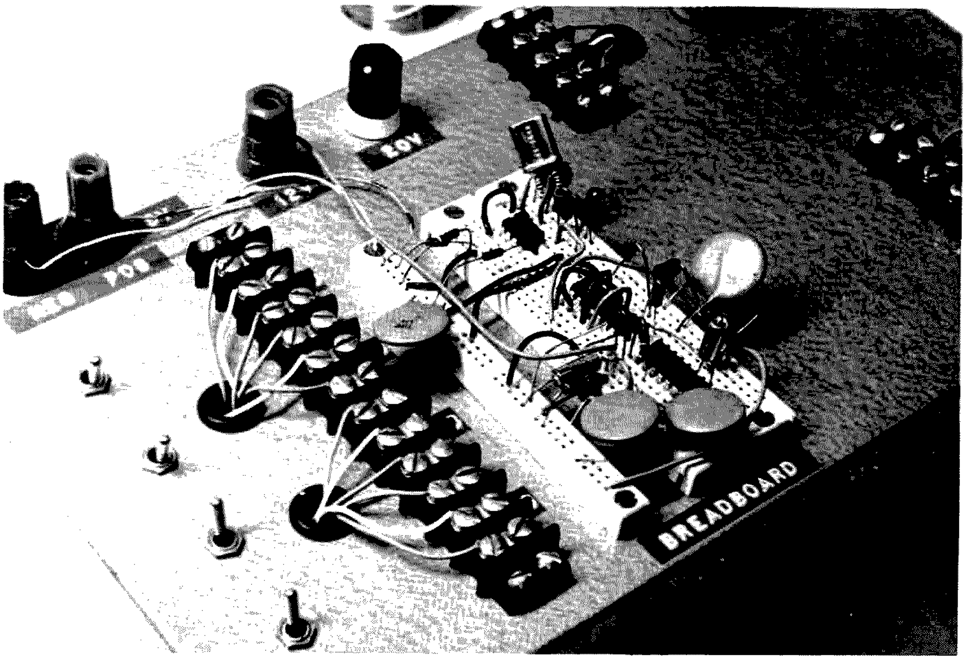


Fig. 2. Transmitter mixer.

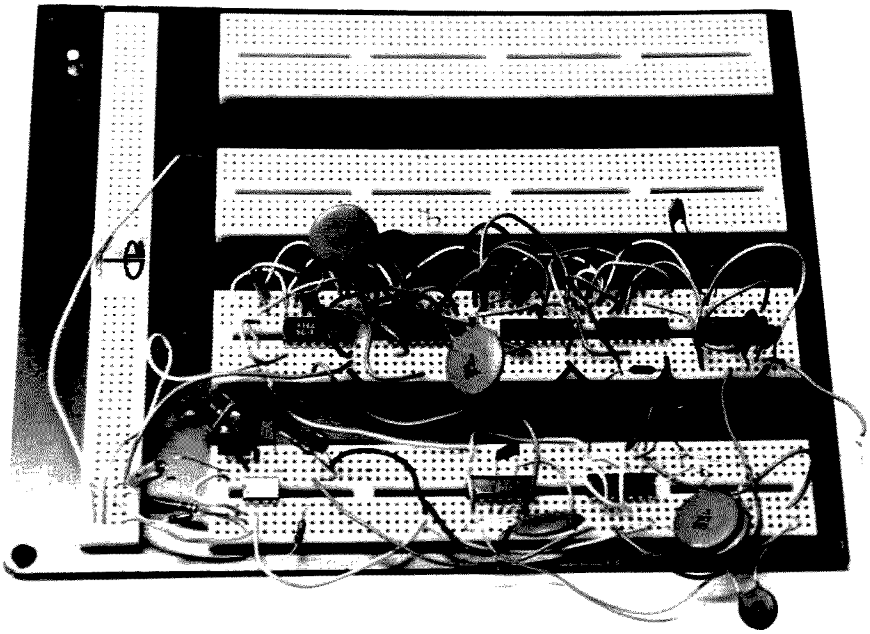


f_2	f_{OUT}
5.000	15.000
5.010	15.010
5.020	15.020
5.030	15.030
5.040	15.040
5.050	15.050
5.060	15.060
5.070	15.070
5.080	15.080
5.090	15.090

Fig. 3. Crystal-mixer synthesizer.



Simple single channel synthesizer built on a Continental Specialties breadboard.



3 to 9 MHz synthesizer constructed in breadboard fashion.

a process that takes building blocks and produces a finished product. The process need not be complex, but may be very simple and be applied to a variety of applications. The average experimenter seldom gives thought to the definition of synthesis; however, the average experimenter commonly uses processes which fit the definition.

The process of summing two voltages to produce a third voltage (a process used in many pieces of electronic equipment) is synthesis, and the process of mixing two frequencies together to produce a third frequency (heterodyning in a receiver) is synthesis.

Oscillator-Mixer Synthesis

Fig. 1 is a mixing circuit of a simple superheterodyne receiver. Frequency F_1 (the heterodyning frequency) mixes with frequency F_2 (the incoming signal) to produce a frequency in the i-f range. This technique is not commonly thought of as synthesis, but is thought of as mixing; however, it is frequency synthesis.

In Fig. 2, a variable frequency oscillator, or vfo, of a transmitter is mixed with a heterodyning crystal to produce an output in a given band. In this case, the output frequency will be variable and is determined by the expression, $F_{out} = F_{vfo} + F_{crystal}$. If the frequency of the vfo can be varied from 5.0 to 5.5 MHz and the mixing crystal is 10.0 MHz, then the "synthesized output" will be in the range of 15.0 to 15.5 MHz. (Note that mixing produces both the sum *and* the difference frequencies, but in this example the difference frequency is filtered out.)

While a synthesizer of this type is very useful and very common, it suffers from a serious problem – the problem of stability. Vfos drift by nature, due to temperature fluctuations, and are subject to frequency variation due to vibration and the inadvertent bumping of the vfo dial. (And, of course, it is difficult to reset the dial back to its original position once it has been bumped.) Fig. 3 shows an improved version of the simple "synthesizer." In this example, the vfo is replaced with another crystal oscillator and a crystal switch. In the example given, ten crystals spaced 10 kHz apart are mixed with the heterodyning crystal to produce ten discrete frequencies in the 15 MHz range, 10 kHz apart. The spacing of the output frequencies is called "channel spacing," and is related to the channel spacing of the "local oscillator" crystals.

The drawbacks to the circuit shown in Fig. 3 are very obvious. First of all, eleven crystals are needed to produce ten frequencies, and second, the output frequencies are limited to discrete frequencies or channels. Furthermore, all frequencies within a given band are not covered. From a cost standpoint, it would be better to use ten crystals at the desired frequencies than to use this circuit.

Fig. 4 is an improved version of the synthesizer shown

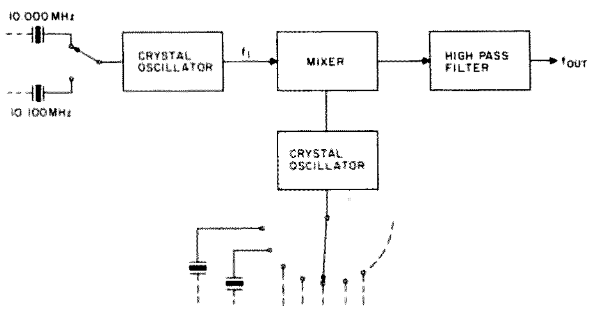


Fig. 4. Twenty frequency crystal-mixer synthesizer.

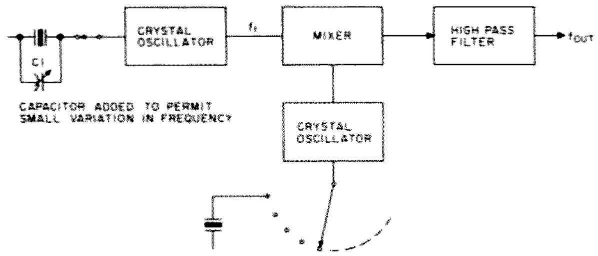


Fig. 5. Varying the frequency of a crystal-mixer synthesizer.

Fig. 6.

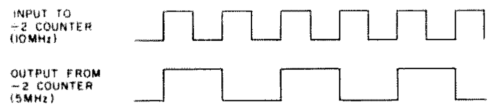


Fig. 7.

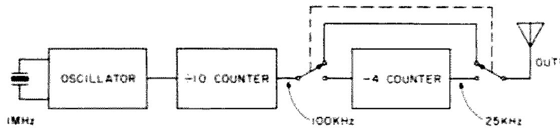


Fig. 8.

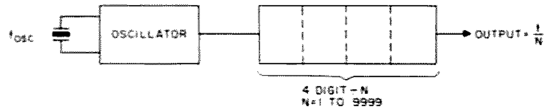


Fig. 9.

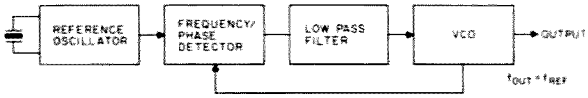


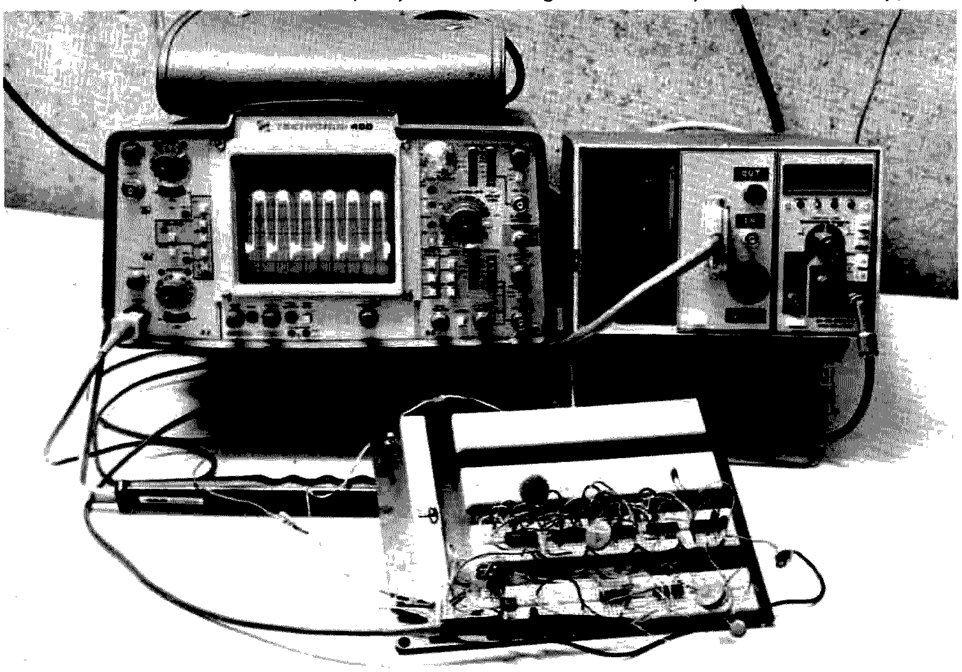
Fig. 10.

in Fig. 3. In this example, two heterodyning crystals are used, F_1 = 10.000 MHz and F_2 = 10.100 MHz. Table 1 shows the output frequencies that can be obtained by mixing the two heterodyning crystals with the ten local oscillator frequencies.

Note that in this case we are using twelve crystals to generate twenty discrete frequencies. At this point we have an economical alternative to the use of twenty crystals to generate twenty discrete frequencies. We have a saving of eight crystals. If we add a third heterodyning crystal, we can generate thirty discrete frequencies with thirteen crystals and save ourselves seventeen crystals. This process can be continued by adding heterodyning crystals to the point where all desired frequencies within a given band are generated; however, at $5.00 and up per crystal, the designer soon reaches the point where a crystal-mixing synthesizer is not economically feasible. This type of synthesizer is useful in cases where it is desirable to generate a limited number of stable, discrete frequencies in a simple manner.

The other drawback of the crystal-mixing type of synthesizer, as previously mentioned, is the problem that the output frequencies are discrete and that all frequencies within an entire band are not covered. Gaps occur in the frequency coverage of the unit. In many cases, such as VHF radiotelephone, this is not a serious drawback (since operation in the VHF radiotelephone bands is channelized to begin with); however, in the case of high frequency operation where fixed channels are not used, discrete frequency operation can present a problem. Fig. 5 shows a simple cure to permit continuous operation in the areas between channels. The trimmer capacitor C_1, across the crystal, is varied and produces a small frequency variation of the frequency of the heterodyning crystal. If the channel spacing is small, the trimmer can permit coverage of all frequencies between channels. The addition of this trimmer does reduce stability a bit, but this reduction in stability in most cases is not too serious.

The crystal-mixing type of



Test setup at W1HCI used for testing 3 to 9 MHz synthesizer. The scope trace shows ringing and noise on the vco signal, due to the random component layout and long lead lengths on the breadboard.

synthesizer is commonly used in amateur and commercial HF and VHF equipment; however, it is becoming less popular due to the high cost of crystals and the availability of the phase locked loop. Furthermore, some of these synthesizers that have been on the market in the past have suffered from a variety of problems and become somewhat unpopular. In some cases it was possible to have several crystals oscillating at one time, producing multiple output frequencies. (Of course, this problem could be put to good use if the operator desired to transmit on several frequencies simultaneously.)

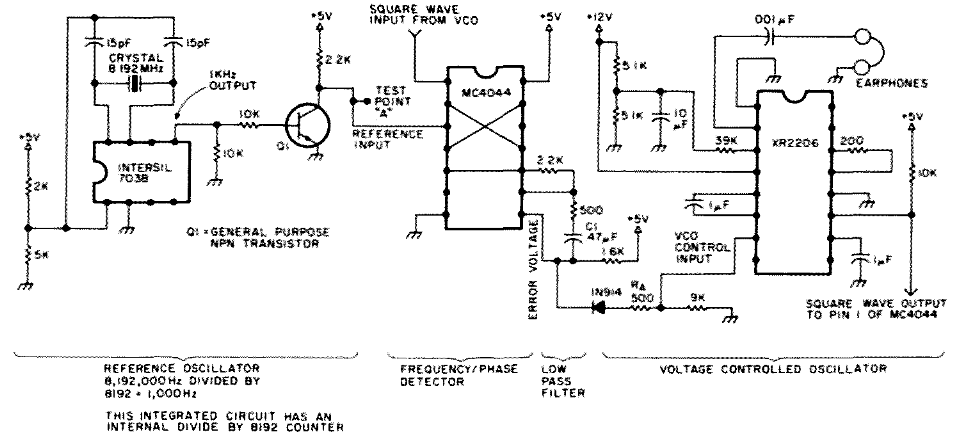


Fig. 11. Simple phase locked loop.

Time Period Synthesis

Time period synthesis, according to some authors, encompasses a variety of techniques, including the phase locked loop. In this article, however, time period synthesis will be defined as a counting technique that generates a waveform with a time period proportional to some "N" number of counts of a standard oscillator. As an example, consider the crystal oscillator in Fig. 6 that feeds a digital divide by two counter. The divide by two counter generates one output pulse for every two input pulses. This is shown graphically in Fig. 7. This is a simple time period synthesizer. If the crystal operates at 10 MHz, then the output from this simple synthesizer will be 5 MHz. This technique is used frequently in crystal calibrators found in many pieces of amateur equipment. Fig. 8 shows a block diagram of a typical calibrator. In this block diagram, a 1 MHz oscillator is fed into either a divide by ten or a divide by ten followed by a divide by 4. The outputs are either 100 kHz or 25 kHz. If a series of digital counters were connected together to form a four digit, divide by N counter, as shown in Fig. 9, then a versatile time period synthesizer could be constructed to produce a large number of frequencies.

One of the drawbacks of time period synthesis is that switch selection (in the divide by N counter) programs the number of counts to divide by, and the number N is not the frequency. The expression for frequency for the time period synthesizer is

$$F_{out} = \frac{f_{osc}}{N}$$

where f_{osc} is the frequency of the standard oscillator.

Note that the frequency is inversely related to the number N. Table 2 gives a list of frequencies for selected values of N.

It is not possible to get standard channel spacing when incrementing N. When N is changed from 51 to 52, the frequency difference or channel spacing is 37,707.4 Hz, but when N is changed from 1001 to 1002, the spacing is 99.701 Hz. The channel spacing is not linear, and produces low frequencies for high values of N (in this case, frequencies in the audio range). Synthesizers of this type are difficult to use for most amateur applications.

One notable use of this type of synthesizer is found in the common "touchtone" generator ICs. These ICs provide a fixed series of dividers used to divide a master oscillator down to the proper audio frequency.

The Phase Locked Loop

The fundamental phase locked loop, as shown in Fig. 10, consists of a frequency standard or reference oscillator, a voltage controlled oscillator, a frequency/phase detector, and a low pass filter. In operation, the frequency and phase of the frequency standard is compared against the output of the voltage controlled oscillator. If there is a difference in frequency or phase, then an output voltage, or error signal, is produced by the frequency/phase detector. This output voltage is fed back into the voltage controlled oscillator to change its frequency. This fundamental phase locked loop is used to synchronize two oscillators together, and is not commonly used in amateur equipment in this fundamental form. This simple example can, however, be

f_1	f_2	f_{out}
10.000 MHz	5.000	15.000
10.000 MHz	5.010	.010
10.000 MHz	5.020	.020
10.000 MHz	5.030	.030
10.000 MHz	5.040	.040
10.000 MHz	5.050	.050
10.000 MHz	5.060	.060
10.000 MHz	5.070	.070
10.000 MHz	5.080	.080
10.000 MHz	5.090	.090
10.100 MHz	5.000	.100
10.100 MHz	5.010	.110
10.100 MHz	5.020	.120
10.100 MHz	5.030	.130
10.100 MHz	5.040	.140
10.100 MHz	5.050	.150
10.100 MHz	5.060	.160
10.100 MHz	5.070	.170
10.100 MHz	5.080	.180
10.100 MHz	5.090	.190

Table 1.

N	Output
1	100,000,000
2	50,000,000
10	10,000,000
50	2,000,000
51	1,960,784.3
52	1,923,076.9
100	1,000,000.00
101	990,099.01
102	980,392.16
1000	100,000.00
1001	99,900.100
1002	99,800.399
1003	99,700.897
9999	1,000.1

If f_{osc} = 100,000,000 Hz (100 MHz)

Table 2.

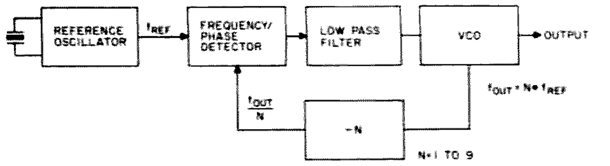


Fig. 12. "N" channel synthesizer.

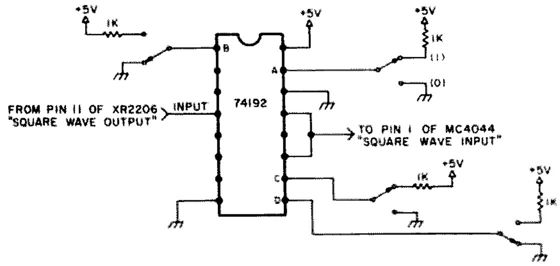


Fig. 13. Adding a ÷N counter to the simple PLL. Remove the old connection from pin 11 of the XR2206 to pin 1 of the MC4044. In this example, switches are set for $0101_2 = 5$.

used as a basis for understanding the PLL and some of the problems that occur in PLL operation.

The Reference Oscillator

The reference oscillator, or frequency standard, for a PLL system must be of high stability and is usually a crystal oscillator. This crystal oscillator may be used by itself, or it may be used in conjunction with a series of frequency dividers to produce a given output frequency. In the case where a series of dividers follows the crystal oscillator, the reference oscillator is in itself a "time period" synthesizer. The output of the reference oscillator is a determining factor in the channel spacing of the synthesizer, and, in the case of the synthesizers discussed in this article, is the same as the channel spacing.

Fig. 11 shows the circuit diagram for a simple reference oscillator. In this example, an 8.192000 MHz crystal is the frequency determining element and is followed by a divide by 8192 stage. The output of the reference oscillator is 1,000 Hz. The 7038 integrated circuit consists of an oscillator and an internal divide by 8192 counter.

The Vco

A voltage controlled oscillator, or vco, is a special version of a vfo. In a vfo, the frequency is changed by manually moving the rotor of a variable capacitor or by manually moving the slug in a variable inductor. In a vco, the frequency is changed by applying a voltage to a device such as a variable capacitance diode in an oscillator circuit or by changing the bias on a multivibrator. A change in voltage will produce a change in frequency of the oscillator.

While the experimenter may build a vco from discrete components, it is convenient to use integrated circuit vcos such as the Motorola MC4024 voltage controlled multivibrator or the Exar XR-2206 monolithic function generator.

The Motorola MC4024 will operate from audio frequencies to 25 MHz, produces a square wave output, and has a maximum control range of 3.5 to 1. The XR-2206 will operate from .01 Hz to 1 MHz, produces either square, triangle, or sine waves at the output, and has a maximum control range of 1000 to 1.

The control range of a vco (also called the sweep range) is defined as the ratio of the highest frequency to the lowest frequency that can be obtained by varying the control voltage while keeping all external components the same. For example, Fig. 11 shows an XR-2206 monolithic function generator configured as a vco to produce audio frequencies in a PLL. By varying the control voltage in this circuit, the output frequency will change from about 400 Hz to about 9500 Hz, for a control range of about 23 to 1.

The Frequency/Phase Detector

The frequency/phase detector is used to compare the output of the vco against the output from the reference oscillator. A typical frequency/phase detector is the Motorola MC4044. While the internal operation of this device is somewhat complex, the results of what it does are easy to see and understand.

Fig. 11 shows an MC4044 frequency/phase detector connected in a PLL. The low pass filter in this circuit is used to smooth the output and eliminate high frequency components in the output.

In this example, if the vco frequency is greater than the reference frequency, then the output will be in the range of about 2.5 to 5 volts. If the frequency is less than the reference voltage, then the output will be in the range of 2.5 to .8 volts.

As the name implies, the frequency/phase detector also detects phase differences between two signals. Consider the case where two signals are at the same frequency but are slightly out of phase with each other. In this case, there will also be an output voltage from the frequency/phase detector. This output voltage is a "phase error" voltage, and will remain constant when the loop is "locked," or in a stable condition. When the loop is not "locked," as when the frequency of the vco is in the process of changing, then this error voltage will be changing. Note that the error voltage may also remain constant if the loop is unable to lock up.

The Fundamental PLL

Fig. 11 shows a circuit diagram for a simple PLL operating in the audio range. This circuit is a good circuit to use for experimentation, since the output is 1 kHz to 9 kHz in the audio range. A pair of earphones may be used on the output to determine if the circuit is operating correctly. An oscilloscope or counter is *not* needed to experiment with this PLL.

To use this circuit for experimentation, first disconnect the square wave output from pin 1 of the MC4024, and then connect the +5 V and +12 V as shown. Connect the earphones to test point A through a .01 uF capacitor. A 1 kHz tone, rich in harmonics, should be heard in the earphones. At this time, the output of the vco will be at about 9.5 kHz, the idling frequency of the vco. Now connect the earphones to the output of the vco, as shown on the schematic. Connect the square wave output of the MC4024 as shown. The output of the vco will change from 9.5 kHz to 1 kHz. Note that it is possible in this example for the PLL to lock to a frequency that is a multiple of 1 kHz, since a PLL can lock to a harmonic or subharmonic of the reference frequency. This property is useful for some applications; however, it would not be useful for amateur applications such as a two meter PLL.

It is difficult to explain the reasons for harmonic or sub-harmonic locking in simple terms. From a practical standpoint, this type of locking can occur due to poor design, or if the tuning range of the vco is too great. In this example, the potential problem of harmonic or subharmonic locking could be eliminated by limiting the tuning range of the PLL. A good rule of thumb is to limit the tuning range of the PLL to 3.5 to 1 or less.

Readers who wish to go into the fine details of the operation of frequency/phase

N	D	C	B	A
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Table 3.

detectors, vcos, and PLLs in general are referred to reference 1. This reference gives a detailed, authoritative explanation of PLLs.

An "N" Channel PLL Synthesizer

The previous "simple PLL" might be called a single channel synthesizer, since its output is on a single channel and cannot be varied from that single channel. A more versatile synthesizer is shown in the block diagram in Fig. 12. This is a one digit "N" channel synthesizer where N can range from 1 to 9. The PLL is the same as the simple PLL, except that a divide by N counter has been placed between the vco and the frequency/phase detector. In operation, the PLL will increase the frequency of the vco such that the output of the vco divided by N is equal to the reference frequency. Thus the output of the vco is "N" times the reference, where N is an integer. If we modify Fig. 11 by adding a divide by N counter as shown in Fig. 13, we will have an N channel synthesizer where the theoretical output range would be 1 kHz to 9 kHz in 1 kHz steps, when N goes from 1 to 9.

As previously mentioned, PLLs can lock to the wrong harmonic if the tuning range of the PLL is too great. In this example, the tuning range of the PLL is about 9.5 to 1. The problems with the tuning range can be demonstrated by performing some very simple experiments with the "N" channel PLL. Again, these experiments can be performed with the use of earphones. A scope or counter is not required, but may be used if desired.

The 74192 divide by N counter can be programmed in BCD format to provide an N of 1 to 9. To program a number, first set all inputs to 0 by grounding. A number is programmed by setting a "1" into an input, according to Table 3. A one is set by connecting the input to +5 V through a 1k resistor.

To experiment with this simple PLL, first connect the earphones as shown. Next, program a 1, to get a 1 kHz tone, as shown in Fig. 14. A 1 kHz tone will be heard. Next, program a 2, 3, and 4, one at a time. Tones of 2, 3, and 4 kHz will be heard. This simple PLL should lock up for these values of N on the correct multiples of 1 kHz, but will probably not lock up for some other values of N. For example, when N = 5, the PLL may lock up on 1 kHz, and when N = 7, it may lock up on 3 kHz. This is an example of a PLL with too great a range. Changing R_a to a value of 1k will limit the range of the loop to about 4 to 1, just slightly greater than the recommended range. With this limit imposed, the loop will lock properly in the desired range of 1 to 4 kHz. An N of greater than 4 will give an output of about 4.7 kHz, and the loop will not be locked. In some cases, it may be necessary to wire in external logic or put limits on switches to prevent the "dialing in" of non-allowed values of N on the switches and the resultant locking to wrong frequencies.

Other Design Considerations for PLLs

While it is not possible in a short article to give complete design information and describe all design considerations for a PLL, there are some key points which must be mentioned.

In the general description of the components of the PLL, the filter was mentioned only briefly. The filter is an important part of the PLL, and must be chosen such that the loop locks up quickly but

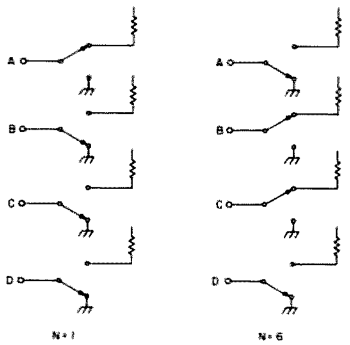


Fig. 14. Examples of programming the ÷N counter.

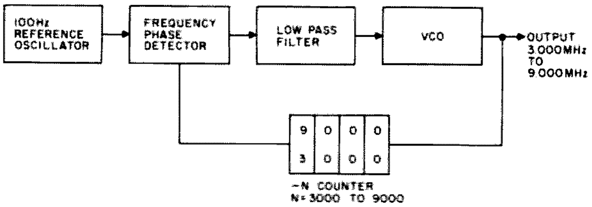


Fig. 15. HF PLL.

still filters out all high frequency components. If the filter is not correct, the loop could be too slow to respond, not operate correctly (producing distorted waveforms), or not lock properly. The value of the capacitor in the low pass filter may be determined experimentally by observing the control voltage on an oscilloscope. C_1 should be chosen just large enough so that the control voltage is pure dc with very little ripple. If a scope is connected to pin 8 of the MC4044 and C_1 is removed, the effects of poor filtering can be observed. High frequency components will be observed on the vco control line, and the output waveform will be distorted. (Reference 1 should be consulted for detailed filter requirements.)

Another consideration for a PLL is the stability of the oscillator. If the oscillator drifts, then the output will drift according to the following expression: $f_{output\ drift} = N \times f_{reference\ drift}$. For example, if the reference drifts by +10 Hz and N = 4, then the output will drift by +40 Hz.

Noise on the vco line can sometimes cause problems. These problems can be reduced by designing the vco so that a relatively large change in control voltage is required to produce a relatively small percentage frequency change. In addition, it is important to sprinkle bypass capacitors liberally from the +5 V, +12 V, or other voltage lines to ground. A good practice is to place a .01 capacitor from the +V terminal of each IC to ground, keeping the leads as short as possible.

Rf can be a problem with PLLs. If rf sneaks into the wrong place within a PLL, the PLL can fail to lock or can lock at the wrong place, the vco can cease to operate, or a myriad of other problems can result. For these reasons, it is important to shield a PLL that is used with a transmitter, to prevent rf from the transmitter from getting back into the PLL synthesizer.

It is also important to remember that PLLs have square waves, rich in harmonics, coming out of the reference as well as the divide by N circuitry. These square waves can cause interference in nearby receiving equipment. It is important to shield a PLL synthesizer to prevent interference to other equipment.

A Synthesizer for the HF Bands

The synthesizer examples

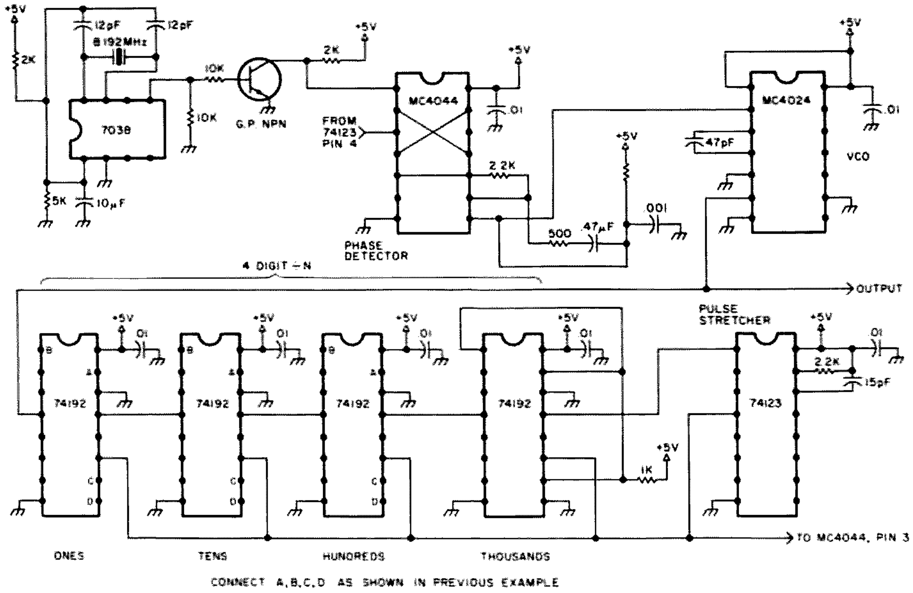


Fig. 16. HF synthesizer.

previously described operated in the audio range, a range ideally suited for experimentation. Synthesizers of general interest to the amateur may lie in the HF region. This section will discuss HF synthesizers.

In designing a synthesizer for HF use, two criteria must first be defined:

1. Output frequency range;
2. Channel spacing.

Consider an example where a synthesizer is required to operate with an output in the range of 3 to 9 MHz in 1 kHz steps. In this case, our PLL will have a range of about 3 to 1. The channel spacing would be 1 kHz, so the output of the reference oscillator must be 1 kHz. In all "direct" PLLs, a PLL where the output is used directly without mixing or multiplication of the output, the channel spacing is the same as the reference frequency. For other types of synthesizers, such as VHF synthesizers (where the output of the PLL is fed into a multiplier stage), the reference frequency is determined by the expression, $f_{reference}$ = (channel spacing)/(total multiplication in multiplier stages). The range of this PLL synthesizer is to be from 3 to 9 MHz. Converting these numbers to kHz, we get 3000 to 9000 kHz; thus, for 1 kHz channel spacing, N would have to range from 3000 to 9000. As can be seen, we require four digits for N. Thus, our divide by N counter would be a four digit divide by N counter.

Fig. 15 shows a block diagram for this PLL. Since the formula for a PLL is $f_{out} = N \times f_{reference}$, and since N can be any number from 1 to 9999 in this example, it seems likely that switches could be set so that N is outside of the desired range of 3000 to 9000. If N is set below the desired range, the vco will idle, but it will not lock at the lower limit of the vco. Likewise, if N is set above the desired range, then the vco would run at this upper limit. In some cases, a value of N outside the range can cause a PLL to lock on an incorrect frequency. Thus, it is a good idea to limit the allowable switch positions either electronically or mechanically. In the example shown in Fig. 16, the most significant digit is hardwired to a 7, so this synthesizer is electronically limited to the range 7000 to 7999. This limit is arbitrary, and may be changed if desired. If the experimenter wishes, the most significant digit could be varied in the same manner as the other three digits.

Fig. 16 is a circuit diagram of a 7.000 to 7.999 MHz synthesizer. This synthesizer can be breadboarded in an evening, and should work the first time it is turned on. Each digit is programmed in BCD in the same manner as the simple audio PLL, except that the first digit is hardwired to a seven and does not change. As previously mentioned, the number 7 was chosen arbitrarily and may be changed. The vco in this PLL is a Motorola MC4024, which generates a square wave output. If a sine wave output were desired, then either a low pass filter would have to be placed on the output of the vco (to eliminate all frequencies above 7.999 MHz, for example), or a different vco would have to be used.

Note that this synthesizer radiates a lot of rf noise, so expect some possible interference in nearby receiving equipment.

The frequency output of this synthesizer may be measured on a counter, or its signal may be heard on a communications receiver. The sound of the signal as heard on a communications receiver will not be pure, due to the fact that this PLL uses a simple loop filter, which allows some inherent modulation of the signal. Furthermore, the PLL divider stages and reference will radiate, causing noise in the receiver. Shielding will improve the sound of the signal, but will not make it perfect.

The 74123 is a monostable multivibrator and is provided to lengthen the reset pulse generated by the divide by N circuitry. When the divide by N circuitry counts to the programmed value, a reset pulse is used to reset the counters so that they may start counting again. For the 74192 ICs, this reset pulse must be at least 20 nanoseconds long to insure proper resetting. During this 20 ns reset period, the counters are not counting. At 7.5 MHz, the time from one cycle of the vco to the next would be 130 ns. If this time period from one cycle to the next of the vco is less than twice the reset time (in this case 40 ns), a missed count will occur, causing the output frequency to be off by one (in the least significant digit). This holds true in cases where the vco generates a square output. In cases where the vco generates sine waves to other waveforms, the period of the vco may have to be greater than the reset time by a factor of 4 or more.

If a missed count does occur, circuitry can be added to automatically compensate for the missing count.

Summary

This article has described the operation of synthesizers and has given simple circuits for experimentation. It is not meant to be the last word in synthesizers, but is meant to whet the appetite of the experimenter. The experimenter is encouraged to read the references given to gain a greater comprehension of the subject. ■

References

[1] ***Phase-Locked Loop Data Book,*** **Motorola, Inc., 1973.**

[2] ***Instruction Manual for the SYN-II Synthesizer,*** **VHF Engineering, Binghamton NY 13902.**

Social Events

ERIE PA
SEPT 25

The 2nd Annual Erie HamJam will be held Sunday, September 25, 1977 at Rainbow Gardens, Waldameer Park. Door prizes, flea market, forums, large indoor facilities. For more information write Radio Association of Erie, Inc., PO Box 844, Erie PA 16512.

NEW BERLIN IL
SEPT 25

The Sangamon Valley Radio Club will hold its Second Annual Hamfest on Sunday, September 25, 1977 at the Sangamon County Fairgrounds, New Berlin, Illinois, 16 miles west of Springfield. Indoor display area and a covered pavilion. Food, refreshments, exhibits and ladies' activities. Overnite camping on grounds. Tickets $1 advance; $1.50 at gate. First prize – Wilson HT. Talk-in 146.28/.88 and .52. Info: Carole Churchill WB9QWR, 622 Magnolia, Rochester IL 62563.

BROOKLYN NY
OCTOBER

The Kings County Repeater Association of Brooklyn, New York, announces the formation of its second Novice class licensing course (theory and code) to begin in October. Contact Carl Weintraub W2YHX, 629 Avenue "T", Brooklyn NY 11223 for full details.

WILLOW GROVE PA
OCT 1

The Mid-Atlantic States VHF Conference will be held on Saturday, October 1, 1977 at the Treadway Inn on Easton Road (Route 611, Exit 27 of the Pennsylvania Turnpike) in Willow Grove, Pennsylvania on the day before Hamarama 77 (at nearby Warrington, Pennsylvania). The conference will be an all day VHF program moderated by prominent VHFers. Advance registration is $2.50 (includes admission to Hamarama 77 on Sunday). Cocktail hour (cash bar) and get-together at 6:30 pm. Buffet dinner at 7:30 pm is $8.00. Special rates for rooms overnight. For advance registration contact Ron Whitsel WA3AXV, Chairman, PO Box 353, Southampton PA 18966, phone (215) 355-5730. Advance registration must be received by September 28, 1977. Indicate motel registration forms required.

HAMDEN CT
OCT 1

The Oktoberfirst Flea Market and Auction will be held October 1, 1977 (rain date Oct. 8). The event, sponsored by the WELI Amateur Radio Club (WA1HRC), will be held at Radio Towers Park, Benham Street, Hamden, Connecticut. Free admission, vendor spaces are $5/ea. Talk-in on 52 direct or 01/61. More information call Doug WA1TUT (203) 389-6458.

MEMPHIS TN
OCT 1-2

The Memphis Hamfest, bigger and better than the 4,500 who attended last year, will be held at State Technical Institute, I-40 at Macon Road, on Saturday and Sunday, October 1 and 2. Demonstrations, displays, MARS meetings, flea market, ladies' flea market, too! Hospitality Room, informal dinners, XYL entertainment, many outstanding prizes. Dealers and distributors welcome. For further information contact Harry Simpson W4SCF, PO Box 27015, Memphis, Tennessee 38127.

CEDAR RAPIDS IA
OCT 2

The Cedar Valley Amateur Radio Club annual Hamfest will be held Sunday, October 2, 1977. Top prizes are Atlas 210X Xcvr, Wilson 1402 SM H/T, Heathkit HW-8 QRP CW Xcvr, Clegg FM-76 Xcvr, plus much more. Technical talks featuring Doug DeMaw W1FB. Manufacturers and dealers welcome. Talk-in on 146.16/.76, 146.52, 3.970, and 223.5 MHz. Advance tickets $1.50, $2.00 at the door. Write CVARC Hamfest, Box 994, Cedar Rapids IA 52406.

NEWPORT NH
OCT 2

Autumnfest, the first annual hamfest of the Connecticut Valley FM Association, will be held on October 2, 1977, at the Community Center, Belknap Ave., off Rt. 10, north end of the Common. Flea market opens at 9 am – auction at 2 pm. Program includes antenna gain contest, fox hunt on 52 simplex, frequency and modulation checks by W1RNZ, and talks and demonstrations throughout the day. Donation: $1.50 in advance – $2.00 at the door. Talk-in on 16/76 or on 52 simplex.

WARRINGTON PA
OCT 2

The Mt. Airy VHF Radio Club (the Packrats) are holding "Hamarama 77" at the Bucks County Drive-In Theater, Route 611 (Easton Road), Warrington, Pennsylvania on Sunday, October 2, 1977, 8 am to 4 pm rain or shine. Registration $1.50, tailgating $2.00/space (bring your own table). Talk-in via W3CCX/3 on 52.525 and 146.52, WR3ACD on 222.98/224.58, WR3ADS on 147.63/147.03, and WR3AHC on 147.60/147.00. Advance registration to the Mid-Atlantic States VHF Conference includes admission to Hamarama. For information contact Ron Whitsel WA3AXV, Chairman, PO Box 353, Southampton PA 18966, phone (215) 355-5730.

BERRIEN SPRINGS MI
OCT 2

The Blossomland annual fall Swap-Shop will be held Sunday, October 2 at the Berrien County Youth Fairgrounds, Berrien Springs, Michigan. Large and convenient facilities, prizes, refreshments, and fun. Open all night for setup. Table space restricted to radio and electronic items. Advance ticket donation $1.50. Tables $2. Talk-in 22/82 and 94. Write John Sullivan, PO Box 345, St. Joseph MI 49085. Make checks payable to Blossomland Hamfest.

EAST RUTHERFORD NJ
OCT 8

The Knight Raiders VHF Club, K2DEL, presents its world famous Auction & Flea Market to be held at St. Joseph's Church of East Rutherford, New Jersey, Saturday, October 8, 1977 beginning at 10 am. Free admission – free parking. Flea market tables (in advance) $5 full table, $3 half table; (at door) $6 full table, $3.50 half table. Directions: take Rt. 17 north from Rt. 3 to East Rutherford, exit onto Paterson Plank Road, follow to traffic light with Diner on the corner, make sharp right, follow for one block, at light you will see St. Joseph's Church on your right, make right turn at corner and enter parking lot. For further information call: Bob Kovaleski (210) 473-7113, evenings only. Talk-in on 146.52. Send reservations and make checks payable to: Knight Raiders VHF Club Inc., PO Box 1054, Passaic NJ 07055 (reservations close October 1).

SHREWSBURY MA
OCT 8-9

The Heart Fund Hamboree (all proceeds to be given to the Heart Fund) will be held on October 8 and 9, 1977, at Simeon's Park on Route 9 in Shrewsbury MA. Program includes door prizes, trophies, special prizes and entertainment. For advance tickets send $1.50 donation (orders must be received by Sept. 15) – $2 donation at gate. Senior citizens and children 12 years or under free. For dealer space and ticket information write: Central Mass. 2-Way Radio Assoc., P.O. Box 154, Northboro MA 01532.

SYRACUSE NY
OCT 8

The Radio Amateurs of Greater Syracuse presents the Syracuse Hamfest, October 8, 1977 from 9 am to 5 pm at the Syracuse Auto Auction, Route 11, Nedrow, New York. Easy access from Route 81, 5 miles south of Syracuse. Food available all day at reasonable prices. Large exhibitor area and flea market under cover. Exhibitors: $13.00 (includes one 8-foot space, 8-foot table, two chairs and admission to hamfest). For further information: general info – RAGS Hamfest, Box 88, Liverpool NY 13088; exhibitors – Dale Mecomber WB2FJC, Box 87, Skaneateles Falls NY 13153.

YONKERS NY
OCT 9

The Yonkers Amateur Radio Club is holding "Super Hamfest 77" on October 9, 1977 (rain date Oct. 16) from 9 am to 5 pm at Redmond Field, Cooke Avenue in Yonkers. Manufacturers' displays, door prizes, raffles, refreshments and a general auction are all in store. Buyers $1, sellers $3 – bring your own table. Talk-in 146.265, 146.865, 146.52 simplex. For further information contact Doug McArtin WA2AUJ, 411 Bellevue Ave., Yonkers NY 10703, (914) 423-0515.

WINDSOR LOCKS CT
OCT 14-16

The Region 1 Air Force MARS Convention will be held on October 14, 15, 16, 1977 at the Howard Johnson's Conference Center, Center Street Exit I-91, Windsor Locks, Connecticut. *73* publisher Wayne Green will be guest speaker.

SAN MATEO CA
OCT 15-16

The Greater Bay Area Hamfest and ARRL Pacific Division Convention will be a combined event this year held on Saturday and Sunday, October 15 and 16, at the Royal Coach Inn, centrally located on the San Francisco Peninsula just off the intersection of U.S. 101 and Route 92 in San Mateo. For more information contact the Greater Bay Area Hamfest, Box 751, San Mateo CA 94401.

TAYLOR MI
OCT 16

The Repeater Association of Downriver Amateur Radio (R.A.D.A.R.) Hamfest will be held on October 16, 1977, at the Kennedy High School located in Taylor, Michigan, on Northline Road, east of Telegraph (U.S. 24). Door prizes and food. Admission $2.00/YLs free. Reserved tables $1. Open 9 am until 3 pm. Talk-in will be on 52-52, 34-94, 93-33. For further info write: R.A.D.A.R., Inc., PO Box 1023, Southgate, Michigan 48195.

ISLIP NY
OCT 16

Hamfest and Giant Swap & Shop sponsored by LIMARC, the Long Island Mobile Amateur Radio Club, will be held on Sunday, October 16, 1977, at the Islip Speedway, Islip, New York. Gates open at 9:30 am to 4 pm. General admission $1.50 (wives, children and sweethearts, free). Exhibitors and swappers $2.50 per car

space. Featuring: amateur radio, CB, computer, amateur television, satellite, ARRL info, theory contest, LIMARC tune-up clinic, awards and door prizes. Located on Route 111, Islip Avenue, one block south of Exit 43 of the Southern State Parkway; trucks, campers and trailers use the Long Island Expressway Exit 56, Rte. 111, south to the speedway. For more information: Hank Wener WB2ALW, days (212) 355-0606, nights (516) 484-4322.

VALPARAISO IN
OCT 16

The new Annual Valpo Tech Hamfest and Fleamarket is Sunday, October 16, 1977, 7 am to 3:30 pm, on the Valparaiso Technical Institute campus, located on Lincolnway (US 130) at Yellowstone Road, west of downtown Valparaiso, Indiana. Held on the day after Valpo Tech Homecoming. Prestigious electronics school offering large storerooms of surplus test instruments, digital equipment, computer circuits, transmitter components, TV equipment, semiconductors, and much more, at give-away prices. Everything must go to make room for new labs. No charge for setup space. Room inside in case of rain. Hourly drawings beginning at 8 am for prizes. Main drawing at 2 pm. Talk-in on 146.94 MHz. Tickets $1.50 advance, $2.00 at the door. For advance tickets send $1.50 each and an SASE to Dale E. Smiley WB9SFF, Operations V-P, Valpo Tech Alumni Association, Box 490, Valparaiso, Indiana 46383.

WAKEFIELD MA
OCT 22

The Quanapowitt Radio Association will hold its annual auction in St. Joseph's Parish Hall, Wakefield MA on Saturday, Oct. 22, 1977. Doors open at 10 am, auction starts at 11 am. Ten percent commission, no minimums. Talk-in on 146.52.

GAITHERSBURG MD
OCT 23

The Foundation for Amateur Radio will hold its annual hamfest at the Gaithersburg Fairgrounds, Gaithersburg, Maryland, on Sunday, October 23, 1977. Featured is a large flea market, food service, exhibits, ladies' events, supervised children's program, and many prizes. Main events are all indoors. Picnic grounds and free parking available; will be held rain or shine; participation fee is $2.00; sales space for flea market is $5.00 each on a first come basis; commercial exhibitors $10.00 each, with preregistration required prior to October 20th. For more information, write or call Hugh Turnbull W3ABC, 6903 Rhode Island Avenue, College Park, Maryland 20740, telephone (301) 927-1797.

FORT LAUDERDALE FL
OCT 29-30

The "International" Pan-American Ham/Exposition Jamboree will be held on October 29 and 30, 1977. Welcome: CB, ham and marine. For further information contact: Broward Amateur Radio Club, Capt. S. F. "Red" Crise (Show Chairman) WA4ZRW, 3701 State Road 84, Fort Lauderdale FL 33312.

PLYMOUTH IN
OCT 30

The Radio and Electronics Swap and Shop, sponsored by the Marshall County Amateur Radio Club, will be held on Sunday, October 30, 1977, at the Plymouth, Indiana National Guard Armory, located at 1220 West Madison Street, from 8 am to 5 pm. Free tables, no charge for setup. Tickets $2 at door. Food, drink and door prizes. Talk-in on 146.07-67 and 146.52 simplex. For further information contact Wayne Zehner WA9INM, Rt. 3, Box 526, Plymouth IN 46563.

CLEARWATER BEACH FL
NOV 19-20

The Florida Gulf Coast Amateur Radio Council is holding its 2nd annual convention on November 19 and 20, 1977 at the Sheraton Sand Key Hotel on Clearwater Beach FL. Official attendance at our last affair was placed in excess of 2200, and this year we expect to double that number as we increase the number of activities and size of the convention. For more information contact: Florida Gulf Coast Amateur Radio Council Inc., PO Box 157, Clearwater FL 33517.

ELLICOTT CITY MD
NOV 27

The Columbia Amateur Radio Association (CARA) will hold its CARA Hamfest on November 27, 1977, at the Ellicott City Armory in Ellicott City, Maryland. Program includes exhibits, flea market, prizes, and refreshments. All indoors. No tailgating. Talk-in on 147.99/39, 146.16/76, 146.52/52. For more info contact CARA, PO Box 850, Columbia MD 21044.

HAZEL PARK MI
DEC 4

The Hazel Park Amateur Radio Club is holding their 12th annual Swap & Shop on December 4, 1977, at the Hazel Park High School. Admission is $1.00 at the door. Main prize tickets are available from Robert Numerick WB8ZPN, 23737 Couzens, Hazel Park MI 48030. Reserve table space is available from WB8ZPN.

See page 214

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	3A	3A	3A	7	7	14	14	14
ARGENTINA	14	7B	7B	7B	7	7	14	14A	21	21	21	14A
AUSTRALIA	14	7B	7B	7B	7B	7B	7B	14	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	14	14A	21	21	21	14A
ENGLAND	7	7	3A	3A	7	7	14	14A	14A	14	14	7
HAWAII	14	7B	7B	7	7	7	7	7B	14	14	14A	14A
INDIA	7	7	7B	7B	7B	7B	14	14	7B	7B	7	7
JAPAN	14	7B	7B	7B	7	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14A	14A
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14A	14
SOUTH AFRICA	7	7	7	7	7B	14	21	21	21	21	14A	14
U. S. S. R.	7	7	3A	7	7	7B	14	14	14	14B	7B	7
WEST COAST	14	7A	7	7	7	7	7	14	14	14	14A	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	3A	3A	3A	7	7	14	14	14
ARGENTINA	14	7B	7B	7B	7	7	7B	14	21	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	7	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	7	14A	21	21	21	21
ENGLAND	7	7	3A	3A	7	3A	7B	14	14	14	14	7
HAWAII	14A	14	7	7	7	7	7	7	14	14A	21	21
INDIA	7	7	7B	7B	7B	3B	3B	7	14	7	7	7
JAPAN	14	14B	7B	7B	7	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	3A	7	7A	14	14	14	14
PHILIPPINES	14	14	7B	7B	3B	7B	3B	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7A	14	14A	14A	21	14A
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	14	14A	14A	14
U. S. S. R.	7	3A	3A	3A	7	7B	7B	14	14	7B	7B	7B

WESTERN UNITED STATES TO:

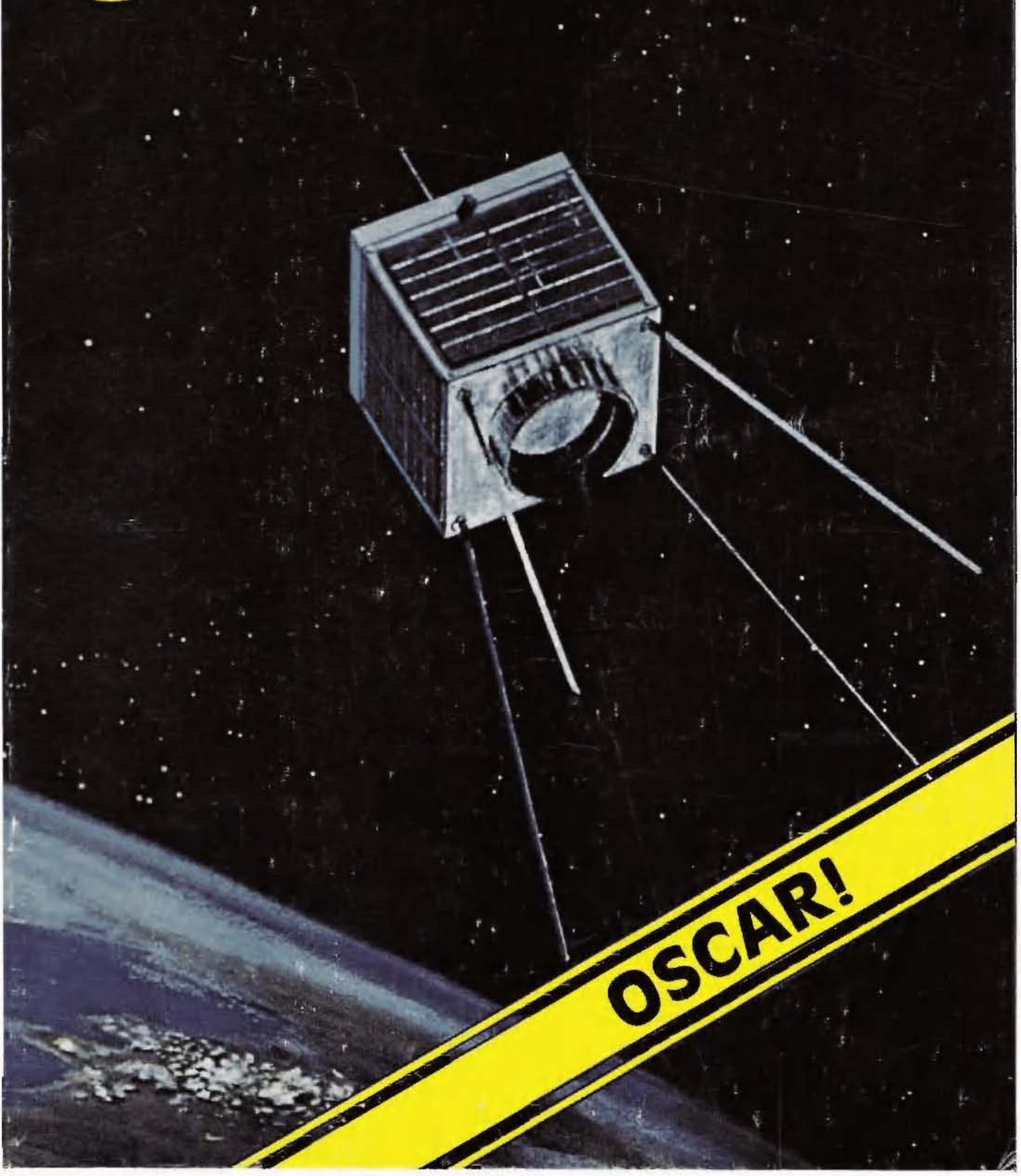
GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	3	3	3	7	7	14	14	14
ARGENTINA	14	14	7B	7B	7	7	7B	14	21	21	21	21
AUSTRALIA	21	21	14	7B	7B	7B	7B	7	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	3A	3A	7	3A	7	7	14	14	14B	7B
HAWAII	21	21	14	7	7	7	7	7	14	14A	21	21
INDIA	7A	14	7B	7B	3B	3B	3B	7	7	7	7	7
JAPAN	14	14	14B	7B	7	7	7	7	7	7B	14B	14
MEXICO	14	14B	7	7	7	7	7	7A	14	14	14A	14A
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14A	21	21
SOUTH AFRICA	7A	7	7	7	7B	7B	7B	14	14	14	14A	14
U. S. S. R.	7	7	7	7	7B	7B	7B	7	14	14	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	14	14	14A	14A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor

1977			OCTOBER			1977
SUN	MON	TUE	WED	THU	FRI	SAT
						1 F
2 F	3 G	4 G	5 G	6 G	7 P	8 P
9 F	10 F	11 G	12 G	13 G	14 F	15 F
16 F	17 F	18 F	19 F	20 G	21 G	22 G
23/30 G/G	24/31 F/G	25 G	26 G	27 G	28 F	29 F

73 AMATEUR RADIO

NOVEMBER 1977
$2.00



73

#206 NOV 1977

COVER: AO-8. Rendering by R. Michael Smithwick WA6TUF; photo courtesy of AMSAT.

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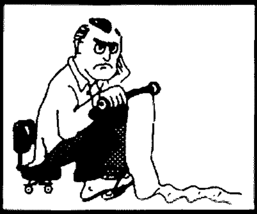


NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

MICROCOMPUTING: HOW'S IT DOING?

In addition to the uses of microcomputers in amateur radio, I looked upon this new field as an opportunity for radio amateurs to get into a new business which had the prospects of growing in an extraordinary way over the next few years. It seemed to me that amateurs were ideally suited to take advantage of this opportunity.

As a result of the large number of articles in *73* during 1975 and 1976, an estimated 25,000 amateurs have gotten interested in microcomputers and become involved with them. Quite a few of them have gone on to try for the golden ring through manufacturing or distributing microcomputers and peripherals.

Has the field grown as I predicted? For once my optimism was about equal to history instead of ahead of it and, yes, it has grown. By way of example, the first computer store opened in August, 1975. Not only is it still going, but by August, 1976, there were 50 computer stores around the country. By August, 1977, there were about 500 computer stores and no sign of any letup in growth. Have you heard of Nashua, New Hampshire? Well, there are two stores in that city, with a third getting ready to open!

What does it take to get into this business? If you go about it right . . . and I wrote a book on this subject a few years ago . . . you can start out with very little and build it quickly. You can also start out with a lot (as an investment) and let a managing firm hire the experienced people for you . . . and there already is such a firm in the business. Figure on about $250,000 if you go the straight investment route.

Perhaps typical of the underfinanced system of starting a store is the experience of a chap who wrote me recently. He opened his computer store in a major city with less than $1000 in the bank. His sales the opening month were $51. The second month he sold $5,500 worth of equipment and books. The third month it was $14,000 in sales. $27,000 the fourth month, and $31,500 the fifth month. Sales were slowed down a bit due to slow deliveries from many manufacturers, plus a growing need for cash for expansion. By the sixth month, he was ready to open a second store in the area.

Growth is a little slower out in the boondocks, but it is still healthy and very forgiving. More and more stories are coming in from readers of *Kilobaud* who have walked into one computer store after another with a big roll of money in their pocket with the intent of buying a computer system . . . only to be turned away by the utter neglect of the "salespeople." The fact is that few stores are run by people experienced in marketing and sales . . . as yet.

How has it been for people entering the manufacturing part of the business? Probably not untypical is the firm run by two young chaps I know. They got interested in microcomputers a couple years ago, but didn't have the money to shell out for an Altair system . . . so they built and programmed their own. I visited them in early August, 1976, and they had a working system which they had put together in a workshop in one corner of the garage. It looked good to me and I suggested that they show it at the next computerfest.

Dealers liked it at the show and placed orders . . . and they are going strong today. Not bad for a couple of 20-year-olds. Their system really had the crowds gathered around at Computermania . . . and every one of the television news teams made sure to include it on their coverage of the show.

Another youngster is 16-year-old Jeff of Jefftronics. He sells parts and small circuits. You'll see him at just about every computerfest in the country with his booth.

THE MARKET IS CHANGING

Microcomputing is a lot more complicated a hobby than amateur radio, so it is limited in its appeal. An awful lot of people won't spend the time and effort necessary to tackle this hobby. The result of this has been the inevitable dropping off of beginners in computing. There are a lot of new hobbyists, but not the flood that came into the hobby last year . . . a good part of which were radio amateurs responding to the articles in *73*.

This drop in hobbyists has, as I predicted, been taken up by the increasing interest of businessmen in microcomputers as ways to save money for their firms. Few computer stores now report less than 50% of their business going this route and many are experiencing up to 90% business sales. The hangup on earlier sales to business was the lack of suitable programs and dependable equipment. Now that these obstacles are being overcome, the increase in sales to this market should overshadow the hobby market completely.

There is still a big need for more equipment and more programs. My prediction is that we will see programs being sold in large numbers . . . perhaps about the way phonograph records and books are sold today. After all, once you have a computer, you can use it for business, for games, to write music, to generate creative art, to study any subject ever known to man, etc. There are hundreds of thousands of programs needed. I think we will see sales volumes on the order of $75 million per day just in programs within the next ten years . . . and I may be very low with that figure.

THE PIRATES ARE COMING! THE PIRATES ARE COMING!

While I've had a few beefs about CBers — in particular the HFer branch of the CBers — getting adventurous and coming into the ham bands, these have all been verbal reports — no one has written as yet about it. I'll take the problem a little more seriously when I have a few written reports on the situation in my hand.

But let's say that it is bound to happen, so what can we do about it? What have you done or would you do if you came up against a bootlegger on the air? It isn't that tough on two meters, where repeater groups have organized their act fairly well and are generally able to talk the bootlegger into getting together for coffee, only to have him met by The Fuzz. This has helped many a ham get back his stolen two meter rig.

On ten meters, you can easily tell if the chap is coming in via ground wave or skip. If he's local, it is time to hook up a loop and start hunting, helped by some other local hams. A personal visit by as many of your club members as you can round up — maybe 50? — will create an impression that should get through to all but the most hardened cases. A mass of people can be intimidating, even without any direct threats of violence.

What about reporting the miscreant to the FCC? Sure, complete with tape recordings, but don't expect much . . . if anything. The fact is that most of the responsibility for preserving our bands is in our hands. If we act to keep bootleggers out, we may succeed. We've seen how powerless the FCC is to keep some 100,000 or so HFers out of a band, even though they have a list of most of the people involved.

If you or your club has had any success with discouraging bootleggers,

Continued on page 183

LETTERS

NEVER SATISFIED

Two FCC policies, both in contradiction to FCC rules, have led to a gross inequity in the reassignment of two-letter W and K callsigns. Rule section 97.53 (j) states that, "Callsigns which have been unassigned for more than one year are normally available for reassignment."

An existing Commission policy does not conform to the spirit or to the letter of that rule. The contradictory policy came to light when an amateur requesting a specific two-letter callsign previously held by a silent key received a "no action" response from the Commission. The following is an excerpt from a letter written by Charles A. Higginbotham, Chief, Safety and Special Radio Services Bureau, to the amateur's congressman. The specific callsign involved has been deleted as the action is currently being reviewed by the FCC. In that letter, Mr. Higginbotham stated, "Although the amateur station license with callsign K- - - did expire on December 15, 1975, Commission procedure is such that callsign K- - - will not be purged from Commission records, and thus be available for reassignment, until some time in the future. We purge our records at irregular intervals. For this reason, we are unable to predict when callsign K- - - will become available." That letter was written in July, 1977, a full eighteen months after the callsign holder's license expired.

That policy, in and of itself, would not be so bad except for another Commission policy. That policy, as set forth in Mr. Higginbotham's letter, is that "... we do not 'hold' applications in anticipation of the availability of callsigns."

That second policy results in the following scenario: An eligible amateur desires a specific two-letter callsign; he researches the status of the callsign and finds that the prior holder is deceased or has let his license expire and a period of twelve months has elapsed; the amateur immediately makes application for the specific two-letter callsign; the Commission, upon receiving the application, returns it with a "no action" letter because the callsign has not yet been "purged" for reassignment. We all know how long it takes from the time an application is sent off until the time a response is received. In the interim, a less diligent amateur puts in a request for the same callsign. By chance, the callsign is "purged" the day before the second amateur's application is reached. An inequity has resulted.

The result of such Commission policies is that amateurs requesting specific two-letter callsigns enter into a game of Russian roulette with the Commission. The object of the game is to guess the date the Commission records will be "purged" and to time one's application for a specific callsign so that it will be received immediately after the purge.

One of these two arbitrary Commission policies must be changed in order to result in the equitable assignment of specific two-letter callsigns. If the Commission's policy with respect to the purging of its records is changed, applicants will know precisely when specific callsigns will become available for assignment. On the other hand, if applications are held until specific callsigns become available, applicants will know that if their application for a specific callsign is received prior to another application, they will be assigned such specific callsign when it becomes available.

Concerned amateurs are urged to write the FCC and demand that these policies be changed so that fairness exists with respect to the assignment of specific two-letter callsigns.

Kenneth S. Widelitz WA6PPZ
President
Personal Communications
Foundation
Los Angeles CA

TOUGH ONE

Many thanks for printing my letter asking for someone to monitor the Novice exam. I was able to contact a helpful ham and I was successful on my first attempt.

I might add that the exam was one of the hardest I have taken dealing with communications. Many of the questions do not appear in any of the guides I bought.

F. Cuillo WA2RQA
Wassaic NY

UNCHARACTERISTIC

I was moved very near to anger and rage (very uncharacteristic) by the letter of one M. P. Lewton appearing in the August issue, favoring the loss of part of the 220-225 MHz amateur band to the citizen's service. After several days, I have calmed sufficiently to write this letter briefly stating my objections to Mr. Lewton and his three points, as follows:

1. His statement that "we amateurs ... could operate on the lost frequencies with our CB license" falsely assumes that I either have such a license now, or would ever stoop so low.

2. To say that giving up any amateur frequency would be compensated for by the availability of cheap radios seems to imply that amateurs cannot now use those frequencies, but will wait for the cast-off and surplus of a citizen's band instead of building or buying equipment intended for amateur service. That would be a sad commentary on the technical and financial state of radio amateurs if it were true. Nobody's making any more frequency spectrum, and to trade this precious resource for a few cheap CB sets that could be converted would be a bad deal for amateurs.

3. My answer to "CB really needs more room ..." is to look at what they are doing with the frequencies they now have. I am deeply embarrassed to think that people all over the world with shortwave receivers can tune across 11 meters during an opening and form their opinion of American mentality and demeanor from what they must hear from CB operators. If I had the power, I would move all CB operation to a single channel at 10 kilohertz, where they could share the frequency on a non-exclusive basis with Project Sanguine!

Jerold R. Johnson WA5RON
Austin TX

WATCH YOUR STEP

The 5th Signal Command in Worms, Germany, reports that the German federal postal and telecommunications department is to begin a "crackdown" on illegal CB operation by Americans in West Germany.

Some of the requirements for CB (low power radiotelephone) operation are: 2 Watts input, 500 milliwatts output to the antenna, omnidirectional antenna only; operation on channels 4 to 15 only; no connections to the public telephone system; and you cannot use a mobile as a base. Fees are DM 5 ($2.25) a month for mobiles, and DM 15 ($7.75) for a base. These must be paid on each unit. Absolutely forbidden are: beam antennas, linear amplifiers, and operation outside the federal republic of Germany. Also, you can't use your ears on the transport routes to and from West Berlin.

Travis Wade, vice-president of the Frankfurt area CB club, reports that most Americans in that area are so afraid of getting a "midnight knock" at the door by a German postal official that many of these people have gone QRT until they think that they can operate their illegal rigs again. It should be noted here that the German Polizei and the American MPs do not hesitate to call up the American CBers when there is an emergency or a lost child, etc.

American hams here in Germany would be well advised to carry a copy of their license in their car at all times, and to remove their equipment when their dependents are using their vehicles.

One good thing about operating in Germany is that you have a great deal of security about having mobile 2 meter gear. The penalties for auto break-in are severe and swift. So is the fine for illegal CB operation, sometimes as high as DM 3,000 ($1,300) plus imprisonment.

Sgt. Charles E. Martin
WA4YRA/DA1NR
APO NY

ACTION

I finally am getting off my rear to write. I have been faithfully reading *73* since I gave up my membership (and sub) to another organization. I think you are publishing the best ham radio magazine on the market

Now, a proposal, strictly food for thought How about a new, completely independent amateur radio league (call it what you like) — an organization that would represent its membership and not just use their money, an organization that thinks more of its duties to its members for WARC rather than a new building, an organization that listens to its members and answers their letters. I could go on and on, but I think you have the idea. Can you imagine a headquarters in New Hampshire? Unheard of! How about some response from *73* readers on this?

Keep up the objectivity of your magazine. A little controversy is great and helps keep the air cleared. Keep up the good work and best of luck.

Chuck Coffee WA6FLV
Rota, Spain

ANTI-RY

I just received my September issue of *73* and am sorry to say I don't like it at all; it is all one-sided for RTTY. I have nothing against RTTY, but a whole issue of it is too much.

I have noticed in the past few months that you are specializing on one field in each issue. I hope that this is not going to be your practice. I think the magazine will be a total loss or a bore to other readers who are not interested in that field.

One more thing I would like to see in your magazine is an article on amplifiers, especially on 15 and 10 meters! They are bad enough on 20m; let's hope they keep it there. I want everybody to enjoy ham radio, not just the ones with high power.

Donald Laroche WA2FXQ
Syracuse NY

HOT STUFF

I just wanted to send off my kudos to Mark Clark WB4CSK for his letter (Sept. 1977). I used to be a CBer, but I learned and studied and worked at the darn thing until I finally started getting regular correspondence from Uncle Charlie (in the form of upgraded licenses!) almost regularly.

I'm 14 years old (I got my Novice and Tech while I was 13) and first got my Novice and Tech back in the fall

Continued on page 48

De WA3ETD

John Molnar WA3ETD
Executive Editor

SPECIAL ISSUES

This issue of *73* is dedicated to OSCAR users, present and future. As you probably know, the newest amateur satellite launching is planned for the first of the year – details are in this issue. This bird will feature a UHF downlink for the first time, in the international amateur satellite band, no less! Many existing Mode B stations will be able to use their equipment with no problems. Hopefully, the new AMSAT entry will promote interest in UHF receiver design and techniques!

Even if you are not interested in satellites, the antenna and equipment referenced in the OSCAR articles can be used for standard VHF/UHF communications – who knows, the antenna you've been looking for might be described in an OSCAR article.

I have had several complaints about the special interest *73* issues this summer. Okay, I agree, not everyone is interested in RTTY and OSCAR. However, the content of the articles is applicable to all aspects of amateur communication. Please don't close your mind to new technology – satellites are becoming more and more commonplace in the amateur community; future AMSAT shots are going to provide hemisphere repeater operations – think about it!

At any rate, there are no more special issues in the mill right now. All suggestions for the same are appreciated!

THE COVER

The cover shot on this issue of *73* is an artist's rendition of the new bird – it really has not been launched yet! Credit to R. Michael Smithwick WA6TUF for the cover.

TAKE COVER

An article slipped into the RTTY issue last month that needed an editor's comment. The article, "RTTY Local Loop," is not really perfect for beginners. An isolation transformer is definitely required to isolate the loop from the power line! Otherwise, a shock could result from contact with the loop jacks if the plug is incorrectly polarized. In order to be safe, the isolation transformer should be inserted between the bridge and the power line. Be careful!

AN APOLOGY

Due to the extra demands placed on the *73* staff by Wayne's Computermania show, I have fallen behind in processing new manuscripts. I am currently about two weeks behind – take heart, your manuscript is not lost. As this is our deadline week, I will make a super effort to read all manuscripts by next week. Expect to have heard from me by the time you read this.

NEW TRENDS

Let me know what you think about the Gunnplexers and microwave information. If the general readership is not especially interested in new things, I will cease – however, until then, prepare yourselves! The experiments with the Gunnplexers are continuing; hopefully, in a month I will be able to write about the Doppler radar system I'm developing. This system is based on a counter with a modified timebase that will allow direct readout of range, speed, or whatever. Again, Computermania cut deeply into my free time!

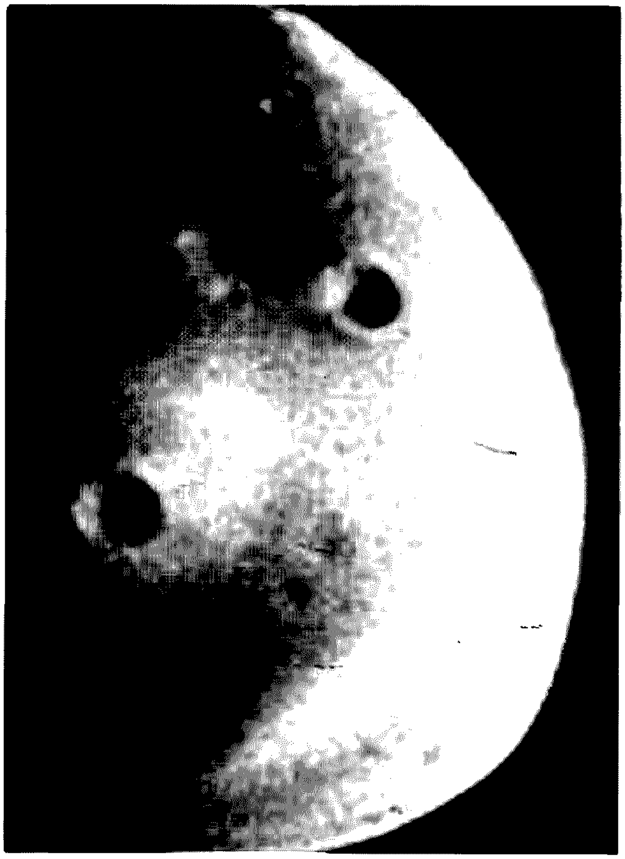
I obtained a Hughes neon-helium laser tube the other day, and am attempting to integrate it into some kind of experimental communications system. So far, a power supply using an automotive ignition coil is under construction. By the way, ignition coils are a good source (cheap) for high voltage at low current. A 24-volt transformer and variac can be used to drive the coil, which is nothing more than an autotransformer. It was very easy to obtain the 1200 volts required to fire my laser using such a scheme.

My wife is beginning to wonder what's up at our home – between the microwaves and now the laser, she's thinking about building a copper screen around the living area. Be careful when playing with these devices!

DEIMOS

So, you think SSTV is only good for transferring QSL cards and pix of the shack? This picture is courtesy of *73* associate editor Dave Ingram K4TWJ. Dave obtained the picture from the "N6V" gang at the Jet Propulsion Laboratory. This picture is computer processed, and formerly unreleased. Dave has been doing considerable work in slow and fast scan television with JPL – so without additional comment, I'll let the Viking News Center (Pasadena CA) tell the story:

"This is a computer-generated color picture of Deimos, smaller of the two satellites of Mars. A pair of images of Deimos from Viking Orbiter 1 – one taken through the camera's violet filter, the other through the orange filter – were combined in this single image to search for color differences on the surface of Deimos. Resolution in this picture shows objects as small as 200 meters. Deimos is a uniform gray color; slight tints of orange on the rims of some craters are artifacts of the image process. A small blur beside the large crater at the right is where scientists removed a reseau mark from the original image. The reseau marks etched on the imaging system are used to make precise measurements of the objects in the photos."



CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

Information on all 1978 contests should be forwarded as soon as possible *directly to me* for publication. Help avoid multiple contests on the same weekend with conflicting schedules by having your dates published as early as possible. Also, don't forget to send abbreviated results and any award information.

For a slight twist this year, take a listen during the OK DX contest. Last year there was good activity from Europe even though it was on the same weekend as Sweepstakes.

Anyone interested in a fine newsletter for contesters should check the *National Contest Journal*, published bi-monthly by the Southern California Contest Club, edited by Pete Grillo N6CJ. Subscription rates are $4/year in USA, $5/year elsewhere. For more information write: NCJ, PO Box 3762, Glendale CA 91201.

ARRL SWEEPSTAKES

CW
Starts: 2100 GMT Saturday, November 5
Ends: 0300 GMT Sunday, November 6
Phone
Starts: 2100 GMT Saturday, November 19
Ends: 0300 GMT Sunday, November 20

Sweepstakes is sponsored by the ARRL and is open to all amateurs in the US, US possessions, and Canada. No more than 24 hours of operation are permitted during the 30-hour contest period. Time spent listening counts as operating time and off periods may not be less than 15 minutes. Times on and off as well as QSO times must be entered in the log. Each station may be worked only once, regardless of band.

CLASSES:

All entries will be classified as either single or multiple operator stations. Single operator stations will be further classified by input power: Class A = 200 Watts dc or less, Class B = above 200 Watts. All ARRL affiliated clubs may also participate in the club competition.

EXCHANGE:

Number, precedence, your call, CK, and ARRL section. Send A for precedence if power is 200 Watts dc or less, otherwise send B. For CK, send the last 2 digits of the year you were first licensed.

SCORING:

Score 2 points for each completed QSO. Final score is sum of QSO points multiplied by the total number of ARRL sections plus VE8 (max. 75).

AWARDS:

Certificates will be awarded to the highest scoring Class A entry and the highest scoring Class B entry in each section, provided there are at least 3 single operator entries or the score is 10,000 points or more. Certificates will also be awarded for high scoring Novices and Technicians. Multi-operator entries are not eligible for certificate awards and will be listed separately in the results.

FORMS:

It is suggested that contest forms be obtained from ARRL, 225 Main St., Newington CT 06111. All entries with 200 or more QSOs must have a cross-check sheet to check for duplicate QSOs. Each log must show date, QSO time, times on/off, exchanges sent and received, band and mode.

Note: These rules were taken from last year's contest.

RSGB 7 MHz DX CONTEST

Phone
Starts: 1800 GMT Saturday, November 5
Ends: 1800 GMT Sunday, November 6

EXCHANGE:

Report and serial number, starting with 001.

SCORING:

Non-British Isles stations score 5 points for each contact with the British Isles; those outside Europe score 50 points. All may claim a bonus of 20 points for each British Isles numerical prefix worked (G, GC, GD, GI, GM, GW — 2, 3, 4, 5, 6). Contacts with stations using GB prefixes will not count for bonus points.

AWARDS:

Non-European stations must make at least 10 QSOs to qualify for an award.

LOGS:

Logs and entries must be addressed to the HF Contests Committee, c/o J. Bazley G3HCT, Brooklands, Ullenhall, Solihull, West Midlands, England, to arrive no later than December 29.

MISSOURI QSO PARTY

Starts: 1800 GMT Saturday, November 12
Ends: 2300 GMT Sunday, November 13

The 13th annual QSO party is sponsored by the St. Louis Amateur Radio Club in an effort to activate some of the hard-to-get Missouri counties. The same station may be worked once per band and mode. Missouri mobiles will count separately from each different county.

EXCHANGE:

QSO Number, RS(T), and QTH; county for MO stations; state, province, or country for others. MO mobiles start with #1 from each county activated.

FREQUENCIES:

3540, 3910, 7040, 7240, 14040, 14270, 21110, 21360, 28110, 28600, 50-50.5.

SCORING:

Score 1 point per QSO; MO stations multiply contact points times number of states, provinces, and countries; others multiply by number of MO counties (115 max). MO mobiles total separate score from each county activated.

AWARDS:

Certificates to top scores in each state, province, country, top 10 MO entries, and top 3 MO mobiles.

ENTRIES:

Mailing deadline for logs is December 15. Address all entries to: St. Louis ARC — KØLIR, 842 Tuxedo Blvd., Webster Groves MO 63119. Include an SASE for results.

DELAWARE QSO PARTY

Saturday, November 12
0001 to 0600 and
1600 to 2200 GMT
Sunday, November 13
0001 to 0600 and
1600 to 2200 GMT

Sponsored by the Delaware ARC, contest is open to all amateurs. Stations may be worked once per band/mode for QSO points.

EXCHANGE:

QSO number, RS(T), and QTH — county for DEL, ARRL section or country for others.

SCORING:

DEL stations score one point per QSO and multiply total by number of ARRL sections and countries worked. Others score 5 points per DEL QSO and multiply by 1 if one DEL county is worked, 3 if two counties worked, and 5 if all three counties worked (counties = Kent, New Castle, and Sussex).

FREQUENCIES:

CW - 3560, 7060, 14060, 21060, 28160.

Phone — 3975, 7275, 14325, 21425, 28650.

Novice — 3710, 7120, 21120, 28160.

ENTRIES AND AWARDS:

Appropriate awards given top scorers and a special certificate to all stations working all three Delaware counties. Mailing deadline is Dec. 31 to John R. Low K3YHR, 11 Scottfield Drive, Newark DE 19713. Include an SASE for results or W-DEL certificate.

EUROPEAN DX CONTEST

RTTY
Starts: 0000 GMT Saturday, November 12
Ends: 2400 GMT Sunday, November 13

Rules for the contest are the same as for the Phone section, with one exception: In the RTTY section, contacts with one's own continent are permitted and count 1 point per QSO. Multipliers will be counted as before.

Complete rules appeared in the August issue on page 22. Briefly, the basic rules are as follows:

Use all bands 3.5 through 28 MHz, with only 36 hours of operation out of the 48-hour contest period for single operator stations. The 12-hour rest period may be taken in up to 3 periods. Classes include single operator (all band), and multi-operator with single transmitter.

EXCHANGE:

RST and progressive QSO number starting with 001.

SCORING:

Each QSO will count 1 point. A station may be worked once per band. Each QTC (given or received) counts 1 point — see August issue. The multiplier for non-European stations is the number of European countries worked on each band. Europeans will use the ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, UA9/UAØ. The multiplier on 3.5 MHz may be multiplied by 4; the multiplier on 7 MHz may be multiplied by 3; the multiplier on

CALENDAR

Nov 3-4	YLRL Anniversary Phone Party
Nov 5-6	ARRL Sweepstakes — CW
Nov 5-6	RSGB 7 MHz CW Contest
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest — RTTY
Nov 12-13	Missouri QSO Party
Nov 12-13	Delaware QSO Party
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes — Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austrian Contest
Nov 26	Ten Meter Ground Wave Contest
Nov 26-27*	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest
Dec 17-18	CW Christmas Party

*Described in last issue.

14/21/28 MHz may be multiplied by 2. The final score is the total QSO points plus QTC points, multiplied by the sum total multipliers from all bands.

AWARDS:

Certificates to highest scorer in each country, reasonable score provided. Continental leaders will be honored. Certificates will also be given to stations with at least half the score of the continental leader.

LOGS:

Use a separate log sheet for each band. Logs for the RTTY section should be mailed no later than December 1. North American stations may send their contest logs to: H. E. Weiss WA3KWD, 762 Church St., Millersburg PA 17061, USA. All others should send their logs to: WAEDC – Committee, D-895 Kaufbeuren, Postbox 262, Germany.

IPA CONTEST

Saturday, November 12
0800 to 1000 and
1400 to 1700 GMT
Sunday, November 13
0800 to 1000 and
1400 to 1700 GMT

Sponsored by the International Police Association Radio Club – German Section (IPARC), the contest is designed to enable participators to work the Sherlock Holmes Award (SHA). The contest is open to all radio amateurs and SWLs. Members may work anyone, non-members may only work members. General call is "CQ IPA." Cross-band and cross-mode contacts are not allowed. All contacts must be on CW or SSB.

EXCHANGE:

Non-members send RS(T) and serial number. Members send IPA, RS(T), and serial number.

SCORING:

Every completed QSO counts 2 points on 80/40 meters, 4 points on 20/15/10 meters. Stations may be worked once per band. Multiplier is number of DXCC countries; every band counts separately. Final score is QSO points times multiplier.

FREQUENCIES (as allowed):

SSB – 3650, 7075, 14295, 21295, 28650.

CW – 3575, 7025, 14075, 21075, 28075.

AWARDS AND ENTRIES:

Certificates to winners and three highest scores. Any amateur fulfilling the conditions of the SHA50, SHA100, or SHA200 during the contest may apply with application sheet. Approval of 2 licensed hams is not necessary for contest application. SHA rules, IPARC membership list, SHA application sheet, contest log sheet, and contest score or certificates are available from Vince Gambina WB4QJO, 7606 Kingsbury Road, Alexandria VA 22310 – include an SASE, please! Contest entries must be postmarked no later than December 31 and sent to Adolf Vogel DL3SZ, Ritter-von-Eyb-Strasse 2, D-8800 Ansbach, Germany.

INTERNATIONAL OK DX CONTEST

Contest Period:
0000 to 2400 GMT
Sunday, November 13

The participating stations work stations of other countries according to the official DXCC Countries List. Contacts between stations of the same country count only as a multiplier, but 0 points. All bands from 160 to 10 meters, CW and phone may be used. (OK stations are only licensed to operate CW on 160 meters.) Cross-band as well as cross-mode contacts are not valid.

EXCHANGE:

Exchanges consist of a 4 or 5 digit number indicating the RS(T) and ITU zone.

SCORING:

A station may be worked once only on each band. A complete exchange of codes counts one point, but three points for a complete contact with a Czechoslovak station (except as noted above for stations in the same country). The multiplier is the sum of the ITU zones from all bands. Final score is then the sum total of contact points times the multiplier.

CATEGORIES:

A – single operator, all bands; B – single operator, one band; C – multi-operator, all bands. Any station operated by a single person obtaining assistance, such as in keeping the log, monitoring other bands, tuning the transmitter, etc., is considered as a multi-operator station. Club stations may work in category C only.

AWARDS:

A performance list of participants will be worked out by the contest committee for each country. A certificate will be awarded to the top scoring operators in each country and each category. The "100 OK" award may be issued to stations for contacts with 100 Czechoslovak stations, and the "S6S" award (and/or endorsements for individual bands) may be issued to a station for the contacts with all continents. Both awards will be issued upon a written application in the log. No QSL cards are required for either award.

LOGS:

A separate log must be kept for each band, and must contain date and time in GMT, station worked, exchange sent and received, points (0, 1 or 3), and ITU zone (with the first QSO for that zone only). The log must contain in its heading the category of the station (A, B, or C), name and callsign, address, and band or bands. Also, indicate the sum of contacts, QSO points, multipliers, and the total score of the participating station. Each log must be accompanied by the following declaration:

I hereby state that my station was operated in accordance with the rules of the contest as well as all regulations established for amateur radio in my country, and that my report is correct and true to the best of my belief.

Logs must be sent to The Central Radio Club, Post Box 69, Prague 1, Czechoslovakia – postmarked no later than December 31, 1977. A list and map of ITU zones is available for 2 IRCs from the same address.

WWDXA INTERNATIONAL CW CONTEST

Starts: **0000 GMT Saturday,**
November 19
Ends: **2400 GMT Sunday,**
November 20

Sponsored by the Worldwide DX Association and *DXers Magazine*, the objective is to contact as many amateurs in as many ITU zones and countries as possible using all available frequencies. All assigned amateur radio frequencies from 0.1 MHz to 25 GHz including transponders and repeaters of amateur satellites may be used. There are no contest limits; you may use complete automation devices, including tape recorders, auto keyers, readout devices, or other automatic CW devices. You must, however, follow the rules and regulations governing amateur radio in your country. Multi-operator, multi-transmitter entrants are encouraged. Single operator, single transmitter, single band entrants must state single category for special recognition. All entrants are assumed to be multi/multi/multi unless otherwise stated. The purpose is to encourage group contesting to enhance teamwork and interaction. Shortwave listener entries are a separate category.

EXCHANGE:

All stations must exchange reports and ITU zone numbers. Mobiles changing zones during the contest period will make changes in report sent to show the new zone. Shortwave listener logs must reflect zone numbers.

SCORING:

3 points for contact on different continent, 1 point for contact of different country but same continent, 10 points for contact by satellite transponders or repeaters, 0 points for your country contact, but multipliers count. Multipliers are each ITU zone contacted per band and each country contacted per band. Final score is total QSO points times total multiplier. SWLs score same but on heard basis. Land and sea mobiles count as different continent (3 points).

ENTRIES AND AWARDS:

Submit your contest summary sheet to the contest committee. *Do not submit your logs* – only the summary sheet. Include name and callsigns of all operators and listeners. Contest committee reserves the right to request your log to verify your entry in the event of close or tie scores. Summary sheet must be postmarked before January 1; contest synopsis will be mailed to each entrant before February 15. Trophies, prizes, or negotiables are solicited for award within country of origin. Results of the contest committee are final. Mail entries to: Frank Jerome W5AT, 908 Holoway, Midwest City OK 73110.

ALL AUSTRIAN CONTEST

Starts: 1900 GMT
November 19
Ends: 0600 GMT
November 20

The contest is open to all amateurs; power input must be in accordance with licensing regulations. All contacts must be on 160 meters, on CW only. Foreign stations use the call "CQ OE," Austrian stations will use the call "CQ TEST." The authorized suballocations for Austria are: 1.823-1.838, 1.854-1.873, 1.873-1.900 MHz.

EXCHANGE:

RST and QSO number starting with 001. Each exchange must be confirmed by repeating the exchange code.

SCORING:

Every completely logged QSO (date, time in GMT, frequency in MHz, call of station, exchanges given and received) counts one point. Multipliers are 2 points for every Austrian "Bundesland" (OE 1-9), and one point for every prefix. Multiply QSO points times multipliers for final score. Every station can be contacted only once. If a station is contacted twice, the second QSO must be clearly marked as a duplicate and does not count.

ENTRIES:

Logs must be postmarked no later than December 15 and sent to: Landesverband Salzburg des OVSV, "AOEC 1977," c/o Ing. Wolfgang Latzenhofer OE2LOL, Pfeifferhofstrabe 7, A-5020 Salzburg, Austria.

TEN METER GROUND WAVE CONTEST

November 26
9 pm to 1 am Local time

Sponsored by the Breeze Shooters of Pennsylvania, send an SASE to Richard Evanuik WA3LUM, 311 Evergreen Ave., Pittsburgh PA 15209, for logs and new rules. There will be separate categories for Novice/Technician classes.

AMSAT

AMSAT-OSCAR 7 ORBITAL DATA CALENDAR

In cooperation with AMSAT, Skip Reymann W6PAJ has published an improved AMSAT-OSCAR orbital data calendar containing all orbits for 1978 for AMSAT-OSCAR 7. Designed so that it may be hung on the wall, the calendar includes information on the operating schedules and frequencies for the spacecraft, and also the telemetry decoding equations. Also included is step-by-step information on how to determine times of passage of the satellite.

The orbital calendar is available postpaid for $5.00 U.S. funds or 30 IRCs ($3.00 to AMSAT members, and free to AMSAT Life Members). Overseas orders will be airmailed. Orders and payments should be made in U.S. currency to: Skip Reymann W6PAJ, P.O. Box 374, San Dimas CA 91773.

Important – To speed up handling of your order, please include a gummed, self-addressed label.

Proceeds from the Orbital Calendar benefit AMSAT.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

Coordinators, coordination councils, and concerned spectrum users should take note of the following date: September 23, 1978. If plans jell as it now appears they will, on that date the Southern California Repeater Association, the San Diego Repeater Association, and the 220 Club of San Diego will cosponsor this nation's first *VHF/UHF National Voluntary Coordination and Band Planning Meeting* in the city of San Diego, California.

It has been obvious for a long time that coordinators and coordination councils all over the nation face similar problems and that some format has to be found to get all of these people under one roof for a day or so to give them a chance to talk over their ideas with one another. No individual or group had made any move toward setting up such a get-together. The initiating step took place at the August 20, 1977, SCRA General Membership Meeting held in La Jolla. In his remarks welcoming the SCRA to the La Jolla-San Diego area, Sam Deer suggested that the SCRA schedule its fall, 1978, meeting so that it could be held at the 1978 ARRL National Convention that he and his staff are putting together at this time. "Why not make it a national coordinators meeting instead?" suggested Bob Thornberg WB6JPI, and at that moment was born the idea of SCRA hosting the first meeting of this kind.

However, an event of this scope would necessitate support from as many amateurs as possible, and since this will be a seminar held in San Diego, it was felt that the amateur community of that city must be directly involved. Therefore, after some quick discussions and a few letters, it was decided that rather than have it be an SCRA-sponsored gathering, it would be cosponsored by the three organizations mentioned above.

Since plans are still in the formative stages, it's hard at this moment to describe any program for the meeting itself. One suggested plan is to hold two separate sessions, with technical issues discussed in the morning and matters of a political nature taken up after a good lunch. However, since it has been but two weeks since the idea itself was conceived, exact plans have yet to be formulated. In either case, it is hoped that this meeting will be attended by delegates from all voluntary coordination councils (and/or coordinators) here in the United States and worldwide, as well as individual amateurs who are truly concerned with overall VHF/UHF voluntary spectrum management.

Further information on this meeting will soon appear both here and in most other amateur publications. In the interim, if you think you might want to attend or wish to make reservations for a seat (the meeting is *free*, but the sponsors would like to know how many people to expect), drop a note to the attention of Mr. Paul McClure, Secretary, Southern California Repeater Association, PO Box 2606, Culver City CA 90230. Mark your envelope "Coordination Meeting Info Request," and please include an SASE. This meeting may mark a historic moment in amateur radio's future, so plan to attend.

CALL FOR PAPERS

SCRA Chairman Jim Hendershot has informed me that I have been "volunteered" by the SCRA to handle their involvement in the meeting. One idea that I have is to invite you who plan on attending to submit formal "papers" for consideration and/or presentation at the seminar next September. In this way, many divergent opinions and ideas could be expressed in a short time on such topics as "The Future of Voluntary Spectrum Management by Amateurs," "Coordination Methods for Relay Communication," "The Anatomy of a Voluntary Coordination Council," "User Involvement in Repeater Coordination," "Advanced Coordination Techniques Using Microprocessors," "Possible Voluntary Coordination of Non-Relay Spectrum Operations," etc. You need not limit yourself to the aforementioned list — use your imagination. Even if you oppose the concept of voluntary spectrum management and feel you have a good argument to prove your point, go ahead and submit a presentation. Since this seems to have been placed in my lap anyhow, it is my intention to get a "judging committee" put together that will be made up of the best technical minds I can muster. Those authors whose papers are selected will be invited to present them at the meeting.

I guess that at this point some "ground rules" might be in order. First, use whatever written format you like. It's content, not writing form, that's important. Second, it should be long enough to present your views in an easy-to-understand manner, yet not so overly long as to put everyone to sleep. One way to be sure is to read it into a tape recorder after you have finished it. If it runs no longer than, say, 15 minutes and holds your interest, then you have a potential winner. If, after listening for 45 minutes, you find yourself falling asleep, then I suspect that some text editing is in order.

Let's set a submission cutoff date of June 15, 1978. This will give the committee a chance to read and judge all submissions and notify those authors selected. However, once you find out that you are one of the chosen presenters, it's up to you to get to the meeting on your own. Neither the SCRA, SANDRA, or the 220 Club of San Diego will be responsible for providing transportation to the meeting, lodging, or any other expenses. Costs of such would be prohibitive. However, if you are one of the "dedicated" ones, you have already planned to attend both the ARRL National and this meeting, so dust off the typewriter and get going. Send all submissions to my attention, in care of the SCRA PO box in Culver City. Also, if you want your presentation returned should it not be chosen, please enclose an SASE.

PETE HOOVER ON USER INVOLVEMENT IN REPEATER COUNCILS

Herbert "Pete" Hoover III W6ZH is probably one of the most respected members of this nation's amateur community. On August 20, 1977, Pete addressed the membership of the SCRA on the topic of "User Involvement in Repeater Councils." Here is a partial text of Pete's talk:

"I've been involved in repeaters at one time or another, of one kind or another, since I got back from Europe in 1964. I had control station for one of them for a while, first AM and now FM. I'm not a stranger to the mode of communication; however, I am not as far aside as Stan Brokl is, who wrote the comment in here *(referring to an article that appeared in various local radio club newsletters)* saying that the two meter repeaters are very close to CB activity. I wish they were in some respects.

"A week ago, I was in Dallas talking to the REACT International Convention. They have a repeater on 460. I think they have a bunch of them. They do a good job with them. They're commercial users.

"I would much rather be stuck on the road and have to ask REACT for help than I would be stuck on the road and have to ask the average repeater user for help. You might as well just forget it. Why? Because repeater operators are primarily interested in themselves. They are interested in commercial communications suppliers like themselves *(referring to repeater owner operators)*. They are not user-oriented. Okay, fine, ATV is the same sort of thing, perhaps. But there is a problem in the southern California region — at least four people have mentioned it in different terms today: There are no more frequencies *(referring to available southern California two meter and 220 MHz channel pairs)* under the present situation.

"And not only that, the communications service suppliers, the people who provide communications services — which are you people primarily — repeater operators *(owners)* are becoming increasingly remote for the reason that you exist: your users. The comment was made here earlier today — Is it possible to include a user viewpoint in this kind of organization? I'm telling you, you'd better!

"You are, for all intents and purposes, a communications utility. Remember the words — they're going to be used more and more. Think back on the utilities that you normally think about when you hear the words. Power company, gas company, railroads, airlines, truckers. They abused the users of their services to the point where the federal government stepped in. And, ladies and gentlemen, if the repeater community does not get its act together, you are going to hear that as a suggestion

Continued on page 23

Pete Hoover W6ZH addresses the SCRA at La Jolla.

FCC Math

John F. Leahy WB6CKN
P.O. Box 539
Gonzales CA 93926

This is the first in a series for hams and would-be hams who have trouble with math. What we'll do over the months is take the equations and other math stuff you run into in FCC exams and handle them in a relaxed yet thorough fashion, so that when you go to face the friendly executioners down at the FCC office, you'll be well prepared to breeze through any math curves thrown at you.

So, if you are a person who can handle simple adding, subtracting, multiplying, and dividing okay, but tend to shrivel up into a quivering blob when faced with math that is more demanding, this series is for you!

First, let me assure you that if you fit into this category, you have plenty of company. Recent studies have shown that better than half the adults in the country can't add. Of course, people in electronics tend to be somewhat more capable along math lines than most, but if you're not a scientist, engineer, math buff, or something, chances are there are areas of math where you do not quite feel at home, to put it mildly.

Since the series will start with simple stuff and progress through all the math you could possibly need to pass any FCC exam (and just about anything you might run into in popular books and magazines, for that matter), you should be able to eliminate areas of difficulty with very little trouble, providing, of course, that you do what's necessary to let the series go to work on you. A good quiet nook (not the ham shack, unless you're good at resisting temptation), far removed from shrieking kids and a hysterical XYL, plentifully supplied with paper and writing materials, is usually helpful.

No doubt some of the math of this series will be second nature to you. There's no reason why you shouldn't skip such. A quick glance through each bite-sized part as it comes along should tell you if this is an area where you need some review or not. Since each part is pretty much self-contained, skipping certain sections or jumping back and forth should introduce few problems.

One urgent recommendation: If you are one of the vast multitude for whom math has been, is now, and, you fear, ever will be a major catastrophe, RELAX! I really mean relax. *The biggest single obstacle to mastery of anything is being uptight about it. If you can learn to relax away the fears, anxieties, and inner turmoil that have built up over the years, you will find that there is no area of math you cannot completely master, given the right approach and sufficient time.*

A good way to relax with math is to consider it a game. If you like checkers or chess or bridge, you can like math. It's just a matter of developing the right outlook. If you enjoy doodling or have ever spent time on picture or crossword puzzles, then you are indubitably a person who can enjoy, yes, take real pleasure in, math. And there is this consideration: Whereas in bridge or checkers or chess, someone has to lose the game if someone else wins, in math no one need lose. You might be delayed for a while, reviewing something you've forgotten, or distracted (that lithesome bikinied lass next door), but there's no losing unless you choose to lose. And you will find that solving a math problem in electronics is just as satisfying as winning a game of chess, if you let it be. In fact, as you progress along finding yourself more and more successful, you may very well become almost as hooked on math (yea, verily) as you are on amateur radio. But enough of this — let's quit talking and start building.

As I said earlier, we'll work primarily with the equations you might well find in an FCC exam. One of the first, which appears in various forms, is f = 300,000,000/wavelength. We'll dally a bit on this formula so as to develop some of the approaches we'll use throughout the series.

Another way you might see it written is $f = c/\lambda$, where c is the symbol ordinarily used for 300,000,000 meters per second, the velocity of light, and λ, the Greek letter lambda, is the symbol used by physicists, engineers, etc., for wavelength.

Before we go any further, let's see what different forms this formula can be wiggled into. To find out what kind of wiggling is legit in electronics math, we'll play around with some numbers. Take the equation $5 = 10/2$, which might be translated: 5 equals 10 divided by 2. [Any fraction can be considered a division. Divide the bottom (denominator) into the top (numerator)]. You'll notice that $5 \times 2 = 10$ and that $10/5 = 2$. Well, if math is universally valid (let's not get into philosophical questions here), then using our formula, $f = c/\lambda$, it must be true $f \times \lambda = c$ and that $c/f = \lambda$. (Remember that for purposes of math manipulation, letters can be handled just as though they were numbers.) So there are three basic configurations of the formula. Which of the three should be used in a particular case depends upon whether you are trying to find the frequency or the wavelength (presumably you'll never be solving for the velocity of light).

You may have heard, somewhere, that light (and other electromagnetic waves, including radio) travels 186,000 miles per second. Of course, scientists, in an effort towards uniformity and logic, use meters per second rather than miles per second. A meter, as you may know, is a lot shorter than a mile, in fact a *thousand* of them is still less than a mile. To be more or less precise, a meter is 39.37 inches, a little over a yard in length (a yard, you will recall, is 3 feet or 36 inches long). Now let's take that 186,000 miles and see if it comes out to the 300,000,000 meters of our formula. There are 5,280 feet in one mile, so there must be 5,280 x 186,000 = 982,080,000 feet in 186,000 miles. Anywhere along the line you're not quite sure of the reasoning, it might be a good idea to stop and play around with the ideas involved so as to get a clearer picture of why we do what we do. For example, why did I multiply 5,280 x 186,000 instead of, say, dividing? If you're not sure, then you want to picture the relative sizes of miles, yards, feet, inches, meters, etc., trying mentally to fit the smaller into the larger, asking yourself how many of the smaller fit inside one of the larger, drawing pictures representing their lengths (trying to draw to scale, if possible) and in general playing with drawings and mental pictures until it's crystal clear how we go about converting one unit of measurement into another. Now take that 982,080,000 feet, multiply by 12 (because there are 12" in one foot), and we have 11,784,960,000, the number of inches in 186,000 miles. Now all we have to do is divide that number, 11,784,960,000 inches, by 39.37, the number of inches in one meter, and we have 299,338,582. So 186,000 miles works out to 299,338,582 meters, quite close to the 300,000,000 of our formula. In fact, both 186,000 miles per second and 300,000,000 meters per second are approximations of the value for the speed of light. Approximations are all we need and, indeed, the best science can do.

A few comments are now in order. Notice the large numbers we were into above. Even with a calculator that can handle such numbers, errors are easily made. Electronics is full of computations with numbers larger than those we just experienced. Hence shorthand methods for handling such numbers had to be developed, and you will need to learn them if you have not already done so. We will cover such shorthands in future lessons.

That 300,000,000, then, is the fantastic distance in meters a radio wave travels in one second. What, you might ask, has that to do with frequency and wavelengths? (Our formula, remember, says that frequency equals 300,000,000 divided by wavelength.) As a matter of fact, everything follows logically from the meaning of the two words, frequency and wavelength. Frequency is the number of complete cycles of a particular signal that occur in one second. Wavelength is the distance a wave front travels, zipping along at the speed of light, during the time it takes the generator of that signal to produce one complete cycle.

If we take an example, we should be able to nail this all down. Supposing your CW transmitter's putting out a signal at 3.625 MHz. That's 3,625,000 cycles per second. M in MHz stands for mega, you may recall, and mega means million. With our decimal system the way it is, the 3 in that 3.625 is the millions and the 625 is therefore thousands.

Now we ask ourselves how long it would take for one cycle of that frequency to be produced. Obviously it would be a mighty short bit of time. Well, if there are 3,625,000 cycles in one second, then one cycle takes 1/3,625,000 of a second (just like if you travel at 60 miles per hour, one mile takes 1/60 of an hour, which just happens to be one minute). Again, play around with these ideas, taking different examples, etc., if everything is not crystal clear to you. Notice that number, 1/3,625,000. It is one over or divided by the frequency. So the time it takes for one cycle is simply *1 divided by the frequency* seconds (providing, of course, that you're dealing with a frequency expressed in cycles per second). This particular configuration, 1 divided by the frequency, is called the *period* of the signal. And physicists use the symbol ν, the Greek letter nu, in formulas, etc., when performing calculations that require the use of a signal's period.

Next we ask how far the wave front of our signal would travel in that short period, 1/3,625,000 sec., because whatever that distance is, it is the *wavelength* of our signal. You may recall distance equals speed times time. If I'm going 60 miles per hour, and do so for 3 hours, then I've traveled 3 x 60 or 180 miles all told. For our radio signal, we multiply speed (300,000,000 meters per second) times time or *period* (1/3,625,000 sec.) thusly: 300,000,000/1 x 1/3,625,000 = 300,000,000/3,625,000 which equals 300,000/3,625. If you're not quite sure how we got rid of those last 3 zeros at the *end* of each number, and you'll find that you get the same answer as you would if you simply dropped those last zeros, providing you drop the *same number* of zeros from top (dividend, numerator) and bottom (divisor, denominator). The principle is simple. You're just dividing some power of ten (we'll go into powers later on) by itself, and, as you probably realize, whenever you divide something by itself, the result (quotient) is 1, and 1 times anything is that same anything. So just by crossing out the same number of end zeros on top and bottom, you've carried out a division and gotten rid of a hidden 1!

Before we find what 300,000/3,625 equals, you might notice that 3625 is our original frequency, but as it would look expressed in kilohertz (kHz). In other words, 3.625 MHz equals 3625 kHz (equals 3,625,000 Hz or cycles per second). We'll get back to this in a later lesson, and show how to use our formula, f = 300,000,000/wavelength, with megahertz, kilohertz, or Hertz (as we are in this lesson) without converting the megahertz or kilohertz into Hertz.

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New Products

OPTOELECTRONICS FC-50 FREQUENCY COUNTER IMPRESSIONS

Considering myself a confirmed UHF/VHF enthusiast, I was pleased to review a new frequency counter useful in the UHF spectrum. My present counter is a home brew 50 MHz job constructed on perfboard, with a prescaler that starts to gasp at 450 MHz. Thus, the new Optoelectronics FC-50 counter with 600 WT prescaler could not have come along at a better time!

Optoelectronics is best known for their clock kits and electronic components. I was surprised to discover that they also offer a quality counter, available in kit and pre-built form. The basic counter is the model FC-50, which will respond in the range of 10 Hz to about 65 MHz. I evaluated a factory-built model, although instructions for the kit builder were provided. The user instructions provided with the kit assume some knowledge of components and mounting techniques; even so, they are easy to follow, and are complemented with several pictorial diagrams.

The FC-50 requires five volts for operation; thus, it can be used in the field with battery power and a 309 regulator. The eight digit LED display features leading zero suppression, which means that only the significant digits of the frequency being monitored will be displayed. The suppressed display is controlled by a front panel toggle switch. The LED display features .4" digits for easy reading. In addition to the leading digit suppress switch, front panel controls consist of a power switch, gate time control, and a prescale switch to enable the optional 650 MHz prescaler. The gate time control is a two-position switch which allows either a one second or 1/10 second sample time. In effect, this allows the display to be updated on either of the time intervals. A BNC connector is provided for rf injection.

The FC-50 counter has a claimed accuracy of 1 ppm (±.0001%). Stability after 25 minutes is also 1 ppm. Input sensitivity to 50 MHz is 10 mV rms, and impedance is 1 megohm with a load of 20 pF. If the 600 WT prescaler is used, the input requirements increase to about 150 mV rms.

Using the counter is a snap! I plugged my unit in and allowed a warm-up period of 10 minutes. My rf probe consisted of a three-inch clip lead twisted into a turn coil. This coil was attached to a short piece of coax which terminated in a BNC connector. I had a 2m Wilson HT nearby, which provided an easy test. Presto . . . the HT provided an accurate count at distances up to five feet from the counter! It was an easy job to calibrate my HT . . . sure enough, several channels were off frequency. No wonder I couldn't hit one of the "local" machines!

The real test came with the 450 MHz HT. This rig provides only 500 mW of output, and was originally calibrated by the old "tweak until you access the machine" method. Amazing — the counter immediately indicated the frequency, and, as it turned out, I was close. Without wasting any time, I checked my entire UHF setup, using the simple coil pickup in all cases.

In my opinion, the Optoelectronics FC-50 counter and 650 MHz prescaler are hard to beat for the price. The eight digit display makes accurate UHF counting possible, and the accuracy is definitely OK for amateur use. Housed in a 6" x 6" x 3" plastic box, the counter is attractive and portable. The most amazing thing about the FC-50, however, is the price. The basic 65 MHz unit in kit form is available for $119.95, complete! Factory wired, the unit costs $165.95. The prescaler kit is available for $29.95, and mounts inside the FC-50 case. This option is controlled by the front panel prescale switch. Sockets are provided for all IC packages, and quality components are in evidence throughout the counter. *Optoelectronics, Inc., Box 219, Hollywood FL 33022.*

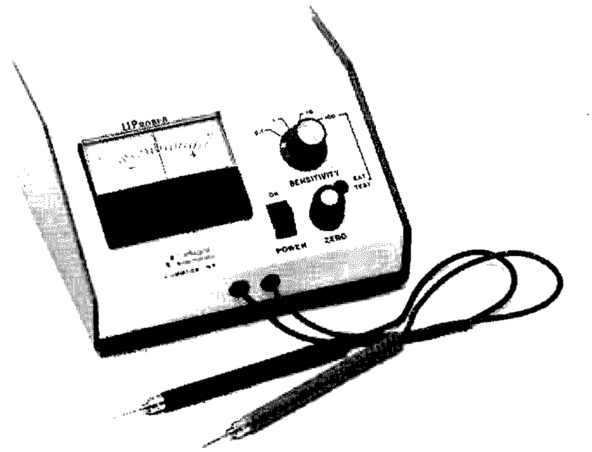
John Molnar WA3ETD
Executive Editor

YAESU INTRODUCES THE MEMORIZER

A solid state, fully synthesized 800 channel 144-148 MHz two meter FM transceiver, Model FT-227R, featuring a photo optic sensor, has been announced by Yaesu Electronics Corporation of Paramount, California. This new Yaesu product has a memory circuit to put you on any preset channel with a flip of the memory switch, and has been designated the Yaesu "Memorizer."

Frequency readout is by means of four large LEDs. Optical sensing eliminates switch problems in frequency selection. PLL techniques are used for fully synthesized frequency control in 5 kHz steps, and a special memory circuit allows instant return to any preselected frequency within the two meter band. Plus or minus 600 kHz offsets, plus any odd split within the two meter band, can be achieved using the memory circuit.

The new FT-227R has automatic final protection, PLL unlock protection, and a busy channel indicator. It provides built-in tone burst, plus optional tone squelch-decoder, and selectable ten Watt or one Watt output. It exceeds the latest FCC requirements with spuries well below the minus 60 dB down requirement with superior cross modulation, overload, and image rejection. Compact (180 mm x 60 mm x 220 mm), lightweight (2.7 kg.), the FT-227R requires 800 mA on receive and 2.5 Amps on transmit at 13.8 V dc plus or minus ten percent. And, best of all, it is priced at under $300! The Yaesu FT-227R is scheduled for late September delivery to all authorized Yaesu dealers. *Yaesu Electronics Corporation, 15954 Downey Ave., P.O. Box 498, Paramount CA 90723, (213) 633-4007.*



Integral's Model 42 current tracing meter.

WIRE-WRAPPING WIRE

The finest industrial quality AWG 30 (0,25 mm) wire-wrapping wire is now available on compact, convenient 50' (15m) rolls. Perfect for small production applications, prototype jobs, or amateur electronics projects, the wire is silver-plated OFHC copper with Kynar insulation. This premium insulation combines excellent electrical and mechanical characteristics with easy stripability and is available in 4 colors (red, white, blue, and yellow), packaged on 1-5/8" (40 mm) diameter spools for easy handling and storage. Available for immediate delivery. *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.*

CURRENT TRACING METER INTRODUCED BY INTEGRAL ELECTRONICS CORPORATION

A current tracing meter, MICROPROBER Model 42, recently introduced by Integral Electronics Corporation, is specifically intended for isolating defective ICs on assembled printed circuit boards. The new instrument is especially useful in the troubleshooting of bus-oriented circuitry, such as encountered in microprocessor assemblies. Detection of random solder shorts on printed circuit boards and location of extraneous wires in back planes and wire-wrap assemblies are greatly simplified with the aid of this device. The sensitivity of the current tracer, spanning a 10,000:1 range, permits equally effective fault isolation of TTL, DTL, CMOS, and ECL circuits. The instrument is portable and powered by a single 9-volt battery, providing up to 300 hours of continuous operation.

Available from stock to 45 days at $94.50 each. For further information, contact Marcy Talbot, Sales Manager, *Integral Electronics Corporation, P.O. Box 286, Commack NY 11725, telephone (516) 269-9207.*

NEW TWO-WAY TEST SET INCLUDES COMPLIMENTARY CARRYING CASE

A Thruline® directional RF wattmeter and a Bird 100 W dry load constitute the core of the new model 4300-064 test set. Selected especially for convenience in servicing mobile communications equipment, accessories include an rf sampler with variable level control for signal frequency, spectrum and envelope analysis, two UHF connectors, two N connectors (on the Model 43 watt-

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The "Memorizer" from Yaesu Electronics Corporation.

Looking West

from page 20

more and more often. And who from? Your users. And how many users are there versus how many suppliers? Repeater operators *(owners)*: You don't stand a chance.

"Okay, what's the answer? You can't do it by legislation. It has to be done in a voluntary manner. No two ways about it. You have to have an end objective, and your end objective must be to make better use of the one resource you have, the spectrum. You have to relate what you are doing to the users of your service. You have to ally yourselves as repeater operators *(owners)* with the organizations that your users belong to — Red Cross, Salvation Army, ARES, RACES. Sure, RACES is part of the repeater operators group. I can think of two RACES repeaters that in times of disasters turn themselves off!

"Suggestion (it's been made before, but please give it some serious thought): You've got some very competent people here. Consider, over a period of two years, phasing in something like the following, which is modeled primarily after the commercial FM broadcast practice. You have class A, B, and C stations, from very low power local machines (and this is akin to JR's comment about it being installed in someone's sub-basement, running a half a Watt to a wet noodle) to the 'clear channel stations' *(wide coverage)*, maybe like a .34/.94 on Mt. Wilson. Who knows? Chances are excellent that if you approach it from the same allocations viewpoint that the FCC has in the past used for allocation of FM frequencies (commercial ones for broadcast), you can increase the number of repeaters on the air by three- or fourfold without increasing your spectrum. But you are going to have to instill in your members a discipline that currently does not exist. It will have to be done by cooperation. This is probably going to require an alliance with users, and I am delighted to see someone from northern California here *(referring to NARC Chairman Dave Metts)*, 'cause that's where it begins.

"As a start, the only repeater that I am presently a user of is the ANY repeater in Pasadena. Talking to the people on that repeater, I understand that there is a potential conflict with AQD here in the Claremont area of San Diego. We are willing in Pasadena to reduce our ERP to 1 Watt. That will give us the possibility of covering the San Gabriel Valley and a portion of Los Angeles. We challenge AQD to do the same thing. This kind of thing, I think, will lead to a lot fewer headaches for your technical committees, and probably will give you a better system all around. That and aligning yourself with the Red Cross or any other communications user. Remember, you are only in business because your users let you stay in business. The moment they tire of you, there goes your toy. No longer can you put these things *(repeaters)* on the air for your own personal amusement — which is what most repeaters are on the air for, I'm sorry *(to say)*.

"That's the end of my general comments; I was delighted to see SCRA members at the L.A. Council of Radio Clubs meeting. To my knowledge, that's the first they had ever attended a meeting. I hope it occurs more often. Okay, enough of the lecture; any questions?"

This was transcribed directly from tape recordings made at the time and, with the exception of the deletion of his opening remarks pertaining to WARC '79, is presented totally unedited. Comments on the foregoing can be made either directly to Mr. Hoover or to him through this column.

THE BIG FIRE

By now, most of you are aware of the fact that this summer California suffered some of the worst wide-area fires in the state's history. They seemed to spring forth without warning to consume hundreds of thousands of acres of valuable land. In the case of the big Santa Barbara fire, hundreds were left homeless in the fire's wake.

I have received many reports of how amateur radio — both HF and VHF — has been working at the front lines to provide the necessary communication when called upon to do so. As I write this, the giant Marble Cone fire has just been "contained," and the weary firefighters are into their final "control" phase of the fight. It still will be many days before it's out.

Two people who have supplied information for us are Bob Couger W6KPS, who lives up near the Santa Maria area, and Bob Jensen W6VGQ, who was up in the fire area with a film crew. Their information, along with input derived from a report given to the SCRA by Southwestern Division Director John Griggs W6KW, make up the background for what you are about to read.

The most important aspect of amateur radio's involvement in the firefighting efforts was that amateurs arrived "ready to set up communications" — but were not pushy about it. They simply let those in charge of the overall effort know of their availability, and then waited to be asked to participate. They did not have to wait very long for the call. The fire being in the type of terrain it was, very little land-based communication already existed — and what there was in the

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FCC Math

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Now back to that 300,000/3,625. Dividing out, we get 82.8, the length of one wavelength of our 3.625 MHz signal *in meters*. I leave to the reader the exercise of converting 82.8 meters to feet. Just remember there are 39.37 inches in a meter. The answer is below.* You may have noticed that I did not carry the division above out beyond one decimal point. The reason is simple. There's no reason to be more accurate than that here. You get a feel for proper degree of accuracy as you increasingly bump into reality.

Finally, let's tie everything together so we can see what we've done and where we've been. We started, you recall, with the formula f = 300,000,000/wavelength, which, with further symbolism, is $f = c/\lambda$. This can be tortured into the two variant forms: $f \times \lambda = c$ (or simply $f\lambda = c$; multiplication sign need not be written between two letters, and two letters next to each other are understood to be a multiplication) and $c/f = \lambda$. Then we took our elementary-school formula, distance = speed times time, and applied it to our case, getting wavelength = 300,000,000 times *period*. And since period is *1 over frequency*, we derived, really, the formula, wavelength = 300,000,000/f or $\lambda = c/f$, which, as you can see, is the second variant above, only written with the symbols interchanged from one side of the equal sign to the other (after all, it doesn't make much difference whether you say $2 + 2 = 4$ or $4 = 2 + 2$, does it?). So really, you don't need to remember the formula: frequency = 300,000,000/wavelength. All you need is distance equals speed times time, remembering that in our case distance is wavelength, speed is 300,000,000 meters per second, and time is *1 over frequency*. And if you can't remember what variants the formula can take, go back to a simple problem, e.g., $2 \times 3 = 6$, so $6/2 = 3$ and $6/3 = 2$, but notice that 6×3 does not equal 2, nor 6×2, 3, nor does $3 \div$ (divided by) $2 = 6$, etc. Only variations that work with numbers will work with letters. So, $fc \neq \lambda$ ($\neq$ means "does not equal"), $f/c \neq \lambda$, etc.

Now, with all this logic and all these tricks under your belt (if you'll pardon the mixed metaphor), here are a couple for you to work out. Check yourself against the answers (and work) below.

1. What is the free space wavelength of a 146.94 MHz signal (meters and feet)?
2. What is the frequency of a signal whose free space wavelength is 5 inches?

*271.7 feet. We multiply 82.8 by 39.37 to get 3259.8, the number of inches in 82.8 meters. Then divide by 12, getting our answer.

Answers

1. We use the formula $\lambda = c/f$. The 146.94 MHz is 146,940,000 cycles per second. So we have: 300,000,000/146,940,000 = 30,000/14,694 = 2.04 meters. Multiply 2.04 x 39.37 and we have 80.31 inches. Divide by 12 and we have 6.69 feet.
2. Here we are looking for frequency, so we use the formula $f = c/\lambda$. Our formula requires meters, remember, rather than inches. So we must first convert 5 inches into meters. Since there are 39.37 inches in one meter, we are here dealing with a lot less than one meter. In fact we are dealing with 5/39.37 of a meter. Divide that out and we have 0.127 meters. Slipping that into the formula, we have f = 300,000,000/0.127 = 2,362,204,000. Again, we need not carry the division all the way out. Just put in the correct number of zeros after working it out a reasonable amount, so as to get us into the right magnitude. 2,362,204,000 cycles per second is 2362.204 MHz, which is our answer. This matter of how far to work a problem out is not terribly important for our purposes, since FCC exams are multiple choice and once you have the first couple of digits and know the *size* of the answer (whether hundreds, millions, or whatever), you can easily select the correct answer.

Tracking the Hamburglar

STOLEN: Collins KWM 2, s/n 11023, Johnson Viking 250 Watt matchbox, swr bridge, Eico tube checker, electro voice dynamic mobile mike, volt ohmmeter, and all my old *73* magazines starting from the first issue through about 1969. Contact Richard M. Olson, 5123 Mezzanine Way, Long Beach CA 90808.

PURLOINED: Heath HW202 with GE mic and BNC ant. conn. on back. WB8TDW, Ohio lic. No. NA228853, and SS No. 232-72-8842 marked in metal of case. Rig was removed from car in Las Vegas, Nevada. Contact Chuck Young WB8TDW/7, 2165 E. Rochelle #79, Las Vegas NV 89109, (702) 733-8248.

SHANGHAIED: Heath Model 2021 handie-talkie with Model 201 touchtone pad built-in. Channel switch wired wrong in that channels 3, 4, and 5 go to crystal sockets 3, 2, and 1. Crystalled for 146.52 (ch. 3), 146.655 (ch. 4), and 146.94 (ch. 5). Stolen July 23, 1977 in Westport CT. S. W. Daskam K1POK, 38 Settlers Trail, Stamford CT 06903, (203) 329-0187.

Build the Omni-OSCAR!

-- practical omnidirectional antenna

Jay Buscemi K2OVS
8 Wexford Ct.
St. James NY 11780

Due to the extremely good sensitivity of the receiver on Mode B, OSCAR 7, extensive antenna arrays with high gain for the 432 MHz uplink are hardly required. In fact, excessive erp due to the use of high gain arrays by ground stations has been a problem for some time. High uplink erp causes the agc on board OSCAR 7 to desensitize the receiver, thus preventing weaker stations from accessing the satellite. Also, the batteries may be excessively drained by the high current demand, shortening their life.

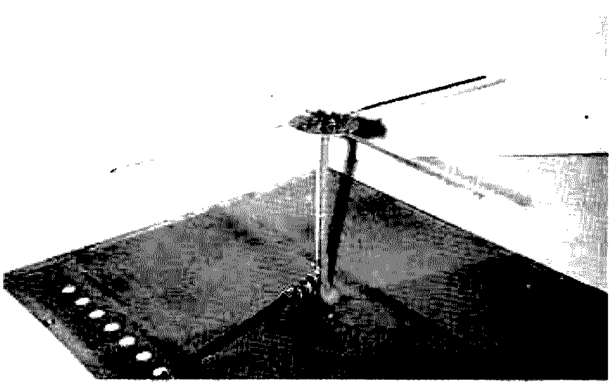
Therefore, simple low gain antennas with omnidirectional characteristics are appropriate for use on this mode. 50-70 Watts of rf into a unity gain antenna will fully access OSCAR 7 for all but the most marginal conditions. The use of an omnidirectional uplink antenna is a tremendous advantage during a satellite pass, as it eliminates the need to track the satellite in azimuth with a directional array. In addition, certain of the antenna designs described here also provide good overhead coverage. Gain arrays perform poorly at high elevation angles unless an elevation rotator is also provided for the antenna.

All the antenna types described here may be constructed for either two meters or 432 MHz. Dimensions for both bands are given in Table 1 and refer to the dimensions designated by A, B, C, etc. in the figures.

Quarter Wave Monopole

The simplest omnidirectional antenna is called the quarter wave monopole (also called the vertical ground plane), which consists of a single vertical element, one-quarter of a wavelength long, mounted over a ground plane of at least one-half wavelength on a side (Fig. 1). This antenna produces a doughnut shaped pattern with a null directly overhead and the pattern falling to zero at the horizon. Obviously, the omnidirectional term as applied to this antenna is only meaningful in the azimuth plane. Its elevation plane pattern is symmetrical but certainly not omnidirectional. This antenna becomes quite ineffective at elevation angles greater than 40 degrees from the horizon, making it almost useless on satellite orbits which pass close (up to 300 miles) to the ground station. Still, its simplicity makes it useful for some applications.

Construction of the monopole is nearly trivial — mount



Turnstile over ground plane (432 MHz).

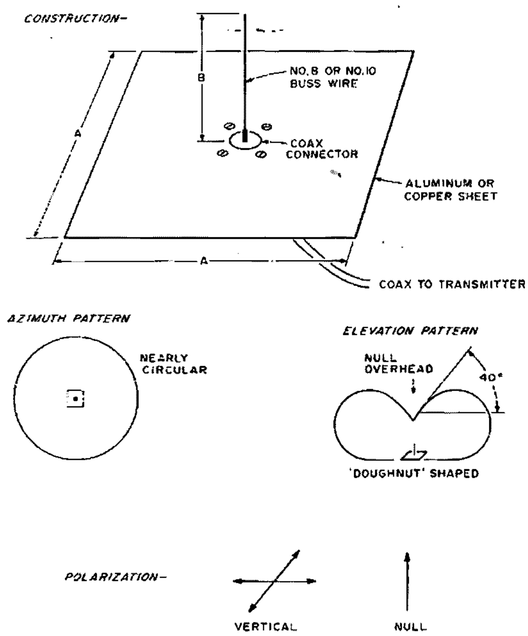
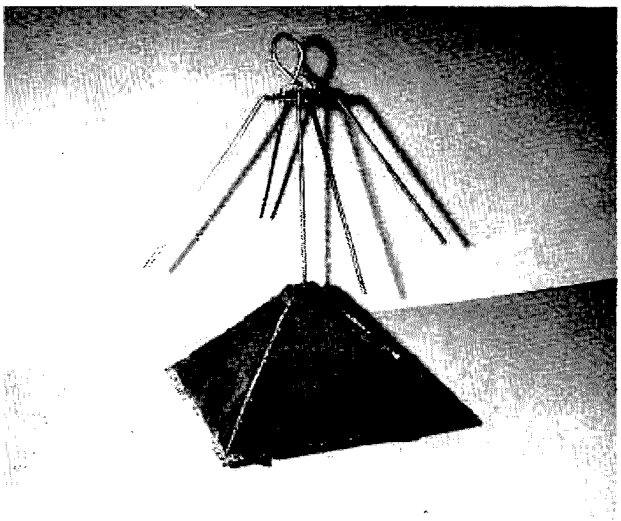
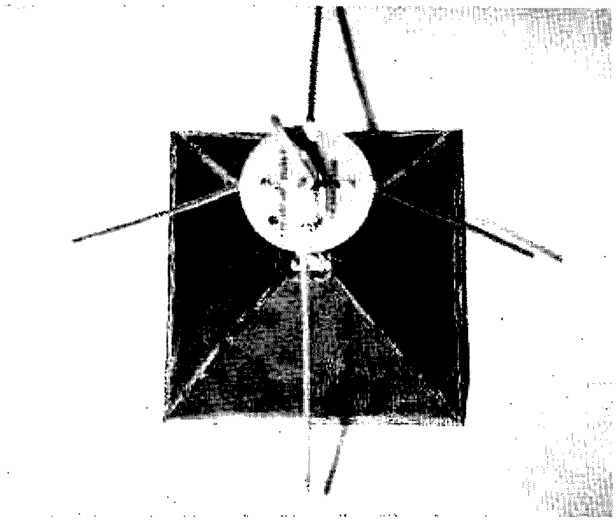


Fig. 1. Quarter wave monopole.



Sloped turnstile over ground plane (432 MHz).



Top view. Sloped turnstile over ground plane.

a panel-mount BNC or N connector in the center of an aluminum or copper sheet and solder a quarter wave long piece of #8 or #10 bus wire to the center pin. The vswr should not exceed 1:5 to 1 without further matching. Trimming the length of the wire will permit a closer match, if desired.

Dipole Over a Ground Plane (Fig. 2)

Another simple antenna which works well on overhead passes of the satellites is the half wave dipole over a ground plane. This antenna provides some gain (1.5-2 dB) overhead, but has nulls off its ends and near the horizon. Like the simple quarter wave monopole, it is linearly polarized (horizontal), so fading due to rotation of the satellite with respect to a ground station is still present. Manual switching between a vertical and horizontal antenna can be done during satellite passes to pick the best polarization at any given time.

In order to minimize the effect of the nulls off the ends of the dipole, this antenna should be oriented so it favors NNW-SSE (in the continental US), as most ascending node passes go out to the NNW during the evening, local time.

No balun is required. The antenna pattern may be slightly skewed, but no real advantage is gained by feeding the antenna in a balanced mode. Purists can add a quarter wave decoupling sleeve over the upright feedline.

As with the quarter wave vertical, the vswr as constructed will generally not exceed 1.5 to 1, and the dipole element lengths may be trimmed to achieve a perfect match. The spacing of the dipole off the ground plane has been chosen for best omnidirectional coverage in the elevation plane. Some gain can be achieved by varying this spacing at the expense of pattern symmetry.

The dipole elements are constructed from 1/8" diameter copper or aluminum tubing, flattened at the end and fastened to a plastic or printed circuit board disc with #4 screws. The feedline (and vertical support) is made from a length of semirigid coaxial cable (RG-405 or equivalent) which is soldered to a coaxial connector mounted on the ground plane. Do not ground the coax connector to the ground plane – it should be mounted on insulated spacers. Cut a clearance hole in the ground plane to provide connector access from the bottom.

Turnstile Over Ground Plane

A worthwhile improvement over the simple dipole may be had by adding an additional dipole fed 90 degrees out of phase to the simple dipole described above. This provides two

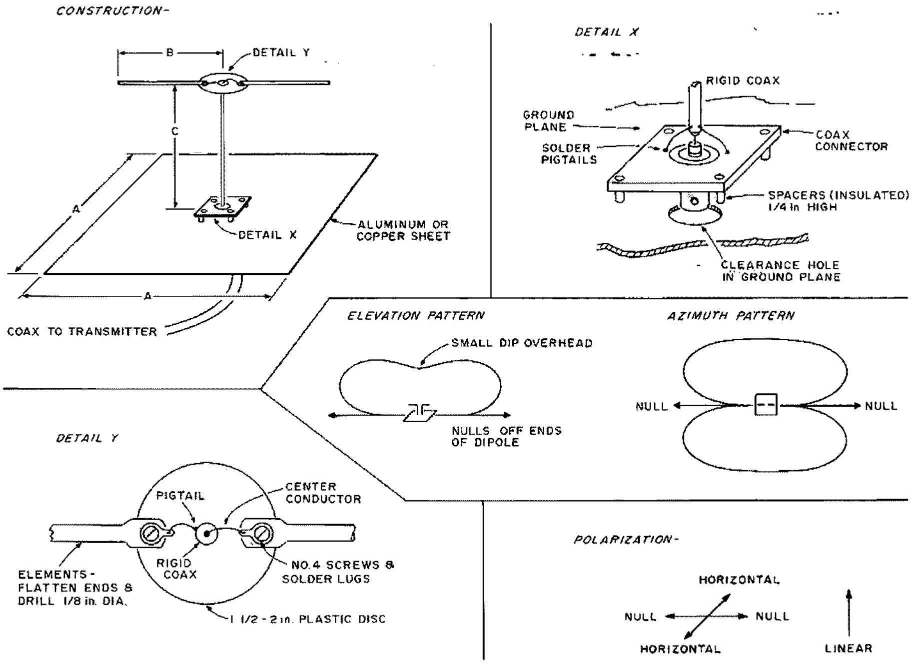


Fig. 2. Dipole over ground plane.

advantages: the antenna will be circularly polarized overhead, and the nulls off the ends of the simple dipole are eliminated, providing a more uniform azimuth pattern.

This antenna, commonly called a turnstile, has been extensively used for HF and VHF ground communications, but its major advantage is in satellite communications — circular polarization overhead is not a factor in ground communications use. Circular polarization minimizes polarization fading overhead when the satellite tumbles or rotates. Near the horizons, this advantage is lost and the antenna exhibits essentially horizontal polarization unless it is aimed at the satellite with an elevator rotator. Obviously, an azimuth rotation is of no advantage, as its azimuth pattern is essentially omnidirectional.

Construction of the turnstile is merely an extension of the technique used for the single dipole over a ground plane (Fig. 2). Two additional dipole elements are installed on the plastic disc at right angles to the original dipole (see Fig. 3). To obtain circular polarization, a one-quarter wavelength phasing line fabricated from RG-405 rigid coaxial cable is connected between the dipole elements. This phasing line is bent into a loop and supported by its solder joints. Detail X of Fig. 2 is also applicable for mounting and feeding this antenna configuration.

If the element lengths, line lengths, and spacings listed in Table 1 are used, vswr should not exceed 2 to 1 over the satellite bandwidth. A near perfect match may be achieved by trimming the element lengths and their spacing off the ground plane. Adjusting the phasing line length for perfect circularity overhead is possible but not critical in this application, as some ellipticity overhead will be of little consequence.

Sloped Turnstile Over Conformal Ground Plane

A developmental antenna presently in use at K2OVS was designed and constructed to overcome one of the major drawbacks of the antenna previously described. All the monopole and dipole configurations exhibit either *all* vertical (monopole) or *all* horizontal polarization on the horizons, thus creating polarization fading when the satellites tumble and rotate. A combination of vertical *and* horizontal polarization (*slant*) at the horizons would be an advantage in obtaining the more uniform performance for all orbiting satellite orientations.

Thus the elements of the basic turnstile were reconfigured at a 45 degree angle and the ground plane beneath them, was shaped to be parallel with each element. Overhead, the antenna is still essentially circularly polarized with slightly less (1 dB or so) gain than the simple turnstile, but the overall gain in uniform performance is worthwhile. In actual tests at this station, no measurable difference in overhead performance was observed between this antenna and the turnstile.

Basic feed and phasing line construction is identical to the turnstile (Fig. 3), and the feedpoint connector is mounted on the base ground plane similar to Detail X in Fig. 2. The elements (Fig. 4)

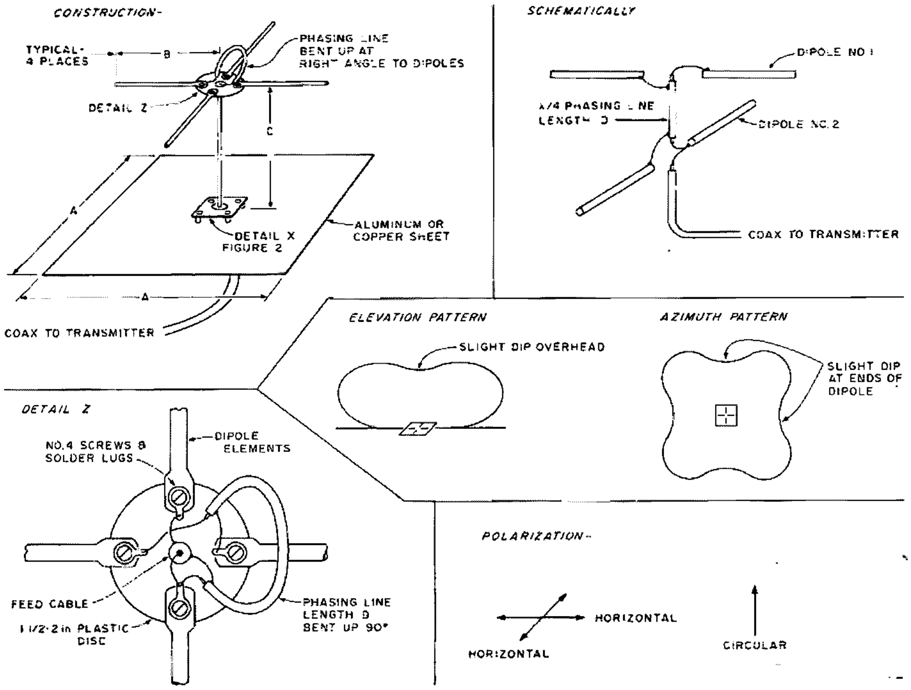


Fig. 3. Turnstile over ground plane.

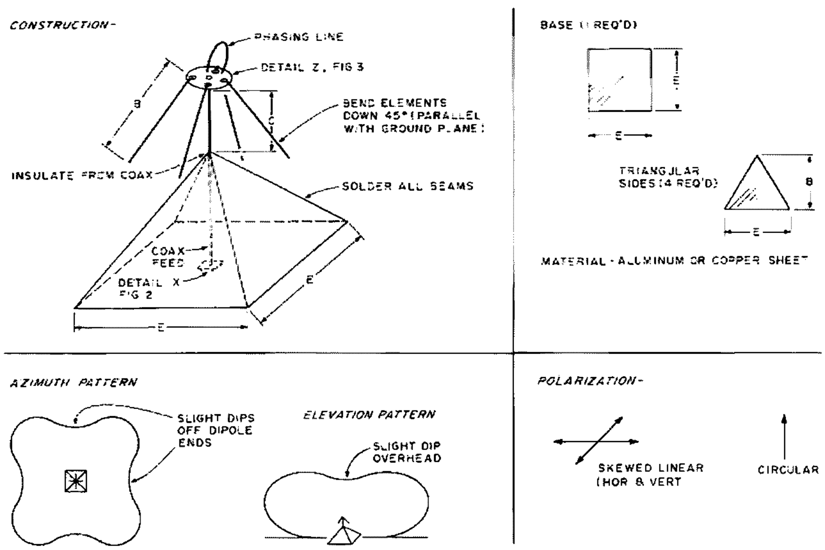


Fig. 4. Sloped turnstile over conformal ground plane.

are bent down at a 45 degree angle to the horizontal and a conformal ground plane is fabricated from either aluminum sheet or thin copper or copperclad printed circuit board material. The use of thin copper sheet allows the ground plane assembly to be soldered together with a 250-300 Watt soldering iron or torch.

Again, dimension adjustments may be required if close matching is desired. Furthermore, slight adjustments (±10 degrees) in the element droop angle will also affect the vswr (*and* the pattern). This angle adjustment should be used only as a final tune-up step. Element lengths have the largest effect on vswr.

Results from this antenna were surprising. The 432 MHz prototype was completed five minutes before a Mode B pass favoring US east coast-Europe contacts. A six-foot piece of RG-58 was temporarily connected to the antenna and the KLM Echo 70 (10 Watts output). Three western European stations were worked on that pass with no difficulty. No inference is intended that this design is the ultimate omnidirectional antenna. Rather, it is presented as an example of an unorthodox design which can serve as a starting point for further development and experimentation.

			Dimensions					
			146 MHz		432 MHz		435 MHz	
Reference	Figures	Use	IN	CM	IN	CM	IN	CM
A *	1, 2, 3	Ground plane edge size	40.5	102.8	13.7	34.7	13.6	34.5
B	1, 2, 3, 4	Radiator length	20.2	51.4	6.9	17.4	6.8	17.2
C	2, 3, 4	Ground plane spacing	17.8	45.2	6.1	15.3	6.0	15.2
D **	3, 4	Phasing line length	12.1	30.8	4.1	10.4	4.0	10.3
E	4	Triangle height	28.5	72.4	9.6	24.5	9.5	24.3

*Table 1. Physical dimensions. *Minimum sizes. **Note: Assumes velocity factor = 0.6. For different coax, use ¼ wavelength electrical length.*

Summary

As with all antennas, good horizon coverage is a function of the height of the antenna. These antennas perform well overhead and at higher elevation angles almost independently of their physical height above ground, but performance out at 2,000 miles (satellite near the horizon) could be severely compromised by terrain blockage. Good low angle (DX) coverage is best accomplished with a unidirectional array, such as a yagi or collinear, mounted high and in the clear. An existing VHF array with azimuth control in conjunction with an omni type antenna for higher radiation angles is an ideal combination for all-around satellite work.

As stated before, the antennas described here are hardly the ultimate in omnidirectional types. Further development and experimentation is most rewarding with antenna design. For example, the sloping turnstile might be further improved by extending or reshaping the ground plane, adding an additional set of dipole elements at a 45 degree angle *above* the horizontal, adjusting the droop angle, etc. Accurate comparisons of several antenna designs can be made quite easily using the satellites themselves as an antenna range signal source. A typical pass of 20-25 minutes permits switching between the antennas under test and evaluation of the results. Modification may be accomplished in time for the next pass. The actual pattern of an antenna may be estimated by physically holding the antenna (particularly 432 MHz versions) and rotating it while pointed at the satellite (to estimate circularity), changing its elevation orientation, etc. Fading effects from the satellites themselves tend to be of relatively slow duration (3-4 minutes), so measurements or comparisons made within 2-3 minutes effectively eliminates errors caused by the satellites or atmospheric conditions.

Gain estimates for higher gain VHF arrays may also be made using the satellite by switching back and forth between a reference antenna (e.g., dipole) and the antenna under test while observing the received signal level on the station receiver. A calibrated attenuator will permit more accurate measurements. Set a level with the reference antenna, switch to the gain array, and insert attenuation in the antenna line until the received level is the same as it was with the reference antenna. The gain of the array may then be read off the attenuator dial. Obviously, different line losses must be accounted for and the polarization of both antennas should be the same.

The present OSCAR satellites are providing the amateur fraternity with a unique opportunity for VHF-UHF antenna experimentation. Future "stationary" (geosynchronous) satellites may serve as permanent antenna ranges in the sky, permitting extended development, adjustment, and measurement times for antenna work.

It is hoped that the ideas presented here will encourage further experimentation and development in VHF-UHF antennas and fill a need for the present OSCAR satellites. ■

Looking West

from page 23

way of phone service was being overloaded with traffic. Much of the communications handled by amateurs was what might best be termed of the "health and welfare" variety, permitting firefighters to get word to their relatives as to where they were, locating people for other people, etc. It should be noted that firefighters came from all over the USA, and for many there was but one way to get a message to the "folks back home": via amateur radio. Amateur communications was not limited to this small aspect, however — not by a long shot.

Both VHF repeaters and HF point-to-point were used to relay information to and from areas where the fire was being fought, relay firefighting orders, and handle just about every conceivable form of traffic that you might imagine. In all, over three hundred amateurs (under the direction of Ed Gribi, emergency coordinator for the area) from all over the state (and even from out-of-state) volunteered their services at one time or another. I am told that no offer of help was turned down.

Repeater systems served well and continue to do so. At least two machines were brought into the area by concerned amateurs who realized the communications need. One came from a group at Vandenberg AFB, and was installed at the Hunter-Liggett Military Reservation near Paso Robles, to give coverage from the Questa Grade to Salinas. Its channel pair is .28/.88, and it's under the trusteeship of W6LIO. I've also been told that the .84/.24 group out of the Bay area literally "smoke tested" their new Motorola repeater (destined for service atop Mt. Diablo) by installing it in a portable configuration at a point near the northern tier of the fire area. It performed flawlessly. Again, it's hard to know exactly what's transpiring since I am forced to report from secondhand information rather than from an eyewitness viewpoint. Suffice it to say that amateur radio and its people have done and are doing their share and more to aid in the formidable effort to stop the raging infernos. They are giving their time, talent, and equipment because there is a need and a job to be done. I am proud of each and every one of them. They know and they care. They're getting the job done.

Get Set For OSCAR 8

-- details on the new bird!

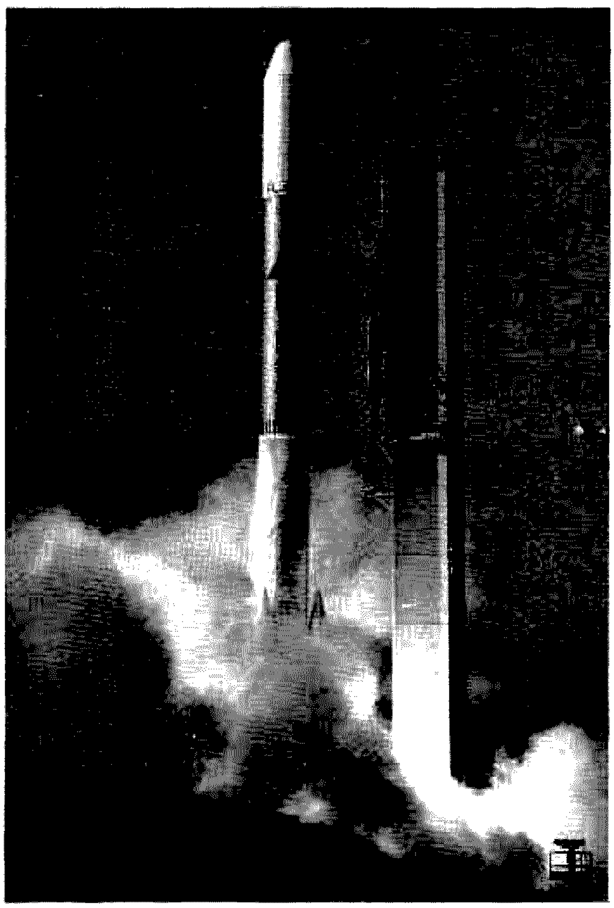


Fig. 1. Up, up, and away! This photo of the OSCAR 7 launch shows what's in store for AMSAT-OSCAR D.

Gary L. Tater W3HUC
7925 Nottingham Way
Ellicott City MD 21043

Five, four, three, two, one, blast-off! Soon a new amateur satellite will be carried into Earth orbit. Are you ready to start making contacts via this new satellite? If not, read on, and you'll discover what you need to use AMSAT-OSCAR D (to be called AMSAT-OSCAR 8 after a successful launch).

Why AMSAT-OSCAR 8?

Because AMSAT's Phase III spacecraft will not be operational until early 1980 and OSCAR 6 cannot be counted on until then, AMSAT felt that AMSAT-OSCAR 8 would provide a continuation of the existing amateur satellite program and insure that amateurs would have a reliable satellite for communications over the next few years.

One major objective of the AMSAT-OSCAR 8 (AO-8) mission is to provide a satellite for use as an educational tool in schools. Other objectives include the continuation of demonstrations by stations in the amateur satellite service, experimenting with the feasibility of using satellites with small amateur terminals for bush communication, emergency communication, communication between medical centers and isolated areas, aeronautical, maritime, and land mobile communications, direct satellite to home voice broadcasting to simple amateur receivers, and other similar applications. Further objectives are to demonstrate special operating techniques that enhance the usefulness of low orbits for these satellite applications and to test a new communications transponder frequency combination for improved operation for moderate power amateur stations.

Building the Satellite

For longer than a year now, AMSAT members from many countries have been planning, designing, and building a satellite called AMSAT-OSCAR D. Because a project like this is extremely complex, it takes many amateurs, pooling all their knowledge and abilities, to turn the stringent design and reliability requirements into a ready-to-launch satellite.

Some of the complex issues that had to be settled and turned into hardware were the receivers and transmitters for the transponders, the antennas and antenna deployment system for the large antennas, the satellite stabilization system, the power system, and hardware both in the satellite and on the ground for commanding the satellite. As a user, you're primarily concerned with the transponders that make satellite communications so much fun, but there are really eleven major subsystems in AO-D:

1. 2m to 70 cm transponder;
2. Two to ten meter transponder;
3. Morse code telem-

1. **Japan AMSAT Association 2m to 70 cm Transponder — Mode J**
   - Input frequency passband between 145.90 and 146.00 MHz.
   - Output frequency passband between 435.10 and 435.20 MHz.
   - Power output is 4 Watts PEP.
   - Downlink passband is inverted from uplink passband.
   - Linear operation — SSB and CW are preferred modes.
   - Morse code telemetry beacon at 435.095 MHz.
2. **AMSAT Two to Ten Meter Transponder — Mode A**
   - Input frequency passband between 145.85 and 145.95 MHz.
   - Output frequency passband between 29.40 and 29.50 MHz.
   - Downlink passband is not inverted from uplink passband.
   - Linear operation — SSB and CW are preferred modes.
   - Morse code telemetry beacon at 29.40 MHz.

Table 1. Summary of AMSAT-OSCAR D transponders.

etry system;
4. Satellite command system;
5. 10m antenna deployment system;
6. Battery charge regulator;
7. Solar cells;
8. Instrumentation switching regulator;
9. Magnetic attitude stabilization system;
10. Satellite structure, wiring, and rf cabling;
11. 14-28 volt power switching regulator.

Building a satellite like AO-D proceeds pretty much along the same lines as most electronic projects do. First, each electronic system is tested as a breadboard and then laid out for a printed circuit board. To insure that the satellite functions reliably for years, each integrated circuit, transistor, and diode is screened by burning the part in by applying power to the part for several hundred hours. Then the component is mounted onto a printed wiring board. After each system is mounted in the satellite structure, the satellite is tested under the vacuum conditions and temperatures it will see in space. Because amateur satellites are launched on a space available basis, they are mounted on the launch vehicle neatly tucked under the primary satellite as you can see from the accompanying pictures. In Fig. 3 you can see Dave W6OAL inspecting the electrical connections for the pyrotechnical shears which, when fired, cut the Marmon clamps that released OSCAR 7 from the Delta launch vehicle. A heavy duty spring then ejects the satellite into its orbit path. A few seconds later, the ten meter antenna is deployed by a pyrotechnical shear mechanism aboard the spacecraft.

Getting Ready

There will be two communication transponders on AO-8 for which you will need equipment. Only one transponder will be operated at a time because of spacecraft battery constraints.

The Mode A transponder is a two to ten meter unit similar to the one on AMSAT-OSCAR 7 and has the same frequency plan (input frequency passband between 145.85 and 145.95 MHz, output frequency passband between 29.4 and 29.5 MHz). You should plan to use about 80 Watts erp made up of output power from your transmitter, coax cable losses, and antenna gain. A ten meter preamp should stand you well for copying the Mode A downlink.

The second transponder, constructed by members of the Japan AMSAT Association in Tokyo, uses a two meter input, 435 MHz output frequency combination which has not yet been flown in the AMSAT Phase II series. This transponder, designated Mode J, operates with an input frequency passband of 145.90-146.00 MHz, and an output frequency passband of 435.10-435.20 MHz. The power output is 4 Watts PEP, so a small 435 MHz antenna should produce a strong signal to your receiver. As noted in Table 1, the output passband is inverted, i.e., upper sideband uplink signals become lower sideband downlink signals. The same transmitter you use for Mode A can be used on Mode J.

Ch. 1	Total solar array current
Ch. 2	Battery charge-discharge current
Ch. 3	Battery voltage
Ch. 4	Baseplate temperature
Ch. 5	Battery temperature
Ch. 6	Rf power out. — Mode J

Table 2. Morse telemetry channels.

Antennas

In general, simple antennas such as ten meter dipoles and four element 2m and 70 cm beams will provide excellent results. The AO-8 Mode J 435 MHz downlink antenna is a simple monopole and will provide a linearly polarized signal. Likewise, the spacecraft's Mode A ten meter downlink antenna is a linearly polarized dipole, oriented perpendicular to the stabilization magnet in the spacecraft as in AMSAT-OSCAR 6.

Although you can transmit on two meters to the satellite using a linearly polarized antenna and get good results, if you are a perfectionist, you might like to try circular polarization.

Both the Mode A and Mode J transponders on AO-8 use the same receiving antenna, a canted turnstile comprised of four 18-inch lengths of ½-inch carpenter's rule fed by a hybrid and matching network so as to develop circular polarization. One port of the hybrid feeds the Mode A receiver such that

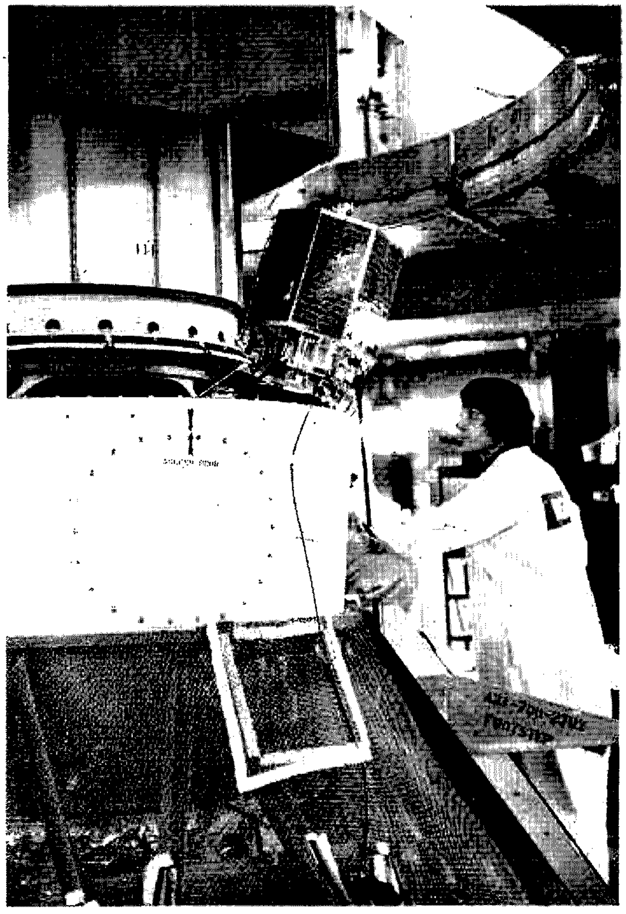


Fig. 2. Jan W3GEY inspecting OSCAR 7 on the Delta launch vehicle.

left-hand circular polarization is required by users in the Northern Hemisphere and right-hand circular polarization in the Southern Hemisphere. A second port of the hybrid is connected to the Mode J receiver such that right-hand circular polarization is required in the Northern Hemisphere, and left-hand circular polarization in the Southern Hemisphere.

Telemetry System

So that everyone can watch the status and health of the spacecraft, AMSAT-OSCAR 8 will contain a six channel Morse code telemetry system. The Morse telemetry on 29.40 or 435.095 MHz will be set at 20 words per minute, but you can slow it down by recording it and playing it back at a slower rate. You will hear the telemetry as three digit numbers with the first digit being the channel number and the next two digits being the telemetry value. A sample telemetry frame would look like this: 120 255 380 451 551 660 HI 120 255.

Although the equations to convert the telemetry values to engineering units have not been finalized as of this writing, the channel selections have been made and they are listed in Table 2.

Using AMSAT-OSCAR 8

Once AO-8 becomes operational and you've assembled your station, you can begin to make contacts picking up new states and countries each time you get on the satellite. If you need help, contact AMSAT at Box 27, Washington DC 20044 for the name of the nearest AMSAT Area Coordinator who, as an experienced satellite user, can give you a hand.

In addition to making contacts and working new states through the satellite, AMSAT hopes that you will consider using AMSAT-OSCAR 8 to perform experiments and educational demonstrations. These efforts gain amateur radio much needed beneficial publicity and provide AMSAT with documented facts to support requests for future launches.

Your experiments might begin with such simple experiments as using a power meter to plot the minimum power needed to hear your return signal in the downlink from your earliest acquisition of signal to loss of signal. Possibly you could measure the frequency change in the beacon due to the Doppler effect of the satellite's velocity.

As a guide to what you can do with AO-8, other experiments are listed in Table 3. Perhaps you can add some interesting experiments to this list. When you complete an experiment, be sure to write to AMSAT with your results, you will be contributing to the future of amateur radio.

Conclusion

If you are already a user of OSCAR 6 and OSCAR 7, then you're set to operate through OSCAR 8, and you know how exciting satellite communications are. If you are not ready for OSCAR 8, then now is the time to get your station ready to join the fun. See you on AMSAT-OSCAR 8! ■

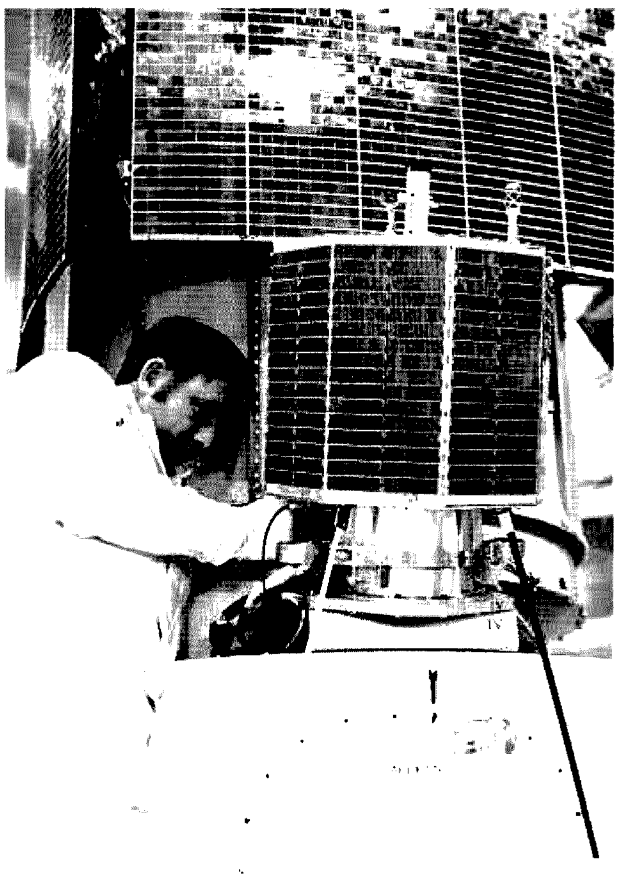


Fig. 3. W6OAL puts the finishing touches on AMSAT-OSCAR 7.

A) Educational demonstrations in schools and for youth groups.
B) Ranging (distance measurement) experiments to determine satellite or user position.
C) Doppler (range rate) measurements to determine satellite or user position.
D) Emergency Locator Transmitter (ELT) experiments to locate downed aircraft or ships in distress.
E) Small terminal user experiments using hand-held equipment, or mobile terminals operated from an automobile, airplane, boat, motorcycle or bicycle.
F) Emergency communications demonstrations with portable equipment.
G) Medical data transmission experiments, including the transmission of analog or digital physiological data (e.g., ECGs and EEGs).
H) Data collection from remote, unattended ground terminals (rain gauges, wind gauges, etc.).
I) ASCII data transmission experiments, including remote accessing of digital computers.
J) Slow scan and medium scan television experiments.
K) Remote control experiments (such as radio control aircraft, garage door opener, remotely controlled kitchen ovens, etc.)
L) Transponder interlinking experiments between AO-7 Mode B and AO-8 Modes A and J.
M) Multiple access experiments (such as quantitative experiments to evaluate the effects of power sharing with different modulation techniques).
N) Ground station automation (closed loop monitoring of downlink signals and automatic adjustment of uplink power and frequency).
O) Broadcast demonstrations using the transponder in a single access mode, evaluating performance for different modulation modes.
P) Extended range communications experiments to attempt transmission or reception beyond the normal maximum satellite range.
R) Low power (QRP) user experiments to determine the minimum power needed to sustain communications.
S) Traffic nets scheduled on the satellite.
T) Automatic tracking of ground station antennas in azimuth and elevation (either on an open loop or closed loop basis).
U) Unattended, automatic telemetry data collection (e.g., using tape recorders for later analysis).
V) Unattended online or offline computer processing of received Morse code telemetry data, with printout of parameter values and units. Automatic decoding of Morse code characters in the presence of noise.
W) Experiments involving physical parameters, e.g., determination of spacecraft spin characteristics and orientation from telemetry data.
X) Traffic handling with RTTY using autostart techniques.

Table 3. Experiments that can be performed using the transponders and telemetry system aboard AMSAT-OSCAR 8.

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Build An OSCAR 2m Transverter

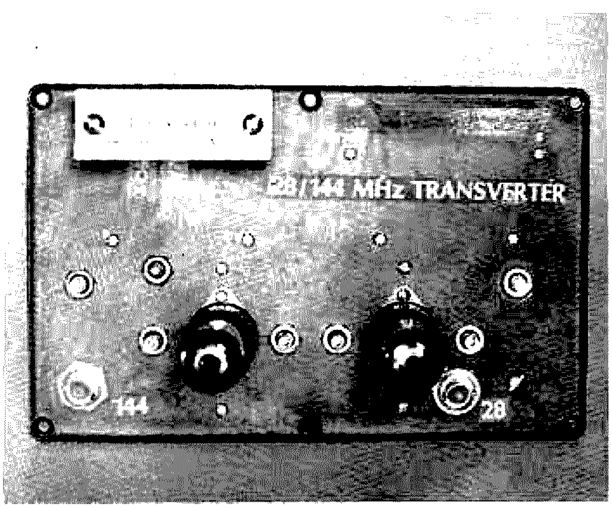
-- make QRP days a success!

There are in use on mode B of OSCAR 7 possibly 200 28-432 MHz transmitting converters made originally by the Carmichaei Communications Co. and more recently by the Amateur Radio Component Service. Using an antenna system with a modest gain, with 4 to 5 Watts output on 432 MHz, these converters seem made to order for low power satellite operation. There are many mode B users who will attest to their performance. W1NU, for example, made about 200 QSOs on mode B with this converter and a mediocre antenna during his 1976 Bermuda jaunt. Considering the successful track record of this converter on 432, its SSB capability and the improved tube performance on 144, the idea of building a 2 meter version was attractive.

The circuitry of the two meter model, shown in block form in Fig. 1, is the same as the 432 model except for the elimination of one stage in the LO chain and the appropriate changes in the LC elements.

The schematic, Fig. 2, illustrates the simple straightforward design characteristic of this converter. A voltage doubler circuit off the 6.3 V ac line provides the voltage for both the 2N4126 and the 2N3866 stages and also the adjustable bias for the 6939 amplifier. Zener regulation is used for the amplifier screen and for the crystal oscillator. The mixer is cathode biased. Input jack J1 is terminated with a 62 Ohm resistor, which may be disconnected if the drive is too low with it in place. A 58.9 MHz crystal may be used if the available driver does not have 29.5 coverage. This will give a mixing frequency of 28.1 MHz for an output on 145.9 MHz.

Construction details are shown in the photos. The unit is built on a Bud CU247 cast aluminum chassis, using the top as a mounting base. A brass partition lengthwise isolates the LO chain, which is built on a circuit board. The mixer and amplifier shielding is provided by two lateral partitions. Five small brass tabs on the partitions provide a connection to the bottom of the chassis to complete the shielding when the unit is placed in the case. Although the construction is a bit fussy, experienced builders will have no difficulty in duplicating either the 2 meter or 70 centimeter converters. For those interested in building, a complete set of information, drawings, and photos covering the two meter converter (and its 220 MHz and 432 MHz counterparts) is available from ARCOS, PO Box 546, East



The complete transverter.

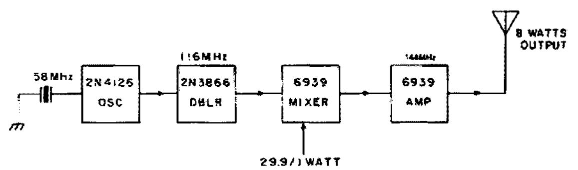
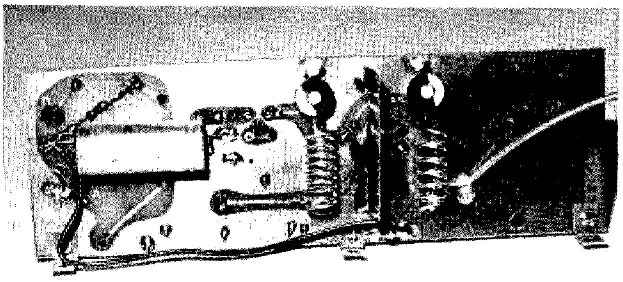
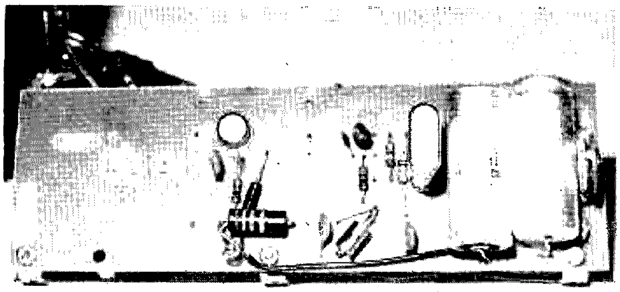


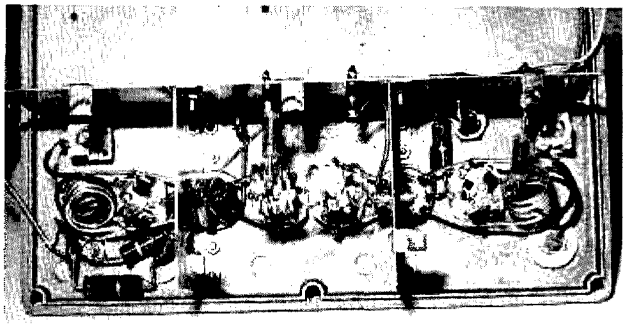
Fig. 1.



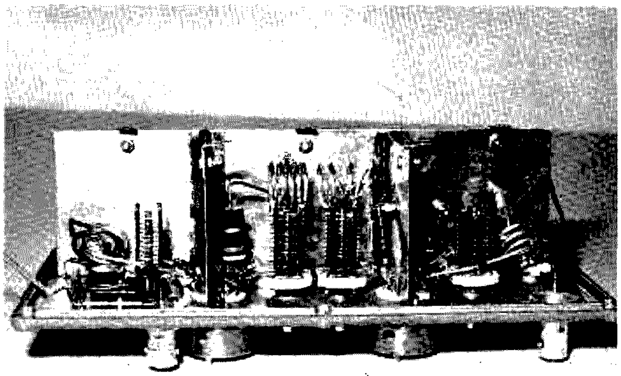
Foil side, local oscillator board.



Parts side, local oscillator board.



Underside of the amp and mixer.



Transmitting converter amplifier and mixer. Note intercompartmental shielding utilized to insure stability.

Greenbush, NY 12061, for $5 (to cover costs and postage). These converters are also sold by ARCOS as assembled and tested units.

For alignment, an output indicator of some kind is needed, and it is best to also have a two meter receiver tuned to the output frequency (observing the S-meter as a tuning indicator). The oscillator and doubler stages may be tuned using an rf probe and meter to maximize output. A counter, if available, coupled loosely to L2 will confirm that the mixing frequency is correct. The rf voltage at the point of connection to the output coax from the circuit board should be 5 or more volts ac. The mixer and amplifier stages of the two meter version of this converter do not appear to have any instability problems, although there is a tendency to oscillation if the mixer grid circuit is mistuned to approach the operating frequency. Spurious outputs, with proper alignment, appear on the Tektronix L-20 to be over 40 dB down. At this low power level, interference with other two meter operations is unlikely and, at least in the Albany NY area, has not been experienced. (More than we can say for some commercial units we have tried to use for satellite work.)

If you haven't yet tried low power, there are still some surprises ahead for you in satellite operation. ■

Coil Data

L1 – 9T – tap at 2½T – ¼ in. diam. – #18 wire – 3/4 in. long
L2 – 5T – tap at 1T – ¼ in. diam. – #18 wire – 3/4 in. long
L3 – not used for 144
L4 – 1½T ½ in. diam. – ½ in. leads – #22 insul. wire
L5 – 3½T ½ in. diam. – 1 1/8 in. leads – #16 wire
L6 – 5T – ½ in. diam. – ¼ in. leads – #16 wire
L7 – 4T – 3/8 in. diam. – ¼ in. leads – #16 wire
L8 – 3½T – ½ in. diam. – 1 1/8 in. leads – #16 wire
L9 – 1T – ½ in. diam. – 3/4 in. leads – #22 ins. wire

Variable Capacitors – Air Type

C1, C6 – 1 to 6 pF
C2, C3, C4, C5 – 2 to 11 pF butterfly type

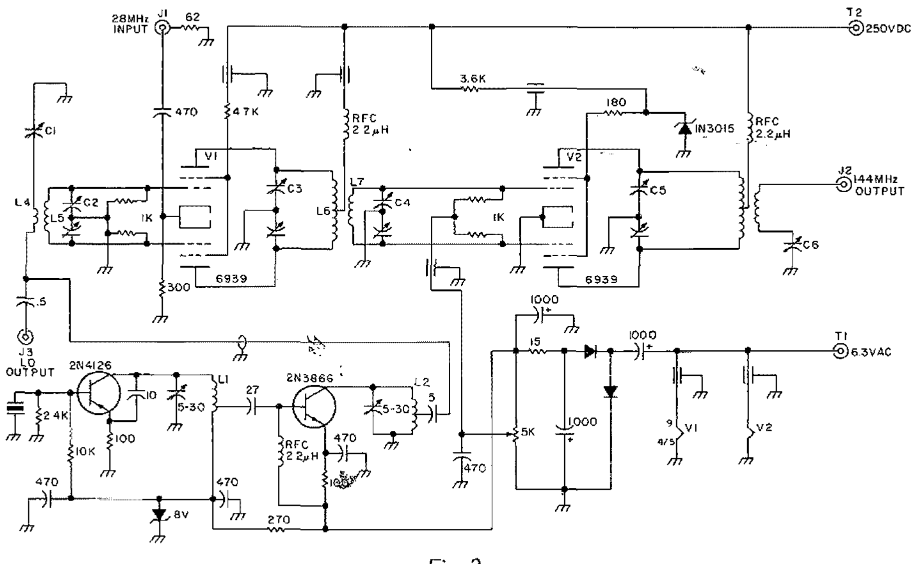


Fig. 2.

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17 Heath Cres.
Hellesdon
Norwich NR6 6XD
Norfolk
England

Predicting OSCAR Propagation

-- not always simple

The earliest case of unexpected radio propagation from an artificial satellite took place in early October, 1957, soon after the launch of SPUTNIK 1. Radio amateurs observed good copy of the world's first man-launched satellite on 20.005 MHz when it was on the opposite side of the Earth to the listener, but not always when it was to be expected, coming up over the horizon. Those observations made during the relatively short life of the spacecraft tended to indicate that good conditions, e.g., a high MUF, were coincident with both of the noticeable effects. Sub-F2 layer reflections during the high sunspot years with the consequent high level ionization were apparently responsible for the antipodeal signal, with the attenuation of lower layers limiting the signal at low angles when the maximum density path was between the beacon and the listener.

A similar effect was apparent on some of the earlier ten meter beacon OSCAR spacecraft.[1,2] With the advent of the OSCAR 6 and 7 Phase II spacecraft in high orbit, well above the maximum possible F2 layers and launched during low sunspot years, similar happenings could hardly have been predicted. Although infrequent, such abnormalities have been evident.[3,4,5,6]

Evidence of beyond-the-horizon audibility of both the 145 and 435 MHz beacons is very rare, but early hearings and late losses have been reported, although rarely for more than three minutes from the calculated AOS or LOS time. One would hardly expect effects like forward scatter to be evident when the signal source is of less than one Watt erp due to the attenuation placing the small signal source well below the noise level at the receiving end.

There is, however, considerable evidence of the two meter uplink of OSCAR users accessing the satellites for up to seven minutes after the time when, according to path theory and calculation geometry, the signal should have ceased to be transponded by the spacecraft. They, regrettably, fell far short of the thirty minute extra presence of the 29 MHz

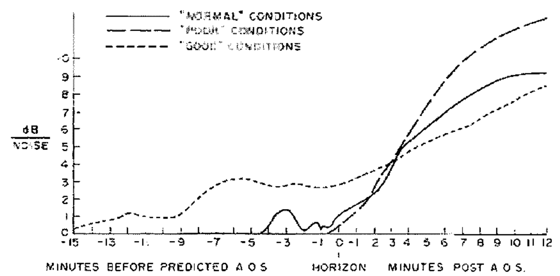

Fig. 1. OSCAR 7 29.502 MHz beacon downlink strength through time in typical different conditions (HF).

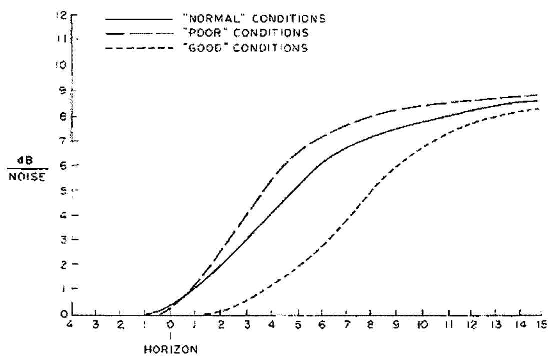

Fig. 2. OSCAR 7 returned (145.95 MHz) signal on 29.5 MHz downlink in typical different conditions (HF).

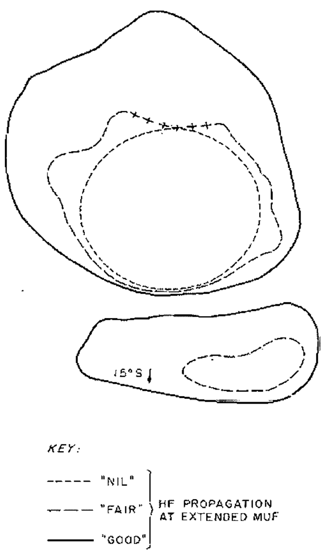

Fig. 3. Contour mapping of maximum distance AO-6 and AO-7A 10 meter detection on polar equidistant projection. Polar areas of no subsatellite points are marked "+" as these are non-definable. Note the distortion of horizon radius circle. This is an effect of using an equidistant projection centered on the pole axis. A stereographic projection would show a true horizon circle, but its center would not be at the observer's specific QTH. A great circle map centered on the observer's QTH would form a true circle with location center, but would further distort distant contours.

downlink, though, and rarely accessed both at the same time.[5,6]

Equally unfortunate is the fact that rarely does the 432 MHz uplink seem to exceed the line of sight by more than about one-and-a-half minutes, within the limitations of my experience.

What appear to be anomalies between the various frequencies' behavior patterns and the apparent contradictions to currently accepted textbook theories may be the subject of a future article when a sufficiency of data has been gathered to give a reasonably statistically sound degree of collated evidence. Already the information obtained and its relationships to other phenomena of interest to the radio amateur are enough to show the value of the OSCAR satellites in fields other than those of through-satellite communication alone.[7]

The following associations between what can be found by listening and using OSCAR for two-way communication, and what may be forthcoming by way of HF, VHF, and UHF (including the effects of aurorae, tropospheric and sporadic E in communication conditions), will be evidenced in an attempt to show that the amateur radio satellites can give a valuable pointer to assist those keen to exploit the improved, and in some cases impaired, propagation that is effected.

The Standard

Many means of extrapolating the precise crossing times of the satellite over one's horizon, calculated from the equatorial satellite crossing time and position,

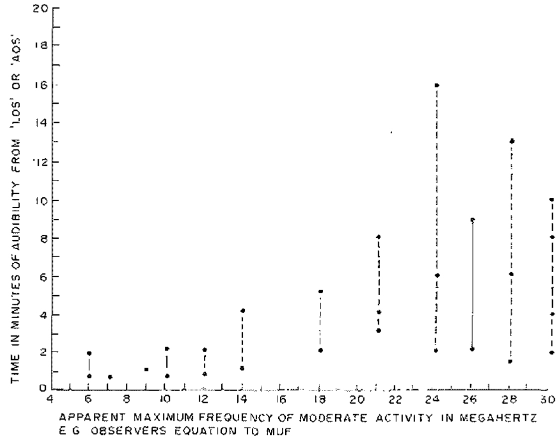

Fig. 4. Plot of all values of extension to horizon to MUF apparent.

now exist.[8,9,10,11,12,13,14] The relationships that I shall use are those related to my own QTH/QRA, just North of Norwich, Norfolk, Eastern England, at 52° 40' N, 1° 10' E. For fine precision, albeit marginal in the wide field employed, the station's height above sea level plus the antenna height is given as 160 feet. With no hill higher than my elevation within the horizon curve, we may evaluate an addition as: $H = 1.42 \sqrt{E}$, where H is the horizon extension in miles, and E is the elevation above sea level in feet. In my case $H = 1.42 \sqrt{(95 + 65)} = 18$ miles. That is neither here nor there in terms of the 3000 mile slant range of OSCAR at horizon, but could add considerably to those in mile high cities like Denver and Mexico. Any blocks to true horizon may be found by the examination of contour maps and plotting out the height against distance on graph paper to find the true contours of the radius of true horizon around one's QTH. (Fortunately, flat old Norfolk suffers from no high hills.)

We now have a means of finding the precise time, say plus or minus 15 seconds, when the satellite comes into our capture. If there is no barometric lift, minimum solar activity, and it is well into the night, OSCAR will appear exactly on schedule, almost simultaneously on the 29.502, 145.971, and 435.1 MHz beacons. One's 432.125-175 or 145.900-146.000 (OSCAR 6) or 145.850-950 MHz (OSCAR 7 mode A) uplinks will appear as transponder output at almost the same time. Any deviation of these times, relative to each other or to the calculated, will indicate an anomaly and show an alternative to "no propagation" conditions.

High Frequency Conditions

Although the variation on calculated AOS and LOS times is not always consistent, the general and average effect may be seen on the graph values of Figs. 1 and 2. At this point let me say that I do not feel that a sufficient number of measurements have been taken to fully substantiate the effect, as time, particularly during daylight hours, is very limited. Furthermore, a number of specific variables need to have attention, e.g., the path preference of normal HF communication at the time of measurement, the skip distance, and a further relationship to the time of year. It did seem that ultra-distant OSCAR audibility was more consistent with short skip conditions, i.e., ionization of the lower layers, than with long skip propagation associated with the F2 layers. But more work needs to be done on this subject. What was apparent from the orbits sampled was threefold:

1. The higher the apparent

usable frequency was, the weaker the OSCAR downlink signal was on 29.502 MHz prior to horizon loss of signal predicted time, and the weaker it was at post-horizon at acquisition of signal times.

2. The increase of maximum usable frequency for HF communication was indicated also by the strength of the downlink signal prior to expected AOS and after expected LOS.

3. The high frequency propagation possibilities tended to coincide with an increase of the time for which the ten meter downlink and beacon were audible both before official AOS and after its LOS.

A further factor is the increase of noise, both on the downlink frequency band itself, and upon the transponder's own downlink.

At this point, two requirements must be pointed out. The first is that the observer must be equipped with a reasonably high antenna, preferably with some gain, as high gain at low angle is an essential to observe these proximate-to-horizon effects. It is assumed that the keen DXer will have this requirement. Second, it is normal to copy reasonably good signals both before and after the above-horizon transit for up to three minutes if the path is in daylight. In low MUF dark path conditions, the signal will normally extinguish promptly at the predicted LOS and arise promptly at AOS. We may summarize by saying that the longer and slower the beacon signal decays, the better the predictor value for favorable HF conditions.

Fig. 3 shows the contour lines found at this QTH with the extra path OSCAR detection, i.e., anything observable above noise in three sets of subjective HF propagations. These are grouped into "good," shown by the continuous contour, "fair," as shown by the dashed contour, and "nil," as shown by the dotted line, which equates the line-of-sight path to the satellite.

While we are dealing with HF conditions, let us mention that curse to the HF man, and the blessing to the VHF enthusiast — aurorae. The period leading up to an aurora will commence with an elevation of the symptoms of good conditions, with an added symptom of greatly increased noise and a marked deterioration of the quality (to use another subjective term) as the satellite nears the polar areas. Immediately preceding the actual event, transponded signals will be all but wiped out by noise and suffer from severe particulate modulation sounding like an old spark transmission. The signals may still be heard post-horizon in the noise for up to several minutes before total loss. More will follow on this subject in the VHF context.

Very High Frequency Conditions

The main indicators of VHF openings are:

1. A severe attenuation upon one's own returned signal, with marked fluttering and very rapid QSB at high maximum to low minimum values when the satellite is at low elevations, i.e., just over the horizon at both AOS and LOS times.

2. A marginal sub-horizon access with the signal popping up suddenly for very brief periods prior to and post the expected path times.

The beacon at these times is marginally affected also, but not to anywhere near the extent of the uplink signal. With increasing elevation, the evidence decreases proportionately. At high altitudes, the effect is virtually unnoticeable, and a normal access proceeds. To differentiate between the HF effect and the VHF effect, which do not always go together, it is necessary to alternately monitor one's own returned signal, and relate this to the beacon for comparison. To the observer, the transponded signal, even in good VHF openings, will rarely be heard more than two to three minutes at best on the downlink at extra horizon times, although other observers closer to the downlink have reported continuing copy for up to seven minutes after

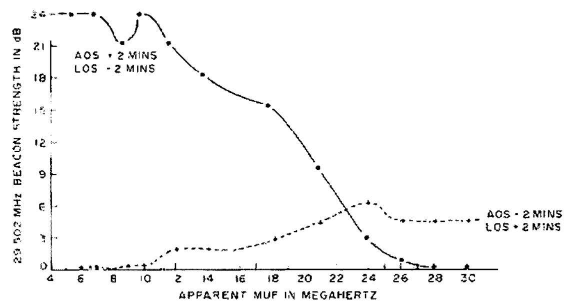

Fig. 5. Mean average signal strength of beacon to apparent MUF of same values.

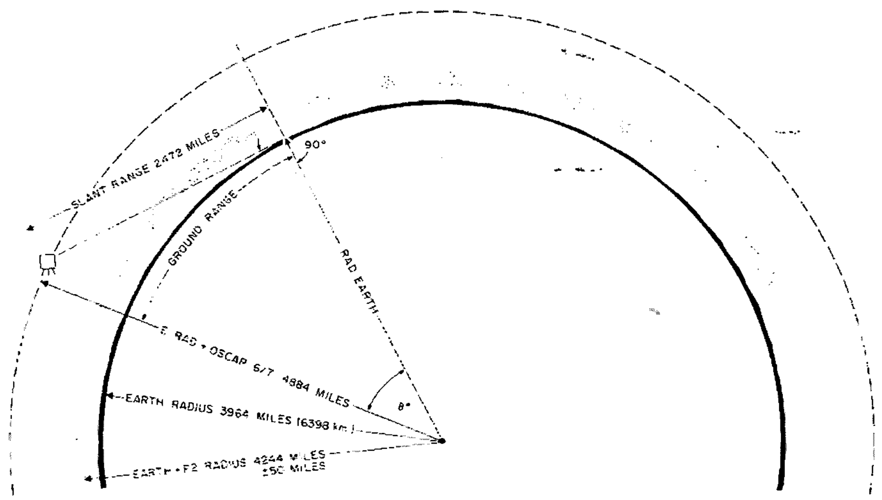

Fig. 6. Horizon geometry. True line-of-sight path calculations and structure for control use. For ground range (subsatellite point to observer) (for use on great circle map), multiply Earth radius by angle formed by it and OSCAR radius in radians. This angle = Θ = $\cos^{-1}$ of Rad Earth/Radius OSCAR = 3964/4884 = 0.8116298 = cos Θ = arcos of 0.81163 in radians = 35° 45' = 0.6238 radians. 0.6238 x 3964 = 2472.7432 miles on great circle + extra horizon.

For horizon crossing point (by Pythagorus): Draw line from Earth's center to surface = Earth radius = 3964 miles (mean). Draw line from Earth's center to OSCAR = satellite path radius = 3964 + 920 = 4884 miles, which is the hypotenuse of the right angle triangle with 90° at the observer's point when "seeing" the satellite at horizon. $H^2 = A^2 + B^2$ ∴ rad. OSC^2 = rad. $Earth^2$ + slant $range^2$ ∴ rad. OSC^2 - rad. $Earth^2$ = slant $range^2$ = $4884^2 - 3964^2$ = 23853456 - 15713296 = 8140160 miles. $\sqrt{8140160}$ = 2853 miles = slant range.

official extinction. It is also apparent at times of good tropospheric conduction that the predicted beam path is not always true. A swing of the beam carrying the uplink signal will often improve the downlink strength considerably by up to a 20° variation in azimuth and some 30° in elevation. The normal polarization preference roll pattern[15,16,17,18] is broken, with quite rapid changes in the preferred linear horizontal or vertical normal pattern that is usually serialized.

The above effects mainly apply to characteristic behavior indicating tropospheric openings.

With sporadic E, the effects are similar, but, instead of the usual evening effects, are more normally present in the central day periods. Now the flutter and rapid fading is far more intense and takes place when OSCAR is at quite high elevations. Sudden extinction and pop-up of the uplink signal is far more evident. Observation of the VHF beacon also shows a similar pronounced effect, which, like the VHF uplink, is also subject to irregular polarization fluctuations at high elevation angles.

Aurorae produce a degree of degradation on the stability and tone of the VHF beacon as the satellite nears the auroral zone. But what are far more distinctive are the isolated uplink returns, which may be quite separately effected with a tone "A" return on the ten meter downlink.[19,20] Often under auroral conditions, even separate GM stations have been observed with the characteristic auroral note, while other northerly stations have been virtually free and other more southerly stations totally free. This indicates that aurorae can be quite specific to a relatively small area, which is surprising, but readily and frequently observed. OSCAR gives a means for the early detection of forthcoming auroral openings prior to the spread to one's parochial observance area on the direct path. An even earlier indication can be given by the follow-on of a period of high MUF conditions due to enhanced solar activity by following the post-horizon ten meter signal, followed by northerly scintillation and tonal degredation.

Ultra High Frequency Openings

Ultra high frequency openings are difficult to detect by the exclusive use of OSCAR, but some small extension to the normal line-of-sight path can be detected for periods of up to one minute. What is more noticeable is the slow rise of the transponded uplink signal returned down on the two meter band, as distinct from the more usual sudden arisal of the downlink. When openings are imminent, rapid flutter coupled with some difficulty of access at very low angles is observable. Possibly a better method is to calculate when stations in the workable area will be beaming at low angles over the top of your QTH as they track OSCAR, and place your receiver on that frequency corresponding with the appropriate uplink frequency on the 432.125 to 432.175 MHz input to that of the 145.875 to 145.925 MHz downlink upon which you are hearing them, allowing for the Doppler shift.[21] It is quite amazing how many openings occur at 432 MHz when no QSOs are evident upon the normal direct path frequency range. It seems many listen, but few transmit, so everyone assumes the band to be dead. OSCAR

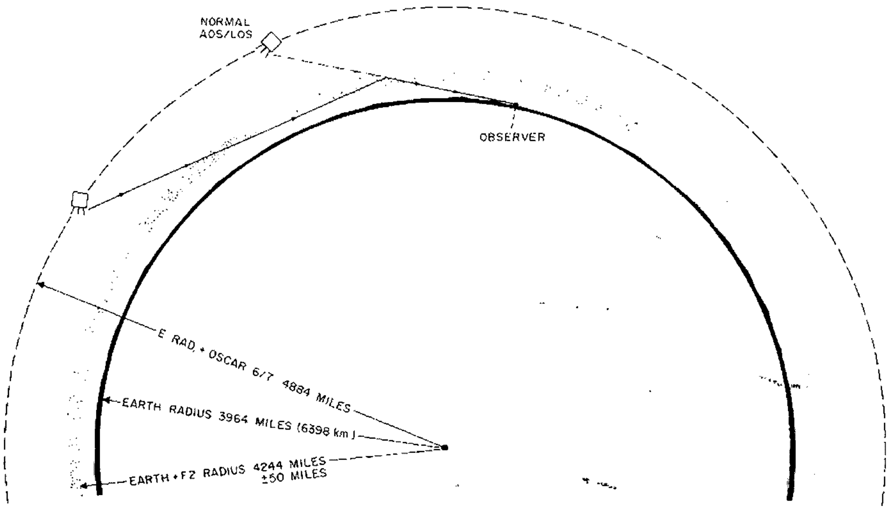

Fig. 7. Possible theory for sub- or post-horizon audibility: At high MUF (dense ionospheric layer) times, the OSCAR signal may enter via less ionized areas according to solar-radiation points. This is thought to be unlikely as its observed signal strength is greater than that expected by such a path.

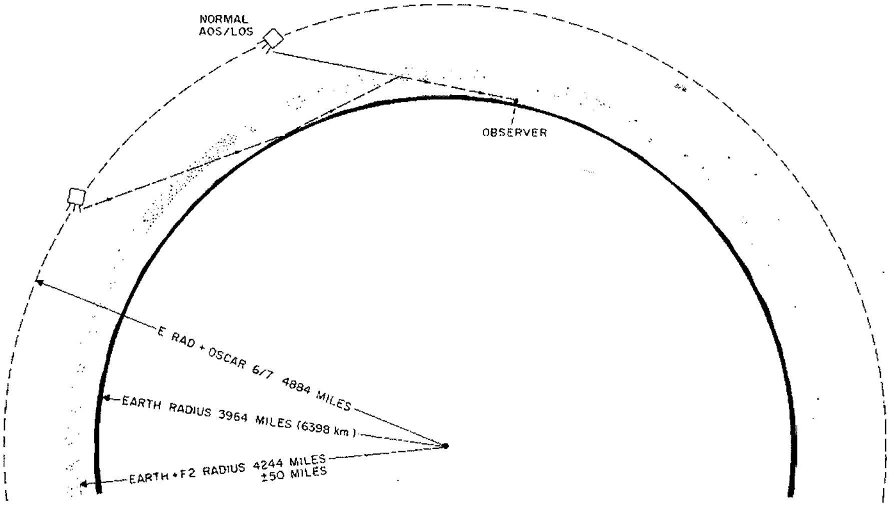

Fig. 8. OSCAR signal may enter through a low ionized area, reflect from Earth, and then return to a reflective F2 area to be returned to observer. This is highly unlikely as signal strengths are far in excess of those expected (if any).

produces known activity on known frequencies with known beam directions and gives a valuable guide to the state of the band.

The theories that may be advanced for the particular effects found can be numerous and complex. The number of variables are considerable, and an insufficiency of observations have taken place to fully define any one single cause, let alone the multiple associations probable. It is hoped that perhaps someone with the time and equipment available may wish to take the investigations over. Ideally, he would be equipped with ionospheric sounding equipment, fine Doppler measurement for determining position and path, and narrow beam antennae. This article is intended to stimulate this approach, as well as to show readers that, whatever their field of interest within the wide framework of amateur radio, the AMSAT-OSCAR spacecraft are a valuable potential asset to their particular aspect. ■

References

1. *QST*, October 1970, p. 74, "Australis Oscar-5 Ionospheric Propagation Results," Ray Soifer K2QBW (now W2RS).
2. *CQ*, May 1970, p. 60, "10 Meter Anomalous Propagation with Australis Oscar-5," K. J. Doyle.
3. *Space Communications*, ARRL Technical Symposium, p. 85-91. "Oscar 6 over Western Europe," Pat Gowen G3IOR, September 1973.
4. *AMSAT Newsletter*, Vol. VI, No. 2, 1975, "Abnormal Reception of Oscar 6 Signals on Ten Meters," report by VU2UV.
5. *AMSAT Newsletter*, Vol. VII, No. 4, December 1975, report of SDX QSO by Bud Schultz W6CG.
6. *AMSAT Newsletter*, Vol. VIII, No. 1, March 1976, report of same SDX QSO by Pat Gowen G3IOR.
7. *CQ-DL*, No. 2, 1976, "Uberreichweiten bei OSCAR-Satelliten im 10-m-Band," Dr. Walter Eichenauer DJ2RE.
8. "Keeping Track of Oscar," booklet published by R.S.G.B. from article series in *Radio Communication* by Bill Browning G2AOX.
9. "Oscalator 6, QSL Card Orbital Calculator," Torsti Paatero OH2RK, *OSCAR News* No. 2, January 1974, p. 21.
10. "The Walland Calculator," *OSCAR News* No. 8, December 1974, p. 17, Dave Walland.
11. "The OSCAR 7 Look-up Chart," *OSCAR News* No. 12, September 1975, p. 21/22. Table plotter by Rudi Schoenberger DL8DF.
12. "Oscar Prediction Look-up Tables," AMSAT-UK Handout, Tony Bailey G3WPO.
13. "Oscar Tracking Computer Programmes," Jack Colsen W3TMZ, David Walland, and Martin Sweeting G3YJO.
14. *AMSAT Newsletter*, Vol. VIII, No. 1, March 1976. "Shoot Oscar with a Satellite," p. 6-14, Kazimierz Deskur K2ZRO. (First published in *73 Magazine*.)
15. *OSCAR News* No. 8, December 1974, p. 5-7, Graphed Roll Patterns by G3IOR and G3PEJ.
16. *OSCAR News* No. 11, June 1975, p. 15, AO-7 Graphed Roll Patterns by G3IOR.
17. *OSCAR News* No. 12, p. 18, September 1975, "Polarization roll graph," G3IOR.
18. *CQ-DL*, No. 2, 1976, "OSCAR-7-Auswertung der Teletype-Telemetrie" Hermann Luer DL3SK, p. 38, 39.
19. *OSCAR News* No. 15, June 1976, p. 3. "General News."
20. *AMSAT Newsletter*, Vol. VIII, No. 1, March 1976, p. 27, Part of GE3IOR letter.
21. *OSCAR News* No. 8, December 1974, p. 12, "A calculator for finding Frequency Relationships, with positive and negative Doppler Shifts," OH2RK.

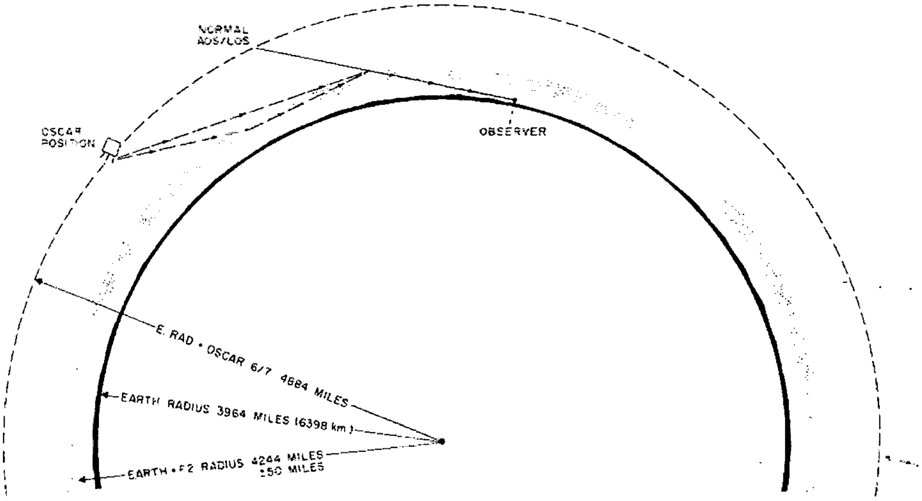

Fig. 9. Possible theory for sub- and post-horizon audibility: At critically ionized areas, the OSCAR signal may enter as a conduction signal upon an "open-ended" duct at the dusk daylight attenuator, hence "conduct" to permit the observer to hear re-radiated signal from the scattering ionized belt.

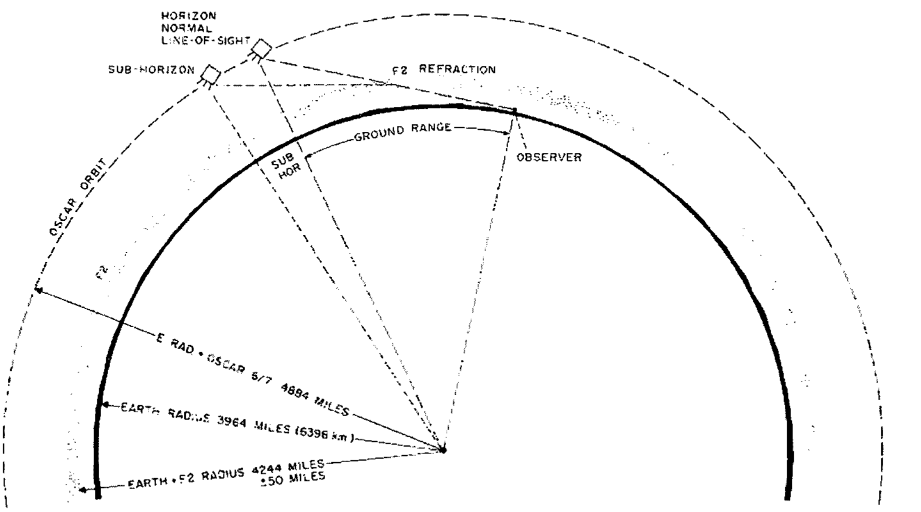

Fig. 10. Possible theory for sub- or post-horizon audibility: simple refraction occurring due to angulation of signal as it transmits an area of higher ionic density.

Further Reading

"OSCAR Anaprop . . . Theory and Practice," G3IOR, in *OSCAR News* No. 5, August 1974. Pages 15-18 give the mathematical formulae required for true horizon slant distances and sub-satellite ground distances.

Photocopies of *OSCAR News* items may be obtained from the AMSAT-UK librarian, G8KME, QTHR, at 3p. or equivalent in IRCs per page and postage coverage.

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Try OSCAR Mobile

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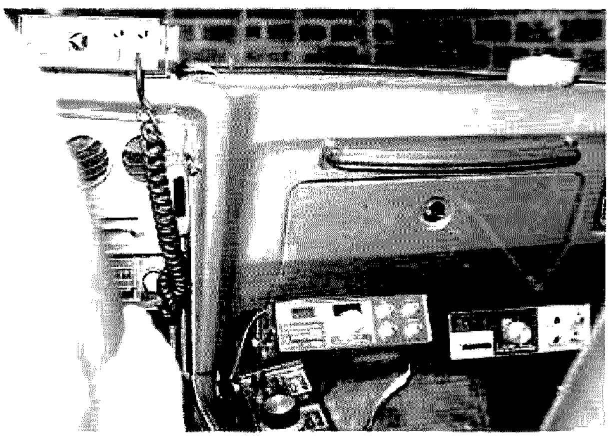
The availability of amateur radio communications via satellite has opened up an entirely new medium for reliable, long or short distance vehicular communications. The amateur radio mobile station equipped for satellite communications is no longer limited by the range of terrestrial FM repeaters, location, or HF propagation vagaries. For example, K8MYN, using the simplest equipment in his vehicle, was able to maintain consistent contact with the USA via the OSCAR 6 satellite from northern Canada and Alaska, when poor propagation conditions in that area rendered the HF amateur bands useless. Other amateurs have successfully used the satellites to communicate from a boat in the Florida Keys, from an airplane over the Pacific, and from various automobile installations. The purpose of this article is to discuss how the OSCAR satellites may be used from a vehicle and give some examples of equipment arrangements and antennas which have been found workable.



Today's equipment — 3 transceivers: 2m, 70 cm and low band. The 2m FM is in the upper left. Solid state amplifiers for the 2m and 70 cm are in the trunk. Antennas: 5/8 wave for 2m and 70 cm; Hustler for 10m and other low bands.

Fig. 1 illustrates the basic concept of mobile to base station communication via satellite. The uplink and downlink frequencies are widely separated, yielding, without filters, a built-in duplex operation. You are, therefore, able to hear not only the signals of the station you are talking to, but your own signals as well – giving a continuous indication of how well you are accessing the transponder in the satellite.

The current OSCAR 6 and 7 satellites are in approximate polar orbits at 900 miles above the earth. Both complete their orbits in about 1 hour and 55 minutes, advancing about 30 degrees of west longitude with each south to north equator crossing. For each *overhead* orbit, they are in good signal range of the relatively limited capability of simple vehicular antennas for about 15 minutes. There will also be about 10 minutes of good signal strength on the orbits two hours before and two hours after the overhead pass.

Thus, for OSCAR 6 and 7, there have been three usable orbits in the evening for the south to north equator crossings and three in the morning for the north to south crossings. This yields for both satellites about two hours total communication time for a 24 hour period. The overhead orbits occur about 9 am and 9 pm local time. There are some variations to this pattern which we don't need to go into here. A vehicular station in the polar regions will access the satellites on every orbit.

To know what time to use the satellites at your location, you keep in the vehicle a table published by W6PAJ showing the time of the equator crossing and the west longitude for every orbit for every day of the year. To the equator crossing time, you add the time for the satellite to come within range. For example, at Albany NY, for an overhead or nearly overhead pass, 4 minutes are added to the published equator crossing time for the evening passes and 34 minutes to the morning crossing time. These times, from experience, allow the satellite to get high enough in the sky to be readily

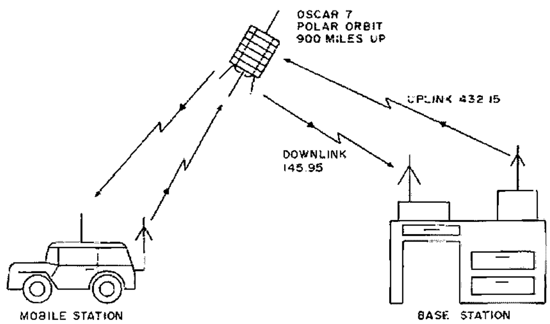
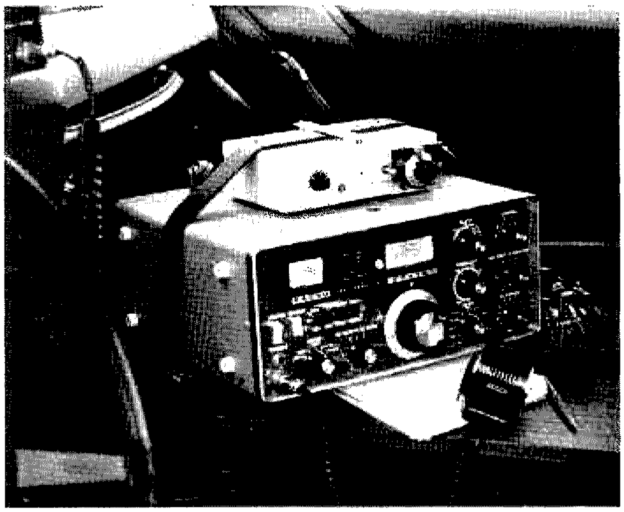
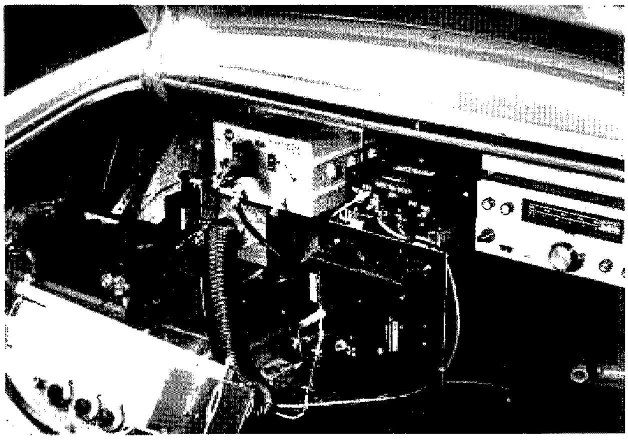


Fig. 1. Mobile to base station operation via satellite.



Transceiver as in Fig. 3 showing the tunable receive converter on top of the FT101.



Power amp on 432 as in Fig. 3. There are 2 power supplies — 12 V dc to 300 V dc and 12 V dc to 1600 V dc — and a 12 V to 115 V ac converter. That's a lot of equipment to generate a 100 Watt plus SSB signal on 432.150.

accessible from the car antennas.

The conservative range over which you can "see" or access the OSCAR 6 and 7 satellites from a vehicle is a circle centered on your location about 2000 miles in radius. If your location is free from obstructions, you will be able to hear your own signals return from the satellite at this range and be able to communicate with any station having an overlapping range during the period of the overlap.

With regard to the mode of transmission, the linear transponders in the satellites will retransmit any mode that is offered. To conserve power and bandwidth, SSB and CW (Morse code) are the preferred modes.

OSCAR 7 Mode B has produced outstanding vehicular communications. Based on calculations by Perry Klein of AMSAT, Table 1 shows the link calculations for Mode B using experimental equipment in my car as an example.

With this brief background of how vehicle communications are established through the OSCAR 6 and 7 satellites, we now describe some equipment arrangements in the vehicle which have been used successfully.

In March of 1973, a few months after OSCAR 6 was launched, the equipment shown in Fig. 2 was installed in my automobile. For the uplink, the equipment consisted simply of a regular amateur type 10 Watt FM transceiver, equipped with a couple of crystals in the uplink passband and arranged for keying the driver stages. An 80 Watt solid state amplifier was located in the trunk. A standard 5/8 wave base-loaded whip was the antenna.

For the downlink, a common amateur band transceiver tuned to the downlink frequencies around 29.5 MHz and a loaded whip cut to this frequency did the job very well.

The first use of OSCAR 6 from a vehicle was made with this simple setup. Over a two year period of operation on the road in various states here in the East, it was very effective, accounting for hundreds of contacts with other amateur radio operators all over the USA and Canada, as well as a few contacts with Europe. The excitement of these early operations with OSCAR 6 will be long remembered by those who participated. This operation was all done with a telegraph key — not the best mode from a moving car. Practically all operation was, in fact, done with the car parked. As mentioned previously, this type operation was also accomplished by several other amateurs, using similar equipment setups readily available from suppliers of amateur radio equipment.

During March, 1975, after a few months of experience with the then new OSCAR 7, it became apparent that the outstanding signals from the Mode B transponder would provide a new level of performance from a vehicle. The first experiments used a transceiver arrangement as shown in Fig. 3.

The uplink starts with the same regular amateur band transceiver as was previously used for receiving OSCAR 6. This is in the front of the car, so the transmit frequency can be controlled from the driver's seat. A low power output (1 Watt) available from this particular unit is cabled to the trunk, and connected to a transmitting converter (28.150 to 432.15 MHz). This converter

Uplink (at 432.150 MHz)	
Transmitter power x antenna gain = EIRP = 100 Watts	+50 dBm
Free space path loss (at 2000 mile range)	-156 dB
Polarization mismatch (linear on ground, circular at satellite)	-3 dB
Net nominal receiving antenna gain at spacecraft	0 dBi
Received signal at input to spacecraft transponder	-109 dBm
Downlink (at 145.950 MHz)	
Satellite transponder output power (with -109 dBm input signal)	+30 dBm
Net nominal transmitting antenna gain at spacecraft	0 dBi
Free space path loss (at 2000 mile range)	-146 dB
Net nominal automobile receiver antenna gain (including transmission line loss)	+2 dBi
Polarization mismatch (circular at satellite, linear on ground)	-3 dB
Received signal at input to automobile receiver	-117 dBm
Receiver noise (bandwidth = 2.4 kHz, noise figure = 3 dB)	-137 dBm
RECEIVED (S+N)/N	+20 dB

Table 1. Note: At a range of 1000 miles (satellite overhead), the (S+N)/N should be 26 to 30 dB. From these figures it can be seen that very effective communication is possible.

W3TMZ was first QSOed from the car via OSCAR 6. The other cards are from the first few days of operation.

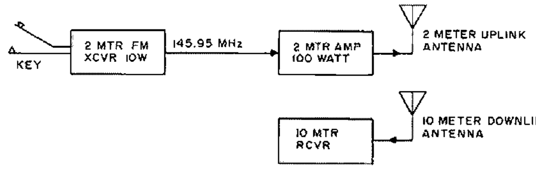


Fig. 2. Simple equipment for vehicular satellite communications.

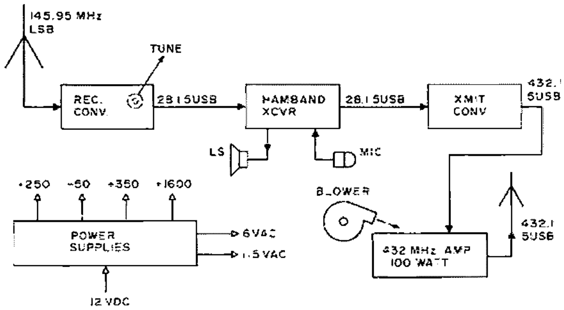


Fig. 3. Transceiver type equipment used in W2GN mobile for SSB communications via OSCAR 7 Mode B.

develops about 3 Watts on the uplink frequency. A stripline tube type power amplifier brings this low power up to the 100 Watt level. A short run of RG-8 cable to a ground plane antenna mounted on top of a standard mobile whip completes the uplink equipment. A rather involved power supply was required to supply all the various voltages required by the tube type uplink equipment in the trunk.

The downlink receiving equipment, since this was to be a transceiver installation, required a special receiving converter to convert the 145.950 MHz passband downlink signals to 28.150 (± 25 kHz) for the transceiver. The crystal in this converter had to be on the high side of the signal to restore the frequency inversion created by the satellite transponder. The crystal also had to be offset to adjust for the small frequency translation irregularity in the satellite transponder and to provide continuous tuning to adjust for the Doppler effect. A crystal tuning capacitor equipped with a vernier dial was employed to facilitate this adjustment. The antenna for the downlink was the same 5/8 wave base-loaded whip previously used for uplink in the OSCAR 6 experiments.

This array of uplink and downlink equipment was tested out thoroughly on the bench by actually communicating via the satellite. The car installation called for a lot of head scratching on equipment location — particularly for the various power supplies.

Murphy must have been looking the other way, because when I finally tried the installation out from my driveway on the first available orbit, I was rewarded with a solid SSB conversation for over ten minutes with W2BXA in New Jersey.

Other than a minor problem in the high voltage power supply, this installation was in troublefree operation for more than two years with impressive results. Particularly on the morning passes, when the 7B transponder was lightly loaded, the return SSB signals were very strong. It was easy to work European stations as well as all of North America and the Caribbean.

Operation in motion is quite practicable with no observable difference from parked. On one occasion, a special test was carried out where the car was kept in continuous motion while the mike was kept continuously active for an entire orbit. The signals from the car were copied by many stations all over the East and Midwest with exceptional clarity. In-motion operation does have a little problem with two-way contacts due to the need for frequent adjustment of the receiver to account for the Doppler shift. One hand on the steering wheel and one on the tuning dial leaves the mike in midair.

A 2 meter sideband transceiver was next installed to supplant the receiving converter described above. This yields the convenience of being able to hear your own downlink signals, an interesting and important aspect of satellite operation. In this setup, the transceiver used to generate the SSB signal on 28.150 was installed in the trunk, taking all the clutter out of the front of the car.

A number of successful demonstrations were conducted at various hamfests and meetings here in the Northeast. The SSB voice signals coming down from the OSCAR 7 Mode B translator invariably gave good loudspeaker copy to large groups by extending an audio line from the car to the meeting hall.

432 MHz SSB transceivers and linear amplifiers became available during 1975, so we continued the equipment saga, and, in early 1976, installed a 432 transceiver alongside the 144 unit in the front of the car and solid state linears for both bands (2m and 70 cm) in the trunk — going whole hog, so to speak.

A regular ham band transceiver plus the usual FM unit provides a capability for all satellite and nearly all regular modes of operation on the ham bands. The antennas continued the same — base-loaded whips on 2m and 70 cm and center-loaded whip for ten meter downlink. We have come a long way in the equipment department since OSCAR 6 was launched in October of 1972. All of the gear mentioned takes up little space in the vehicle. The availability of satellite communications has helped to stimulate this development.

As the AMSAT program for future satellites unfolds, we can expect mobile operation via satellite to be a regular part of the day-to-day ham operation. Continuous coverage via satellite must be held as the ultimate goal, either through use of high altitude satellites or by operating several satellites properly spaced at a lower altitude.

Once that is accomplished, there will be no barrier to communication by amateur radio from any point on the Earth at any time. ■

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Tic Tac Touchtone

-- a new method!

Between the looks of the push-button pad arrangement of the Touchtone™ and the hit-and-miss aiming technique I had been running until recently, the title seemed a likely one for the circuit block diagram in Fig. 1. What the circuitry allows you to do is tape record (or manually enter) TT tones that are then entered into a decoder for a one-of-ten number choice. These tones are changed to TTL levels, and from one-of-ten code to BCD. A set of storage latches allows you to enter a six-digit number sequentially, and yet store it as six sets of parallel BCD data. Now, what can you use it for?

As described, I use it to record (or enter manually) azimuth (3 digits) and elevation (3 digits) information on convenient cassette audio tape for a given OSCAR pass. Depending on how you do the recording and playback, you have enough time on one side of a 60-minute cassette to record even the longest 24- to 28-minute pass in real time. At real time, you would start your recording with the starting position coordinates for your antennas, and then enter new information from your calculated data (or Satellabe™) every one-half minute or so, with the tape always running. Two drawbacks! One, this can eat up a lot of tape. Two, it takes as long to record every pass as the pass really takes! I record and play back mine a bit differently. By using a circuit very similar to Fig. 7 (R-S flip-flop wired gates) to control the tape recorder run/stop circuit via the microphone third wire, I waste no tape. You build a second Fig. 7 leaving off Rs, Cs, Rg, Cg, and both switches, since the tape control inputs will be TTL levels. The relay contacts are then wired as in Fig. 7(a) to control the tape recorder run/stop circuit. For inputs to this added IC, refer first to Fig. 2. IC5-11 shows a lead going off to tape. Attach this lead to the new IC pin 13, taking the place of the hold switch of Fig. 7 and forming the tape stop command. Whenever a # is decoded from the tape or direct command, the tape stops. To start the tape, any TTL-compatible pulse from high to low into pin 9 of the new IC will start the tape. The relay will close and the tape will run. To record using this method, let the pulse (from timer or electronic

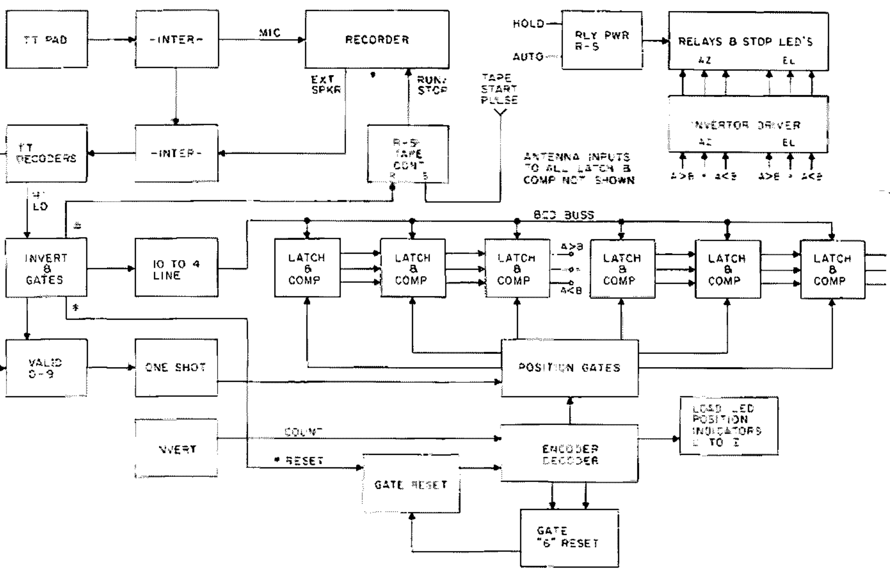


Fig. 1. Block diagram.

clock at 1 or 2 per minute) start the tape on playback, and use a momentary low on pin 9 to start the tape when you are ready to enter new data for a pass when recording. You enter your data in 6-digit format shown by this example for an azimuth heading of 163 degrees and an elevation of 45 degrees: Enter by pushing the TT pad buttons 1, 6, 3, 0, 4, 5, #, for a 163045# sequence. When you hit the # key, the tape will stop, but the tone will be on the tape. Start the tape with a pulse again, and after 2 to 3 seconds, enter the next headings, followed again by #, and so on. When the timer plays back the tape, one 6-digit number and stop tones will be played back for each timer pulse, so be sure to enter data for every minute if a one-per-minute timer is used, or data for every one-half minute if a 2-pulses-per-minute is used, etc.

The interface shown between the TT pad and the recorder is a combination of the TT pad level control, the ALC circuit of the recorder, switches you choose to use, cables and plugs, and so on. Nothing fancy, and not included here due to the many types of pads and recorders. The same goes for the interface shown between the recorder and the TT decoders in the playback mode. It can be any ALC, or the recorder playback volume control, or anything to hold the tone levels to about 50 to 100 mV (if you are using PLL decoders). The TT decoders are also not shown, as they have been in many forms, in many magazines. It's your choice, just as long as the output goes from about +4.5 V dc to ground on the output line when that tone is received.

Taking it from the output of the TT decoders, the high and low tone group outputs (lows) are fed to an inverter so that both high and low are available for each output. Then the inverted forms are fed to gates to decode a single number for any tone pair received. Output from these gates is fed to a 10-line to 4-line converter IC. This 74147 IC happens to accept a low on the 0 to 9 input line side, and outputs $\overline{BCD}$ code equivalents of the digit that was entered. This inversion doesn't bother us, as the $\overline{BCD}$ is inverted again in the 7475 latches by using the $\overline{Q}$ outputs. The then BCD code is fed to a 7485 comparator IC to compare it with the BCD code sent down from the antennas. That covers the signal path, which is really easy. Now for the controlling part!

Going to Fig. 3, all lines that enter each half of IC17 are normally high during no tone. When any valid TT tones are received, one input line of one half of IC17 (pin 1, 2, 4, or 5) and one input line of the other half of IC17 (pin 9, 10, 12, or 13) will go low (for the numbers 0 to 9, but more on that later). Since IC17 is a 7420 4-input NAND gate, all 4 lines of either half input must be high for a low output. When the tones cause these IC17 outputs to go high, IC28-3 goes low. This causes the one-shot IC18 to fire for approximately 5 ms. The one-shot IC18 output enables half of IC19 and IC20, 7408, and gates. The other half of only one of these gates at a time is enabled by what line (U, V, W, X, Y, Z) is also high. If we are in the first digit position, for example, the counter 7490 (IC15) and decoder 7442 (IC14) would be in the zero (reset – 1st digit) position. IC14-1 will be low, and when inverted by IC13-1 to IC13-2, a high results, enabling IC19-3 to a high. This high turns on the latch enable line of IC7-4 and IC7-13. The BCD data for the first digit present on the common BCD bus in Fig. 2 are transferred to the output side of *only* that latch. It is then compared by the 7485 (IC21) with the current antenna BCD read down to the other side of the 7485.

Going back to Fig. 3, the same low for a valid TT tone at IC28-3 that keyed the one-shot IC18 is also fed to IC16-12 and IC16-13, causing a high at IC16-11 and IC15-14. This low to high transition when tones are received does nothing at the counter input IC15-14; however, when the tones stop, the condition reverses (high to low), and the counter advances one position and is ready for the next number. You can follow through the counter (IC15) and decoder (IC14) up through IC14-2 to IC13-1 to IC13-4 to IC19-5, and see that the next position is then half enabled and needs only the one-shot pulse from IC18 when the next tones come along to load the second position latch (IC8) with second digit BCD data.

It should be noted at this time that the TT pad * key can be used to reset the counter and latch positions. IC16-4 and IC16-5 are used in upside-down gate fashion, much like IC28-1 and IC28-2, in that if either high goes away from the inputs, the output goes high and resets the counter. IC16-5 is also used to reset the counter when position "6" is reached in the 7442, so the counter does not rely on the * to reset. The position "6" reset is detected as a BCD 6 by IC16-1 and IC16-2 to IC16-3 to IC15-5.

Referring to Fig. 3 and IC17: The inputs to these gates were originally wired to detect all valid TT pairs, but this leads to both limited and confusing control. By using

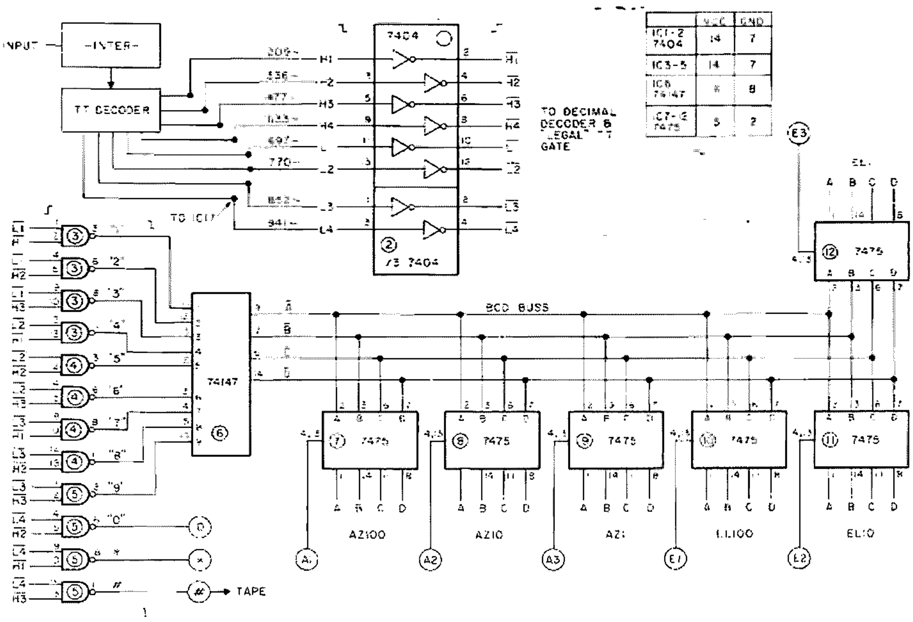
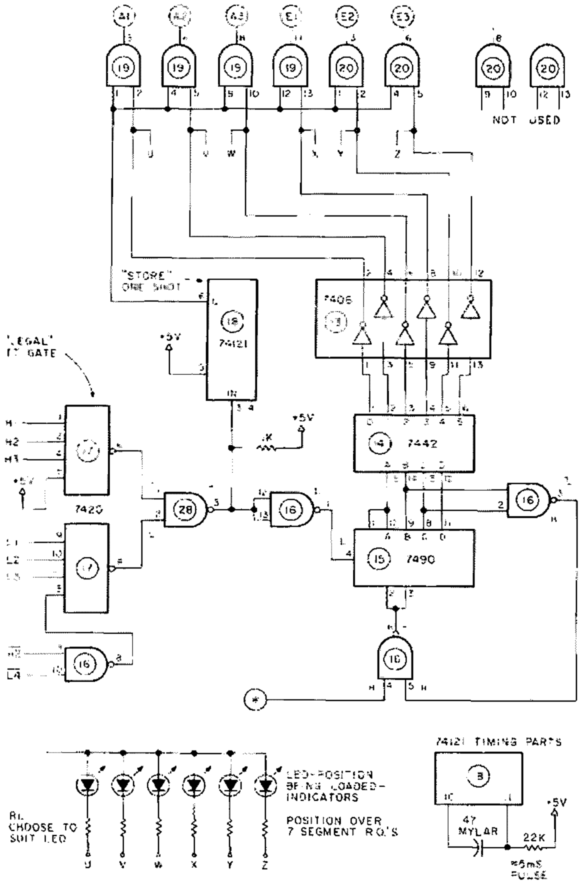


Fig. 2. Decode and store diagram.



IC #	Name	Vcc	Gnd
13	7406	14	7
14	7442	16	8
15	7490	5	10-6-7
16	7400	14	7
17	7420	14	7
18	74121	14	7
19	7408	14	7
20	7408	14	7

Fig. 3. Control unit.

pin 5 wired to +5 V dc instead of H4 where it was, we delete the decoding of the entire H4 group (A, B, C, and D letters on some TT pads). This allows their detection by NAND gates wired like IC3, 4, and 5, without causing any counter or latch action. After all, you never want to enter this as data to the number latch anyway, but you may want them for tape or local control signals (future use!).

Also, in the low tone group inputs, a gate is added to the L4 input. By doing so, we set up the low tone half of IC17 to only recognize 0 of the L4 group (*, 0, #, D) as a valid number to be loaded into a latch when received. This occurs when the tone pair for zero (H2 and L4) are inverted in IC2 and appear as $\overline{H2}$ at IC16-9 and $\overline{L4}$ at IC16-10 as highs. This causes a low at IC16-8 and a high at IC17-6, and with both outputs of IC17 high, a valid number is "seen" for loading the latch.

Both * and # are L4 tone numbers, but neither has the H2 high tone, so they both are ignored by IC17. Thus, by wiring the IC17 high group correctly, and adding a simple gate to the low tone group, only the numbers 0 to 9 are used to load the latches.

I believe that covers the line by line, so let's examine the 163045 example given earlier, as it progresses through the digital hardware. The 1, of course, was decoded and stored in latch IC7. Then the 6 is put in, decoded, and stored in latch IC8, the 3 is put in latch IC9, the 0 in latch IC10, the 4 in latch IC11, and the 5 in latch IC12. Going to Fig. 4, you can see by the "numbers" shown in ICs 7 through 12 just what is stored where.

If the relay power is in the automatic rotate mode of Fig. 7, IC28, then the antennas will begin to move the instant the first digit is received, decoded, and latched, if it differs from the antenna position in that digit. Fig. 4 also shows the output relay control lines of the 7485s under "other 7485 connections." The 7485 has cascade inputs available at pins 2, 3, and 4, and these pins are used. The overall output of the 7485s seen by IC27, pins 1, 3, and 5 for azimuth, and 9, 11, and 13 for elevation, can be in only one state at a time – either A > B, A = B, or A < B. These overall outputs are in whatever state the 100 IC21 commands until A = B in that IC. IC22 then takes over, followed by IC23 (azimuth example). For instance, if we started the beams mechanically at 000 degrees (north) for azimuth, and 000 degrees elevation, the following would take place after the data was all in and stored (163045), and then the relay power applied with the "auto-rotate" button: IC21 says A > B, output A > B, and the CW relay pulls in to increase degrees azimuth on beams (increase B data) until 100 degrees is reached and IC21 says A = B in this digit. Then IC22 takes over with its own A > B, output A > B, and the CW relay stays in until 160 degrees is reached and IC22 says A = B in that digit. Then IC23 takes over with its own A > B, output A > B, the CW relay stays in until 163 degrees is reached and IC23 says A = B, the azimuth stop LED comes on, and the CW relay drops out.

The same thing happens independently in IC24, IC25, and IC26 for elevation. In our example, IC24 immediately sees an A = B (0 = 0) and transfers control to IC25 until 40 degrees elevation is reached and an A = B condition is reached in IC25. Then IC26 takes over with an A > B command until 45 degrees is reached when the up relay (energized until now and driving the beams upward) drops out and the elevation stop LED light comes on. The system is then at rest, and remains so until further data streams are received from the tape-timer or by manual entry.

While on the subject of the relays, Fig. 7 was added so that data commands could be entered when in the hold (no relay power) mode without actually turning on the antennas. It is a handy override, because if you want to stop the antennas at any time, you can do so with a push on the "hold" button. Hitting the "auto-rotate" button returns control to the latches of the TT controller system. This also means that you can cancel a taped command by overriding it with the hold button, enter a manual command, and return to automatic by pushing the auto-rotate button.

I included a panel layout (Fig. 6) to give you a starting point. Laid out this way, it is functional and not confusing. I used orange plexiglas over the BEAM 7 segment displays, and ruby red in front of the DATA entered readouts to avoid mix-ups. The hold LED is red, the auto-rotate green, and (in my case) the CW, CCW, Dn, and Up LEDs are all yellow. The az and el stop LEDs are, of course, red. The panel is gray, with black TT keys with white lettering, so it makes a nice addition to my Drake equipment. In fact, I used a Drake speaker cabinet (MS-4) and had tons of room left over, both on the panel and

in the box.

This system replaces the earlier Autotrak* at my QTH, but to each his own. If you have the RTTY gear, the earlier system was okay, but required a lot of hardware to get from Baudot to BCD and the like just to have the advantage of pre-stored tape (paper tape in that case). The advantages of this newer system override any drawbacks of not having a hard copy printout, and careful labeling of the cassettes should eliminate any problems.

With the average OSCAR antenna setup, having tapes for every 5 degrees of longitude seems to be more than adequate, amounting to some 15 to 20 pass combinations, worst case. All this fits nicely on 2 cassettes in my non-real time system. You can get sneaky as you record by using a pass "code" information right on the tapes. Let me show you by example. Since azimuth information is the closest to longitude or surface information, I chose to use those readouts to locate a point on a tape containing some 4 to 6 passes. When recording, ahead of each sequence of pass information enter the following "code":

*"Introducing Autotrak!", W9CGI, *73*, July, 1977.

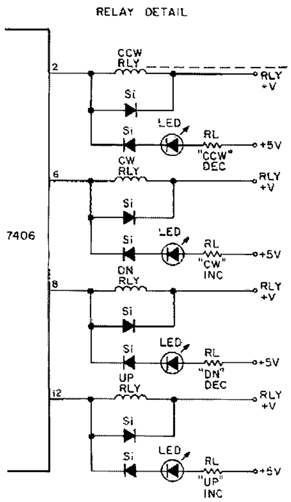


Fig. 5. Si = silicon diode, 50 V, 100 mA. All RL chosen for LED used.

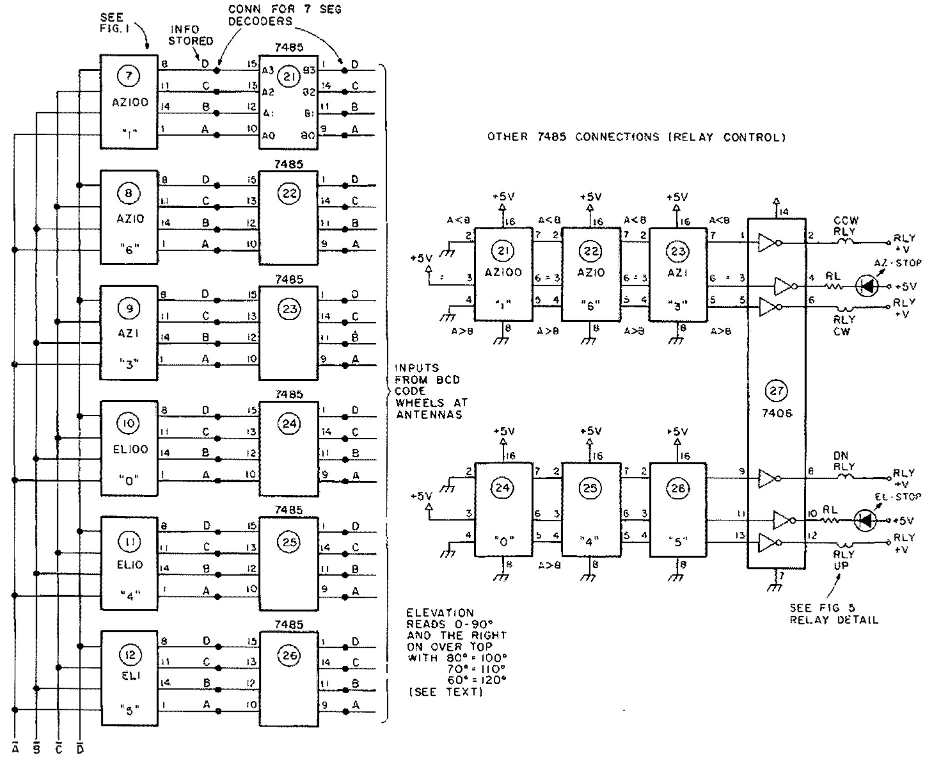


Fig. 4. TT controller.

Push *, then whichever of the A through D keys you want to use for this function, then the longitude of the equator crossing for that pass you are about to enter next as a 3 digit number, then 0, then 0, then 0, then the A to D key you chose above again, then wait 10 seconds, then push the * key to clear the register (counter), then wait 5 seconds, then begin entering your data for the pass as shown before.

By opening the antenna circuit with the hold key, and defeating the tape stop command by closing the defeat switch in Fig. 7, you can go down about 30 minutes ahead of the pass. While letting the gear warm up (*please!*), you begin playing the proper tape back. Example: An overhead pass for me is 72 degrees crossing at the equator, so I take my 52 degree to 77 degree tape (I go in 5 degree increments on either side of an overhead pass here) and put it on the recorder. The pass I am looking for is the fifth one on this tape. When the tape begins playing back, the first information I get is a *, to clear the counter to position one regardless of where it came on when power was applied. Then the D tone is in my case decoded and wired into an audio monitor (NE555s and a speaker) to form a 1000 Hz warning tone that in this case means that longitude information is about to be presented on the data readouts. Next, the tape decodes and displays the digits 052 000 on the data readouts, telling me that the information that follows is for a pass having a 52 degree equator crossing. The audio warning is repeated. Then the decoded * clears the data counter to the 1st position (it should be there due to a detected 6th digit position after the last 0 was entered — but why risk it?). The information that follows is pass data, and the # does not shut off the tape, since you defeated that circuit. When the tape reaches the next "code" information, the above is repeated (in my case: clear, tone, 057000, tone, clear), so that you stop the tape manually right after the equator crossing you want (072000). You would then push the defeat switch to normal and the auto-rotate button, and set up your timer to control tape starts. For the exact time of the crossing, I

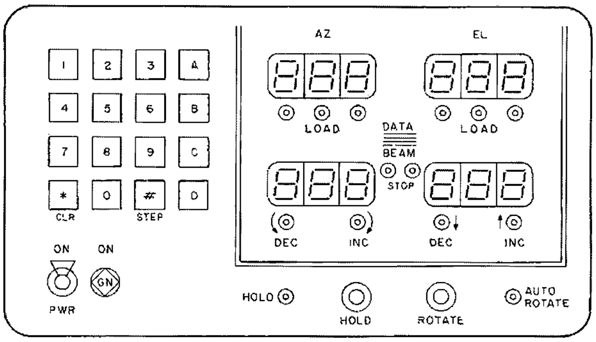


Fig. 6.

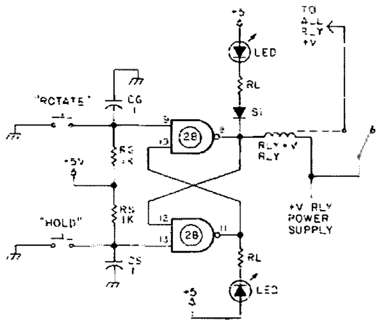


Fig. 7(a).

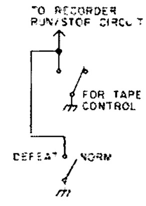


Fig. 7(b).

enter the approximate azimuth from the Satellabe™, and an elevation of 000 degrees. Two reasons: One, I can start all runs with the published crossing time, even though the satellite is out of range — it is not always out of range! Two, this gets the antennas into approximate position for your AOS position anyway, so you don't have to wait on them coming around. I use an automatic call sender that keys off the same high to low transition from the timer that starts the tape, so I listen for myself even before normal AOS and then turn off the sender. This all makes every pass a very repeatable situation — they all start at the equator, and the first tape information is for equator plus 30 seconds. I run the beams around to the equator start point with a manual entry from the keyboard, just before doing the timer setup. This way, I have *one* manual function to do concerning the antennas when the satellite crosses the equator — pushing the "go" button on the timer to start the first thirty second period. Thirty seconds later, the timer sends a pulse to the controller — tape start — and the T + 30 data is read in and the beams run to that position. At 40 degrees latitude, this is always the same as what you manually loaded, so you could include it on the tape and let the tape read in the initial condition by turning the normal defeat switch from defeat to normal (*after* the longitude figures you want are read and clear themselves, but *before* the first data coordinates are picked up off the tape — we left about 5 seconds). This way, the decoder picks up the first tape stop #, and would wait there until the timer T + 30 pulse — putting you right back in sync.

That sums up the theory and the how-to-tape information part. It works great, and allows me to concentrate on the receiver instead of growing a third hand for the antennas. No doubt you will find your own uses and probably some variations, and that's good — write them up! I have no beef with anyone who starts with my idea and improves on it — chances are I'll add it to my system, too.

Please include an SASE if you need help. The letter load has increased with the increase in my "articles published" count, but same day answers are usually still possible if you make your questions clear and concise. Adaptations and modifications by you take a while longer, since I like to try what you did on the hardware here and see what really happens. ■

LETTERS

from page 16

of '76. In January '77, I flunked my first time on the General, but then went in February and passed it. Then 3 months later (May), I passed my Advanced; 2 weeks later in June, and during the last week of school, with all the final exams, yea, I walked away with the Extra on my first try. Same day I sent away for my 1 x 2 call. Youngest ham to get (or have) a 1 x 2 call?

I guess if you show this letter to some of your local CBers, it'll get 'em off their tails and show 'em how easy it is.

How did I do it? Naw, I'm not a "child prodigy" and my marks in school aren't too good. It took a lot of time and energy and staying away from all the wild women. And if you wanna speak to me, I'll probably be on the bottom of 20 meters CW (or where I am now, relegated to 2 meter FM with a borrowed HT because of antenna problems). And I'll talk to anyone.

Howie Goldstein WB2IWX
Brooklyn NY

PLUGGED IN

Right on, Mark Clark WB4CSK, "Letters," September issue of *73!*

Through studying and a conscientious effort, I earned my license (Advanced). Because of that, I have a certain sense of accomplishment and pride in being part of the fraternity of ham radio. Also, because of that, I would not knowingly do anything to jeopardize its existence.

For those who subscribe to the quantity theorem for getting newcomers into ham radio, I propose that you listen to Ch. 19 CB for a couple of days, then ask yourself, "Do I want to listen to that on the ham bands?" There are too many appliance operators in our ranks as it is now.

For those existing amateurs who believe in easier upgrade privileges, take another look. Maybe you are one of those appliance operators.

Richard L. Miller WA4OET
Ft. Belvoir VA

UPDATE

We were indeed happy to see your three-page coverage of TEN-TEC modifications to the Argonaut in the August, 1977, issue of *73*. The only problem that we see is that it was not pointed out anywhere in the article that the modifications described were performed on our old Model 505 Argonaut, which was replaced in June of 1975 with the Model 509. The Model 509 indeed incorporates the modifications shown in the article with the exception of the disconnect socket on the speaker. The reverse polarity protection and the drive control on the front panel are incorporated in the Model 509 and always have been. I would appreciate it if you would run this information in your letters column so that owners of the Model 509 do not feel that modifications are desired or necessary with their units.

The only statement in the article that we take exception to is the one where it is intimated that TEN-TEC had a prepackaged kit of parts for repairs to units that were connected up reverse polarity. I know of no such prepackaged kit, but the usual damage was to the switching transistors on the control board, and possibly the large electrolytic capacitor across the dc line.

TEN-TEC, Inc.
Daniel J. Tomcik
Executive Vice-President
Sevierville TN

GUD QSO, OM

Most hams have listened to something like this: "We are a doctor here and have a patient due in our office in ten minutes, so we will have to say 73 for now," etc.

I have been a ham for over 25 years and have heard "we" used to denote a

Continued on page 75

Michael J. Di Julio WB2BWJ
97 Woodside Road
Maplewood NJ 07040

Visual OSCAR Finder

-- nice side effects!

A very unique OSCAR-locating aid appeared in *QST* in May, 1974, described by WØCY. It consisted of a rotating globe with several LEDs around it, sequentially turning on and off to simulate the position of OSCAR. The project used several gearing arrangements, entirely too many LEDs, and a 115-position rotary switch to accomplish its task. I felt this to be too costly and mechanically complicated, and I was prompted to simplify this otherwise excellent article.

Completed OSCAR finder.

The only mechanical device in my locator is a 24-hour clock movement, obtained from a Master Crafters 24-hour world clock. This clock was popular with hams in the 1960s and can be found at hamfest flea markets. Mine had been retired years ago, when I built a digital station clock. The movement and all hands are removed from the clock, and the back cover is removed from the movement to expose the gears. For this project, it is necessary to reverse the rotation of the clock. The motor will go in any direction in which it is started, but there is a ratchet underneath the only yellow nylon gear in the movement that forces the clock to turn clockwise. This ratchet is removed by drilling out the rivet holding it. Now the clock will turn in any direction in which it is started.

The globe used was bought in a five-and-ten-cent store, and it is made by the Ohio Art Co. It was originally intended to be a bank, so the base on it must be removed. This is easily accomplished by pulling the base straight out from the globe. Next, a ¼" hole is drilled in the south pole, and the outer ring, salvaged from the hour hand, is soldered to the globe at the south pole, after removing the paint from the globe and the ring at the point of attachment. The globe will now fit snugly on the outer shaft of the movement, as the hour hand did. On the globe, a 2500-mile-radius circle, drawn to scale, is centered around your QTH and drawn with a marking pen. This indicates the area within

Parts List

ICs
1 7493 Lafayette 32P06919V
1 74154 Radio Shack 276-1834
3 NE555 Radio Shack 276-1723

Resistors
3 10k ¼ Watt 10% all Radio Shack 271-1300
2 1k ¼ Watt 10%
1 2.2k ¼ Watt 10%
1 1 meg ¼ Watt 10%
1 68k ¼ Watt 10%
1 360 ¼ Watt 10%
1 1k ½ Watt 10% Radio Shack 271-000
1 10k 10-turn trimmer pot R1

Capacitors
2 0.01 uF disc ceramic: one at 200 V Radio Shack 272-131 and one at 25 V Radio Shack 272-131
1 3200 uF 6 V electrolytic Radio Shack 272-1021
1 3200 uF 10 V electrolytic (can be smaller – see text) Radio Shack 272-1021 C1
1 1 uF 5 V electrolytic Radio Shack 272-1406
1 10 uF 10 V electrolytic Radio Shack 272-1002
1 0.05 25 V disc ceramic Radio Shack 272-134

Other Semiconductors
16 LEDs miniature or subminiature Radio Shack 276-042
4 1N4001 Radio Shack 276-1101
1 2N3906 Radio Shack 276-2021
1 5.1 V 1 Watt zener 1N4733A Lafayette 32P08691V

Miscellaneous
1 8 Ohm miniature speaker Lafayette 99P60360V
1 SPST switch Radio Shack 275-612
1 normally-open push-button Radio Shack 275-1547
1 117 V to 6.3 V transformer 300 mA Radio Shack 273-1384

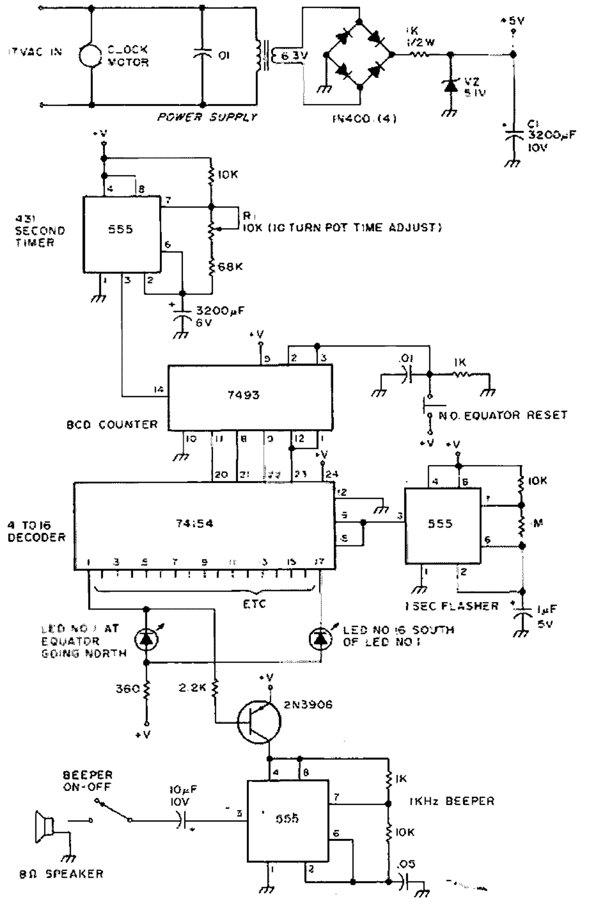


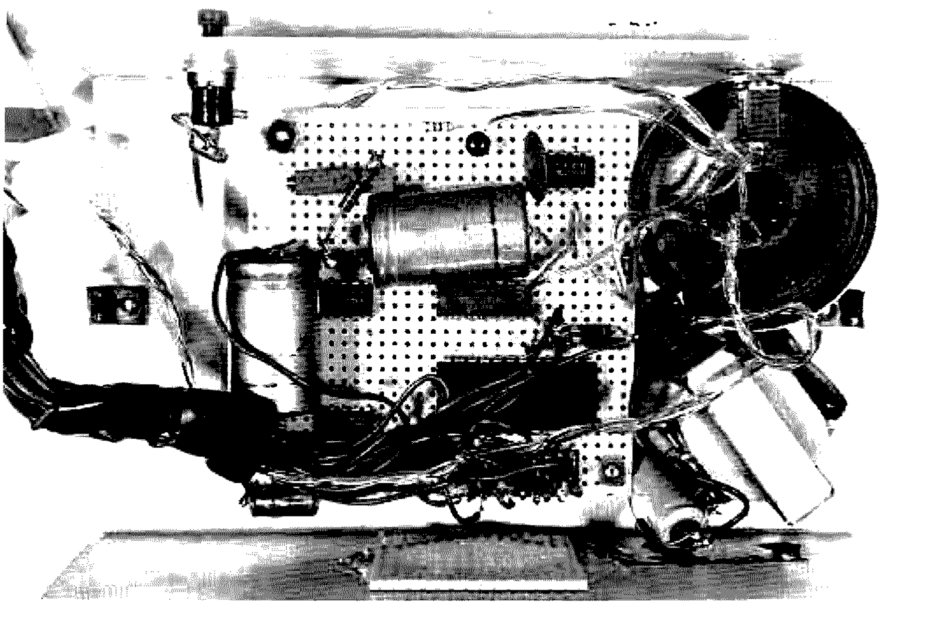
Fig. 1.

which the satellite may be worked.

The 16 LEDs are soldered to a piece of bus wire shaped in a 5" diameter ring, to simulate the satellite's orbit. Separate wires are run from the cathodes to the appropriate pin on the 74154 chip. Small pieces of plastic tubing are used between the LEDs, covering the bus wire and connecting wires. The LEDs are spaced so that one is placed at each of the poles and at the equator on both sides, and three are evenly spaced between each of these. The ring is held to the cabinet with a cable clamp and adjusted to an angle of 102 degrees for the OSCAR 6 orbit.

A 555 timer chip is connected for astable operation with a period of 431 seconds (114.9946 min./16). The exact time is set by adjusting the 10k 10-turn pot, which is in series with the 68k resistor. The output from this clock goes to the input of a 7493 BCD counter. This device gives the appropriate 4-bit BCD code for the number of transitions that occur on pin 14. After reaching 16 counts, the counter resets to the 0000 state. There is also provision for externally resetting the counter for setting the device up initially.

The four lines from the 7493 drive the inputs of a 74154 4-to-16-line decoder. This device has four lines in and sixteen lines out. All outputs except one are normally high. The output that



Suggested parts placement for OSCAR finder

PC boards are available from the author for
$6.00 plus $1.00 for postage and handling.

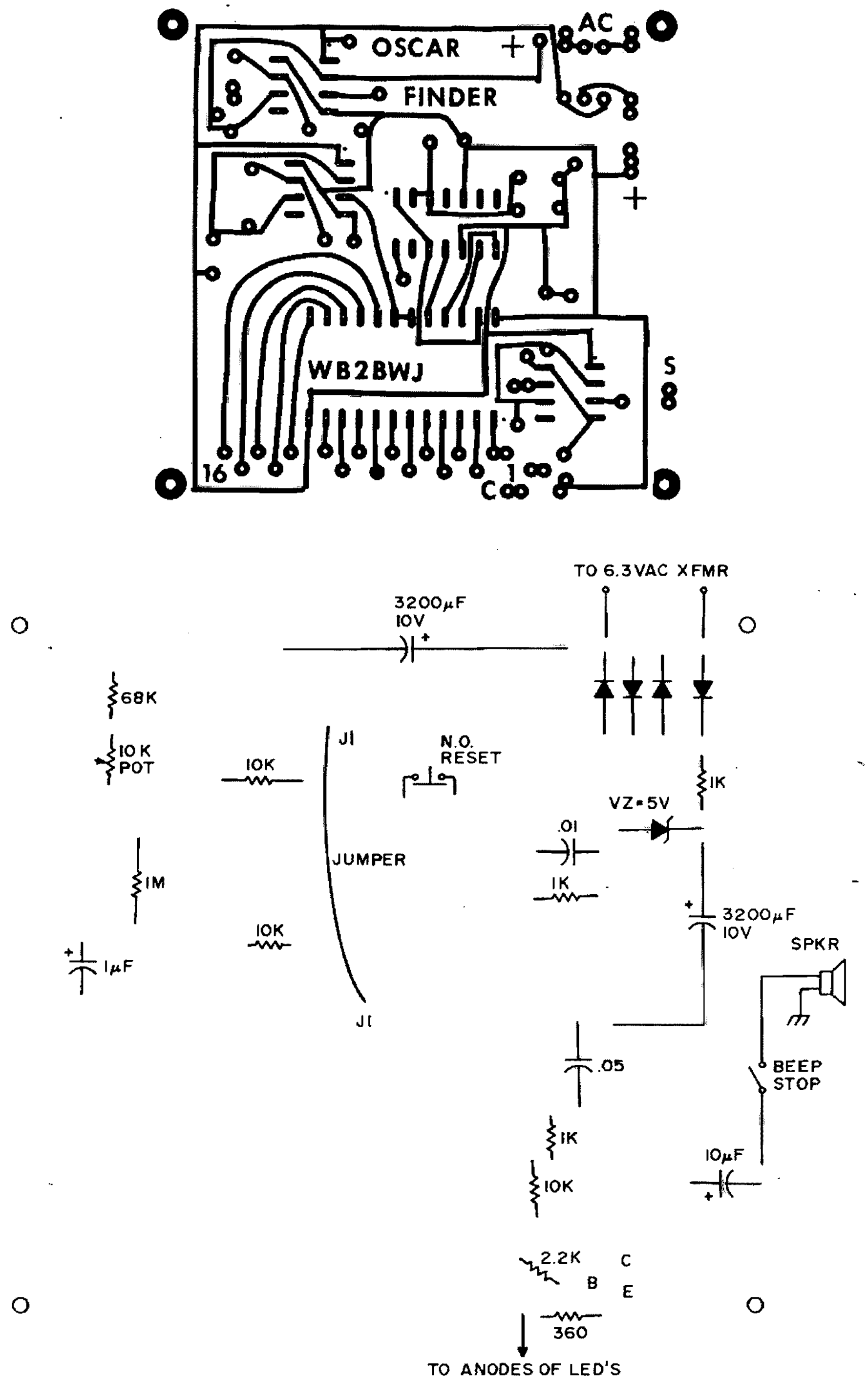


Fig. 2. PC board.

goes low is the one whose BCD code has been addressed at the input. For example, if the four lines in are 1010, the tenth output goes low (pin 11). These output lines directly drive the appropriate LEDs through a current-limiting resistor.

LED number one is placed at the equator going north, and the other LEDs follow it sequentially. To make the LEDs more visible, they are made to blink on and off. This is done by driving the strobe inputs of the 74154 with another 555 astable set at about 1 Hz. When LED number one comes on, it turns the 2N3906 transistor on, which, in turn, activates a third 555 astable which oscillates at about 1 kHz. This chip drives a small 8-Ohm speaker, when the LED at the equator is on, with a beeping tone. This alerts the operator that the satellite is entering the Northern Hemisphere. A switch is provided to turn the beeper off, if it becomes annoying.

The power supply is conventional and adequate, and it should be noted that one does not really need a 3200 uF filter capacitor. I used it because I had an extra one in the junk box. Use one large enough to give a clean tone, free from hum, in the loudspeaker.

I found the accuracy of the 555 timer used as a clock entirely adequate. However, greater accuracy can be obtained by using a smaller capacitor of the tantalum or polycarbonate variety and using a larger value precision resistor. This might buy some thermal accuracy, but, within the box, we find a thermal equilibrium, due to the heat produced by the clock motor, transformer, and chips. As long as the shack's temperature doesn't change too drastically, the clock averages quite well. For the real perfectionist, I suggest a crystal oscillator with an appropriate divider chain.

To align the unit, the 10k pot must first be set so that the period of the clock astable is 431 seconds. This is a somewhat lengthy process, but it must be done as accurately as possible to insure correct tracking of the satellite. Allow the unit to thermally stabilize itself before finalizing the adjust-

ment.

To set the satellite's position, the following should be done. Use an OSCAR locator or similar device to determine an equator crossing on the day that you are setting the OSCAR finder. Determine the local time of the crossing and the degrees of longitude. Remove the globe, and observe if the second-hand shaft is turning counterclockwise. If it isn't, take a pair of needle-nose pliers and force the shaft to turn counterclockwise. Replace the globe, and set the globe by turning the time-setting knob until the number one LED is at the correct crossing point on the equator. This globe is marked at every 15 degrees of longitude, so it is easy to estimate the correct point. Press the zero-degree start button, and wait until the beeping stops. At this instant, press the reset button again. This will insure that a complete cycle is started. Readjust the globe so that the LED lines up with the crossing point. One must use good timing to insure that this process can be completed by the time that the pass is to occur.

Periodically check the accuracy of the OSCAR finder with an OSCAR locator or similar device, and recalibrate it by turning the globe, if necessary.

Whenever an LED appears within the circle on the globe, OSCAR is within range. Although designed for OSCAR 6, the OSCAR finder can be used with any satellite by adjusting three things: angle of orbit, period of orbit, and radius of circle on globe, which is related to the altitude of orbit, which is related to the period. Finally, any 24-hour movement or globe that is available can be used, and most of the other parts are readily available, as listed in the parts list, from local stores as well as from the mail-order houses. Good luck on OSCAR hunting! ■

FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of

Dismissal of six Petitions for Rulemaking in the Amateur Radio Service

RM-1455, RM-1536, RM-1703, RM-2080, RM-2797, RM-2907

ORDER
Adopted: August 24, 1977
Released: August 26, 1977

1. The Commission, by its Chief, Safety and Special Radio Services Bureau, acting under delegated authority, has under consideration the six petitions for rulemaking listed above, each of which was submitted in accordance with the Administrative Procedure Act, 5 USC 553(e), and Section 1.401 of the Commission's Rules. The petitions we are considering each request certain changes in the Commission's rules or policies governing the assignment of station callsigns in the Amateur Radio Service. Petitioners' specific requests are as follows:

a. *RM-1455.* Mr. Wayne Green requests amendment of Section 97.53 of the Rules to permit a licensee moving from one callsign area to another to obtain a "counterpart" callsign upon modification of his station license. (A "counterpart" callsign is a callsign with a suffix identical to the suffix of a callsign held in another callsign area.)

b. *RM-1536.* The American Radio Relay League, Incorporated (ARRL), also requests that provisions be made in the rules for the issuance of "counterpart" callsigns.

c. *RM-1703.* Mr. Thomas V. Appler asks for revision of Section 97.51 of the Rules to permit the assignment of a specific unassigned callsign to the widow, son, or daughter of a deceased former holder of that specific callsign.

d. *RM-2080.* Mr. Chester L. Smith, Mr. Joseph Santangelo, Mr. Charles A. Walbridge, and Mr. Donald A. Freeland want the Commission to amend its rules to permit the issuance of callsigns containing a special indicator designating the operator license classification of the station licensee.

e. *RM-2797.* Mr. Cliff Ryan requests that the Commission issue station callsigns with a special designator to indicate the state in which the station is located.

f. *RM-2907.* Mr. Robert E. Babb requests the rules be amended to permit the issuance of so-called "one letter" callsigns in the Amateur Service. (A "one letter" callsign is a callsign consisting of one letter, followed by one number, followed by one letter.)

2. We have fully and carefully analyzed petitioners' requests and have concluded that petitioners' proposals have been and are being considered in connection with other rulemaking proceedings. With respect to each of these petitions, we note that in Docket 21135, Notice of Proposed Rulemaking released March 11, 1977, 42 Fed. Reg. 15438 (1977), the Commission proposed to simplify its amateur station callsign regulations by replacing the existing complex rules with a very simple general rule stating that all callsigns shall be assigned by the Commission on a systematic basis. The Commission's proposals in Docket 21135 would, if adopted, preclude granting any of the petitions under consideration, each of which requests the issuance of special format, non-systematically assigned callsigns. In connection with RM-1703, we would also note that the Commission explicitly considered the question of "in memoriam" callsigns in its First Report and Order in Docket 20092, FCC 76-348, released April 22, 1976. In that Report and Order, the Commission eliminated the availability of "in memoriam" callsigns. (Such callsigns had previously been available to qualified amateur clubs and organizations.) Finally, we would observe that the suggestions contained in RM-2080 were considered, and rejected, in Docket 15928, Report and Order adopted August 24, 1967, FCC 67-978.

3. From the foregoing, it is clear that the factors on which petitioners' proposals are based have been and are being fully considered by the Commission in connection with other rulemaking proceedings. Further, petitioners have not advanced any new or novel arguments warranting additional consideration.

4. Accordingly, the Commission ORDERS, by its Chief, Safety and Special Radio Services Bureau, acting under authority delegated to him by Section 0.331 of the Commission's Rules, that RM-1455, RM-1536, RM-1703, RM-2080, RM-2797, and RM-2907 ARE DISMISSED.

Charles A. Higginbotham
Chief, Safety and Special
Radio Services Bureau

Oscar Orbits

Oscar 6 Orbital Information				Oscar 7 Orbital Information			
Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W
NA 23071 BTN	1	0147:46	91.2	13547 A	1	0100:39	70.0
NA 23083 BTN	2	0047.42	76.2	13560 BX	2	0154:56	83.6
N 23096	3	0142:38	89.9	13572 A	3	0054:17	68.5
NA 23108 BTN	4	0042.34	74.9	13585 B	4	0148:34	82.1
N 23121	5	0137.29	88.7	13597 A	5	0047:55	66.9
NA 23133 BTN	6	0037:25	73.7	13610 B	6	0142:12	80.5
N 23146	7	0132:21	87.5	13622 A	7	0041:33	65.3
NA 23158 BTN	8	0032:17	72.5	13635 B	8	0135:50	78.9
NA 23171 BTN	9	0127:12	86.2	13647 AX	9	0035:10	63.8
N 23183	10	0027:08	71.2	13660 B	10	0129:28	77.3
NA 23196 BTN	11	0122:04	85.0	13672 A	11	0028:48	62.2
N 23208	12	0022:00	70.0	13685 B	12	0123:05	75.8
NA 23221 BTN	13	0116:56	83.7	13697 A	13	0022:26	60.6
N 23233	14	0016:51	68.7	13710 BQ	14	0116:43	74.2
NA 23246 BTN	15	0111.47	82.5	13722 A	15	0016:04	59.1
NA 23258 BTN	16	0011:43	67.5	13735 BX	16	0110:21	72.6
N 23271	17	0106:39	81.2	13747 A	17	0009:41	57.5
NA 23283 BTN	18	0006:35	66.2	13760 B	18	0103:59	71.1
N 23296	19	0101:30	80.0	13772 A	19	0003:19	55.9
NA 23308 BTN	20	0001:26	65.0	13785 B	20	0057:36	69.5
N 23321	21	0056:22	78.7	13798 A	21	0151:54	83.1
NA 23334 BTN	22	0151:18	92.5	13810 B	22	0051:14	67.9
NA 23346 BTN	23	0051.13	77.5	13823 AX	23	0145:31	81.5
N 23359	24	0146.09	91.3	13835 B	24	0044:52	66.4
NA 23371 BTN	25	0046:05	76.3	13848 A	25	0139:09	79.9
N 23384	26	0141.01	90.0	13860 B	26	0038:30	64.8
NA 23396 BTN	27	0040:57	75.0	13873 A	27	0132:47	78.4
N 23409	28	0135:52	88.8	13885 BQ	28	0032:07	63.2
NA 23421 BTN	29	0035:48	73.8	13898 A	29	0126:25	76.8
NA 28434 BTN	30	0130:44	87.5	13910 BX	30	0025:45	61.7

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

David J. Brown W9CGI
RR 5, Box 39
Noblesville IN 46060

Cheap Ears For OSCAR

-- an effective satellite antenna

Have you been thinking about trying to work through OSCAR 6 or OSCAR 7? How about even just listening to it? You can perform a valuable service to amateur radio, especially now, if all you do is listen! The OSCAR beacon frequencies on the downlink provide AMSAT with much valuable data on the satellite's health and well-being, and, at the time of this writing, we have an ailing bird up there. Even though by the time you read this the problem may be cured, it has happened before, and we all can help ourselves and AMSAT by listening to and forwarding the telemetry information to them.

This brings us to the need for a 10 meter antenna for receiving the downlink activities. The antenna described in this article will do a fine job for you for a minimum of cash outlay, and it has a few distinctive advantages over even the full-sized beam placed outdoors. First, you do all the aiming and rotating electrically and without rotors. Second, it has the advantage of being indoors in the attic. The second point is nice because there will be no weather wear and tear. It's also nice if you live in a neighborhood that objects to large outdoor antennas because of their appearance and their potential for causing TVI, RFI, etc.

This antenna is only a group of dipoles. Many stations use only a simple dipole or folded dipole for OSCAR, and that is where I began. Once I tried that, I began to wonder what I could do to rotate it to allow for azimuth heading changes (a rotor?) and how to account for polarization shifts as OSCAR tumbles. You may find, as I did, that the polarization makes the mechanical rotation a physical beast, if not impossible to control.

About the time I discovered that, I had been reading an article on electronically steered antennas for the military. Between their thoughts for the initial idea and the physical limitations of my attic, I came up with the following indoor antenna that beats everything I've ever tried outdoors, including a 3 element yagi. I'm sure in the latter case it was a matter of unwieldy steering and not lack of gain.

The antenna is a combination of 4 dipoles, 2 phasing lines, and 3 relays – nothing more. The main reason it works so well is the almost perfect repeatability of the OSCAR pass for any given longitude equator crossing.

Two of the dipoles lie horizontal, or parallel to the attic floor, are oriented east and west at the ends, and are ½ wavelength apart. The other two dipoles are a bit harder to explain. Half of each of them looks like a continuation of the phasing harness running north and south, respectively, on each end where the phasing lines join the first pair of dipoles. The other half of the second pair of dipoles extends straight up, or vertical to the phasing lines/dipole connecting points, or as close to vertical as your roof allows. Mine slope inward toward the center feedpoint (and each other) at an angle of 30 degrees off vertical. Looking at half of the antenna from the east end of my attic, so you are looking west with your eye at floor level, gives you Fig. 1. You are looking at the south half of the array, and the backward "L" is one dipole. The box represents relay 2, and the circle is the other half of the south end pair of dipoles. It extends straight out of the page, half toward you, and half out of the back of the page away from you. Fig. 2 is the view of the north half of the array, viewed from the same place (east of the antenna, looking west, at floor level). The dotted lines in both figures are the vertical portion of the dipoles, which I had to slant toward each other because of my roofline.

Fig. 3 describes how the relays are wired to the antenna to allow changes in pattern (or, in other words, steering). To describe which antenna goes where electrically on the relays, I use the following terminology. The dipoles that lie horizontal and parallel to the floor I call north A and south A. The dipoles that have half of themselves vertical or perpendicular to the floor (or slanted as your roof allows) are north B and south B.

I haven't gone into just what pattern results from what, but I can tell you what the relays are doing as far as the antenna feed. Relay 1 lets

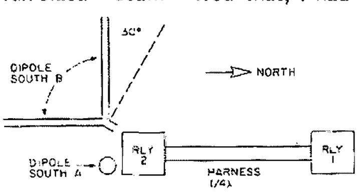


Fig. 1. Looking into the page, you are looking west.

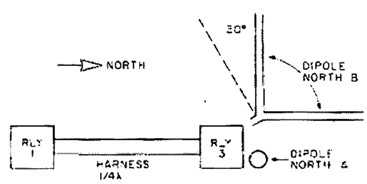


Fig. 2. Looking into the page, you are looking west.

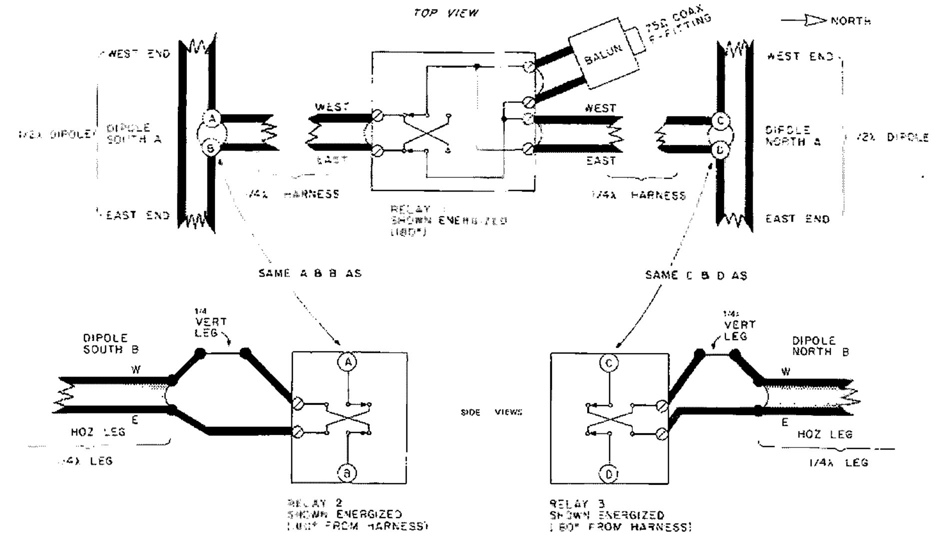


Fig. 3. Allow for strip and tin on all ends of twinlead, i.e., short at outer ends of dipoles, connections to relays, etc.

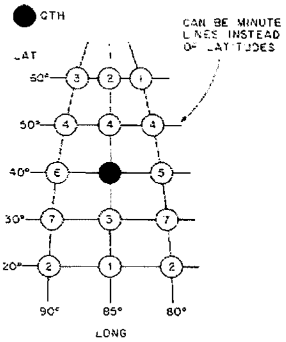


Fig. 4.

you feed the north end pair 180 degrees out of phase from the south end. Relay 2 lets you change the feed phase 180 degrees on south B. Relay 3 lets you change the feed phase 180 degrees on north B. You antenna engineers can drop me a line on just what antenna patterns are supposed to be occurring. I seem to be getting more than the circle of coverage would indicate I should, allowing complete passes of beacon coverage. The beacon is the best indicator, since it does not rely on the other station properly aiming his 2 meter antenna.

Speaking of the circle of coverage you have all seen on maps used for OSCAR tracking, mine now has a slightly different look. It is a grid with small circles at the intersections as shown in part in Fig. 4. The numbers represent the best antenna switch position for the satellite when it is over that map point. After a few runs, and if you determine where the satellite should be by using a Satellabe or equal device, you can find the satellite and form your own chart. You can immediately see there are more than three numbers, representing more than the three individual relays. Fig. 5 shows how I have mine wired to have the following relay combinations: none, 1 only, 2 only, 3 only, 1 and 2, 1 and 3, 2 and 3, and all (energized).

Since I had automated control in mind from the beginning, I wired my relays and switch as in Fig. 6. By using a BCD output decimal display switch, you can choose any of the positions 0 to 7 for any relay combination. Once you learn what position you want and where and when, the BCD switch can become a tape input that is stepped with time during the pass of OSCAR.

I did say automated, didn't I? Well, the tape was good, but the latest adventure seems to be the greatest of all ways! By hooking a 7490 encoder to the 7445 inputs instead of the BCD switch or tape, and driving the 7490 clock input with a variable square wave from a pot controlled VCO (LM 566, etc.), you have much what the military has for a steered antenna for radar, which scans the horizontal plane for targets!

So far I have been limited by the switch speed of the relays in my system, and weather (no heat in attic) has prevented their change to a diode steering scheme. Now come spring . . . hmmm? Since the antenna never handles transmitter type power levels, diodes should be a cinch. If the ideal sampling rate can be found, the antenna will be looking where it should for a long enough time to reproduce enough segments of good audio to sound like it is not switching at all. I believe this to be a rate well above the audio frequencies I can use on the relays, limited only by the ICs (20 MHz?), the diodes, and the other components. Someday I may be able to reduce the total feedline to the attic to just that — the coaxial feedline, running rf power filtered for the switch rate down, and all the switching up.

My first idea was to tie 8 op amps to the agc line of the receiver via some gates to gate them on with the sample switch. Then I would use a voting system to return to the highest agc reading on a sample for .1 second and go back and hold for .9 seconds basis (or 1/sec sampling). If the agc were audio derived and a noise blanker was used, this may still be the best bet. At the very least, this whole thing offers some really nice possibilities. You could use "chain gang" methods of

Switch position	Relays energized
0	none
1	relay 1
2	relay 2
3	relay 3
4	relays 1 and 2
5	relays 1 and 3
6	relays 2 and 3
7	all relays

Fig. 5.

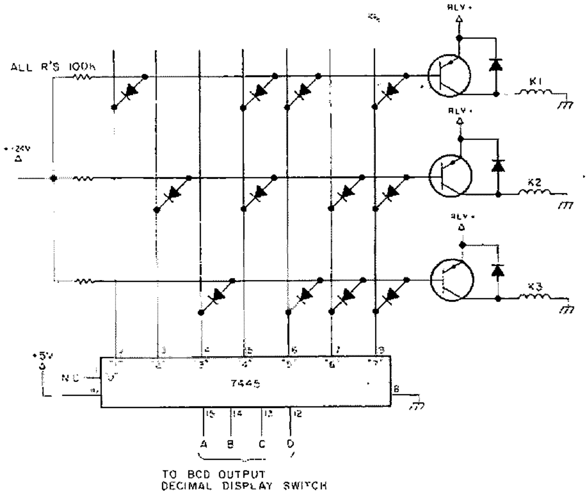


Fig. 6.

7490 connections as blocked out in Fig. 7.

The vco runs the 7490 (B) at antenna switch rate. For the 1 out of 10 sample period, 7490 (C) divides the antenna rate by 10 and only enables the gate ahead of 7490(A) during 1 of 10 periods (1/10 of a total sample to sample period). Position "8" of 7490 (A) and 7445 (A) can be used to do the settling and voting time (half enable a gate, etc.); position "9" would then switch the antenna to that best antenna position decided on in the voting process. A 9 sample period's length of time from 7490 (C) and 7445 (B) later [for example, 7445 (B) positions "0" and "2" through "9"], the process would repeat by 7445 (B) returning to "1" and gating on gate (A). I have tried to block diagram only one of several possibilities. Let your imagination be your guide, as the real intent of this article was the antenna itself.

The antenna (dipoles and harness) is made of inexpensive TV receiver type 300 Ohm twinlead. Since all four dipoles are hooked up all the time (one configuration or another), the north pair in parallel represent about a 150 Ohm feedpoint. The same holds for the south pair. By using a ¼ wavelength harness from relay 1 to relay 2 common poles and relay 1 to relay 3 common poles, the feed looking into each harness from the relay 1 end is about 300 Ohms. When the harnesses are put in parallel by relay 1, the feedline input point looks like about 150 Ohms. Even though it is a mismatch, I attached a 75 Ohm unbalanced (coax) to 300 Ohm balanced balun to this feedpoint with no adverse results. This allows me to use the 75 Ohm RG-59 coaxial cable down the 30 odd feet to the basement and the receiver. I probably make up most of the balun loss, and then some, by running a pretty hot VHF Engineering preamp ahead of the receiver.

As stated before, any ideas on how it works would really be appreciated, and any questions — just SASE. Happy OSCAR times to you. ■

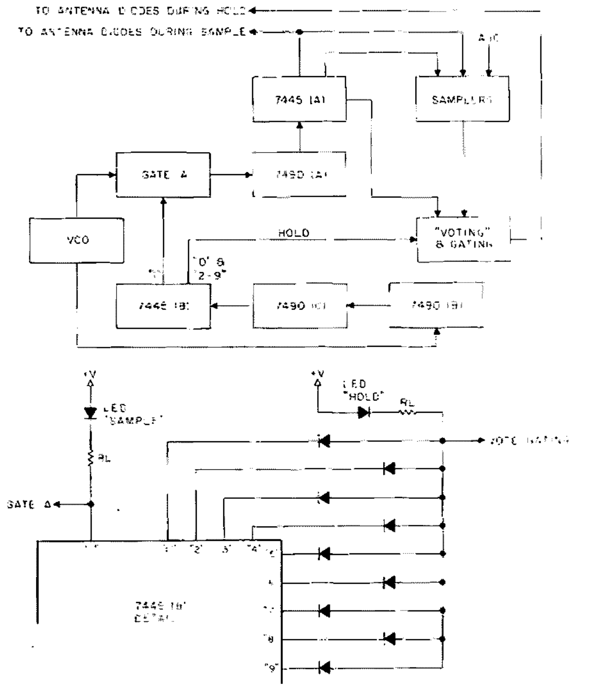


Fig. 7. Voting system.

Track OSCAR With Your SR-52

-- requires the PC 100 option

Art Burke W6UIX
4011 College Avenue
San Diego CA 92115

The program listed in Table 1 will do the following for you, while you QSO, have breakfast, mow the lawn, go shopping, etc.: (1) calculate the position of OSCAR 6 or 7 at the time intervals you select; (2) determine whether OSCAR is above the horizon; (3) print out the time (local or GMT) to the minute, azimuth (bearing), and elevation angle to the nearest degree only when OSCAR is above the horizon; (4) do the above for all the passes (northbound and southbound) for an entire day (longer, if desired); and, finally, (5) do this wherever you are in the world.

Item 5 is especially important for those hams operating near the equator or in the Southern Hemisphere. The usual formulas give erroneous azimuth pointing angles when OSCAR is south of the equator. Formula 3 (see below) corrects for this condition. Additional features are that your QTH is stored in registers 98 and 99 (unaffected by "clear memories"), and all OSCAR orbit data is stored in the upper data registers (15-19), so the calculator can be used for other problems without disturbing the OSCAR data.

Let's examine item 5 in more detail. Fig. 1 shows the actual OSCAR track (solid line) for the example given later where OSCAR crosses the equator northbound at 78.1° West, and the apparent track in the Southern Hemisphere (dotted line) of the track for the preceding orbit which results in the 78.1° crossing. The usual formulas (which are good only in the Northern Hemisphere) will make OSCAR apparently change course as soon as it crosses the equator. Thus, instead of continuing in a southwesterly direction after crossing the equator at 243.7° W., OSCAR apparently abruptly turns southeasterly, as shown by the dotted line, and ultimately crosses the equator in a northeasterly direction at 78.1° W., and then abruptly turns and proceeds in the correct northwesterly direction. Of course, OSCAR doesn't really do these acrobatics, but formulas 1 and 2, as usually given,[1] which calculate the latitude and longitude of OSCAR at the selected time intervals, give these apparent positions. And, since these positions are used in conjunction with our own positions on Earth (latitude and longitude of our QTH) to calculate the direction to point our antenna at OSCAR, we will be wrong!

Well, if this is really so, why haven't we hams in the United States noticed this before? Why do the formulas seem to work okay for us? The answer is that we are so far from the equator, and our antennas have broad enough beamwidths (approximately 40° wide at the "3 dB down" points for a so-called 13 dB beam), that the apparent "dogleg" in the path is entirely contained within our beam coverage and goes unnoticed. I have shown a 40° beam pointed from Miami toward the 78.1° W. crossing in Fig. 1. Notice how it encompasses both the true and apparent paths of OSCAR within the "OSCAR horizon" of Miami, shown as the dotted arc centered on Miami. And, of course, the effect is diminished as we are even further north, because OSCAR is in range below the equator for a shorter distance (or not at all), and the antenna beam covers a large area below the equator.

Now let's take a ham in Quito, Equador, whose QTH is at 0.2° S. latitude and 78.5° W. longitude. He is really in trouble if he uses formulas 1 and 2. His calculator will tell him to point his antenna in a southwesterly direction to

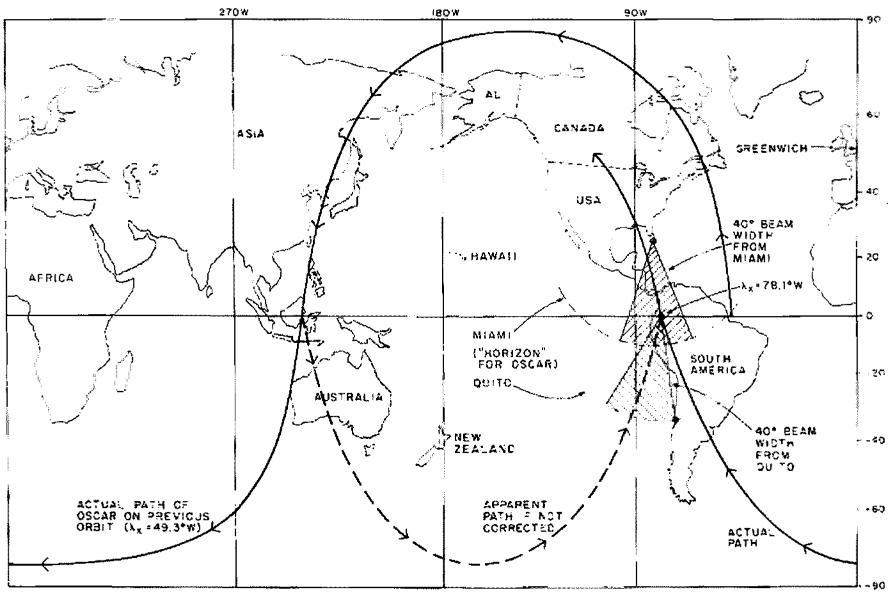


Fig. 1. OSCAR paths, actual and apparent, on the Earth.

pick up the approaching OSCAR, instead of the correct southeasterly direction. Although his antenna may be 40° wide, it is not wide enough to include the direction of OSCAR, as shown by Fig. 1.

In even worse shape would be a ham in New Zealand, for example. The apparent path of OSCAR is south of him, heading east, when in reality it is clear around the world below South Africa.

The part of equation 2 that causes this trouble is the first portion in the brackets:

$$[\mathrm{INV}\cos(\cos\frac{360t}{P}/\cos L_s)]$$

When OSCAR is in the Northern Hemisphere, but approaching the equator, it is a trifle less than ½ P, since it is the time since OSCAR crossed the equator going north, and P is the time of the full orbit. Thus 360t/P will be less than 180 (let's say 176.9, for example). The cosine of 176.9° is -.99854. L_s, the latitude of OSCAR from equation 1, is about 3°; its cosine is .99863. The result is the inverse cosine of -.99991 or 179.2°. Now, let the OSCAR go an equal distance past the equator so that 360t/P is 183.1°. The calculator computes the cosine as -.99854 (the same as for 176.9); the latitude is now about 3° S. or -3°, whose cosine is .99863 (the same as for 3°). The result is that the calculator give you the same inverse cosine of -.99991 = 179.2° as before. After all, how can the calculator know that you want an answer greater than 180°? Thus, the OSCAR seems to be backtracking in an easterly direction as it heads south, and gives the apparent track as shown in Fig. 1.

The answer to this problem is simple: If the latitude of OSCAR is positive (north of equator), use the equation as is; if the latitude is negative, subtract the angle obtained from the bracket from 360° (e.g., 360 - 179.2 = 180.8), and use that value of longitude in the subsequent calculations. (In the program listed in Table 1, I have done the equivalent by testing the sign of the sine of L_s to save program steps.)

For those hams with an interest in how and why things work (most of us, I think), here are the formulas used and a brief explanation of their place in the program. 1 and 2 are adapted from reference 1; the other expressions are from reference 2.

1. $L_s = \mathrm{INV}\sin(\sin a \sin\frac{360t}{P})$
2. $\lambda_s = [\mathrm{INV}\cos(\cos\frac{360t}{P}/\cos L_s)] + \lambda_x + t(15)$
3. If $\sin L_s$ is positive, λ_s is as given by 2. If $\sin L_s$ is not positive, $\lambda_s = 360 - [\ \ ] + \lambda_x + t(15)$
4. $v = \lambda_s - \lambda_q$
5. $c = \mathrm{INV}\cos(\sin L_s \sin L_q + \cos L_s \cos L_q \cos v)$
6. $\beta = \mathrm{INV}\cos[(\sin L_s - \sin L_q \cos c)/(\cos L_q \sin c)]$
7. If $\sin v$ is positive, $B = 360 - \beta$. If $\sin v$ is not positive, $B = \beta$
8. $EL = \mathrm{INV}\tan[(\cos c - \frac{R}{R+h})/\sin c]$

where (all degrees are in decimal form, e.g., 24.1°):

L_s is the latitude of OSCAR in degrees — positive if north of equator, negative if south;

a is the inclination of OSCAR's orbit in degrees counterclockwise from east;

t is the time in decimal hours from T_x;

T_x is the time of a northbound equatorial crossing by OSCAR, in hours and minutes (GMT or local);

P is the period of the orbit in decimal hours;

λ_s is the longitude of OSCAR in degrees west from Greenwich, England;

λ_x is the longitude of the northbound equatorial crossing (at T_x) in degrees west;

λ_q is the longitude of the QTH in degrees west;

L_q is the latitude of the QTH in degrees — positive if north of the equator, negative if south;

B is the azimuth (bearing) to OSCAR from the QTH in degrees clockwise from north;

EL is the elevation angle to OSCAR from the QTH in degrees, from the horizontal upwards;

R/(R+h) is the ratio of the Earth's radius to the sum of Earth radius and orbit height.

Program steps 000 to 009 initialize the program, fix the decimal point to four places (necessary for accurate time displays later), print the entered time, T_x, convert T_x into decimal hours, store it in register 11, and halt, ready for the next entry. When λ_x is entered on the keyboard and RUN is pressed, steps 010 to 017 store λ_x in register 14, print it, and put a 0 in register 13. Steps 018 to 138 solve equation 1 and store sin L_s in register 63. Steps 039 to 080 solve expressions 2, 3, and 4. Steps 081 to 157 solve 6 and 8. Steps 158 and 159 test the elevation angle and, if negative, skip to step 214, after which Δt (your selected orbital time interval) is added to register 13, and the program repeats, beginning with

70377.0700	PRT	14.	PRT	289.	PRT
18.3800	PRT	22.42	PRT	1.	PRT
78.1000	PRT	301.	PRT	17.50	PRT
18.46	PRT	9.	PRT	69.	PRT
99.	PRT	8.42	PRT	2.	PRT
8.	PRT	31.	PRT	17.54	PRT
18.50	PRT	8.	PRT	45.	PRT
72.	PRT	8.46	PRT	4.	PRT
16.	PRT	48.	PRT	17.58	PRT
18.54	PRT	25.	PRT	22.	PRT
39.	PRT	8.50	PRT	2.	PRT
16.	PRT	95.	PRT	19.38	PRT
18.58	PRT	41.	PRT	126.	PRT
13.	PRT	8.54	PRT	14.	PRT
7.	PRT	148.	PRT	19.42	PRT
20.34	PRT	28.	PRT	99.	PRT
162.	PRT	8.58	PRT	32.	PRT
5.	PRT	168.	PRT	19.46	PRT
20.38	PRT	10.	PRT	43.	PRT
162.	PRT	10.34	PRT	37.	PRT
24.	PRT	4.	PRT	19.50	PRT
20.42	PRT	5.	PRT	8.	PRT
164.	PRT	10.38	PRT	19.	PRT
63.	PRT	350.	PRT	19.54	PRT
20.46	PRT	21.	PRT	355.	PRT
342.	PRT	10.42	PRT	3.	PRT
54.	PRT	310.	PRT	21.30	PRT
20.50	PRT	38.	PRT	194.	PRT
343.	PRT	10.46	PRT	12.	PRT
20.	PRT	256.	PRT	21.34	PRT
20.54	PRT	30.	PRT	217.	PRT
344.	PRT	10.50	PRT	30.	PRT
3.	PRT	233.	PRT	21.38	PRT
22.30	PRT	12.	PRT	273.	PRT
220.	PRT	12.30	PRT	40.	PRT
3.	PRT	335.	PRT	21.42	PRT
22.34	PRT	3.	PRT	314.	PRT
243.	PRT	12.34	PRT	22.	PRT
11.	PRT	312.	PRT	21.46	PRT
22.38	PRT	4.	PRT	331.	PRT
273.	PRT	12.38	PRT	6.	PRT

Fig. 2. Printout of 36 hours of OSCAR 7.

LBL	000 46	INV	056 22	8	112 08	=	168 95
A	001 11	sin	057 32	x	113 65	INV	169 22
fix	002 57	cos	058 33	RCL	114 43	D.MS	170 37
4	003 04	STO	059 42	9	115 09	fix	171 57
prt	004 98	6	060 06	8	116 08	2	172 02
D.MS	005 37	4	061 04	cos	117 33	-	173 75
STO	006 42	)	062 54	=	118 95	2	174 02
1	007 01	INV	063 22	1/x	119 20	4	175 04
1	008 01	cos	064 33	x	120 65	=	176 95
HLT	009 81	+	065 85	(	121 53	if pos	177 80
STO	010 42	RCL	066 43	RCL	122 43	log	178 28
1	011 01	1	067 01	6	123 06	+	179 85
4	012 04	3	068 03	3	124 03	2	180 02
prt	013 98	x	069 65	-	125 75	4	181 04
0	014 00	1	070 01	RCL	126 43	=	182 95
STO	015 42	5	071 05	9	127 09	LBL	183 46
1	016 01	+	072 85	8	128 08	log	184 28
3	017 03	RCL	073 43	sin	129 32	prt	185 98
RCL	018 43	1	074 01	x	130 65	RCL	186 43
1	019 01	4	075 04	RCL	131 43	1	187 01
3	020 03	-	076 75	6	132 06	2	188 02
x	021 65	RCL	077 43	7	133 07	sin	189 32
RCL	022 43	9	078 09	=	134 95	INV	190 22
1	023 01	9	079 09	INV	135 22	if pos	191 80
5	024 05	=	080 95	cos	136 33	sin	192 32
=	025 95	STO	081 42	STO	137 42	3	193 03
STO	026 42	1	082 01	6	138 06	6	194 06
6	027 06	2	083 02	5	139 05	0	195 00
9	028 09	cos	084 33	RCL	140 43	-	196 75
sin	029 32	x	085 65	6	141 06	LBL	197 46
x	030 65	RCL	086 43	7	142 07	sin	198 32
RCL	031 43	9	087 09	-	143 75	RCL	199 43
1	032 01	8	088 08	RCL	144 43	6	200 06
6	033 06	cos	089 33	1	145 01	5	201 05
sin	034 32	x	090 65	8	146 08	=	202 95
=	035 95	RCL	091 43	=	147 95	fix	203 57
STO	036 42	6	092 06	÷	148 55	0	204 00
6	037 06	4	093 04	RCL	149 43	prt	205 98
3	038 03	+	094 85	6	150 06	RCL	206 43
if pos	039 80	RCL	095 43	8	151 08	6	207 06
tan	040 34	9	096 09	=	152 95	6	208 06
3	041 03	8	097 08	INV	153 22	prt	209 98
6	042 06	sin	098 32	tan	154 34	fix	210 57
0	043 00	x	099 65	STO	155 42	4	211 04
-	044 75	RCL	100 43	6	156 06	LBL	212 46
LBL	045 46	6	101 06	6	157 06	cos	213 33
tan	046 34	3	102 03	INV	158 22	RCL	214 43
(	047 53	=	103 95	if pos	159 80	1	215 01
RCL	048 43	STO	104 42	cos	160 33	7	216 07
6	049 06	6	105 06	RCL	161 43	SUM	217 44
9	050 09	7	106 07	1	162 01	1	218 01
cos	051 33	INV	107 22	1	163 01	3	219 03
÷	052 55	cos	108 33	+	164 85	GTO	220 41
RCL	053 43	sin	109 32	RCL	165 43	0	221 00
6	054 06	STO	110 42	1	166 01	1	222 01
3	055 03	6	111 06	3	167 03	8	223 08

Table 1. OSCAR SR-52/PC 100A program.

step 018.

However, if the elevation angle tests as not negative, steps 161 to 211 add t to T_x, convert the result to hours and minutes, and print. Then they apply expression 7, print azimuth and elevation to the nearest degree, refix the decimal point to 4 places, and go to step 214, where the cycle begins again. Thus, a printout is made only when OSCAR is not below the horizon. Labels sin, cos, tan, and log are used internally to save program steps.

OK, so much for the sales pitch and the explanations — how do we go about using the program? Simple! Here is a step-by-step procedure:

FIRST — Key in the program listed in Table 1 (don't forget to either reset or GTO 000 before pressing the LRN key). Now, press LRN to put the calculator back into the calculate mode. Record the program on a magnetic card for future use. If you already have the program on a card, enter it in the usual manner.

SECOND — Key in the west longitude of your QTH (λ_q) in decimal degrees and STO 99; key in the latitude L_q in decimal degrees (if south of the equator, key +/- for the minus sign) and STO 98.

THIRD — Key in the following OSCAR orbit data, and store as shown:

1.916 STO 19 (P)
0.813 STO 18 [R/(R+h)]
101.7 STO 16 (a)
187.9 STO 15 (360/P)

(These values are averaged for OSCARS 6 and 7 and give good results for at least 36 hours of orbit. You can, of course, put more accurate values in if you wish.)

FOURTH — Key in your desired orbital time intervals (Δt) in decimal hours; e.g., if you want 4 minute Δt, key 4 ÷ 60 =, and store the result in register 17 by STO 17. (This will store 0.0666666667 in reg. 17 for this example.)

FIFTH — Set the R-D switch to D (degrees).

This completes setting up the calculator with its permanent data base. Note that, if you have already used the program, then replaced the program with another to work on some other problem but have not turned off the calculator or otherwise disturbed registers 15 through 19, 98 and 99, the second through fourth steps can be omitted.

Now let's take an actual example (which can be used by you as a "check" problem), using my QTH (L_q 32.75, λ_q 117 are stored in registers 98 and 99), and OSCAR 7, beginning on the evening of July 3, 1977, Pacific Daylight Savings Time. Page 16 of the July, 1977, issue of *73 Magazine* lists orbit 12044, A mode, July 4, 0138:05 GMT, 78.1°. This is July 3 at 1838:05, my time. When I enter T_x, I can use either GMT (1.38) or PDST (18.38), as I choose. The resulting times will then be in the same time zone. I will choose PDST and enter to the nearest minute in H.M (Hours.Minutes) as follows:

STEP 1 — (optional) Key 703.77.07 PRT to print my Pacific date and indicate OSCAR 7 (07).

STEP 2 — Key 18.38 (T_x in H.M).

STEP 3 — Press A (the calculator will stop, showing 18.6333, which is T_x in decimal hours, and will print 18.3800 PRT).

STEP 4 — Key 78.1 (λ_x).

STEP 5 — Press RUN.

Now you can relax and do other things, as you wish. The calculator-printer has taken over. It will immediately print 78.1000 PRT, thus giving you T_x and λ_x for reference. It will then print out the time (in H.M), azimuth, and elevation angles in degrees every 4 minutes of orbit time that OSCAR 7 is within the QTH's horizon, throughout the rest of the

night of July 3 and throughout July 4. It takes the calculator about 13 seconds for each Δt, thus the first printout will be about 40 seconds after you pressed RUN, because the satellite is not above the horizon until 18.46. At that time, the azimuth is 99°, and the elevation is 8°. It will take the calculator approximately 70 minutes to finish 24 hours of orbit time, and thus about 1½ hours to finish the July 4 evening passes. Fig. 2 is an actual PC 100A tape for this example.

OK, you say, that's fine for a west coast ham, because the orbits listed in *73* are usually the first ones that are within range of the west coast. But how about someone on the east coast? It's still simple: Take that orbit for July 4 GMT, and subtract 115 minutes and 28.75° several times from the listed values in *73* until you get the T_X and λ_X of the first orbit that will be in your range. I have found that the first northbound orbit must be about 65° or less east of my QTH to be within range; this should be suitable within the 48 states and Hawaii.

Or, for the really lazy (or busy?), just start with the preceding day's first orbit, as listed in *73*, and let the calculator crank out about 36 hours of orbital data. This suggestion is probably the easiest for hams in the equatorial and sub-equatorial regions to use, because their usable passes will be either northbound passes, starting from below the equator, or southbound passes.

Well, so far so good, for the fat cats with the printers; now, how about those of you with the bare bones SR-52? Here's how: First, put in the program and data registers, just as indicated earlier, but with 3 simple changes. Change program steps 185, 205 and 209 from prt (98) to HLT (81). The calculator is used in the same way, except that paper and pencil are used instead of the automatic printer.

After T_X and λ_X are entered as above, the calculator will halt and display the first time the satellite is in your range. After writing it down, press RUN, and the calculator will halt with the azimuth displayed. Write it, press RUN, and the calculator will halt with elevation displayed. Write it, press RUN, and a new time will be displayed when the calculator halts, etc., etc. However, remember that each calculation cycle takes about 13 seconds, so that, if the satellite takes 12 minutes to come into range, as in the example above, it will be about 40 seconds before the calculator halts with the first time display, and, after the OSCAR goes beyond your horizon, it will be about 5 minutes before the calculator halts with the next northbound pass in range displayed. It will be much longer than that, after the last northbound pass, until the first southbound pass comes within range. You may find it more convenient to press HLT, if no display has appeared in 20 seconds after a series of displays. Then, add (use the calculator for this; it won't hurt the program) 115 minutes to the previous T_X and 28.75° to the previous λ_X, enter these new values for the T_X and λ_X in the program, and you thus bypass the time to circle the world. A convenient way to do this is to key in the previous T_X (e.g., 18.38), press D.MS, +, RCL 19, =, INV D.MS, and then press A. At the halt, key in the previous λ_X (e.g., 78.1), press +, 28.75, =, and then press RUN.

Well, there it is. Have fun with the program and good hunting on OSCAR. ■

References

[1]W. Danielson and S. Glick, *QST*, Oct., 1969, pg. 54.

[2]HP-65 program, by Dr. Earl F. Skelton WA3THD, Aug., 1975.

Try A T-R For OSCAR 8

-- turnstile over reflector system

David J. Brown W9CGI
RR 5, Box 39
Noblesville IN 46060

T-R, in this case, is *T*urnstile over *R*eflector antenna, and it could definitely aid your OSCAR performance. Built for three band capability, it will do well for you on the present OSCAR satellites, not to mention the upcoming AMSAT high orbit type machine. If you think using mechanical tracking rotors for the present OSCARs is tough, the next one is going to be impossible for you. True, it moves more slowly, relative to a position on Earth, but I'm sure we will hear the same, "Where the heck is it?" comments we had about OSCARs 6 and 7.

Referring to Fig. 1, I have only shown the two-band 2m/10m version, because that is all I have had a chance to check out. There is no reason at all why two ten-foot masts could not be used in place of the ten- and five-foot versions shown for the vertical mast. An alternative is to build it as shown, and, due to the very small size of the ¾m version, it could even be bracketed to the top at a later date. That is my reason for drawing the unused extra ¼ wavelength of mast poking out of the top on 2m.

Construction is entirely with commercially available antenna parts (especially from Hy-Gain 64Bs). The crossed dipoles on the 10m T-R can be 10m beam driven elements. Two of these are used on mine, less the beta matches, and with the elements stretched out to 10m dimensions. I did this by using some CB antenna aluminum tubing. These tubes were the same o.d. as the tube/reducers on the original 64B and fit nicely into the 64B dipole insulators. The old 64B element o.d. is not quite the same as the i.d. of the new CB tubing, but there are ways around this. You can wrap the smaller element with aluminum foil and then clamp it into the larger element with hose clamps, or go the more complex route I went. I added plugs about 2 inches long, that were bored out and tapped on one end to 3/8-24. This exactly matches the threaded stud on a full-size stainless steel CB whip. I obtained several of these whips, that had been damaged in one way or another, but still had good studs and about 40 inches plus of undamaged whip. If you figure out the average height of a car versus a bumper-mounted CB whip, believe me, there are several whips in this condition around. They are worthless to use on CB, so you can buy them even cheaper than the replacement full-size whips. My CB aluminum tubing came out at 56 inches, so the whips were cut off at 39 inches and screwed into the plugs. The plugs are held in the tubing by ¼-20 hardware through the tubing and plug.

For the reflectors, I used the CB parts that would normally be the ground plane elements. The largest parts just fit the same insulators, and then are grounded to the

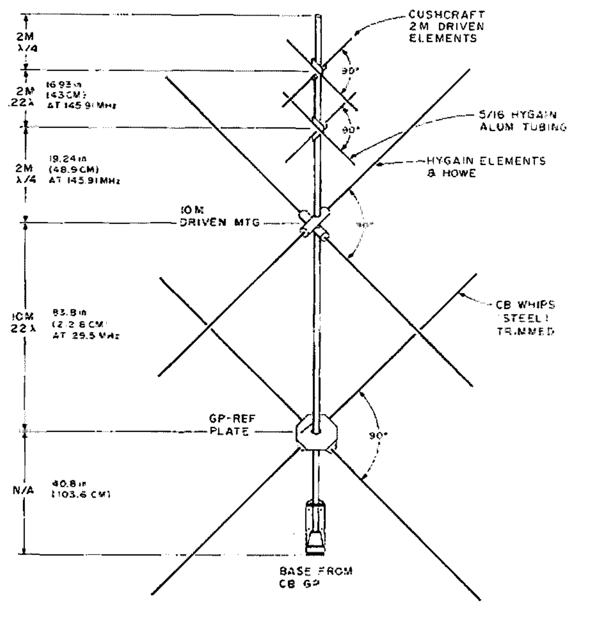


Fig. 1. Vertical mast is 10' x 5' heavy-wall TV mast (bolt through joint). Cut off lower flare to fit into or onto CB base used.

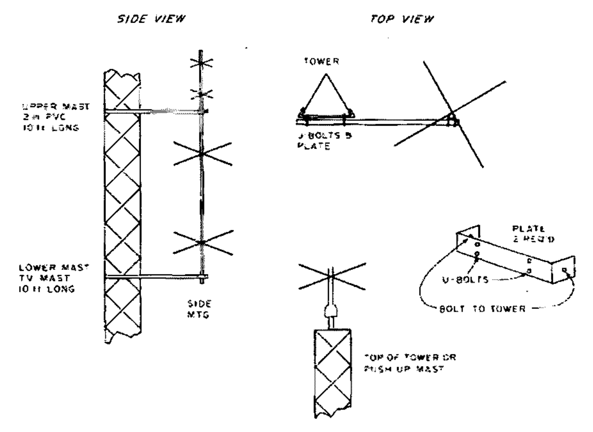


Fig. 2. Mounting.

	General	@ f_o in Fig. 1.
2m driven	$234/f_o$	19.24" 48.9 cm
2m reflected	$234/f_o$ + 5%	20.2" 51.32 cm
10m driven	$234/f_o$	95.2" 241.8 cm
10m reflected	$234/f_o$ + 5%	99.94" 253.86 cm

Table 1. Mast CTR to tip of element.

boom by a 1-inch wide strap, from feed clamp to boom to feed clamp. If you order parts, just use the director clamps instead, and the element will be already grounded.

The 2m T-R is not much different. You can even use a plate and CB whips (or the parts cut off above) to make the reflector elements. You only need pieces about 20 inches long. Simple brackets will mount them to the vertical mast.

The driven elements are made to order, used as is, parts from the A147 type CushCraft antennas. They are just the driven elements from those antennas. When I lost the EME array a while back, I saved the parts off the broken 3 yagis. They are 50 Ohm, coaxial-fed dipoles with gamma matches, so it can't be much simpler. Even their mounting method is obvious from their construction.

All that leaves are the matching harnesses. A letter to Hy-Gain produced the figure of 200 Ohms for a feedpoint impedance using the dipole alone – no beta match. The harness of Fig. 3 shows the material and cutting instructions. Use good lugs on the bolted connections, tape well, and use a good quality, clear spray liberally. Since the clear sets up so rapidly, I have found 4 or 5 light coats work better and crack less.

The 2m harness is even easier, since it uses all coaxial connectors. Measure and solder carefully, and check all the harnesses piece by piece for braid to center shorts, as each piece is completed. Then screw it all together and to the antennas, and tape and spray well. Nothing is more disgusting than to build a good antenna and have it die a month or two later, so please forgive me for belaboring the tape and spray routines.

Fig. 2 covers mounting possibilities. The array size, weight, and low wind load make it a reasonable candidate for chimney mounts. Just remember this is a last resort spot for antennas. It is the most corrosive, thermally changing, lousy spot available, but if it's all you have, it's all you have. I used the side bracket method, with the lower ground planes about 20 feet off the real ground. It is on a tower that also has two stacked halos for a backup on 6m and the Hy-Gain 66B 6m yagi up on top. None of the 6m goodies seems to cause shadows or create any loading effect problems. It all looked the same looking into the feedpoints up and mounted as it did on the ground. The 2m swr was very good at 1.15:1, and it is not worth messing with to improve. The 10m must be getting a little pattern distortion, no doubt from the tower; but it had a 1.1:1 on the ground and a 1.25:1 now. It works fine, and I'm not going to push it to get a little more here and there.

This whole story seems terribly short, but then there just was not much to the construction, either. One weekend of an hour here and an hour there, and it was both done and up. The antenna design is not new, but I thought you might like to share some of my construction methods.

Here's one final note of help: When you get it all together, try the following: As the beast gets larger (as you add the 10m hardware), it pays to have a pipe stuck in

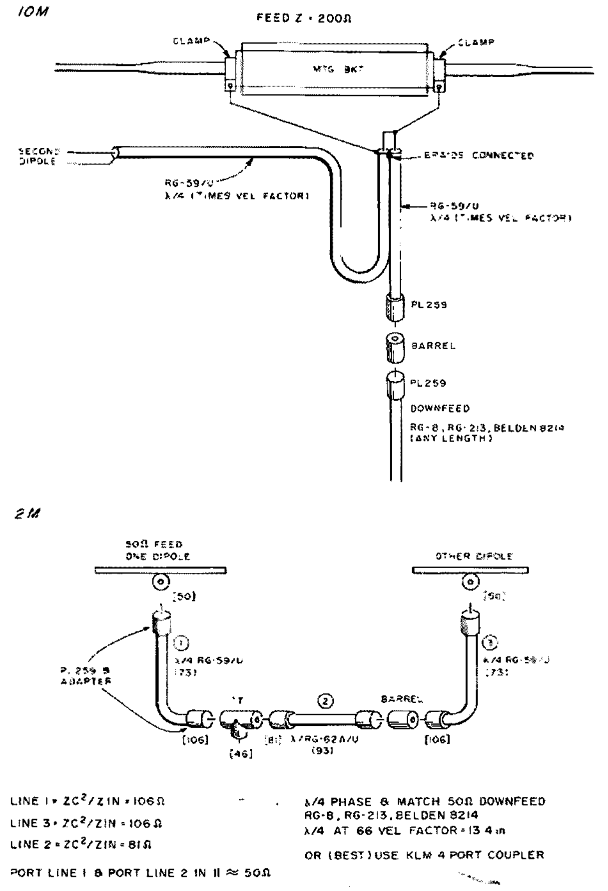


Fig. 3. Feed and phase.

the ground that you can U-bolt it to and work on it upright. I have a 4-foot pipe stuck 3 feet in the ground in a post hole and filled around with concrete. Level the concrete off with the ground in sympathy for your lawn mower. Don't place it where you can break a leg on it, and you have a utility mast and antenna holder. If you saw the expanded end off of a TV mast (as you will do in making the vertical mast in this article), and make the cut-off piece about 8 inches long, you will end up with a dandy test setup. Keep two 10-foot TV masts around (up in garage rafters, etc.), and, if you fit them together to make a 20-foot mast, add the sawed off piece to the unexpanded end of the 20-foot pair, use the whole business upside down (expanded ends up), and choose your 4 feet of water pipe in the ground with an ID larger than the TV mast (but smaller than the expanded part), you wind up with a quicky test setup for checking out small antennas at 21 feet off the ground. Even some of the small and lightweight 6m beams aren't too big to swing up. For larger antennas, two water pipes in the post hole, with the mast pivoted between them (tilt-over tower style), also work well.

Keep me posted on how it all works out for you, preferably when I hear you having fun on OSCAR. I mounted mine in a direction southeast from the tower, due to the tower sides' orientation. The way the legs are on my tower left me the general directions of 0, 120, and 240 degrees, so I chose the 120 degree direction. I favor the early evening passes east of me, since I can be home and make more of them. It also does just fine on passes west of me, too, so have no fear of it being deaf off the tower side. See you on OSCAR. ■

Thomas A. Prewitt W9IJ
2212 S. Webster
Kokomo IN 46901

Track OSCAR In Real Time

-- with your HP-67 calculator

Program Description

H-P 67/97 CALCULATOR

Program Title: OSCAR TRACK
Name: T.A. Prewitt, W9IJ Date: 5/22/77
Address: 2212 S. Webster
City: Kokomo State: IN Zip Code: 46901

Program Description, Equations, Variables, etc. Adapted from equations given in Computerized Satellite Tracking, 73 Magazine, February, 1977, page 72, by WBØJHS.

Store these constants in the indicated registers:

4 Longitude increment (28.7363)*
5 360
6 1/60
8 Inclination to equator (101.77)
9 Period (114.945)
12 -1
13 360
15 Height (910)
16 Latitude of your station
17 Longitude of your station
18 3959
19 69.09

*Values in parentheses are for OSCAR VII

Operating Limits and Warnings: Program has been checked for station locations in North latitude and West longitude. Should work for East longitude if longitude is complemented.

DO NOT USE THIS SPACE

User Instructions

OSCAR TRACK - 70522
1 TRACK | NEXT ORBIT | ENTER ORBIT #, TIME, LONG. 2

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1.	Load Program and Data			
2.	Enter Reference Orbit Data	Orbit #		
		GMT (H.MS)		
		Long.	E.	0.
3.	To Look Ahead N Orbits (Immediately Following 2).	N.	R/S	Orbit #
				Long.
				Time
3a.	To Look Ahead One Orbit		D.	Orbit #
				Long.
				Time
4.	To Track AZ-EL in Real Time During A Pass, First Perform 1, 2 and 3 (If Needed). Wait Until Real Time Reaches Time Shown In Display		A.	Note 1
	Note 1 - Display During Track Mode Consists Of Elapsed Time In Minutes, Followed By A Zero and AZ-EL Bearings. AZ Angle Appears Immediately To Left Of Decimal Point And EL Angle Is Immediately To Right Of Decimal Point, Which Serves Only As A Separator. EL Is Zero If Satellite Is Below Horizon.			

In the February (1977) *73*, Henson* presented a beautifully-documented mini-computer program for tracking OSCAR. The program described here calculates and displays the same information (except range), and, in addition, runs in real time during a satellite pass. Written in RPN for a Hewlett-Packard HP-67 pocket calculator, it will run on an HP-97 as well. I'm sure that an equivalent program could be written for the TI SR-52, although I have not done so.

After loading the program and data constants, begin by entering reference orbit data. Then step ahead one or more orbits to the one of interest. The calculator will pause to display the orbit number and the longitude of the equatorial crossing, and will halt with the display containing the predicted time of the equatorial crossing (with all data needed for a real-time track of the satellite on the selected orbit stored in the proper registers).

When real time (clock time) reaches the time shown in the calculator display, press the "TRACK" button to commence a real-time track. Thereafter, the program will run continuously, calculating beam-aiming data once each minute, and pausing every few seconds to display the current results.

Several data display formats have been programmed and evaluated. Although many tracking parameters can be calculated, the ones finally selected for display are the elapsed time, the beam heading, and the elevation angles. To keep the waiting time between successive displays to no more than a few seconds, these three data items are merged into a single line, which is displayed three times as frequently as each would be if they were displayed in sequence.

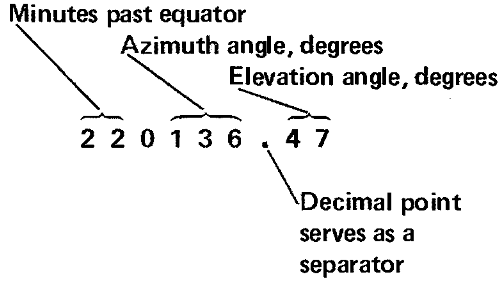


Fig. 1. Typical merged display.

Fig. 1 shows a typical merged display. The elapsed time, in minutes, appears to the left of the first zero. The azimuth heading appears to the left of the decimal point, and the elevation angle is shown to the right of the decimal point. Both angles are in whole degrees, and the decimal point serves only as a separator. The elevation angle will be shown as zero if the satellite is below the horizon.

Approximately thirty seconds of each minute are used in calculating and formatting new data, and the remaining thirty seconds are devoted to six 5-second data displays, which are distributed throughout the one minute period. If your calculator runs the program correctly but completes a loop in less than sixty seconds, add one or more PAUSE commands at the end of a display to pad it out to a full minute.

After the program is running correctly, record it on a program card and save the contents of the registers on a second data card. ■

*Henson WBØJHS, "Computerized Satellite Tracking," *73*, February, 1977, p. 72.

Program Listing

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL E		STORE REF. ORBIT DATA
	GSB 2		
	STO 1		
	↓		
	H	31 74	
	STO 7		
	STO 0		
	↓		
	STO 2		
010	0		
	STO C		
	ST I		
	R/S		HALTS HERE, TO ADV. ORBIT NO. BY N>1, ENTER N IN X-REG & PRESS R/S. *LBL 7 UPDATES ORBIT NO., TIME & LONG., CHECKS FOR T>24HRS & L>360° & FIXES IF FOUND.
	*LBL 7		
	STO 3		
	STO+2		
	RCL 4		
	*		
	STO+1		
020	RCL 1		
	RCL 5		
	x≤y		
	STO−1		
	RCL 9		
	RCL 6		
	*		
	RCL 3		
	*		
	STO+7		
030	RCL 7		
	2		
	4		
	x≤y		
	STO−0		
	RCL 2		
	DSP 0		
	PAUSE		
	RCL 1		
	PAUSE		
040	RCL 7		
	H.MS		
	DSP 2		
	RTN		
	*LBL D		ADVANCES ONE ORBIT ONLY.
	1		
	GSB 7		
	RTN		
	*LBL A		REAL-TIME TRACK ROUTINE. -UPDATES CLOCK
	GSB 2		
050	ISZ		
	RCL 6		
	RC I		
	*		
	RCL 7		
	+		
	STO 0		
	DSP 2		
	GSB 8		
	RCL 5		- THEN CALCULATES LAT & LONG. OF SSP.
060	RCL 9		
	÷		
	RC I		
	*		
	SIN		
	RCL 8		
	SIN		
	*		
	SIN−1		
	STO A		- STORES LAT.
070	RCL 5		
	RCL 9		
	÷		
	RC I		
	*		
	COS		
	RCL A		
	COS		
	÷		
	COS−1		
080	RC I		
	4		
	÷		
	+		
	RCL 1		
	+		
	STO B		- STORES LONG.
	GSB 8		
	P/S		- CALCULATES GT-CIRCLE ARC TO SSP
	RCL B		
090	RCL 7		
	−		
	SIN		
	x<0		
	SF2		
	SIN−1		
	COS		
	RCL 6		
	COS		
	*		
100	RCL A		
	COS		
	*		
	RCL 6		
	SIN		
	RCL A		
	SIN		
	*		
	+		
	COS−1		
110	STO 4		... AND STORES IT.
	GSB 8		
	RCL A		- CALCULATES AZ ∠
	SIN		
	RCL 4		
	COS		
	RCL 6		
	SIN		
	*		
	−		
120	RCL 4		
	SIN		
	÷		
	RCL 6		
	COS		
	÷		
	COS−1		
	F? 2		
	GTO 4		
	RCL 3		
130	x/y		
	−		
	*LBL 4		
	STO D		... AND STORES IT.
	GSB 8		
	RCL 8		- CALCULATES EL ANGLE
	RCL 5		
	+		
	RCL 4		
	SIN		
140	*		
	RCL 8		
	RCL 5		
	+		
	RCL 4		
	COS		
	*		
	RCL 8		
	−		
	÷		
150	TAN−1		
	x<0		
	GTO 9		
	9		
	0		
	x/y		
	−		
	*LBL 9		
	STO E		... AND STORES IT.
	GSB 8		
160	P/S		- FORMATS MERGED DISPLAY
	RCL E		
	x<0		
	0		
	EEX		
	2		
	÷		
	RCL D		
	INT		
	+		
170	RC I		
	EEX		
	4		
	*		
	+		
	STO C		... AND STORES IT.
	GSB 8		
	GTO A		... THEN LOOPS BACK.
	*LBL 8		DATA DISPLAY SUBROUTINE
	RCL C		
180	-x-		
	RTN		
	*LBL 2		CHECKS P/S REGISTERS AT STARTUP AND REVERSES IF NECESSARY
	RCL 2		
	x<0		
	P/S		
	↓		
	RTN		
190			
200			
210			
220			

REGISTERS

0 REAL TIME	1 LONG. OF EQX	2 ORBIT NO.	3 used	4 Δ LONG = 28.7363	5 360	6 1/60 = 0.01667	7 TIME OF EQX	8 INCLIN = 101.77	9 PERIOD = 114.945
S0	S1	S2 −1	S3 360	S4 ARC	S5 H = 910	S6 LAT. OF STN	S7 LONG. OF STN.	S8 R = 3959	S9 MI/DEGREE 69.09
A LAT. OF SSP	B LONG. OF SSP	C FORMATTED DISPLAY	D AZ ANGLE	E EL ANGLE	I ELAPSED TIME SINCE EQX				

LABELS

A TRACK	B	C	D NEXT ORBIT	E STORE REF. ORBIT
a	b	c	d	e
0	1	2	3	4
5	6	7	8	9

FLAGS

0	
1	
2	
3	

SET STATUS

FLAGS (ON / OFF)	TRIG	DISP
0 ☐ ☐	DEG ☒	FIX ☒
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n 2

Logical Thoughts About OSCAR

-- meaningful to computers!

Wm. Denison Y. Rich OA6AD
Casilla 751
Arequipa, Peru

Several months ago I received a free copy of *Ham Radio Horizons* and read the article about the OSCAR (Orbital Satellite Carrying Amateur Radio) satellites.[1] Up to that time, I had heard of OSCAR but supposed I would need a good deal of auxiliary equipment to access the satellites. However, according to the author, my trusty SB-102 should have been able to hear either of the OSCARs. The only problem was when to listen. Since the maximum exposure (during an overhead pass) is a little more then 20 minutes, and there are, at most, four favorable passes per day, random listening is definitely out.

At the time, I recalled that the ARRL was publishing AMSAT-supplied[2] equator crossings for the OSCARs in daily CW bulletins. A day of poking around in the QRM/N on 20 (why does everyone tune up on 14.080?) netted me a dozen crossings, and, with a dandy desk calculator, I was able to fill in the gaps and make several days of predictions.

Shortly after, I heard OSCAR 7 on one of the passes I had predicted, and I was hooked. I also heard half a dozen or so stations working through the satellite and am now working on a solid state, 2 meter CW rig (you convince *your* wife you absolutely must have a new $700 transceiver, so you can talk to a satellite) and some sort of antenna to go with it.

But, if I can do these predictions on a desk calculator, why can't I do them on a computer?

At work (oddly enough, a satellite tracking facility of the Smithsonian Astrophysical Observatory), we have a NOVA 1200 minicomputer.[3] Since this machine is available for some time each day, the next step was to write a program to predict successive OSCAR passes.

Language

Although we have two more efficient languages available, I chose to use BASIC[4] (DGC Extended BASIC as modified by COI[5]) for three reasons:

1. BASIC is one of the most easily understood languages available. Its clarity far outweighs any lack of speed, especially for the beginner. In this case, speed is no consideration anyway, because the actual computation takes only a few milliseconds, with most of the program time spent in controlling the teletypewriter output device.

2. BASIC is widespread. Most school computers, be they in high schools, colleges, junior colleges or even in grade schools, run in BASIC, in addition to other languages. The chances are good that, if you have ever used a computer, you have programmed in BASIC.

Check with your local school board or with the science and math departments in your school system. If the school does have computer facilities, this might make a nice tie-in for a new educational use for OSCAR.

3. Many advertisements for microprocessor/computer systems list BASIC as a ready-to-run language, either supplied or available as an option.

Programming

For any nontrivial program, a flowchart is almost essential and is an easy way to block out the job. The flowchart will usually suggest ways of breaking up one large job into several smaller ones. Fig. 9 shows some commonly used flowchart symbols and their meanings.

In the main chart for this program (Fig. 1 and Fig. 10, lines 1 through 299), each phase of the program is represented by a separate block. Some blocks stand for a single instruction, but most stand for two, three, or more.

Fig. 1 begins with the block RUN and "flows" in an orderly manner to the block END. Some of the blocks (SELECT A SATELLITE) stand for what are called subroutines. A subroutine is a short program which takes care of some special job, like selecting the elements for a particular satellite. Usually, a subroutine is written because the same small job is to be performed several times, and there is no sense in repeating the same "code" over and over.

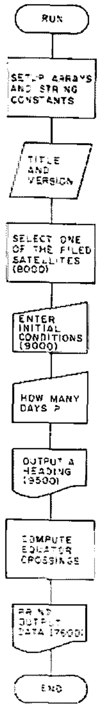


Fig. 1. Main program flow showing data entry points, computations, output points, and major subroutine calls.

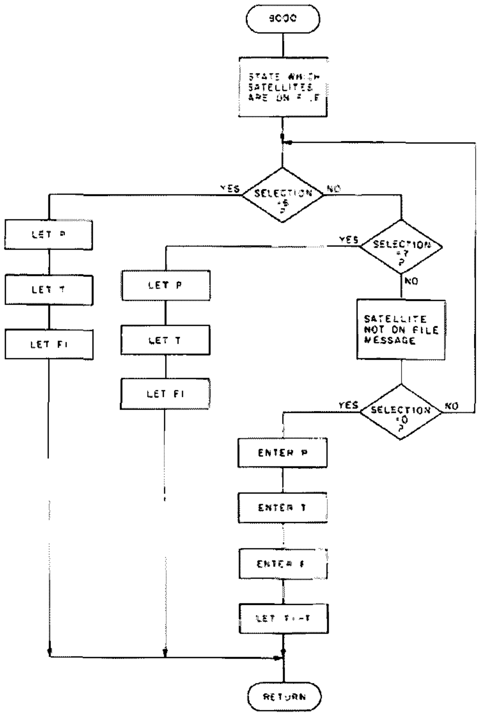


Fig. 2. Subroutine 8000, which is used to select either a filed satellite or a new, unfiled satellite.

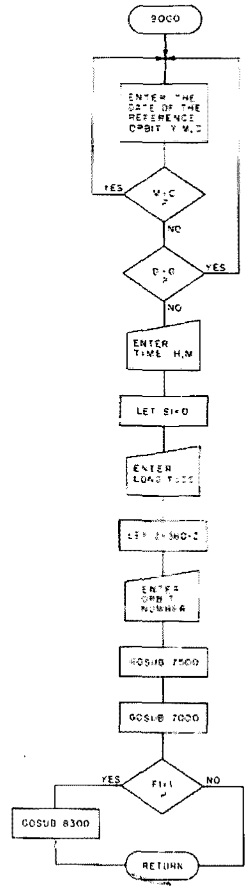


Fig. 3. Subroutine 9000, which is used to enter the reference day and position for the selected satellite.

Quite often a stock subroutine can be used in other programs with little or no modification. For example, I have already used the "calendar" subroutine (7000) in two other programs.

I like to use subroutines to make the big job smaller and easier. If all the subroutines used in this program were combined into a single program and flowchart, we might need a square meter of paper on which to draw it and, certainly, a tour guide to help us through it.

An "ultimate" main program might even begin at RUN, consist of nothing more than GOSUB statements, and finally terminate with an END statement.

To keep things simple:
1. Break up the big job into individual steps.
2. Keep the "main" program and its flowchart in as straight a line as possible.
3. Document your program with explanatory remarks wherever possible. If you decide to make changes in 6 months, you'll be awfully glad you have these notes.

In BASIC, it is not necessary that line numbers follow sequentially. The program always goes to the next highest line number for execution (unless, of course, it encounters a GOTO, GOSUB, or RETURN statement).

I like to think of the available program area (lines 1 to 9999) as a notebook. Early "pages" are used for the main program, with plenty of blank pages left for later changes or corrections; later pages are used for subroutines, filling the "book" from the back toward the front. If you put everything in the front of the "book," and then have to rewrite some section or insert corrections, you will have a major rewrite job on your hands because of the lack of vacant line numbers ("pages").

Equator Crossings

The objective of this program is to produce OSCAR equator crossings (time – UT, longitude – W), based on reference orbits (initial conditions) supplied by AMSAT via W1AW.

In the following discussions, no attempt is made to explain, in detail, the workings of BASIC. It is assumed that, if you have access to a computer and BASIC, you also have access to any necessary "how-to-use" manuals.

Lines 1 and 2 (Fig. 10) are self-explanatory. Lines 10 through 39 are used to set up several constants and an array, all of which will be used later by different sections of the program. Lines 40 and 41 are the "TITLE" block of Fig. 1, followed by line 55, which sends us to the "SELECT-SATELLITE" subroutine, beginning at line 8000.

This subroutine (lines 8000 through 8201 and Fig. 2) tells us which satellites are preprogrammed and asks which we want. Lines 8025 and 8030 direct the flow to the appropriate set of elements, each of which is terminated by a GOTO 8200. Line 8200 announces the chosen satellite, and 8201 contains the RETURN statement, which must end all BASIC subroutines, and which transfers control back to the main program. Lines 8063 and 8083 set the state of a flag, F1, which will be used later to help format the printed output of the program.

If the tests in lines 8025 and 8030 fail, then line 8040, the next instruction in sequence, sends control to line 8090. These are self-explanatory, except for line 8140, which converts the westerly drift, entered by the operator, to easterly drift, the form which will be used by the program in its calculations. We will, of course, convert the output back to westerly degrees before printing.

New satellites may be programmed by inserting an appropriate test in the decision chain, starting at line 8025, and, of course, a block of elements ending with GOTO

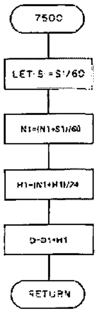


Fig. 4. Subroutine 7500, in reality only one line long, but shown here as 4 separate steps in the interest of clarity. This subroutine converts integer hours, minutes, and seconds into decimal parts of a day, and then adds this number to the current day.

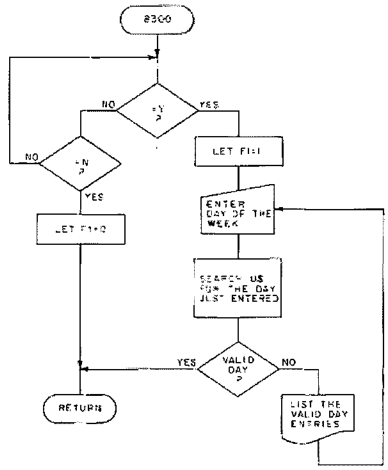


Fig. 5. Subroutine 8300, which sets up the flag, F1, for later use by the output routine. In the event that the unavailable days are to be suppressed, the day of the week for the reference orbit is entered here.

8200. One would also change line 8000. The element block may go anywhere in the subroutine, provided that the elements end with GOTO 8200.

Now, go back in the main program for a second. Line 70 transfers control to the subroutine at line 9000 (Fig. 3).

Lines 9000 to 9040 are self-explanatory. Line 9045 is included because time is only requested to the nearest minute, but, since seconds (S1) are used in the calculations, S1 must have some value. If, later, you want to include seconds as an input variable, the only change needed will be to delete line 9045 and add S1 to the input lines, 9035 and 9040. S1 is already included in all pertinent calculations.

Once again, line 9053 converts west longitude to east longitude, just as was done back at line 8140.

At line 9065, we find another subroutine call. Subroutine 7500 (Fig. 4) is a one-liner which turns seconds, minutes, and hours to decimal parts of a day. "Decimal" days are by far the simplest way of keeping time in a program!

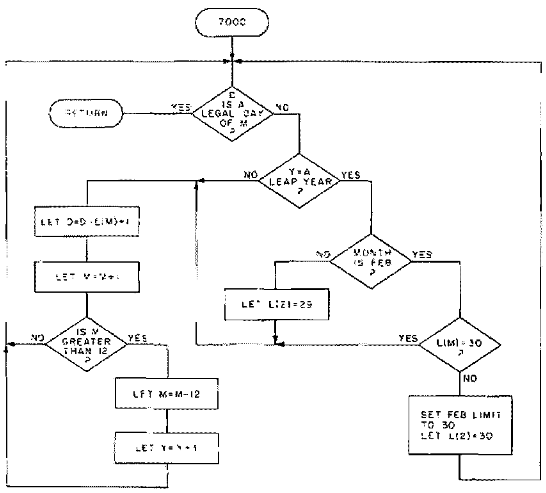


Fig. 6. Subroutine 7000, the calendar subroutine which takes care of advancing the month and year, when required. This subroutine also takes into account the possibility that the current year is a leap year and that, therefore, February must have 29 days instead of the usual 28.

After returning via line 7550, we are immediately sent, by line 9070, to subroutine 7000 (Fig. 6). This is the calendar manager and is perhaps the most complex subroutine in the program. What does it do?

First, it checks to see if the current day is still inside the current month. If it is, then control is passed right back to the calling program. If not (say we had typed FEB 29), the subroutine checks to see if the current year is a leap year. If this is so, the limit day of February is set to 30, if not already so set, and the current day is again tested at line 7020 to see if it has become a legal day by virtue of the limit change. It is the accounting for leap year that makes this subroutine so complex. Without leap years, the only branch would be the first one, at line 7020.

If the current day still fails the test at line 7020, then we must move on to the next month, so lines 7038 through 7060 are executed, and a return is again made via line 7020. This last test is cheap insurance against having created an illegal day.

If line 7045 finds month (M) value greater than 12, it increments year (Y) and returns via the legal day test.

Note that, if the test "L(2)=30?" is not included at line 7085, one logical course of action, after finding that the month is February, would be to set the limit to 30, then reenter at line 7020. This is okay until the day gets to be February 31 or greater, at which point the program has no way of breaking the loop and performs: (LEGAL DAY?) – (MONTH IS FEB?) – (SET LIMIT = 30) – (LEGAL DAY?) – (MONTH IS FEB?) – etc., – etc. . . ., until the cows come home. Flowcharts are a great help in avoiding this sort of bug.

Now let's go back to line 9073 – that is, just following the subroutine call to the calendar manager. Remember, we are entering initial conditions for a prediction run. Only one more parameter needs to be checked – the flag, F1. This is done at line 9073. Subroutine 8300 (Fig. 5) is called, if necessary, and asks if you want all crossings or only those available for use. So far, only OSCAR 6 has a serious restriction, but, since any satellite might have one, the option is included. Return is made to the calling subroutine and then to the main program via line 9075.

Lines 80 through 130 of the main program are self-explanatory. Line 140 sends us to subroutine 9500 (Fig. 7), which will print the satellite number and date for each

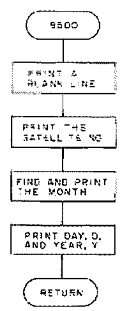


Fig. 7. Subroutine 9500, which prints headings for each day's passes. These headings will be printed even if the output for a particular day is suppressed.

new day predicted.

The actual calculation loop, lines 150 through 195, is executed (13 x I)/S times. See lines 80 through 100 for I and S. Subroutine 7600 (Fig. 8) is the output routine and immediately calls the calendar (7000). Subroutine 7600 then checks to see if this is a new day (line 7612), and, if it is, calls for a heading to be printed.

The decimal day is converted to a day, hour, and minute (lines 7682 through 7691). The orbit number and time are printed (lines 7693 and 7696), and the longitude is converted to west and printed by line 7698.

The odd decision chain, at lines 7625 through 7635, tests the value of F1, which was set up back at lines 8063 and 8083. If F1 is nonzero, only the "available days" are printed. More available days could be added to the chain, if needed.

Note that, since the "new day" test (line 7612) is done before the test of F1 (line 7620), a heading will be printed for every new day, even though the passes for that day are suppressed. The heading doesn't take much paper and lets you see at a glance what the program is up to.

Fig. 11 is a sample run. All human typing is underlined. Computer output is not.

Simplicity or Flexibility

A program such as this requires a lot of work to write, especially when compared with the actual amount of calculation it does. But it takes me several hours to prepare 30 days of predictions, not counting my penchant for arithmetic errors, while the machine can compute and print the same number of predictions in about 20 minutes, with no errors, provided it is programmed properly. Thirty days comes to about 400 crossings.

The amount of work required to prepare this and, perhaps, most programs can be justified only if an equivalent or greater amount of time can be saved later on. It is for this reason that the program was made flexible. A simpler program would not have options like the choice of satellites preprogrammed, entry of trial satellites, and the like. For a little extra work now, I have a program which allows me to file a new satellite in a matter of minutes or to run a trial on a new satellite at the cost of entering its period and westward drift. I can easily suppress output of any day's passes, and the days to be suppressed can be changed by changing only one or two lines.

When OSCARs 8, 9, and 10 come along, this program will be running within minutes of my receipt of the necessary data.

Speaking of data, you may get it from a magazine article, as I did, or you could compute it, if you know any two reference orbits, ORB1 and ORB2. It helps somewhat if the two known orbits are a few days apart.

Period = P = (TIME2 - TIME1)/(ORB2 - ORB1)
Drift (W) = T = (LAT2 - LAT1)/(ORB2 - ORB1),

where TIME and LAT are the initial conditions for two crossings, and ORB1 and ORB2 are the orbit numbers.

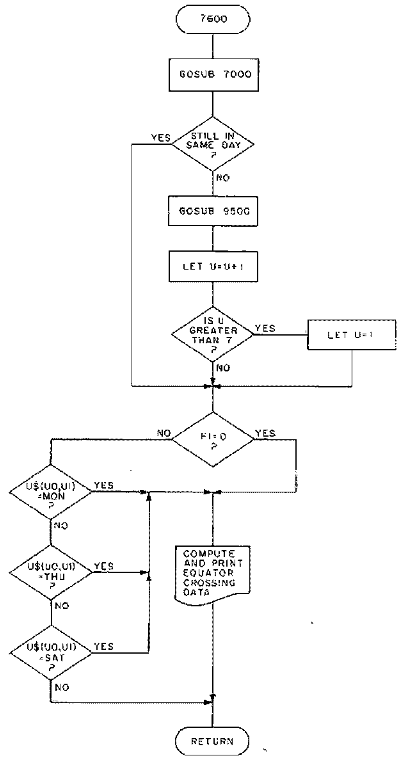
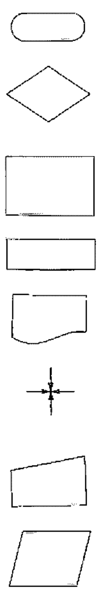


Fig. 8. Subroutine 7600, which causes a heading to be output, if necessary, and then decides which, if any, of the crossings will be printed.

One further improvement might be to add a longitude test to the output routine, such that only passes which will be "visible" from your station will be printed. This would drastically cut the total running time.

Parting Thoughts

Keep track of the residuals, or the differences in time and longitude, between



Usually used to signify a start point (RUN) or an END. Also used for entry and exit points of subroutines.

This symbol always signifies a decision point. Usually the branch paths run out from the side of the diamond; however, this is not necessary if the paths are clearly marked — yes, no, true, or false.

This and the following symbol describe any "process." A process may be a GOSUB, GOTO, LET, PRINT, or any other operational instruction.

Output, in the form of a printed document. This symbol may be used for either teletype or line printer output.

These arrows indicate program flow. They are one-way only, like diodes. Once flow has passed through an arrow, it may not go back. In this example, there is an insolvable problem in that all four arrows point into the intersection. There is no exit!

Input, usually from a keyboard terminal.

Comment, either an output from the program or an explanatory block for the programmer. This symbol does not have to represent a section of the program.

Fig. 9. Some of the symbols used in flowcharts and some of their possible meanings.

```
0001 REM MAIN PROGRAM: COMPUTES AND PRINTS
0002 REM EQUATOR CROSSINGS FOR OSCAR SATELLITES.
0010 DIM L[12 ],M$[36],U$[21]
0011 DIM Y$[1],D$[3],A$[8]
0015 DATA 32,29,32,31,32,31,32,32,31,32,31,32
0017 LET U$=" SUNMONTUEWEDTHUFRISAT    "
0018 LET M$=" JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC"
0020 FOR I=1TO 12
0025   READ L[I]
0030 NEXT I
0038 LET A$="8 JUNE"
0039 LET V =2.13
0040 PRINT " EQUATOR CROSSINGS: VERSION";V;
0041 PRINT " OF ";A$;" 1977  [COI-XBASIC]"
0055 GOSUB 8000
0070 GOSUB 9000
0080 PRINT " HOW MANY DAYS OF PREDICTIONS";
0085 INPUT I
0090 LET I=I*13
0095 REM ORBITAL INCREMENT: 1=EACH, 2=EVERY OTHER, ETC
0100 LET S=1
0105 REM CONVERT P FROM MINUTES TO DAYS
0110 LET P=P/60/24
0120 PRINT
0130 PRINT " ORBIT       TIME(UT)       LONGITUDE-WEST"
0140 GOSUB 9500
0150 FOR J=0TO ISTEP S
0155   LET W=W+ S
0160   LET Z= Z+ T*S
0165   LET Z=(Z/360-INT(Z/360))*360
0170   LET D=D+P*S
0185   GOSUB 7600
0195 NEXT J
0299 END
7000 REM $$$ SUBROUTINE: CALENDAR
7020 IF D=>L[M]THEN GOTO 7035
7025 GOTO 7099
7035 IF Y/4-INT(Y/4)=0THEN GOTO 7070
7038 LET D=D-L[M]+1
7040 LET M =M+1
7045 IF M=<12 THEN GOTO 7020
7050 LET Y= Y+1
7060 LET M =M-12
7065 GOTO 7020
7070 IF M=2 THEN GOTO 7085
7075 LET L[2 ]=29
7080 GOTO 7038
7085 IF L[2 ]=30THEN GOTO 7038
7090 LET L[2 ]=30
7095 GOTO 7020
7099 RETURN
7500 LET D=D1+(H1+(N1+S1/60)/60)/24
7550 RETURN
7600 GOSUB 7000
7612 IF INT(D)=D1THEN GOTO 7620
7615 LET D1=INT(D)
7616 GOSUB 9500
7617 LET U=U+1
7618 IF U=<7THEN GOTO 7620
7619 LET U=1
7620 IF F1=0THEN OOTO 7682
7623 LET U0=3* U-2
7624 LET U1=3* U
7625 IF U$[U0,U1] =" MON" THEN GOTO 7682
7630 IF U$[U0,U1 ]=" THU"THEN GOTO 7682
7635 IF U$[U0,U1 ]=" SAT" THEN GOTO 7682
7680 GOTO 7699
7682 LET D1 = INT(D)
7686 LET H1 =(D-D1)*24
7690 LET N1=INT((H1-INT(H1))*60+.5)
7691 LET H1=INT(H1)
7693 PRINT W,
7696 PRINT USING "####",H1*100+N1;
7697 PRINT "",
7698 PRINT USING "###.#",360-Z+.05
7699 RETURN
8000 PRINT " OSCAR 6 AND 7 ARE ON FILE. ENTER DESIRED SATFLLITF;";
8020 INPUT O
8025 IF O=6THEN GOTO 8050
8030 IF O=7THEN GOTO 8070
8035 REM DEFAULT: REQUESTED SATELLITE NOT ON FILE
8040 GOTO 8090
8045 REM ELEMENTS FOLLOW:
8050 REM ***** OSCAR-6 *****
8055 LET P=114.994+0
8060 LET T=-28.7486+0
8063 LET F1=1
8065 GOTO 8200
8070 REM ***** OSCAR-7 *****
8075 LET P=114.945+0
8080 LET T=-28.7362+0
8083 LET F1=0
8085 GOTO 8200
8090 PRINT " OSCAR";O;" IS NOT ON FILE. TYPE 0 TO RUN A TRIAL";
8095 INPUT O
8100 IF O>0THEN GOTO 8025
8120 PRINT " PERIOD (MINUTES)",
8125 INPUT P
8130 PRINT " DRIFT (DEG WEST)  ",
8135 INPUT T
8140 LET T=T*-1
8145 LET F1=0
8200 PRINT " PREDICTING FOR OSCAR";O
8201 RETURN
8300 PRINT "SUPPRESS UNAVAILABLE ORBITS(Y/N)";
8325 INPUT Y$
8330 IF Y$><" Y" THEN GOTO 8340
8335 LET F1=1
8338 GOTO 8350
8340 IF Y$><" N" THEN GOTO 8325
8345 LET F1=0
8347 GOTO 8399
8350 PRINT "  REFERENCE DAY      ",
8360 INPUT D$
8365 FOR I=1TO 7
8370   LET U=I
8375   IF D$=U$[3* I-2,3*I]THEN GOTO 8399
8380 NEXT I
8384 PRINT "  LEGAL DAYS ARE: ";
8386 FOR I=1TO 7
8388   PRINT U$[3*I-2,3*I];"  ";
8390 NEXT I
8392 GOTO 8350
8399 RETURN
9000 PRINT " REFERENCE ORBIT:"
9015 PRINT "  YY , MM , DD   ",
9020 INPUT Y,M,D1
9025 IF M=0THEN GOTO 9015
9030 IF D1=0THEN GOTO 9015
9035 PRINT "  HH , MM         ",
9040 INPUT H1,N1
9045 LET S1=0
9048 PRINT "  LONGITUDE (DEGR-WEST)",
9050 INPUT Z
9053 LET Z=360-Z
9055 PRINT "  ORBIT NUMBER        ",
9060 INPUT W
9065 GOSUB 7500
9070 GOSUB 7000
9073 IF F1=1THEN GOSUB 8300
9075 RETURN
9500 PRINT
9515 PRINT " OSCAR";O;"        "M$[3* M-2,3*M];INT(D);Y+1900
9550 RETURN
```

Fig. 10. A complete listing of the program.

your predictions and the W1AW bulletins. I once predicted OSCAR 7 for 30 days, only to discover later that there was a 10-minute bias to all the times because the reference orbit had been wrongly copied from W1AW. Typical residuals, over a 30-day prediction cycle, have been ±1 minute and ±.1 degree of longitude. These differences creep in mainly because the AMSAT/W1AW bulletins only give time and longitude to these accuracies. We cannot expect the program to be more accurate than the data given it.

This program is only one way of reaching the stated objective. There are usually as many programs per problem as there are programmers

```
RUN
EQUATOR CROSSINGS: VERSION 2.13 OF 8 JUNE 1977  [COI-XBASIC]
OSCAR 6 AND 7 ARE ON FILE. ENTER DESIRED SATELLITE: ? 7
PREDICTING FOR OSCAR 7
REFERENCE ORBIT:
  YY , MM , DD                  ? 77,5,30
  HH , MM                       ? 0,37
  LONGITUDE (DEGR-WEST)         ? 62.6
  ORBIT NUMBER                  ? 11605
HOW MANY DAYS OF PREDICTIONS ? 2

 ORBIT       TIME(UT)       LONGITUDE-WEST

OSCAR 7         MAY 30  1977
 11606          232             91.4
 11607          427            120.1
 11608          622            148.9
 11609          817            177.6
 11610         1012            206.3
 11611         1207            235.1
 11612         1402            263.8
 11613         1557            292.5
 11614         1751            321.3
 11615         1946            350.0
 11616         2141             18.7
 11617         2336             47.5

OSCAR 7         MAY 31  1977
 11618          131             76.2
 11619          326            105.0
 11620          521            133.7
 11621          716            162.4
 11622          911            191.2
 11623         1106            219.9
 11624         1301            248.6
 11625         1456            277.4
 11626         1651            306.1
 11627         1846            334.8
 11628         2041              3.6
 11629         2236             32.3

OSCAR 7         JUN 1  1977
 11630           30             61.1
 11631          225             89.8
 11632          420            118.5

END AT 0299
```

Fig. 11. A sample run for OSCAR 7. Human input to the program is underlined. Everything else is the product of the program.

attacking the problem. In this case, for example, certain sections of the coding were made to take up several lines, where only one line was really needed. This has resulted (I hope!) in greater clarity at the expense of space. Why not try improving this program?

Not all BASIC versions are identical. Make sure the features I have used are available in your version of the language, before writing a stiff letter to the editor.

Important note: When listing a program, this particular version of BASIC often inserts phantom spaces. These are only important in the following lines:

Line 17 must begin "SUNMON..." with no spaces between the quotation marks and SUN. "...FRISAT " does include 3 spaces following SAT, and then the quotation mark. Line 18 is similar to 17 and must begin "JANFEB ...", without spaces after the leading quotation mark. There are no spaces following DEC.

Lines 7625, 7630, and 7635 are similar in that the test day, for example "MON", must be enclosed in quotation marks without spaces as "MON", "THU", or "SAT".

Lines 8330 and 8340 are the same; the Y and N must be entered as "Y" and "N", without enclosed spaces.

All other blank spaces in Fig. 10 are not critical and may be inserted or deleted according to your whims or the requirements of your flavor of BASIC. ■

References

1. *Ham Radio Horizons*, March, 1977, pp. 18ff.
2. Radio Amateur Satellite Corporation, P.O. Box 27, Washington DC 20044.
3. NOVA is a registered trademark of the Data General Corporation (DGC), Southboro MA 01772.
4. BASIC was developed at Dartmouth College.
5. Computer Operations, Inc. (COI), Beltsville MD 20705.

RTTY Loop

I hope you enjoyed the special RTTY issue! Now that you are completely ready to operate, a few hints and suggestions are in order. Required equipment is a printer/keyboard combination (Model 15), a loop supply, a terminal unit, and an AFSK generator. I assume that you already have a transceiver capable of operating SSB on the low bands. Let's get started!

RECEIVING RTTY

By convention, RTTY operators congregate on certain areas within the CW portion of the band in question. There is activity on both 80 and 20, not much on 40, 15, or 10. Eighty meter activity is usually found around 3615 kHz and up. Twenty meter teletype freaks are found from 14.08 to 14.1 MHz. Sideband conventions are reversed on all HF bands except 80. Therefore, RTTY is received and transmitted on lower sideband on twenty — voice is upper. On 80, SSB and RTTY are both transmitted on the lower sideband.

In order to properly receive RTTY, the signal must be carefully tuned. Allow your transceiver to perk for an hour or so before tuning up the first time. An audio sample must be coupled to the TU ... normally through a matching transformer. Many of the popular TUs such as the HAL ST-6 and Flesher DM-170 require a 500-600 Ohm feed for proper operation. In a pinch, however, the TU can be paralleled across the speaker line. There are two common methods for tuning a RTTY signal. The first, and easiest, method employs a meter. The TU meter indicates a steady value when the signal is properly tuned — if not, it will jump randomly in the presence of RTTY or CW. Carefully tune the receiver until the meter is steady ... it's best to start out on a strong signal! Consult the operating instructions for your particular TU for specific details. The second tuning method uses an oscilloscope with the horizontal sweep disabled. Almost all TUs have "scope output" terminals which allow the mark and space discriminator output to be coupled to the scope. When receiving a RTTY signal, a pattern of crossed ellipses or circles will be present. The technique is to tune the receiver until the elliptical patterns are as large as possible, and as close to right angles to each other as possible. Most modern TUs have both scope outputs and meter tuning; try the meter method until you have the hang of tuning RTTY.

At this point, you should be able to copy amateur QSOs. Saturday afternoon is the best for 20 meters — if you are lucky you'll hear Ricky WAØCKY transmitting one of his classic RTTY pix! You should also hear (see!) stations calling CQ. If you're ready to answer, read on!

TRANSMITTING RTTY

Transmitting is simple. The output of your AFSK generator is connected to the microphone input of the SSB transceiver. When the loop is keyed, either by the keyboard or tape reader, the AFSK oscillator converts the Baudot pulses into frequency shifted mark and space tones. A caution is in order at this point: RTTY, like CW, is a continuous duty transmission. Unlike SSB, RTTY imposes extra strain on the final of your transmitter. It is wise to derate SSB ratings by a factor of four — if your rig is rated at 200 Watts PEP, do not allow the continuous RTTY output to exceed about 50 Watts. Save a tube! You will soon find that most RTTY operators do not use high power ... like CW, a bit goes a long way. In most cases, 200 Watts and a beam will do the trick. I run 75 Watts, and have needed more on few occasions.

When using a standard SSB transceiver, use 170 Hz shift. This insures that the audio tones are well within the passband of your transceiver's filter. It is possible when using 850 shift to produce a secondary, and illegal, carrier. Most current activity is on 170 shift anyway.

An aside: A good beginner's RTTY transmitter is an old Heath HW-32 20 meter singlebander, popular a few years ago. This rig is designed for phone only service, but can be put on RTTY (or CW) by changing a single crystal. I performed this modification, and threw in a new filter crystal to be safe. The HW-32 will put out 40 Watts continuously, using sweep tubes in the final.

Although this issue marks my last as Executive Editor of *73*, I'll still look forward to seeing you on 14.090 or 3615 in the evening!

John Molnar WA3ETD
Executive Editor

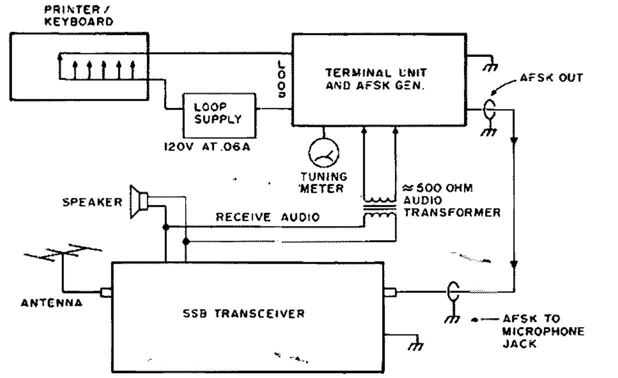


Fig. 1.

Many modern terminal units use a meter for tuning. A steady value indicates a properly tuned RTTY signal. Once the signal is tuned, the printer can be activated. The TU pictured is the HAL ST-5000.

Jack Colson W3TMZ
RFD 3
Mt. Airy MD 21771

OSCAR DX

-- a new challenge

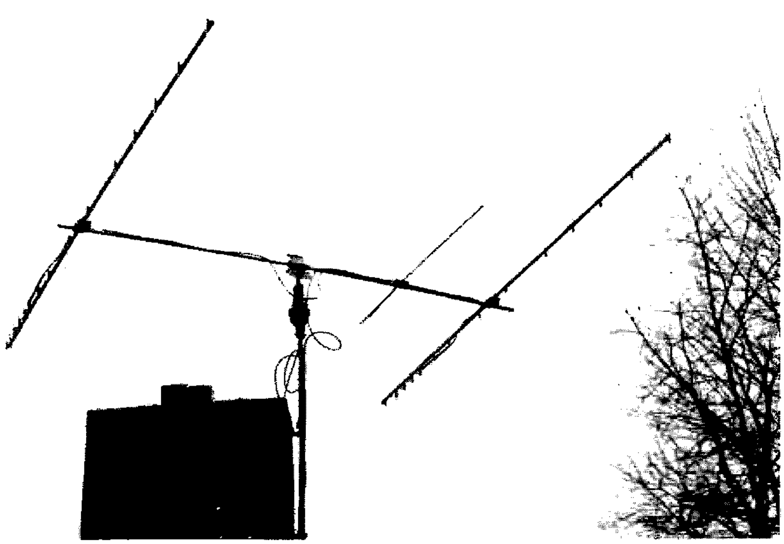
At one time or another, each of us has experienced difficulty in working DX stations because the HF propagation has been poor. We now have an alternative. With amateur satellites it is now possible to communicate consistently with stations up to 4500 miles away and predict exactly when they can be worked without the propagation problems incurred at HF.

A number of well-known HF DXers are now quite active chasing DX via amateur satellites. In the United States, in less than two and a half years, Ben Stevenson W2BXA has worked 86 countries via satellite. Actually, Ben and Pat McGowen G3IOR are having a battle to see who will be the first to work DXCC via satellite. Pat has at least 86 countries worked to date. Bill Hunter K4TI did a study several years ago and concluded that DXCC was possible via the present OSCAR satellites. Today with OSCAR 6 and 7 it is possible to communicate with amateurs in Europe and Africa every morning and early evening. On subsequent passes, amateurs in South and Central America as well as the Caribbean and Asia (AU9 and Ø) are within range. Between 0300 and 0500 GMT the satellites are passing over California, which brings the KH6s in range. And we can work these DX stations every day, day after day. In fact, when HF propagation disturbances occur occasionally, satellite communications are even enhanced.

As a matter of history, in mid-October, 1972, the first long life amateur satellite was orbited. This satellite, OSCAR 6, has provided many new aspects to DX chasing. In mid-November, 1974, a second long life satellite, OSCAR 7, was orbited. It has provided even more DXing activities.

OSCAR 6 contains a 2 to 10 meter transponder with a 100 kHz bandwidth. Specifically, the input frequencies are 145.90 to 146.00 MHz, which translates to 29.450 to 29.550 MHz respectively. For normal communications, a power of approximately 100 Watts effective radiated power (ERP) provides a satisfactory return signal on the 10 meter downlink. For DX chasing, one should be able to access the satellite when it is near the horizon; to be consistent, an ERP of 1 kW is recommended. To keep the AMSAT officials happy and prevent overload of the satellite's receiver, one should adjust his ERP to maintain a reasonable but not strong return signal (comparable to other signals). Effective radiated power is defined as: matched power at the antenna terminal(s) times the antenna gain as a ratio. For example, consider an antenna with 12.5 dB of gain; this relates to a power ratio of 17.78. If the power at the antenna terminals was 100 Watts, the ERP would be 1778 Watts.

OSCAR 7 has two transponders. The first is similar to OSCAR 6 – this is termed Mode A. Its input frequencies are 145.850 to 145.950 MHz, translating to 29.400 to 29.500 MHz output. The second is a 432 to 145 MHz repeater – it is termed Mode B. Its frequencies are a 432.130 - 432.170 input, translating to a 145.970 to 145.930 output. There is an inversion in this transponder – as the operating frequency is increased, the output frequency decreases. This was done intentionally to reduce the effects of Doppler shift. Also, because of the inversion, a USB uplink (input)



Two 14 element KLM beams for 2 meters and a 432 MHz KLM beam for satellite DX in use at W3TMZ.

AZ/EL	VS	Equator Crossing Of -.35.0
Time Min.	AZ Deg.	EL Deg.
7	109.	1.
8	102.	6.
11	92.	11.
13	78.	17.
15	61.	20.
17	43.	20.
19	26.	17.
21	13.	12.
23	3.	6.
25	356.	1.

AZ/EL	VS	Equator Crossing Of -40.0
Time Min.	AZ Deg.	EL Deg.
6	118.	1.
8	111.	7.
10	101.	14.
12	88.	20.
14	70.	25.
16	48.	26.
18	28.	22.
20	14.	16.
22	3.	9.
24	356.	3.

AZ/EL	VS	Equator Crossing Of -45.0
Time Min.	AZ Deg.	EL Deg.
4	129.	-1.
6	124.	5.
8	117.	12.
10	107.	20.
12	91.	28.
14	68.	34.
16	41.	32.
18	21.	25.
20	7.	17.
22	359.	9.
24	353.	3.

AZ/EL	VS	Equator Crossing Of -50.0
Time Min.	AZ Deg.	EL Deg.
4	136.	2.
6	131.	9.
8	125.	17.
10	114.	27.
12	95.	38.
14	63.	44.
16	31.	39.
18	11.	28.
20	1.	18.
22	354.	9.
24	350.	2.

Fig. 1. OSCAR 6 and 7 tracking data for Washington DC and vicinity. (-) = west longitude; time = after ascending node equator crossing.

signal becomes an LSB on the downlink (output).

For OSCAR 7, Mode A, a somewhat higher ERP is needed than with OSCAR 6. A good value is 10 dB more or 1 to 10 kW ERP. For Mode B, an ERP of 80-100 Watts will provide an excellent return signal.

Both OSCAR 6 and 7 are termed to be in sun-synchronous orbit — that is, they are available for communications at every point on the earth at the same local time of day. Each satellite is fixed in a near polar orbit approximately 900 miles above Earth. With such an altitude, it is possible to communicate with the satellite when it is 2450 miles away from your location. This yields a maximum communications range of 4900 miles. This can be extended considerably at times due to peculiar propagation phenomena which will be discussed later.

Probably the most exciting facet of DXing via satellite is that you can operate every day and not be concerned with normal HF ionospheric problems. Once the satellite is within your range, you are ready. There are occasional VHF/UHF propagation disturbances which do affect communications, but not to the extent that a solar storm would have upon HF. An example: Last spring when HF communications were almost totally wiped out by a storm, many Europeans were worked via satellite.

Operating

In order to operate via the satellite, one must know when it is available and in what mode it will be for a given day. Orbital data is available from many sources. Probably the most convenient source is the W6PAJ handbook. This book is published yearly and contains all revolutions for OSCAR 6 and 7*. The data is published in the form of date (GMT), revolution number, time (GMT) that the satellite crosses the equator in an ascending node (south to north) and the longitude in degrees west of Greenwich. With this data, one can compute when the satellite will be within his particular window.

The next problem is where to point the antenna. Unfortunately, this is difficult to accurately describe in a few words. Obviously it would be far easier to use a high power transmitter and almost non-directional antenna, thus eliminating the need for antenna directional data. Sad to say, high power equipment is rare and expensive.

Generally, for ascending node revolutions, the satellite will rise from the south to southeast and go east of your QTH and leave in northwestern azimuth. If the longitudinal crossing is west of your longitude, then instead of passing to the east, it will pass to the west.

This is fine for azimuth, but what about elevation? In most cases the operator will not be interested in elevation, because he is only interested in DX which can be worked principally when the satellite is near the horizon. The only reason for a DXer to use an elevation mount is to achieve practice in satellite usage and communicate with nearby amateurs.

When OSCAR 6 was first launched, the VK amateurs generated AZ/EL data based on longitudinal crossing for many major cities in the world. I personally use this table for my antenna pointing. The second feature of the table is that it defines the satellite coverage for a particular QTH. An example of this information for the Washington area is given in Fig. 1.

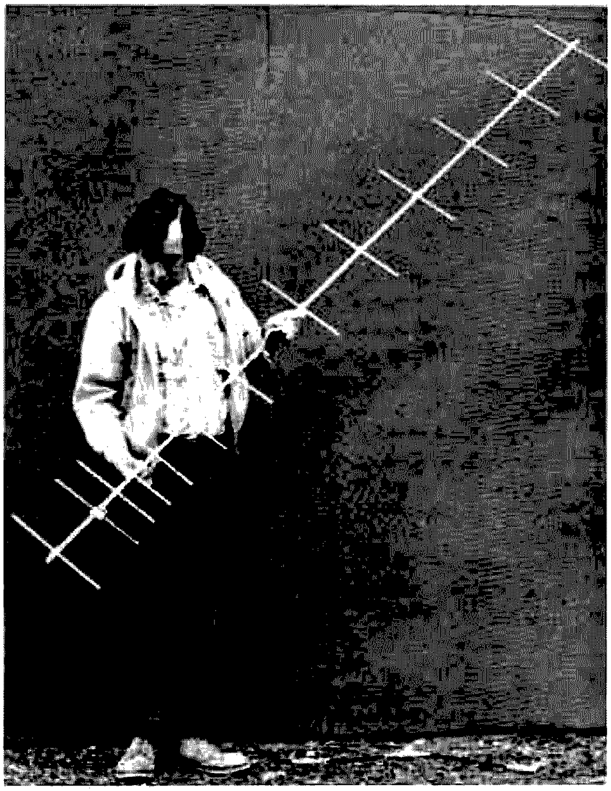
To generate this data, a computer program (written in Fortran IV and adaptable to most machines), is available.

Operating Tips for the Beginner

There are several very important techniques that will be helpful.

Pick an input/output frequency combination to which you can repeatedly reset your equipment, and always start

*Skip Reymann W6PAJ, PO Box 374, San Dimas CA 91773. For 1977 handbook send $5.00 non-AMSAT members; $3.00 AMSAT members and a self-addressed sticky label.



W3TMZ and his home brew 14 element KLM 432.

operating from that frequency. This technique is quite valuable for the following reasons. To find your own downlink signal at the beginning of a pass, you will always know where to expect your signal (± 1 kHz). Once you find your downlink signal, then you can QSY in increments – if you get lost, you can always return to your reference frequency plus Doppler and start over. Believe me, this happens, and this technique works.

On OSCAR 6 and 7, Mode A, it is not unusual to actually be accessing the satellite, but, due to a number of phenomena which are not clearly understood, you may not hear your own return signal. I have worked quite a bit of DX without hearing my own signal.

During my initial contact on OSCAR 7, Mode B, I was unable to hear my own signal because of downlink receiver desensing. Every time I keyed the transmitter I wiped out my receiver and, therefore, could not find my signal. I did not know whether I was getting into the satellite or not, but, by calling CQ repeatedly and tuning the satellite passband, I finally heard W2GN answering my CQ (this is actually poor practice) and now had a reference set of frequencies.

The Art of DXing via Satellite

For working DX alone, it is best to limit your antenna systems to low elevation angles. Concentrate as much energy (within reason) at the satellite so that as soon as it comes into range you have a workable signal. As has been mentioned previously, do not count on always hearing your signal. Sometimes it just isn't there, but others can hear you. To really work super DX via space is similar to 20 meters – you must use or try any tricks that seem reasonable. A technique for working a specified area is to use a high gain antenna(s) positioned at the midpoint of the satellite's ground track. This is a technique that was used to work KH6 from this area. The same technique could be used to attempt to work a UA9.

At some frequencies (28 MHz and above), another interesting phenomena can occur – signal ducting. This is best described by example.

I have heard OSCAR 6 when it was over Eastern Russia heading for the North Pole with excellent signals. This particular pass was quite removed from my normal window.

On several occasions, WA4JID (Ft. Lauderdale, Florida) has had an excellent return signal from OSCAR 6 when the satellite was out beyond KH6 traveling toward ZL. Actually he had acquisition for a period of 7 minutes after his normal loss of signal (LOS) time. There was no one to work, so he called CQ. Finally he dropped out and the next signal he heard was ZL1WB calling CQ on his frequency. WA4JID uses .35 Watts to a 10 element cross-polarized antenna.

ZK1DX regularly hears OSCAR 6 when it is over the East Coast of the U.S.

Based on these observations, it appears highly possible that one could QSO a ZL from Southern latitudes. I believe with a kW, some antenna gain and good CW operating, it would be possible to really stretch the normal communication ranges.

In this regard, I do not believe that OSCAR 7, Mode B, is as easily stretched. The received signals just seem to drop when predicted LOS occurs. I can state that the downlink received signals on Mode B are much better than what one will hear on 28 MHz. An example of this is hearing OA8V with his 10 Watt ERP with a beautiful signal.

Equipment and Antennas

The equipment required to work OSCAR 6 and 7A is some type of 2 meter transmitter and a 10 meter receiver. A good preamplifier for 10 meters will help immensely. Almost anything will work as the transmitter as long as the particular operator is satisfied with its performance. Here are several ideas for equipment that will work:

1. An FM transmitter with provisions for keying installed and control of normal T/R relay (you do not want the relay to follow your keying or you will soon need to replace the relay). Note: Do not use FM for communications via the satellites.
2. A GE/Motorola FM transmit (TX) strip adapted for CW.
3. VHF Engineering TX-150 strip.
4. Homemade/commercial transverter and amplifier.
5. Two meter CW/SSB transceiver and amplifier.

For OSCAR 7, Mode B, the equipment required is somewhat more difficult to obtain. For the downlink, a reasonable 2 meter converter for an HF receiver will do quite well as will almost any of the present multimode 2 meter transceivers.

The uplink transmitter availability is somewhat limited. Several ideas for equipment include:

1. GE/Motorola 450 FM strip converted for CW.
2. Tripler for a 2 meter transmitter.
3. Homemade/commercial transverter and amplifier.
4. Commercial 432 MHz CW/SSB transceiver.
5. GE/Motorola FM strip converted to be a high mixer/amplifier (SSB/CW).

Further information on equipment requirements is given in the reference section at the end of this article.

With respect to antennas, almost anything will work to some degree or another, but remember that the satellite requires a minimum ERP and the antenna for most low power transmitters is quite important. There are several general rules concerning good satellite antenna practice.

Antennas do not need to be particularly high. For

DXing, what is important is that they be high enough to be in the clear.

The antenna feedline loss becomes an ever increasing factor in VHF/UHF satellite operations. As the antenna height is raised, so is the amount of feedline, preferably coax. At VHF/UHF RG-8 is ok, but, for example, at 146 MHz, 100 feet of RG-8 will have a loss of 3 dB (including connectors). This 3 dB loss reduces the ERP to half of what there would have been if the feedline were lossless. At 432 MHz, 100 feet of RG-8 has 5 dB of loss.

For 28 MHz, it is best to use two antennas, a beam pointed at the satellite (which need not be elevated), and a vertical (I use a vertical dipole). As the downlink signal fades, I switch from one to the other and vice versa.

For 146 MHz, I prefer linear polarization. For DX, I use vertical polarization, and for the remainder I use horizontal. Circular polarization works quite well, but I don't like it on the horizon due to losing half my ERP in the opposite polarization. Circular will have less fading, but for DXing the fading is minimal and can be tolerated.

For 432 MHz, the antenna situation becomes a little sticky – the size of the antenna is small but the chance for error in home built antennas is much greater. I recommend using standard proven antennas. Beware: Some antennas on 432 simply do not have the gain that is advertised. Basically a 6 to 16 element yagi will be adequate. But, remember, the larger the antenna, the sharper the beamwidth, thus requiring accurate pointing. Conversely, as the antenna size is reduced, so is its gain, and thereby the ERP.

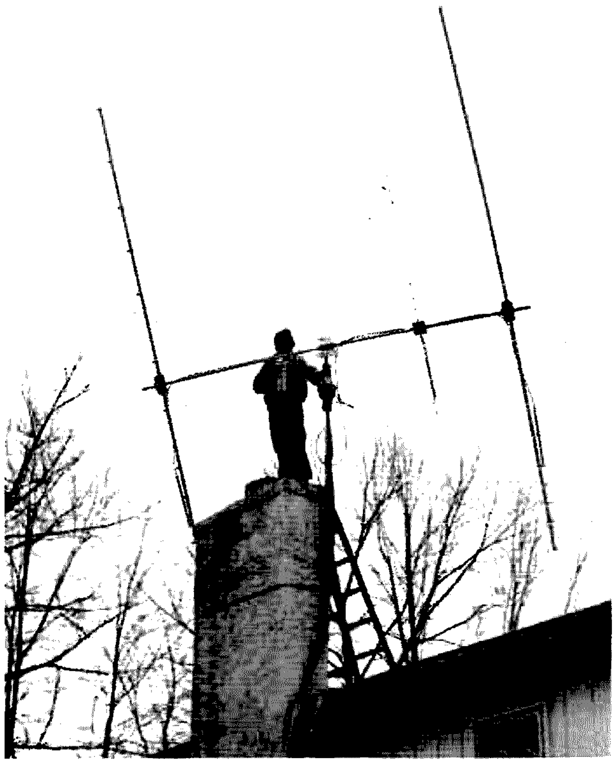
In summary, a balance or compromise must be achieved in transmitter power, feedline and antenna size versus pointing problems to obtain the performance that is desired.

Various Amateurs' DX Accomplishments

First of all, I am sure that there are sufficient unique DX accomplishments by a number of individuals that we could go on for some time. To mention a few – when a new country comes on via satellite, you can bet that W2BXA will be in there as if it were a "new one" for him for the DXCC Honor Roll. W8DX, W1NU, K1HTV, W1FTX, VE3SAT and a number of the Northern Jersey DX club members have worked over 50 plus countries. Many have worked 5 continents from the US. Asia is the most difficult.

Conclusion

Many amateurs, who have for years chased DX on the HF bands, have recently started working DX on the satellites and found it to be every bit as challenging. Perhaps you too would like to join many of the HF DXers on OSCAR 6 and 7? If so, it is hoped that many of the ideas in this article will help you along to your fifty states via satellite or maybe even fifty countries. ■



W3TMZ with his OSCAR array.

References

1. *ARRL VHF Handbook*, 3rd edition, p. 197, "Turnstile Antenna," p. 133, "Two-meter Transverter."
2. *ARRL Radio Amateur's Handbook*, 1976, p. 108, "Two-meter Transverter," p. 474, "Space Communications."
3. *Ham Radio*, December, 1972, p. 6, "Signal Polarization," June, 1974, p. 36, "Two-meter Preamp;" March, 1975, p. 34, "Az-El Antenna Mount," July, 1975, p. 58, "432 MHz Oscar Antenna," January, 1976, p. 46, "432-16LB Antenna," March, 1976, p. 44, "VHF/UHF Receivers – How to Improve Them," May, 1976, p. 54, "VHF/UHF Techniques," July, 1976, p. 50, "VHF/UHF Techniques."
4. *QST*, December, 1974, Satellite feature issue.
5. *QST*, September, 1975, p. 15, "Method for Phasing Crossed Yagis for Circular Polarization."

LETTERS

from page 48

single person much more than "I".

I have never referred to myself as "we" and I have discussed this with ham friends, who generally agree that "we" is used only by hams who have a Lindberg complex; they seem to try to create the impression that they never use it in this way, but the very next time I hear them on the air, they are referring to themselves as "we."

All this is somewhat confusing to me and the purpose of this letter is to locate someone who can tell me why this is done, how it got started, and, if there is no logical reason for its use, why do hams continue to use it?

Just as a parting shot, why don't hams on voice just laugh instead of saying "hi"?

Keep the good work going, Wayne; you have a forty over nine magazine.

Walter A. Deiter KH6ANM
Kailua HI

SCI-FI

Several months ago I sent you a note which requested hams who read science fiction to write me. You printed it in the Ham Help column. For that I thank you very much. I received a number of replies and have come up with some more information. I would appreciate it if you would print it as a follow-up.

7250-7255 kHz have been designated as calling frequencies for hams who want to discuss science fiction. 7250 will be used in the evenings, and 14310 can be used on weekends daytime. This will not be a net or any type of directed operation; rather, it will be simply a gathering frequency for interested persons. Just get on and holler "CQ SF!"

For any other information, write me at the following address.

Neil Preston WB0DQW
7024 Bales Ave.
Kansas City MO 64132

OSCAR Frequency Relationships

-- now, where is my downlink?

Robert H. Main W1ZAW
Bible Hill Rd.
Hillsboro NH 03244

One of the most difficult things to get a handle on when you first start out on OSCAR is the relationship between uplink and downlink frequencies. Ever hear a signal on 29.440 MHz and wonder what frequency you should be transmitting on? You look for your hand calculator,

UP DOWN		
145.900=29.450	145.932=29.482	145.966=29.516
145.901=29.451	145.933=29.483	145.967=29.517
145.902=29.452	145.934=29.484	145.968=29.518
145.903=29.453	145.935=29.485	145.969=29.519
145.904=29.454	145.936=29.486	145.970=29.520
145.905=29.455	145.937=29.487	145.971=29.521
145.906=29.456	145.938=29.488	145.972=29.522
145.907=29.457	145.939=29.489	145.973=29.523
145.908=29.458	145.940=29.490	145.974=29.524
145.909=29.459	145.941=29.491	145.975=29.525
145.910=29.460	145.942=29.492	145.976=29.526
145.911=29.461	145.943=29.493	145.977=29.527
145.912=29.462	145.944=29.494	145.978=29.528
145.913=29.463	145.945=29.495	145.979=29.529
145.914=29.464	145.946=29.496	145.980=29.530
145.915=29.465	145.947=29.497	145.981=29.531
145.916=29.466	145.948=29.498	145.982=29.532
145.917=29.467	145.949=29.499	145.983=29.533
145.918=29.468	145.950=29.500	145.984=29.534
145.919=29.469	145.951=29.501	145.985=29.535
145.920=29.470	145.952=29.502	145.986=29.536
145.921=29.471	145.953=29.503	145.987=29.537
145.922=29.472	145.954=29.504	145.988=29.538
145.923=29.473	145.955=29.505	145.989=29.539
145.924=29.474	145.956=29.506	145.990=29.540
145.925=29.475	145.957=29.507	145.991=29.541
145.926=29.476	145.958=29.508	145.992=29.542
145.927=29.477	145.959=29.509	145.993=29.543
145.928=29.478	145.960=29.510	145.994=29.544
145.929=29.479	145.961=29.511	145.995=29.545
145.930=29.480	145.962=29.512	145.996=29.546
145.931=29.481	145.963=29.513	145.997=29.547
	145.964=29.514	145.998=29.548
	145.965=29.515	145.999=29.549

Fig. 1. OSCAR 6.

only to find that it is on your desk at work. So you have to take pencil in hand and try to find some paper to figure things out. By the time all that has been accomplished, either the satellite has flown over, the station you were hearing is talking to someone else, or the station is out of range.

Having had that experience too many times, I decided it was time to have some printouts at my fingertips, or on the wall next to my operating location. So, with the help of a computer, the accompanying tables have been developed. As you can see, OSCAR 7 users (mode B) would really have a calculating problem tripling up from 2m. It's a simple matter to use the desired listening frequency and follow across the chart to find the desired transmitting frequency. We carried this out to five places so that anyone rockbound could order crystals easily. Also, the telemetry fix on board OSCAR 7 has been putting out a good signal and is an excellent way of

UP	DOWN
145.850=29.400	
145.851=29.401	
145.852=29.402	
145.853=29.403	
145.854=29.404	
145.855=29.405	
145.856=29.406	
145.857=29.407	
145.858=29.408	
145.859=29.409	
145.860=29.410	
145.861=29.411	
145.862=29.412	
145.863=29.413	
145.864=29.414	
145.865=29.415	
145.866=29.416	
145.867=29.417	
145.868=29.418	
145.869=29.419	
145.870=29.420	
145.871=29.421	
145.872=29.422	
145.873=29.423	
145.874=29.424	
145.875=29.425	
145.876=29.426	
145.877=29.427	
145.878=29.428	
145.879=29.429	
145.880=29.430	
145.881=29.431	
145.882=29.432	
145.883=29.433	
145.884=29.434	
145.885=29.435	
145.886=29.436	
145.887=29.437	
145.888=29.438	
145.889=29.439	
145.890=29.440	
145.891=29.441	
145.892=29.442	
145.893=29.443	
145.894=29.444	
145.895=29.445	
145.896=29.446	
145.897=29.447	
145.898=29.448	
145.899=29.449	
145.900=29.450	
145.901=29.451	
145.902=29.452	
145.903=29.453	
145.904=29.454	
145.905=29.455	
145.906=29.456	
145.907=29.457	
145.908=29.458	
145.909=29.459	
145.910=29.460	
145.911=29.461	
145.912=29.462	
145.913=29.463	
145.914=29.464	
145.915=29.465	
145.916=29.466	
145.917=29.467	
145.918=29.468	
145.919=29.469	
145.920=29.470	
145.921=29.471	
145.922=29.472	
145.923=29.473	
145.924=29.474	
145.925=29.475	
145.926=29.476	
145.927=29.477	
145.928=29.478	
145.929=29.479	
145.930=29.480	
145.931=29.481	
145.932=29.482	
145.933=29.483	
145.934=29.484	
145.935=29.485	
145.936=29.486	
145.937=29.487	
145.938=29.488	
145.939=29.489	
145.940=29.490	
145.941=29.491	
145.942=29.492	
145.943=29.493	
145.944=29.494	
145.945=29.495	
145.946=29.496	
145.947=29.497	
145.948=29.498	
145.949=29.499	

Fig. 2. OSCAR 7, mode A.

UP INPUT FC	DOWN OUTPUT FC
432.125 =	145.975
432.126 =	145.974
432.127 =	145.973
432.128 =	145.972
432.129 =	145.971
432.130 =	145.970
432.131 =	145.969
432.132 =	145.968
432.133 =	145.967
432.134 =	145.966
432.135 =	145.965
432.136 =	145.964
432.137 =	145.963
432.138 =	145.962
432.139 =	145.961
432.140 =	145.960
432.141 =	145.959
432.142 =	145.958
432.143 =	145.957
432.144 =	145.956
432.145 =	145.955
432.146 =	145.954
432.147 =	145.953
432.148 =	145.952
432.149 =	145.951
432.150 =	145.950
432.151 =	145.949
432.152 =	145.948
432.153 =	145.947
432.154 =	145.946
432.155 =	145.945
432.156 =	145.944
432.157 =	145.943
432.158 =	145.942
432.159 =	145.941
432.160 =	145.940
432.161 =	145.939
432.162 =	145.938
432.163 =	145.937
432.164 =	145.936
432.165 =	145.935
432.166 =	145.934
432.167 =	145.933
432.168 =	145.932
432.169 =	145.931
432.170 =	145.930
432.171 =	145.929
432.172 =	145.928
432.173 =	145.927
432.174 =	145.926
432.175 =	145.925

UP INPUT FC	DOWN TRIPLER FC
432.125 =	144.04167
432.126 =	144.04200
432.127 =	144.04233
432.128 =	144.04267
432.129 =	144.04300
432.130 =	144.04333
432.131 =	144.04367
432.132 =	144.04400
432.133 =	144.04433
432.134 =	144.04467
432.135 =	144.04500
432.136 =	144.04533
432.137 =	144.04567
432.138 =	144.04600
432.139 =	144.04633
432.140 =	144.04667
432.141 =	144.04700
432.142 =	144.04733
432.143 =	144.04767
432.144 =	144.04800
432.145 =	144.04833
432.146 =	144.04867
432.147 =	144.04900
432.148 =	144.04933
432.149 =	144.04967
432.150 =	144.05000
432.151 =	144.05033
432.152 =	144.05067
432.153 =	144.05100
432.154 =	144.05133
432.155 =	144.05167
432.156 =	144.05200
432.157 =	144.05233
432.158 =	144.05267
432.159 =	144.05300
432.160 =	144.05333
432.161 =	144.05367
432.162 =	144.05400
432.163 =	144.05433
432.164 =	144.05467
432.165 =	144.05500
432.166 =	144.05533
432.167 =	144.05567
432.168 =	144.05600
432.169 =	144.05633
432.170 =	144.05667
432.171 =	144.05700
432.172 =	144.05733
432.173 =	144.05767
432.174 =	144.05800
432.175 =	144.05833

Fig. 3. OSCAR 7, mode B. Telemetry beacon: 432.100.

IN	OUT	IN	OUT	IN	OUT	IN	OUT
145.850	29.400	145.901	29.451	145.900	435.200	145.951	435.149
145.851	29.401	145.902	29.452	145.901	435.199	145.952	435.148
145.852	29.402	145.903	29.453	145.902	435.198	145.953	435.147
145.853	29.403	145.904	29.454	145.903	435.197	145.954	435.146
145.854	29.404	145.905	29.455	145.904	435.196	145.955	435.145
145.855	29.405	145.906	29.456	145.905	435.195	145.956	435.144
145.856	29.406	145.907	29.457	145.906	435.194	145.957	435.143
145.857	29.407	145.908	29.458	145.907	435.193	145.958	435.142
145.858	29.408	145.909	29.459	145.908	435.192	145.959	435.141
145.859	29.409	145.910	29.460	145.909	435.191	145.960	435.140
145.860	29.410	145.911	29.461	145.910	435.190	145.961	435.139
145.861	29.411	145.912	29.462	145.911	435.189	145.962	435.138
145.862	29.412	145.913	29.463	145.912	435.188	145.963	435.137
145.863	29.413	145.914	29.464	145.913	435.187	145.964	435.136
145.864	29.414	145.915	29.465	145.914	435.186	145.965	435.135
145.865	29.415	145.916	29.466	145.915	435.185	145.966	435.134
145.866	29.416	145.917	29.467	145.916	435.184	145.967	435.133
145.867	29.417	145.918	29.468	145.917	435.183	145.968	435.132
145.868	29.418	145.919	29.469	145.918	435.182	145.969	435.131
145.869	29.419	145.920	29.470	145.919	435.181	145.970	435.130
145.870	29.420	145.921	29.471	145.920	435.180	145.971	435.129
145.871	29.421	145.922	29.472	145.921	435.179	145.972	435.128
145.872	29.422	145.923	29.473	145.922	435.178	145.973	435.127
145.873	29.423	145.924	29.474	145.923	435.177	145.974	435.126
145.874	29.424	145.925	29.475	145.924	435.176	145.975	435.125
145.875	29.425	145.926	29.476	145.925	435.175	145.976	435.124
145.876	29.426	145.927	29.477	145.926	435.174	145.977	435.123
145.877	29.427	145.928	29.478	145.927	435.173	145.978	435.122
145.878	29.428	145.929	29.479	145.928	435.172	145.979	435.121
145.879	29.429	145.930	29.480	145.929	435.171	145.980	435.120
145.880	29.430	145.931	29.481	145.930	435.170	145.981	435.119
145.881	29.431	145.932	29.482	145.931	435.169	145.982	435.118
145.882	29.432	145.933	29.483	145.932	435.168	145.983	435.117
145.883	29.433	145.934	29.484	145.933	435.167	145.984	435.116
145.884	29.434	145.935	29.485	145.934	435.166	145.985	435.115
145.885	29.435	145.936	29.486	145.935	435.165	145.986	435.114
145.886	29.436	145.937	29.487	145.936	435.164	145.987	435.113
145.887	29.437	145.938	29.488	145.937	435.163	145.988	435.112
145.888	29.438	145.939	29.489	145.938	435.162	145.989	435.111
145.889	29.439	145.940	29.490	145.939	435.161	145.990	435.110
145.890	29.440	145.941	29.491	145.940	435.160	145.991	435.109
145.891	29.441	145.942	29.492	145.941	435.159	145.992	435.108
145.892	29.442	145.943	29.493	145.942	435.158	145.993	435.107
145.893	29.443	145.944	29.494	145.943	435.157	145.994	435.106
145.894	29.444	145.945	29.495	145.944	435.156	145.995	435.105
145.895	29.445	145.946	29.496	145.945	435.155	145.996	435.104
145.896	29.446	145.947	29.497	145.946	435.154	145.997	435.103
145.897	29.447	145.948	29.498	145.947	435.153	145.998	435.102
145.898	29.448	145.949	29.499	145.948	435.152	145.999	435.101
145.899	29.449	145.950	29.500	145.949	435.151	146.000	435.100
145.900	29.450	145.951	29.501	145.950	435.150	146.001	435.099

Fig. 4. OSCAR D, mode A. Telemetry: 29.400.

Fig. 5. OSCAR D, mode J. Telemetry: 435.095.

checking your receiver.

By the way, don't forget the Doppler effect which causes the satellite to gradually shift in frequency as the bird moves toward or away from your location. But Doppler effect or not, the relationship between the various uplink and downlink freqencies will remain consistent. ■

J. W. Marriette VE7BGX
#302-33400 Bourquin Place
Abbotsford, British Columbia
Canada V25 5G3

Calculate OSCAR Orbits

-- with your HP-25 calculator

Last year I developed an interest in OSCAR activity after having read a back issue of *73* that was entirely devoted to this subject. When I sat down to work out the orbital times to look for 06 and 07 in my area, I decided very quickly there had to be a better way. The calculation of orbit #5, for example, on any given day can be a time-consuming effort at best, and, if you want the most likely times for communication via this mode on a daily basis throughout the month, these calculations could be a downright nuisance unless you have access to a complete list of tables for this purpose.

Since my HP-25 was sitting idle and I was still trying to justify its purchase price, I decided that it was about time it should start doing more than calculating debits from my savings account.

This program is not very complicated in the sense that it doesn't work out any heavy math problems, but it does do the job of working out the orbits of either 06 or 07 between the times listed each month in *73*. The program will update the orbital number, the equatorial crossing and time of crossing for each successive pass from the first pass listed for each day. If you wish, subtracting the number of hours you are from GMT on the first entry will result in a local time readout for the equatorial crossing.

An example is probably worth a thousand words, so let's take the case of orbit #19264 on January 1, 1977, for OSCAR 6. (See Table 1.) My QTH is eight hours from GMT; therefore, subtracting 8 hours from 0124:02 and adding 24, we arrive at 1724:02 local time. This, of course, is the day before or 5:24 pm on December 31.

HP-25 Program Form

Title *OSCAR ORBITAL DATA* Page *1* of *1*
Programmer *J. MARRIETTE*

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Key in Program			
2	Set Constants in Registers			
	(a) Precession	28.75°	STO 2	
	(b) Orbital Period			
	Oscar 6	1.545567	STO 3	
	Oscar 7	1.5456	STO 3	
	(c) # of Degrees in a Circle	360	STO 4	
	(d) Orbit #	19264	STO 5	Data Only For This Example
3	1st Orbit Time	01:24:02	↑	
4	1st Equatorial Crossing	[illegible]° Long		
5	Initialize		f PRGM R/S	Orbit # & Time
			R/S	Local Crossing Long.
6	Next Orbit		R/S	

HP-25 Program Form

Title Page of
Switch to PRGM mode, press f PRGM, then key in the program

LINE	CODE	KEY ENTRY	X	Y	Z	T	COMMENTS
00							
01	141104	f FIX 4					
02	2300	STO 0					
03	31	↑					
04	2301	STO 1					
05	2400	RCL 0					
06	2402	RCL 2					
07	51	+					
08	2307	STO 7					
09	2401	RCL 1					
10	1500	g H ←					
11	2403	RCL 3					
12	1500	g H ←					
13	51	+					
14	1400	f HMS					
15	2306	STO 6					
16	2405	RCL 5					
17	01	1					
18	51	+					
19	2305	STO 5					
20	1474	f PAUSE					
21	02	2					
22	04	4					
23	2406	RCL 6					
24	1441	f x < y					
25	1329	GTO 29					
26	41	−					
27	32	CH S					
28	2306	STO 6					
29	74	R/S					
30	2404	RCL 4					
31	2407	RCL 7					
32	1441	f x < y					
33	1337	GTO 37					
34	41	−					
35	32	CH S					
36	2307	STO 7					
37	74	R/S					
38	2406	RCL 6					
39	2407	RCL 7					
40	1301	GTO 01					
41							
42							
43							
44							
45							
46							
47							
48							
49							

REGISTERS	
R_0	LAST LONG
R_1	LAST TIME
R_2	PRECESSION 28.75
R_3	ORBITAL PERIOD 1.54:59/1.55
R_4	360
R_5	ORBIT #
R_6	TIME
R_7	LONG

Orbit #	Date	Time (GMT)	Eq. Crossing °W
19264	1	1:24:02	79.5

Table 1.

Key in the program information using the HP program forms. When the program is run, the pause will give the pass number, and the first stop will give the time. Pressing the R/S key will then give the equatorial crossing longitude for this orbit. The drawback to this program is that you have to go through each pass to reach the one you want, but, unfortunately, I haven't figured out how to get an extra register and 30 more program steps into the calculator in order to eliminate this problem, so I guess this will have to do until I can get my Micro P operational. (See Table 2.)

Hopefully this article will encourage other members of the ham community with access to one of these calculators to sit down and work out additional programs for this and other areas of our hobby. If this is the case, I will be looking forward to seeing these programs in future issues of *73*. ■

Data

Orbit #	Local Time	Equatorial Crossing (°Long.)
19264	1724:02	79.5
19265	1919:01	108.25
19266	2114:00	137
19267	2308:59	165.75
19268	0103:58	194.5
19269	0258:57	223.25

Table 2.

Corrections

Texas legal beagles and scanner manners have indicted us for stating that the "Big Bust In Amarillo" (Oct., p. 154) took place on July 7th. We throw ourselves on the mercy of the readership, and readily admit that the date was, indeed, July 6th. No more letters, please.

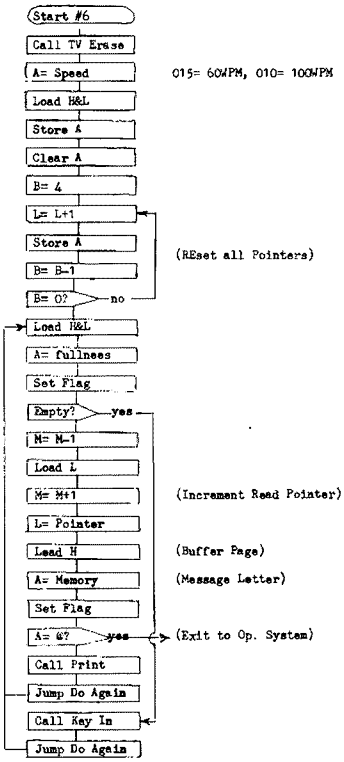
John C. Burnett
Managing Editor

Our apologies to Harry Matthews K2AOU, for inadvertently omitting the documentation for his Main Buffer System ("Digital Group RTTY Micro," Sept., p. 98). Here it is.

John C. Burnett
Managing Editor

Main Buffer System

007 300	315 021 002
007 303	076 015
007 305	041 132 007
007 310	167
007 311	257
007 312	006 004
007 314	054
007 315	167
007 316	005
007 317	302 314 007
007 322	041 133 007
007 325	176
007 326	247
007 327	312 355 007
007 332	065
007 333	056 136
007 335	064
007 336	156
007 337	046 006
007 341	176
007 342	376 200
007 344	312 000 000
007 347	315 000 007
007 352	303 322 007
007 355	315 140 005
007 360	303 322 007



I think I've found an error on page 47 of your August issue. The diagram for the Zeppy Vertical shows the braid of the coax attached to the radiator and the center conductor to the matching stub. These connections should be reversed. As written, the antenna was inferior to a ¼ wave whip. Reversed, it improved on the ¼ wave by several S-units. Keep up the good magazine.

Tim Knauer WD9AMY
Peoria IL

In addition to my new call and address, please note several minor changes to "Synthesize Yourself!" (Oct., p. 182):

1. Page 186, col. 4, lines 16 and 17, should read, "nect the square wave *input* from pin 1 of the MC*4044*,".
2. Page 186, col. 4, line 32, should read, "MC*4044* as shown. The out-".
3. Page 188, col. 4, lines 36 through 38, should read, "generates a square *wave* output. In cases where the vco generates sine waves *or* other wave-".

George R. Allen W2FPP
161 Rosendale Drive
Binghamton NY 13905

Ham Help

I have been interested in ham radio for the past couple of years. I currently hold a Citizens Band license, but I am totally disenchanted with that type of communication. I have been studying on my own and have no trouble with the technical aspect of the license. But the code has been very disheartening. I would like to know if there are any clubs that give Morse code classes in my area. Or if I could meet or contact amateur radio operators who would be willing to help. Any and all help will be deeply appreciated.

Ed Rojas
Box 490
Union City NJ 07087

Help! I purchased a Hallicrafters Tornado SR-500 SSB 500 Watt 80-40-20 rig and need help finding someone who carries the 8236 final amplifiers. Can't find listing in Sylvania, RCA, Amperex, or other tube makers. Where can you get these 8236s and what is their cost (understand Hallicrafters is no longer in business)?

Also, if anyone has information on modifications, improvements, changes, etc., to the SR-500, I would appreciate their writing to me. Can the 8236s be subbed for (for example, with a pair of 6146Bs with only 200 Watts PEP instead of 500 Watts)?

Any assistance from other hams would be appreciated. Thanks.

Marvin Jack Moss W4UXJ
P.O. Box 28601
Atlanta GA 30328

With the ever-increasing use of electronics in hospitals and related health care facilities, there has been a large influx of EE and E Techs to provide repair and calibration for the medical electronic equipment that lies scattered throughout these establishments. It is my guess there must be several hundred amateur radio operators hidden within these ranks. With the help of your column, I would like to compile a listing of all licensed amateur radio operators employed by hospitals/health care facilities/medical electronic equipment manufacturers and service centers.

Interested hams should send their name/callsign/QTH to my attention.

Dave Miller WA4ZKZ
721 Due West Ave.
Apt. G 202
Madison TN 37115

I am the proud owner of a Sumner Model HCV-1B SSTV Camera and a Model HCV-2A SSTV Monitor, neither of which are operating satisfactorily. I urgently require a copy of the circuit diagrams and component listing of these units.

Ken Squires VK2SD
1 Simpson Street
Bondi, N.S.W. 2161
Australia

Help! I am looking for manuals for the following low band radios: Motorola Model L41G-1A — this is an ac base; Motorola Model T71-GKT 1100B — low band 12 V dc mobile. If anyone has manuals or schematics for the radios, a copy would be appreciated. Please drop me a line.

Ron Lula WB9WXO
55428 Meadowview Ave.
South Bend IN 46628

I need the tube test data for the TV-4 tube tester. This is part of the USM-3A. Will buy or copy.

Gary P. Cain W8MFL
2464 Hand Rd.
Niles MI 49120

Would like to hear from anyone who has a National AN/WRR-2.

N. K. Maxwell K5BA
623 Ute Drive
Stillwater OK 74074

David J. Brown W9CGI
RR5, Box 39
Noblesville IN 46060

CB to OSCAR

-- from 10 to the sky!

This article describes how to convert a specific 23 CB radio for use on the OSCAR satellites and gives you my ideas on an OSCAR 10 meter bandplan very much like that of W4NVH in the May, 1977, issue of *73 Magazine*, p. 106. (He covered the 28 MHz portion of 10 meters, but used the same channel and conversion of CB gear principles.) If you read that article, you will see that the method applies very nicely to many of the now very inexpensive 23 channel CB rigs. The more I read W4NVH's article, the more things I could find that directly applied to the Sears 23 chanhel Model 934.36740500 CB I already had.

The CB channels have a few blanks between the 23 channels (remote control, etc.) that are taken care of by one each of the transmitter offset oscillator crystals and receiver offset oscillator crystals. In my transmitter, the crystal frequencies of 10.595, 10.615, 10.625, and 10.635 MHz are used, and, in the receiver, 10.140, 10.160, 10.170, and 10.180 MHz are used. Following a numbers progression, the oddballs are obviously the 10.595 and 10.140 crystals. In order to maintain continuous coverage, I changed the 10.595 to 10.605 MHz and the 10.140 to 10.150 MHz. Then I had a synthesis scheme capable of 230 kHz coverage in 10 kHz steps.

Considering that the OSCAR 6 and OSCAR 7 combined bandwidth is only 150 kHz, and further considering that an AM or AM/SSB mode (even when CW keying is added) would not be at all welcome above 146.000 MHz, my bandplan starts at 146 MHz and works downward. A couple of unique quirks came out of that fact. They alone might add merit to the bandplan, when using CB radios. The first is that, when you convert a CB radio over to the 10 meter band for transmit and receive, two things happen. The receiver winds up being in the 10 meter downlink, where it belongs, by only changing crystals and repeaking a very few front end stages (on signal, if need be — for those of you with little building experience and test equipment).

On transmit, the transmitter signal output is on 10 meters to go to the upconverter, and, believe me, just about every commercially made transverter uses a 10 meter input. I know, because I have spent two years trying to find a Drake TC-2 to go with my Drake TR-6 to get up to 2 meters. Unfortunately, the Drakes run a 14 MHz i-f out of the TR-6 and into the TC-2, negating using anything but Drake's TC-2. Couple this to very few TC-2s having been made at all (that's when Drake dumped their VHF line altogether, leaving us at the mercy of imports), and you can appreciate my problem.

Another transmitter benefit is that the transverter winds up being 116.45 MHz — exactly the OSCAR offset through the translator in reverse. So, when you tune the receiver, you are tracking the transmitter right along with you, plus or minus Doppler. As for Doppler, the CB manufacturers never could get together to decide on what channel they were transmitting or who was on the channel frequency and who was off. So, manufacturers include a little control on most panels now, marked ± delta - i.e., a Doppler control.

As for the bandplan, if you begin at 146 MHz as the 29.55 MHz downlink (or 146 MHz uplink), the cardinal frequencies of 29.5 MHz and 29.4 MHz (OSCAR 7 band edges) just happen to fall on channel 19 and channel 9 respectively.

Plug in the new synthesizer crystals X-1 to X-6 and change the offset crystals X-10 and X-14 to pull the band together. Then peak up the synthesizer output tank (T8 in mine). C37, across the primary in the Sears, may have to be reduced in capacity slightly, if the synthesizer output transformer lacks enough tuning range. Now, with the new synthesized frequencies from 39.955 to 40.155 MHz coming out of the synthesizer, feed a 10 meter signal (signal generator or off air) into the coax fitting. Align the 10 meter (was 27 MHz) front end receiver coil(s), which are T1 and T2 in mine, by backing out the slugs a bit and tuning for maximum agc, signal, etc. Do *not* touch any other receiver tuning, assuming the rig is new and/or properly aligned for CB frequencies. The i-fs do *not* change. For CW reception, the easiest way is build a little 455 kHz vco, so you can "pot" control it with dc from outside the radio and not botch things up by drilling holes in the panels. Assuming you like channelized transceiving as little as I do, you can build a second

New Channel	Freq.	Equiv. 2m Freq. + 116.45	Synthesizer	Transmit osc.	Receive osc.	Note
1	29.32	145.77	X1 39.955	X11 10.635	X7 10.180	
2	29.33	145.78	X1 39.955	X12 10.625	X8 10.170	
3	29.34	145.79	X1 39.955	X13 10.615	X9 10.160	
4	29.35	145.80	X1 39.955	X14 10.605	X10 10.150	
5	29.36	145.81	X2 39.995	X11	X7	
6	29.37	145.82	X2 39.995	X12	X8	
7	29.38	145.83	X2 39.995	X13	X9	
8	29.39	145.84	X2 39.995	X14	X10	
* 9	29.40	145.85	X3 40.035	X11	X7	Band edge 7
10	29.41	145.86	X3 40.035	X12	X8	
11	29.42	145.87	X3 40.035	X13	X9	
12	29.43	145.88	X3 40.035	X14	X10	
13	29.44	145.89	X4 40.075	X11	X7	
14	29.45	145.90	X4 40.075	X12	X8 Beacon 6	Band edge 6
15	29.46	145.91	X4 40.075	X13	X9	
16	29.47	145.92	X4 40.075	X14	X10	
17	29.48	145.93	X5 40.115	X11	X7	
18	29.49	145.94	X5 40.115	X12	X8	
*19	29.50	145.95	X5 40.115	X13	X9 Beacon 7	Band edge 7
20	29.51	145.96	X5 40.115	X14	X10	
21	29.52	145.97	X6 40.155	X11	X7	
22	29.53	145.98	X6 40.155	X12	X8	
23	29.54	145.99	X6 40.155	X13	X9	
24	29.55	146.00	X6 40.155	X14	X10	Band edge 6

Table 1. CB radios to OSCAR bandplan for a Sears 934.36740500. All figures in MHz. Xmit: Fsynth - Fxmit osc = four MHz; Rcv: Fsynth - Fin - Frcv osc = .455 MHz Lo i-f.

vco on the synthesizer frequency, or some submultiple of it and multiply, and run it, too, from an outside pot. After all, it is no longer a CB radio, so vfo/vcos are legal. In my own, I kept the crystals in the X-3, X-4, X-5, and X-6 positions (but at the new frequencies shown), and a vco runs into the X-1 position, with X-2 a blank. This way you can run the vco from 39.955 MHz to 40.155 MHz using a ten-turn pot for vernier action and, by switching from channel 1 through 4 positions, cover the entire 29.32 to 29.55 MHz range on receive and have the proper transmitter frequencies to upconvert to 145.77 to 146 MHz. With the lower edge below OSCAR, you are about in 2 meter AM land. With the same synthesizer schemes used by so many rigs, even an AM/SSB (23 channel version) is cheaper now and would really be a great way to go, if you want the SSB mode through OSCAR and can afford an extra few bucks. By allowing the vco to tune down to 38.185 MHz (or shifting it to cover 230 kHz there, as 39.185 to 39.405 MHz – with a small C switched in?), you can have a dandy 145 to 145.230 MHz out of the transverter and be right with the 2 meter SSB gang. Add a small 2 meter to 10 meter converter (Hamtronics makes a great one), using the same 116.45 MHz oscillator offset, and you have a rig as versatile as the most expensive ones designed for OSCAR and 2 meter gear on the market.

The transmitter conversion is just about as tough as the receiver – in other words, not at all. In mine, once the receiver was done (hence, the synthesizer), it involved peaking up the old 27 MHz transmitter stages to the 10 meter band by backing out the slugs a little and, where needed, reducing the tuning capacitors across the transformers, when the slug had to be backed out too far to be practical (slug showing out of the coil form). In my radio this involves T12-C69, T13, T14-C72, T15-C77, T16-114, T17, and T18. This is as easy as tuning up the average Heathkit for the same reasons, because the test equipment is built in the form of a built-in wattmeter (rf output) and swr combination meter function in transmit. Incidentally, when I said peak the receiver for maximum agc on an incoming steady signal, I had an S-meter in my radio to measure that by.

In the extraneous department, the rig I have has a noise limiter that works pretty well as is, so I left that alone. It also has a PA position that can be put to good use. Since mine is an AM only rig, I had only CW in mind. The modulator-audio stages in the transmit mode (they are shared) can be put to use by placing them in PA (which routes the audio to that jack from the receiver as well) and then causing the low audio stages to be an oscillator at some pleasant tone. Or you could use a separate tone oscillator, so that when you key the rig, you have sidetone. On the AM only rigs you might as well, because AM is not very welcome through OSCAR because of its unnecessary BW.

On the subject of keying, since this is an AM rig only, the + voltage for the modulation is broken away from the modulation winding of the common audio transformer by removing an isolation diode (D13) and opening that path. The + voltage from the power supply section is routed out to the external speaker jack, after taking it out of the receiver audio output path and putting a permanent ground on the low side of the speaker.

While on the subject of the speaker, I had a problem with mine. There is a 10 Ohm resistor in series with the 8 Ohm speaker, whose only purpose I can see is to allow them to run one common audio circuit, transformer, and a lower wattage speaker, and to accept the lower audio output on the bottom-of-the-line sets. This was a 1 W 3-inch round unit in my radio, and it was shorted, to boot.

Part of the reason I got the radio for the right price was that it did not work. It had one open copper foil in the +V copper, where the shorted speaker had tried to make a fuse out of it – and it succeeded. That is absolutely all that was wrong, and I ran it as a base by sharing my Heathkit supply for the HW 202 FM for months before I tried working on it. I got mine for less than $10, so check your local sources.

Back to the speaker – when I replaced it, I got a 3-inch round, 2 W replacement speaker and stuffed a small, 2 Ohm ½ W resistor in the 10 Ohm spot. I can now drive you out of the room with audio!

When you plug a key in the external speaker jack now, the key opens and closes the driver and final + voltages, and you have a CW rig – almost. The microphone circuit in my model is rather tricky, as it does all the changeover (X/R) by voltage switching. I substituted another DPDT switch – toggle type – on the same panel as the vco synthesizer and vco/bfo pots, and used it for the transmit position. Leave the microphone and connections off the switch and wire the rest the same, just to be rid of the PTT/hold-the-button-down routine.

When the key is depressed, the LED modulation light comes on, as it is activated by the same power line as the driver and final. It makes a good CW monitor, if you like the visual types and don't want to add the tone oscillator into the audio circuits.

To get the vco lines in and out of the radio, mine had a Heyco type grommet that "bites" the +12 V and ground where it goes into the back panel through a 3/8" hole. Replace it with a normal 3/8" rubber grommet, and you have a hole you can drive a bus through, with plenty of room for 6 to 8 wires.

Convince your CB "good buddy" that he really needs SSB or 40 channels, and offer him a good trade price for his old 23 channel rig. The dealers are offering peanuts on 23 channel rigs, because you can buy a new 23 channel so cheaply now that they can't sell a used one. He will end up happy and so will you! Or, go see your local CB store, and see if he took the same bath most dealers and wholesalers took, when they were stuck with warehouses of 23 channel stock, when 40 channel hit the market. Talk it up at your club (and the bandplan and see if they agree), and then go make an offer on 10 or more identical units – quantity talks. They are great for CD type groups in crowded 2 meter FM areas!

Last, but certainly not least, if you are the least bit adept at repair work and common logic and own just a VOM or VTVM, you can buy a non-working unit from places like Sears Save Shop and local radio dealers who don't really have much in the way of repair facilities.

Well, I've given you a plan of attack, a bandplan so you will have company in the present wasteland of 10 meters, a cheap way to get up on OSCAR, some hints for using my unit, and the source for one of your own if you go looking. Even schematics and manuals are a breeze (unlike the old FM conversion days when *any* Motorola manual or even a close schematic you saw as a ham was yellowed, battered, torn, thumbprinted, and worn from the use of 50-plus hams).

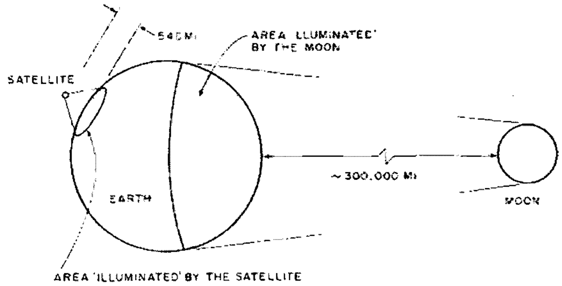
You should know that T18, in my rig, is used to adjust the output to 5 Watts and also that the final device used is a 2SC799 with a 10 W hfe of 50 to 90, 150 MHz rating with a BVcbo = 80 V, BVebo = 5 V, and BV well above the rated use! Consider the low duty cycle of CW versus the AM cycle which it was running a steady 5 Watts at. I run mine off the high regulated 18 V dc and load it up (tune) for about 14 W key down. I haven't lost a device yet, but, to be safe, you may want to quit at the manufacturer's (Nippon Electric) rated 10 Watts.

There are only two words of caution I will add in closing. If you tackle a PLL type synthesizer, it's not so easy. It can be done – on some -- at some time and expense and risk of odd products sneaking out.

My only other comment is that you should turn back a few issues and read through W4NVH's article. It is excellent background and easy to follow and use. You can figure out just what kind of rig you have, if you already have it, and how to apply my antics to it.

Don't try to part-convert one to cover 10 meters (say, low end, per W4NVH) for CD activity and try to save a chosen "few" of the CB channels for CB use. You void the manufacturer's approval when you cut into the rig, even if you hold a 1st class radiotelephone license, as I do. You void any warranty on the rig any way you cut it. And you could just void your license if you get caught with this modification. Pick your band, and have fun. ■

Fig. 1. Two stations must "see" the satellite's transponder simultaneously in order to communicate with each other, i.e., they both must be located in the area "illuminated" by the satellite. Note that a transponder located on the moon will allow communication with stations separated farther apart than a satellite orbiting the Earth at lower altitude.



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Endicott NY 13760

Track OSCAR 8!

-- step-by-step method

The launching of the AMSAT OSCAR 6 and 7 satellites gave amateur radio a permanent foothold in space communication. In years to come, satellite communications will become as common as 2m FM or DXing on 20m is today.

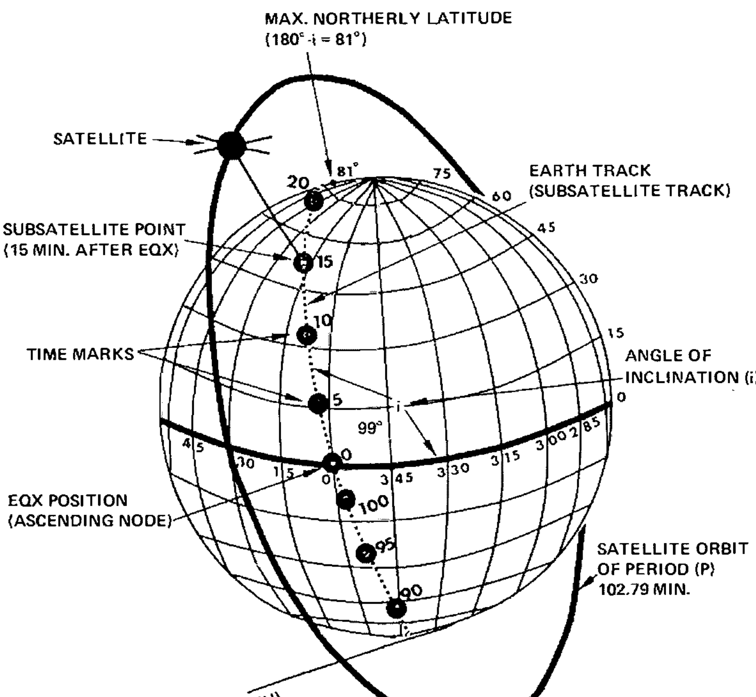

Fig. 2. Model of orbiting satellite (static Earth).

Although there are now thousands of users of OSCARs 6 and 7, they represent only a very small fraction of the total amateur community. Why is it that so many VHFers who own perfectly suitable equipment never worked through OSCARs?

Apparently, the major deterrent is the lack of familiarity with satellite tracking, which many consider to be a formidable and complex problem requiring knowledge of astronomy, astrophysics, higher mathematics, and other disciplines of science. But, in fact, satellite tracking is a relatively simple procedure easily grasped by those who show even a slight interest in this subject.

The purpose of this article is to explain the procedure of satellite tracking from the standpoint of common sense and simple reasoning. I suggest that the reader follow

the presented sequence of reasoning step by step and not go to the next paragraph before the previous one is fully understood.

Space communication is the future of amateur radio. We might as well get familiar with it, and the knowledge of satellite tracking is the first step.

The First Earth Satellite — The Moon

Let's suppose that an OSCAR transponder was placed on the moon. Using suitable equipment, we could communicate through it the way we communicate via 2m repeaters. Since VHF waves don't bend around the curvature of the Earth, we may assume that the lunar transponder can be accessed only if the moon is above the horizon in respect to the stations that attempt to communicate through it. Obviously, a two-way QSO between distant stations can only take place if both stations have the moon in direct view.

Without any knowledge of astronomy, we can guess that at a particular instant of time the moon will be visible in different directions, and at different angles above the horizon, in different parts of the world. Also, there will be locations on the Earth where the moon will not be visible at all.

With the combination of the revolution of the Earth and the orbiting of the moon, the prediction of its exact celestial position, at a particular day and hour for a chosen geographical location, represents apparently a very complex problem. Nevertheless, this "difficulty" was solved thousands of years ago by ancient astronomers before trigonometry, calculus, computers, and even writing were invented.

The artificial satellites, such as the OSCARs, behave very much like a moon with the following small differences:

— Artificial satellites are too small to be visible to the naked eye, so their positions can only be predicted.
— They orbit the Earth at the rate of hours per revolution instead of weeks. This implies that their rising and setting at a particular location of the Earth will be more frequent.
— They orbit at low altitudes; therefore, the range from which two stations can "see" a satellite simultaneously will be much shorter (see Fig. 1).

Terminology

In order to better understand satellite tracking, we must form a three-dimensional mental picture of a satellite orbiting the Earth. A globe or any spherical object (even an orange) will greatly facilitate the comprehension of the subject.

In order to simplify the analysis of the orbital flight of the satellite, we are going to assume, for a while, that the Earth is *static*, i.e., it does *not* rotate on its axis. Once the static Earth concept is well understood, the introduction of the Earth's rotation, to complete the picture, will not present much difficulty. Fig. 2 shows a view of a satellite orbiting the static Earth. The orbit is circular.

At this time, familiarization with the principal parameters of orbital flight and related terminology is necessary because it will be used throughout the remainder of the article.

Orbit: The imaginary track of the path the satellite follows around the world. The plane of the orbit is fixed in space and is independent of the rotation of the Earth.

Altitude (H): The distance between the satellite and the surface of the Earth. For satellites in circular orbits, the altitude is virtually constant.

Period (P): The time it takes a satellite to make one full revolution around the Earth. The exact moment the satellite crosses the equator from south to north is used as a reference point. The period, therefore, is the time elapsed between two such equatorial crossings.

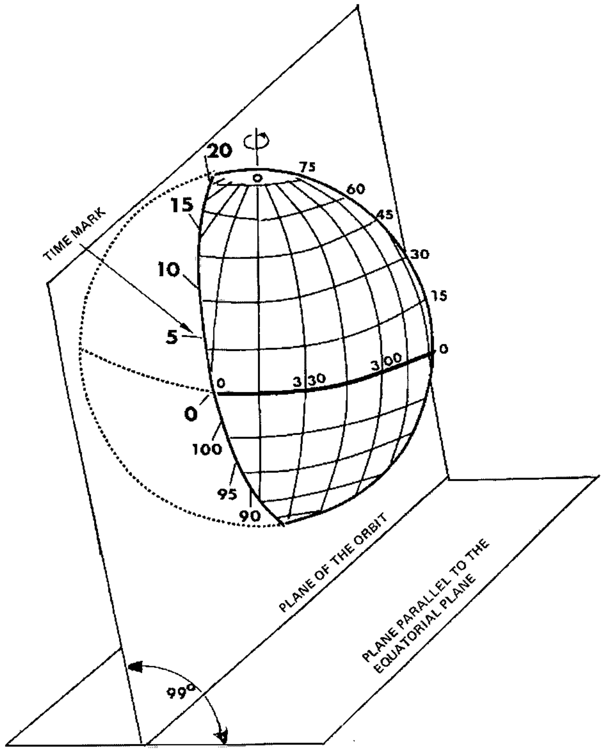

Fig. 3. Simulated Earth track on a plane inclined 99° from the equator (static Earth). Note that the orbital plane is fixed in space and the Earth rotates inside this plane from west to east (counterclockwise as viewed from a point above the North Pole).

Subsatellite Point: A point on the surface of the Earth where the satellite is directly overhead.

Ground Track (also Subsatellite Track): An imaginary path on the surface of the Earth consisting of all subsatellite points (during one period).

Inclination (i): The angle between the equator and the ground track (or the plane) of the satellite. It should be noted that this angle will remain constant through the entire life of the satellite and is not affected by the rotation of the Earth.

The angle of inclination determines the most northerly and most southerly latitude the ground track will ever reach. You may notice that even if the Earth is rotating on its axis, the ground track will never pass beyond a certain latitude.

Max. Lat. (N. or S.) = 180° - i
For OSCAR AO-D: i = 99°
Max. Lat. = 180° - 99° = 81° N. or S.

Equatorial Crossing Time (EQX Time): The exact time in UTC (GMT) at which the ground track crosses the equator from south to north. Knowing the exact EQX time of any orbit and the time of the period makes it easy to predict subsequent EQX times. We simply add the period (in minutes) to the exact time at which the previous EQX took place. In fact, the EQX prediction tables published by AMSAT and other amateur journals are derived this way.

In order to complete long-range prediction tables, the

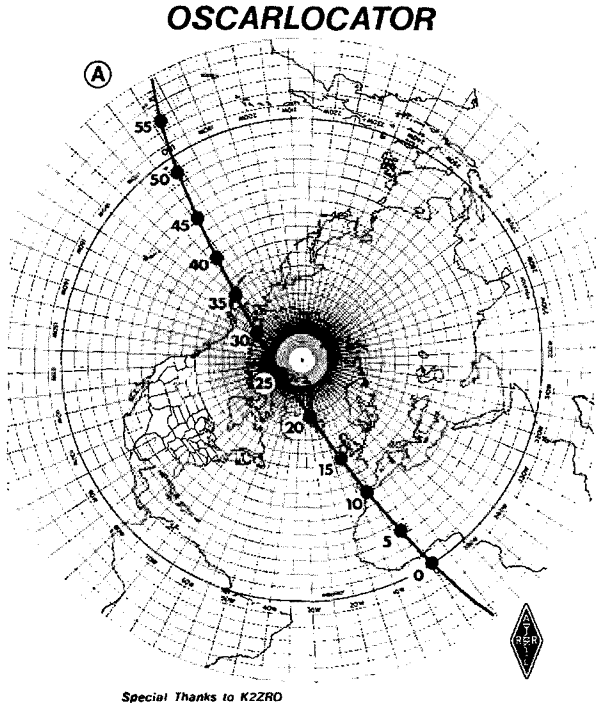

Fig. 4. Static Earth projection of the track of AO-D over the map of the Northern Hemisphere.

period must be known with great accuracy, because even small errors accumulate rapidly. (Example: Period of OSCAR 6 is 114.99441 min.; OSCAR 7 is 114.94513 min.)

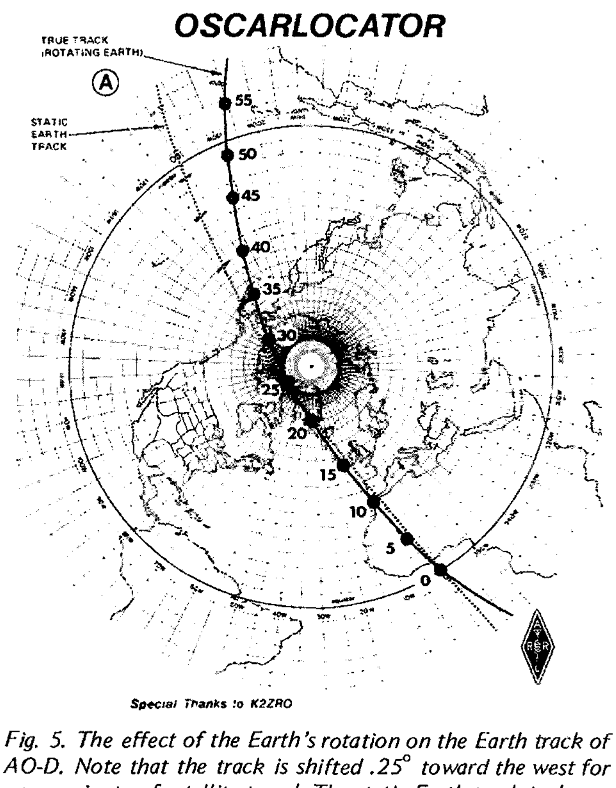

Fig. 5. The effect of the Earth's rotation on the Earth track of AO-D. Note that the track is shifted .25° toward the west for every minute of satellite travel. The static Earth track is shown as a dotted line.

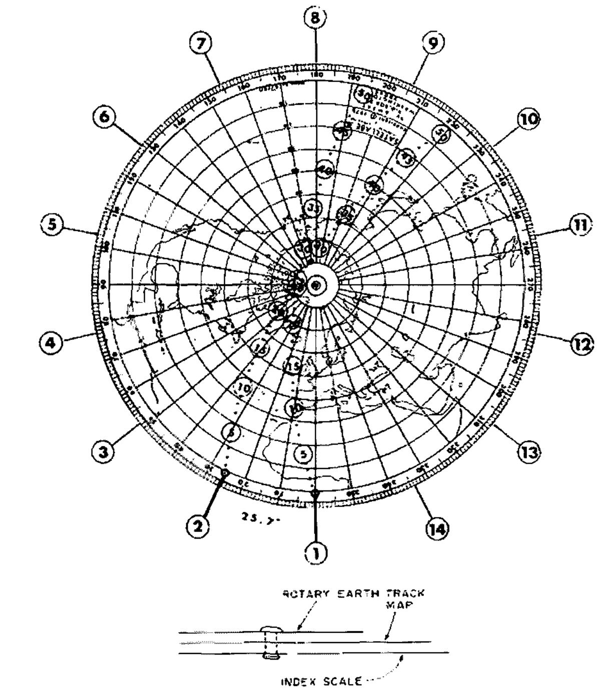

Fig. 6. Index scale. After setting the longitude of the EQX of the reference orbit, all longitudes of EQXs of successive orbits of the day can be predicted.

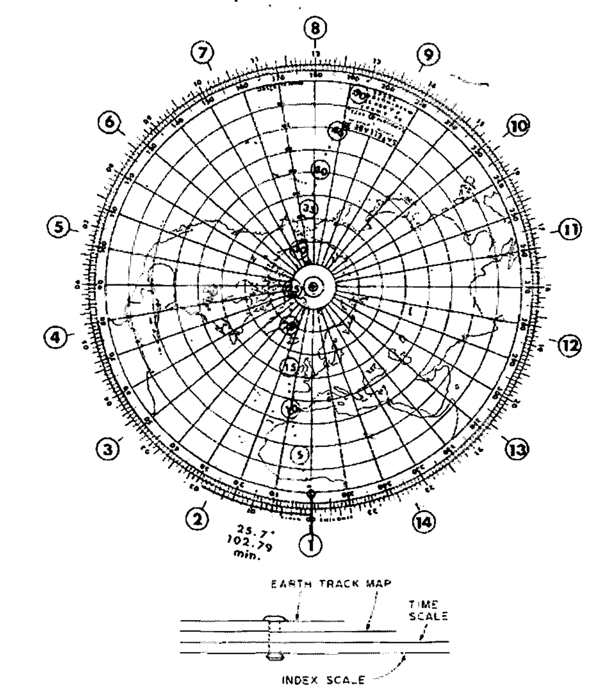

Fig. 7. Time scale. Setting the time of the EQX time of the reference orbit opposite index #1 allows prediction of EQX times of all consecutive orbits of that GMT day. Note that the Earth moving .25°/min. will rotate P x .25° during one period of the satellite, or 25.7° for AO-D. This corresponds to the index mark separation as shown in Fig. 6. Now, if the longitude and the time of the reference EQX are set against index mark #1, we can predict both time and longitude of subsequent EQXs of that GMT day.

Equatorial Crossing Longitude (EQX Lon.): The exact longitude on the equator at which a particular EQX, from south to north, takes place. Also called the "Ascending Node."

It will be shown later that subsequent EQX longitudes are separated by P/4 degrees. These figures are also used for long-range prediction of the EQX data.

Reference Orbit: The first orbit of a UTC (GMT) day, i.e., the first orbit that crosses the equator after 0000 UTC (GMT) from south to north.

Orbit Number: The count of the satellite's full revolutions around the Earth from the instant of the launching.

Reference Orbit Data: The date, orbit number, time, and longitude of EQX of a particular reference orbit. (Example: Mar. 17, 1978, 10526, 0012:24, 56.3°.)

Ascending Orbit or Pass: The part of the orbit when the satellite travels from south to north (over either the Southern or Northern Hemisphere).

Descending Orbit or Pass: The part of the orbit when the satellite travels from north to south. Note: The orbit will change from ascending to descending at the point where the ground track reaches its most northerly position (closest to the North Pole). The orbit will change from descending to ascending at the point where the ground track reaches its most southerly position (closest to the South Pole).

Ascending Node: The EQX position (longitude) during the ascending part of the orbit. It is often used as a reference point for orbital calculations (see Reference Orbit).

Descending Node: EQX position (longitude) during the descending part of the orbit.

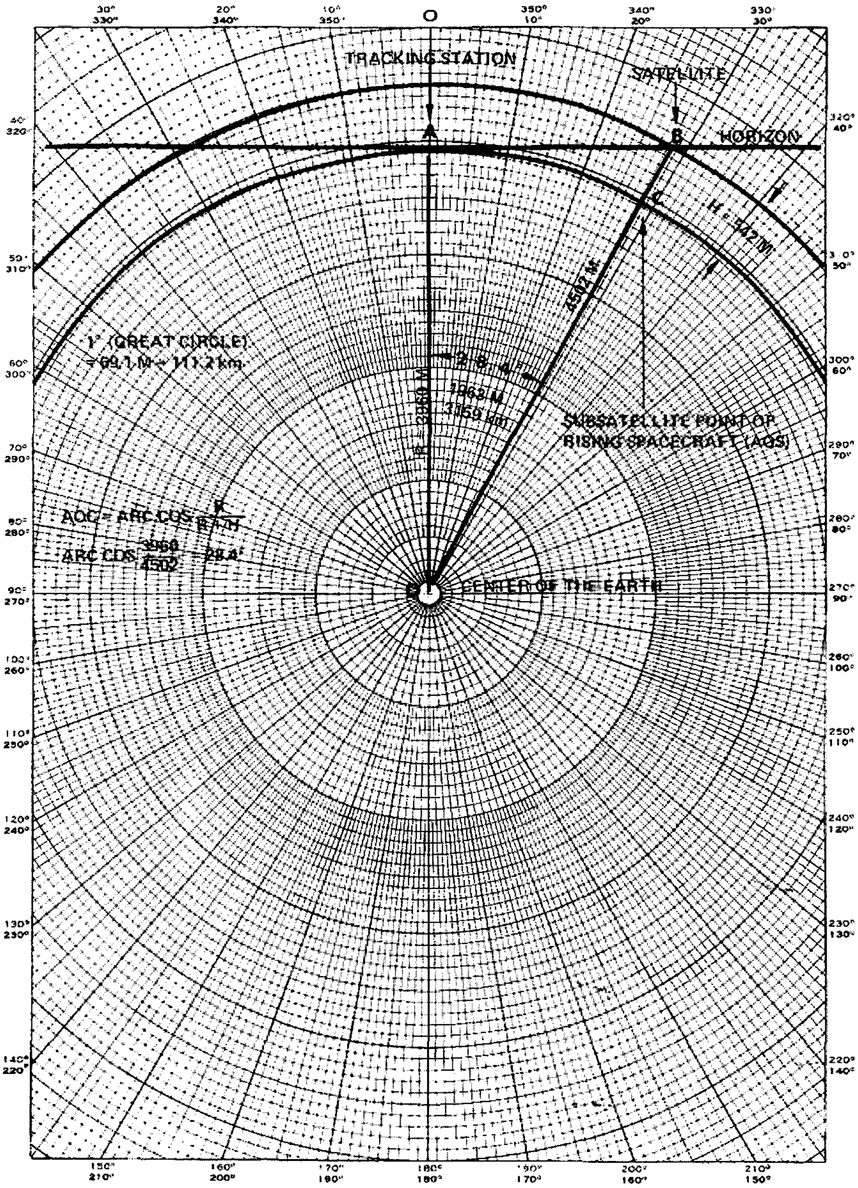

Fig. 8. Calculation of the distance from the tracking station at which the satellite enters the area of accessibility (acquisition of signal — AOS).

Developing the Ground Track on a Static Earth

As previously stated, we are going to assume at first that the Earth is static (non-rotating). The satellite is the proposed OSCAR AO-D with the following orbital parameters:

Period: P = 102.79 min.
Inclination: i = 99°
Average Altitude: H = 542 miles (872 km)

Examining Fig. 2 again, let's follow the ground track of the satellite.

Assuming the reference point to be of 0° longitude at the equator (ascending node), with the ground track inclined to 99° in respect to the equator, the satellite will follow the following path:

— Starts at 0° longitude at the equator (ascending node).

— Travels northward reaching the most northern latitude of 81° (180°-i).

— Begins descending and then crosses the equator at 180° longitude (descending node).

— Continues moving southward until it reaches the most southern latitude of -81°.

— Starts ascending and crosses the equator again at 0° longitude.

The total elapsed time of one such trip around the world would be equal to the period of the satellite, or ≈ 103 minutes.

If we would slice the globe at a 99° angle, in respect to the equator, and put both halves together again, the seam line would follow exactly the ground path of OSCAR AO-D on a static Earth.

Another way to visualize the Earth track is to cut a circular hole equal to the diameter of the globe in a sheet of stiff material and fit the sheet over the globe at an angle of 99° in respect to the

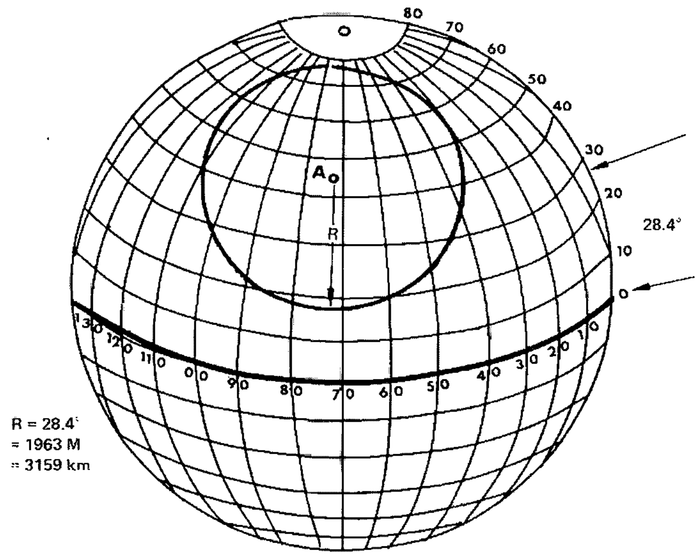

Fig. 9. Area of accessibility. The satellite will be available for communication when its subsatellite point is found inside the circle of accessibility.

equator, as shown in Fig. 3.

A satellite traveling in a circular orbit moves with a constant velocity. Consequently, all equal distances will be covered in equal increments of time.

The period of the AO-D is 103 minutes. Therefore, if we divide the entire length of the ground track into 103 equal segments, each segment would represent a distance traveled during a time interval of one minute.

In spite of its good accuracy, tracking of the satellite on a globe is rather cumbersome. A flat map is much more convenient for this purpose. Probably the best and most easily obtainable polar projection map suitable for satellite tracking is the OSCARLOCATOR, distributed and sold for just \$1 by the ARRL. This handy device can be adapted for tracking almost any satellite.

Let's now project the static Earth satellite track onto the map. Once the track is drawn on the globe, including the time marks, its coordinates, latitude and longitude at one minute intervals, can now be drawn at corresponding coordinates on the map as shown in Fig. 4.

If the track is traced on a separate piece of transparent material and pivoted on the North Pole, it can now be rotated to allow the start of its origin (Ø min. mark) at the longitude of any chosen equatorial crossing.

Setting an auxiliary clock to read ØØ minutes at the exact time of the equatorial crossing, we can now follow the progress of the satellite minute by minute. The time on the auxiliary clock will correspond to the time marks on the track that, in turn, will indicate the position of the satellite at that very time.

Time (min.) After EQX	Lat.	Long.
-8	-27.6	353.3
-6	-20.7	355.3
-4	-13.8	356.7
-2	-6.3	358.4
0	0.0	0.0
2	6.3	1.6
4	13.8	3.3
6	20.7	4.9
8	27.6	6.7
10	34.5	8.5
12	41.3	11.3
14	48.1	13.8
16	54.9	17.0
18	61.6	21.3
20	68.1	28.0
22	74.1	39.6
24	79.1	61.7
26	81.0	102.1
28	78.1	138.6
30	72.7	157.0
32	66.5	169.0
34	59.9	172.6
36	53.2	176.7
38	46.4	179.7
40	39.6	182.5
42	32.7	184.4
44	25.9	186.8
46	19.0	188.5
48	12.1	190.2
50	5.2	191.8
52	-1.7	193.4
54	-8.6	195.1
56	-15.5	196.7
58	-22.4	198.4
60	-29.3	200.1

Table 1.

Obviously, tracking of the satellite on the static Earth is of little use. Therefore, we will now introduce the effect of the rotation of the Earth.

As mentioned previously, the plane of the orbit of the satellite is fixed in space, but the Earth rotates on its axis. As the Earth rotates, the ground track will no longer retrace itself during each orbit, but will be displaced .25° towards the west for every minute of satellite travel. The rationale is as follows:

– The Earth rotates on its axis from east to west (counterclockwise as viewed from a point above the North Pole).

– The Earth makes one full revolution of 360° in 24 hours or 1440 minutes.

– This corresponds to angular travel of 15° per hour (360 ÷ 24) or 1° in 4 minutes.

– In one minute, the Earth will rotate .25°.

Now, how will this affect the Earth track developed for the static Earth (Fig. 4)?

In Fig. 5, the static Earth track is drawn with a dotted line; the true Earth track (for the rotating Earth) is the solid line. You will notice that the true track is shifted .25° for every minute of satellite travel.

For example: 10 minutes after EQX, the true track will be shifted 2.5° west of the static Earth track; 20 minutes after EQX – 5°; 30 minutes after EQX – 7.5°; 51.4 minutes (half of the period) after EQX – 12.85°; 102.79 minutes after EQX (full period) – 25.70°.

From the last figure, we may draw the correct conclusion that after one full period, the EQX longitude (ascending node) will be located P/4° west from the preceding one (in this example, 102.79/4 = 25.70°).

The effect of the Earth's rotation may be demonstrated another way. Using Fig. 4 with the Earth track (static Earth) drawn on a transparent material and

pivoted on the North Pole, we immobilize the track and rotate the map counterclockwise at a steady rate. The time checks on the track indicate the position of the satellite at so many minutes after EQX. If while rotating the map we mark the location of substatellite points, we will notice that the resulting track will look similar to the one shown in Fig. 5.

For example: To establish the satellite location 10 minutes after EQX, we rotate the map 2.5°; for 20 minutes after EQX, rotate the map 5°; for 30 minutes after EQX, rotate the map 7.5°; etc.

Fortunately, you don't have to go to all this trouble to develop the Earth track for AO-D. For your convenience, Table 1 lists the coordinates for the normalized Earth track for OSCAR AO-D. These equations were used in the preparation of the table:

$$\text{Latitude} = \arc \sin [(\sin i) \sin (360\ T/P)] \tag{1}$$

$$\text{Longitude} = \arc \cos [\cos(360\ T/P) / \cos \emptyset] + \frac{T}{4} \tag{2}$$

where: i = orbit's inclination to equator, P = satellite period, T = time after EQX (ascending node), and $\emptyset$ = latitude (result of equation 1).

Note: Equation 2 minus the last term (T/4) will calculate longitudes for the Earth track on the static Earth. Equation 1 is valid for both the static and rotating Earth.

Employing the above formulas, the Earth track of any satellite in a circular orbit can be easily calculated using a simple scientific calculator, as long as its period and inclination are known.

To use the device, we take published EQX data (time and longitude) of a chosen orbit. Align the zero minute mark of the pivoting transparent ground track on the equatorial longitude of the EQX. Start the clock at ØØ minutes at the time of EQX and follow the satellite's progress minute by minute by relating the time marks on the track to the time indicated on the clock.

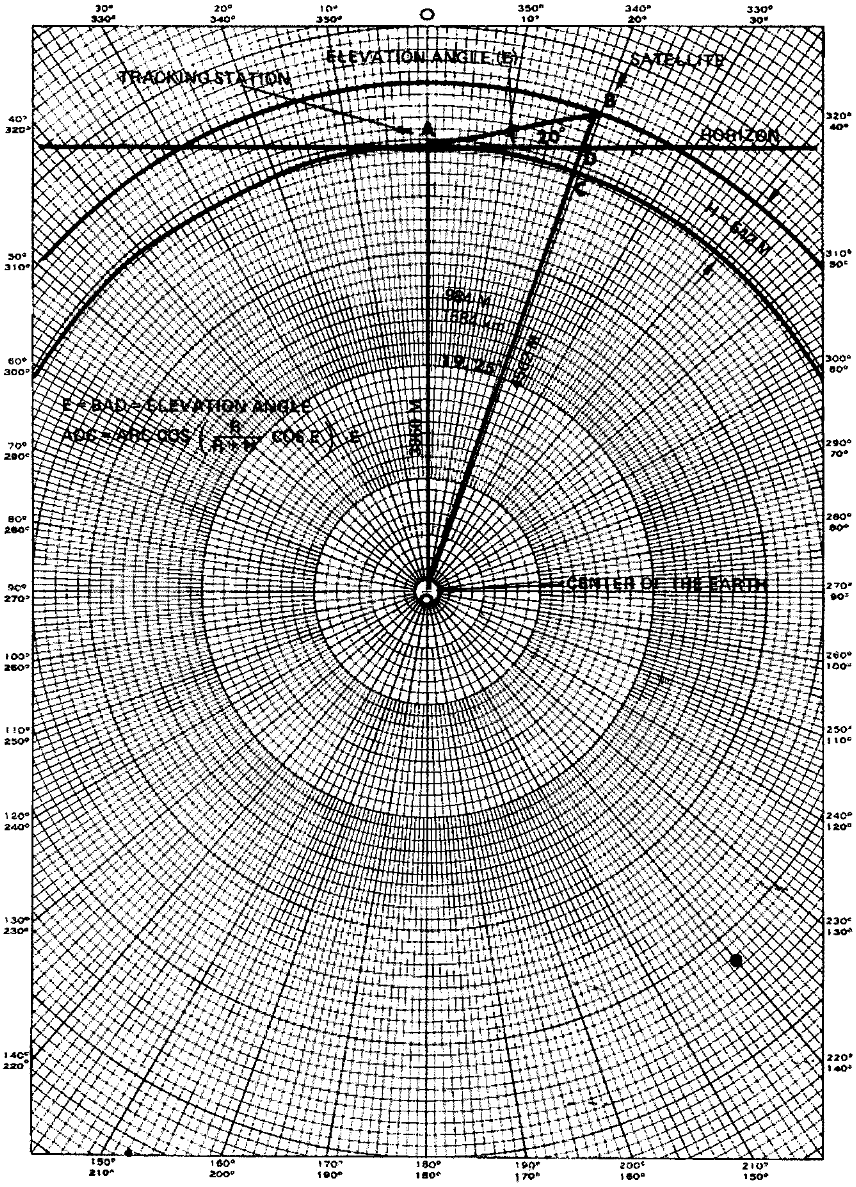

Fig. 10. Calculation of the distance from the tracking station at which the satellite is located 20° above the horizon.

Successive EQX Index Scale

We learned that the longitudes of successive equatorial crossings are separated by P/4° (25.70° for AO-D in which the period is 102.79 min.), and that in order to predict the EQX of the next orbit, we must add that value to the EQX longitude of the previous pass.

This process can be easily "automated" by adding a circular scale to be located under the map and pivoted on the North Pole. The scale consists of index marks separated by P/4° and numbered from 1 to 14. We will consider index mark number 1 as a reference and use it as a starting point for calculations of EQX longitudes of all satellite orbits of one full UTC (GMT) day (see Fig. 6).

Obtaining the data of the reference orbit of a chosen day, we align both the origin of the ground track and the longitude of the reference orbit against index mark #1 on the index scale.

Now, without disturbing the position of the map and the index scale, we can pivot the ground track and set its origin on the successive index marks and read the value of the longitude of the equator on the map. These will be the EQX longitudes of successive passes of the satellite.

In this way, we are able to predict EQX longitudes and follow the satellite's ground track over the Northern Hemisphere throughout the entire day.

EQX Time Scale

We also learned that the

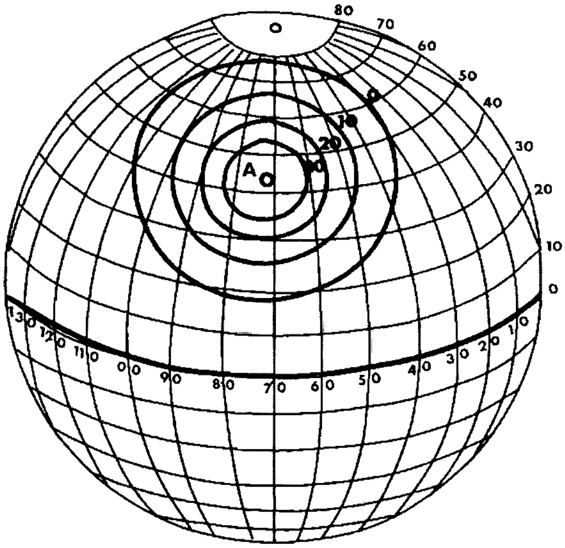

Fig. 11. Circles of equal elevation in respect to tracking station located at A.

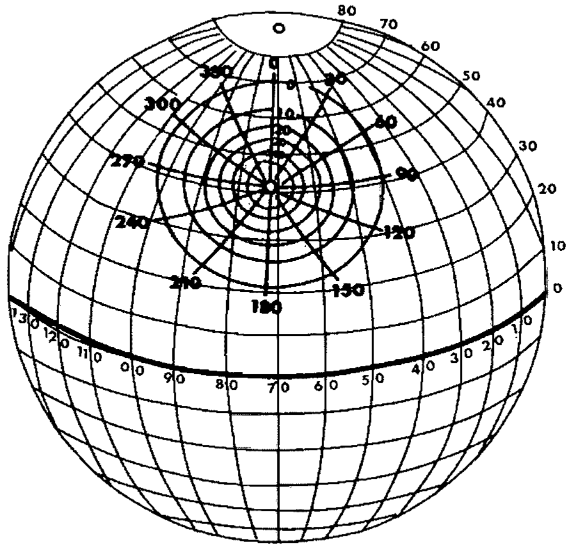

Fig. 12. Complete range overlay showing both azimuth and elevation.

time of the successive EQX can be predicted by adding the value of the period of the satellite to the actual time of the previous EQX. For OSCARs 6 and 7, with periods almost exactly 115 minutes, it was a relatively simple procedure: Two hours were added and then 5 minutes were subtracted. For OSCAR AO-D, with a period of ≈103 minutes, such calculations are a little more cumbersome and prone to frequent mistakes.

In order to simplify this problem, a rotary *time scale* has been added. It is placed between the map and the previously described index scale (see Fig. 7). The circumference of the scale (360°) is divided into 24 sections of 15°, each corresponding to 1 hour of Earth rotation. The hour segments can further be subdivided into 10 minute intervals 2.5° long. If more accuracy is needed, more subdivisions can be made; one minute will correspond to .25° on the scale.

Now, the setting of all scales for the reference orbit is as follows:

– Align the track, the map, and the index mark #1 as described previously.

– Align the exact time of the EQX of the reference orbit also against the index mark #1.

– Now the EQX times of successive orbits can be read directly on the time scale just opposite the corresponding index marks.

Once set for any chosen reference orbit of a particular satellite, both the map and the time scale can be cemented together (but not too permanently) and will not require resetting for a period of several months. The rationale is as follows:

– EQX longitudes are separated P/4° apart.

– During one period of the satellite, the Earth rotates P x .25° (.25° per minute) or also P/4°. Therefore, index marks spaced P/4° apart will correctly indicate the correct time intervals between successive equatorial crossings.

– Cementing the map and the time scale will imply that each longitude of EQX will have a specific time associated with it. This can easily be verified by consulting any long-range orbital predictions. You will find that like equatorial crossing longitudes always occur at the same UTC (GMT) time.

In practice, this relation is not that constant. Due to various factors, such as the solar year not being exactly 365 days, gravitational pull of the moon, etc., a slight drift between both scales will be noticed over a period of time. Therefore, it will be necessary to realign the scale slightly a couple times a year if high accuracy is required.

Summary

An orbital calculator described above consisting of four scales (the Earth track, the map, the time scale, and the index scale) provides a complete satellite tracking system, as long as the data of the reference orbits are available. The system allows prediction of EQX times and the longitudes of all successive orbits of that day. In addition, this system permits tracking the exact position of the satellite during the entire 24 hour period when the spacecraft is passing over the Northern Hemisphere.

Azimuth/Elevation Overlay

Just to be able to track a satellite in respect to the Earth is not sufficient for an OSCAR user. Since the communication via satellite is only possible when the satellite is within the "view" (above the horizon) of the tracking station, the user must be able to predict the rising and setting of the spacecraft at his geographical location. Moreover, if directional antennas are used, the azimuth (bearing) and the elevation (angle above the horizon) of the satellite in reference to the communicating station must be known at all times so the antenna can be aimed directly toward the orbiting transponder.

Communication Range

Fig. 8 depicts, diagramatically, the Earth and the orbit of the satellite. Both are drawn to scale. The Earth radius is 3960 miles (6371 km), and the average altitude (H) of AO-D is 542 miles (872 km). Consequently, the radius of the orbit will be 4502 miles (7243 km).

Point A in Fig. 8 represents the QTH of the user and the horizontal line represents the horizon as viewed from point A. As long as the path of the satellite lies below the horizon, the bulk of the Earth will prevent radio waves from reaching the transponder and no communications will be possible.

At the very moment the satellite crosses the local horizon, it will become "visible" to the user and two-way communication through the spacecraft's transponder will be possible. It stands to rea-

son that at the instant the satellite sets below the horizon, the communication via its transponder will be abruptly terminated.

With the aid of Fig. 8, we can easily calculate the maximum communication range of OSCAR AO-D. Point B on Fig. 8 represents the location of the satellite just crossing the local horizon of a station located at A. A straight line drawn between B and the center of the Earth will intersect the surface of the Earth at point C, which becomes the subsatellite point of the spacecraft just rising above the horizon.

It becomes evident that the distance AC on the surface of the Earth is the maximum distance from which the satellite will be visible from point A. In other words, as long as the subsatellite point of the spacecraft is no further away than distance AC, the satellite will be within communication range of a station at point A.

The distance AD, on the surface of the Earth measured in Great Circle degrees, is the angle AOC. Careful measurements of this angle, or mathematical calculations, will show that for OSCAR AO-D, this distance is 28.4° Great Circle degrees (1 Great Circle degree equals 69.1 statute miles, or 111.2 km).

Therefore, we may conclude that as long as the subsatellite point of AO-D is found within a circle with the radius of 1963 miles (3159 km) from the user's QTH, the satellite will be available for communication.

This circle of accessibility is easily plotted on the globe. Using a compass, measure the distance of 28.4° (using longitude markings on the equator) and inscribe a circle centered on the user's QTH (Fig. 9).

Two stations communicating with each other must have the satellite in view simultaneously. Therefore, their areas of accessibility must overlap. Also, the satellite must be passing through that

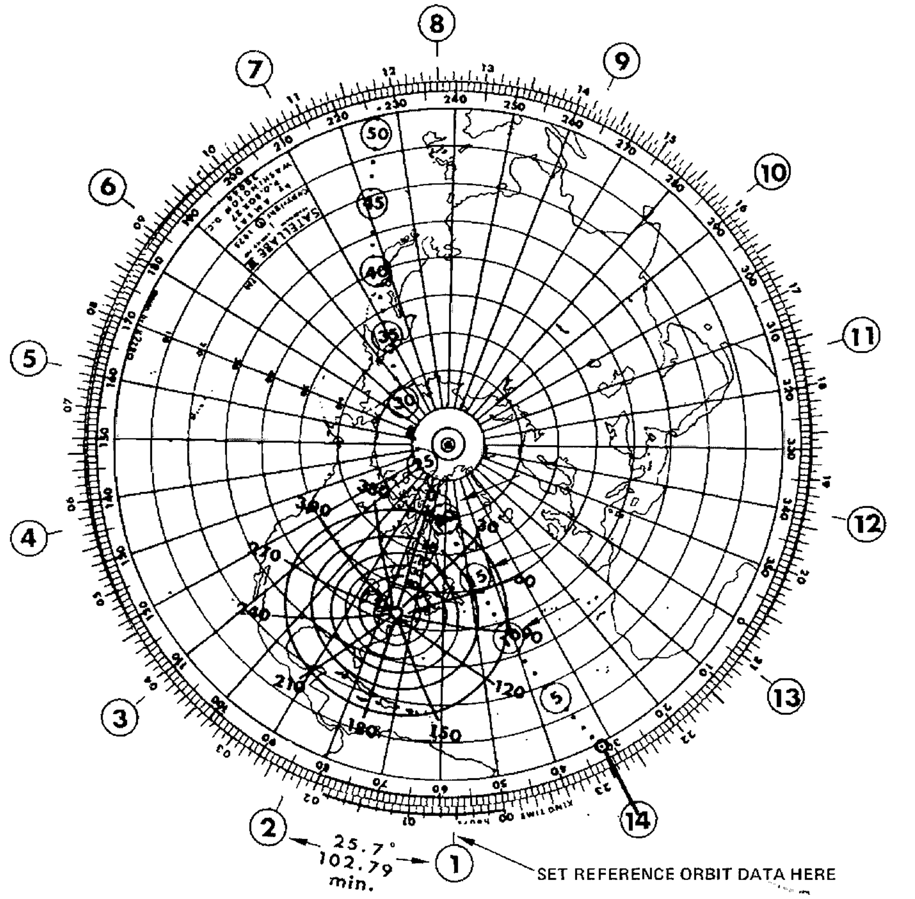

Fig. 13. Complete tracking system. Example: Reference orbit — 0032 GMT, longitude 57.2°. Set these values against index #1. We want to track AO-D during 14th orbit. Under index #14, we read EQX data: time 2247 GMT, longitude 31.8°. Tracking: satellite AOS (acquisition of signal) 10 minutes after EQX, 90° azimuth. 15 minutes after EQX — azimuth 45°, elevation ≈ 8°. LOS (loss of signal) 20 minutes after EQX, 10° azimuth.

overlapping area in order to be visible from both QTHs at the same time. With this in mind, we may conclude that the maximum theoretical separation between two distant stations capable of communicating via AO-D will be 2 x 28.4° = 56.8 Great Circle degrees or 3926 miles (6318 km).

Equal Elevation Range

Using a procedure similar to the one described above, we may plot distances from which the satellite will be seen at a constant elevation angle above the horizon in respect to point A. Fig. 10 shows how it is done.

Angle BAD is the angle of the satellite above the horizon, say 20°. Point C is the subsatellite point at this elevation. Consequently, the angle AOC is its distance from A in Great Circle degrees.

Using a graphical method, or mathematical calculations, distance AD can now be calculated. As in the previous example, a circle corresponding to that distance can be drawn on the globe. Repeating this procedure for different values of elevation angles,

Elev. Angle	c	Distance Miles	Distance Km
0	28.4	1962	3158
1	27.4	1893	3096
2	26.5	1831	2947
3	25.5	1762	2836
5	23.8	1644	2647
10	20.0	1382	2224
15	16.8	1161	1868
20	14.3	988	1590
30	10.4	719	1156
40	7.6	525	845
50	5.6	387	623
60	3.9	269	434
70	2.5	173	278
80	1.2	83	133
90	0	0	0

Table 2. Distance between subsatellite point and tracking station at different elevation angles. Note that even a small topological obstacle that elevates the horizon angle by 3° will shorten the distance of accessibility by 200 miles.

a family of concentric circles can be plotted, each representing a different angle of elevation (Fig. 11).

Elevation angles as a function of distance from the user's QTH for OSCAR AO-D are given in Table 2. You may observe, by examining Table 2, that even a small loss of low angle radiation due to topological configuration of one's QTH may result in substantial loss of the maximum communication range.

Azimuth Lines (Bearing)

Once the circle of accessibility is drawn on the globe, the azimuth, or bearing, lines can easily be added.

If, for example, we want to draw azimuth lines every 15°, we divide the circumference of the circle of accessibility into 24 equal parts and draw straight lines toward the center of the circle as shown in Fig. 12. If azimuth lines at 10° intervals are needed, the circle must be divided into 36 equal parts.

Projecting Azimuth/Elevation Overlay on a Flat Map

Once the azimuth/elevation overlay is drawn on the globe, it can be transferred on the circular orbital calculator described previously.

This is accomplished by transferring coordinates (longitudes and latitudes) of various points of the overlay from the globe to the corresponding coordinates of the flat map. The result will be an elliptical overlay with curved azimuth lines as shown on Fig. 13.

Due to projection distortion, the shape of the overlay will be different for different latitudes of the user's QTH — circular for North Pole and quite elliptical for points close to the equator. It should be noted, however, that the overlays will be identical in shape for QTHs located at identical latitudes.

Notes

1. A globe produced by the National Geographic Society comes equipped with a transparent "cap." If the azimuth/elevation overlay is drawn on the cap, it can easily be centered on any chosen location of the globe allowing instant determination of coordinates for azimuth and elevation points from that location.

2. Those who possess a so-called "azimuthal equidistance projection map" centered on (or very close to) his own geographical location can use it easily for plotting the azimuth and elevation overlay and don't have to resort to the more cumbersome globe. (The ARRL DX map is of this type and is centered on Wichita, Kansas. Other maps centered on principal cities are available from the U.S. Dept. of Commerce, Coast and Geodetic Survey.)

Calculations involved in the development of the az/el overlays are quite complicated and involve knowledge of spherical trigonometry. This subject is beyond the scope of this article.

A circle drawn on the northern projection map (such as used in the ARRL's OSCARLOCATOR) is a reasonable solution, if utmost accuracy is not required. The circle, however, will indicate somewhat shorter than actual range to the west and east of the tracking station.

Application

To use the az/el overlay, we simply follow the satellite's progress and determine its subsatellite points during the pass.

If the location of the satellite is found within the borders of the overlay, the spacecraft is accessible for communication.

Then, the correct antenna bearings are determined by relating the satellite's position in respect to the azimuth/elevation markings on the overlay as shown on Fig. 13. ■

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Build A 2m Power Amp

- - great for OSCAR uplink

Class C amplifiers have been popular for some time for 2 meter use. However, to go to the trouble of adding an outboard amplifier, it must produce enough gain to make it worthwhile. A minimum of 6 to 8 dB is required to make the additional amplifier worthwhile and 10 dB gain is desirable.

Many amplifiers I have observed, both commercial and homebuilt, have used two generation old transistors, 2N5590 and 2N5591, for power levels of 10 to 25 Watts. There is a much better device available in the 25 to 30 Watt range, the Motorola MRF238. For comparison of the data sheets of the 2N5591 and MRF238, see Table 1.

At 150 MHz, the gain of the MRF238 is approximately 0.5 dB higher than at 160 MHz (shown in Table 1). The MRF238 is rated at 30 Watts and the 2N5591 is rated at 25 Watts. In practice, the MRF238 has proven much more rugged than the 2N5591 series (more tolerant of high VSWR). The MRF238 also has higher efficiency.

The amplifier shown schematically and pictorially in Figs. 1 and 2 respectively is not unlike many others; however, it makes use of the high performance MRF238.

The performance data in Table 2 was recorded for this

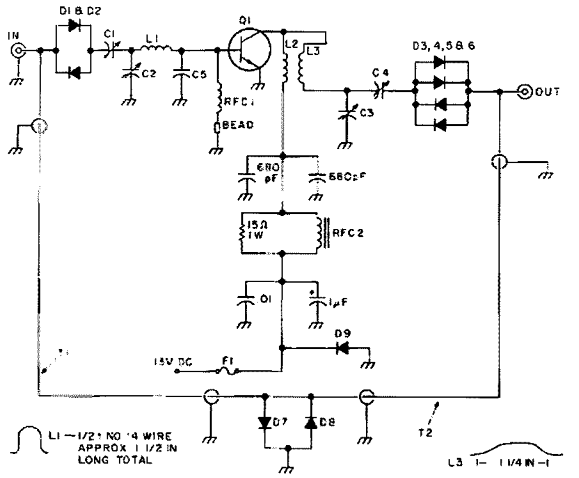

Fig. 1. Amplifier schematic. C1-C4 — Arco 463, 464, or 424; RFC1 — 10t #20 on 270 Ohm 1/2 Watt resistor; C5 -- 3-90 pF silver mica in parallel or 2-150 pF uncased micas also in parallel; RFC2 — 6 to 8 turns #18 around toroid core; L1 — 1/2 turn #14 approx. 1½ inches long; L2 — 4t #14, 1/4" I.D. spaced wire diameter; L3 — Curved wire #14, 1-1/4" long; Q1 — MRF238 Motorola rf power trans.; D1-D8 — 1N4148; T1-T2 — 1/4 wavelength of RG-174 or similar 50 Ohm coax cable; D9 — 2 Amp silicon rectifier.

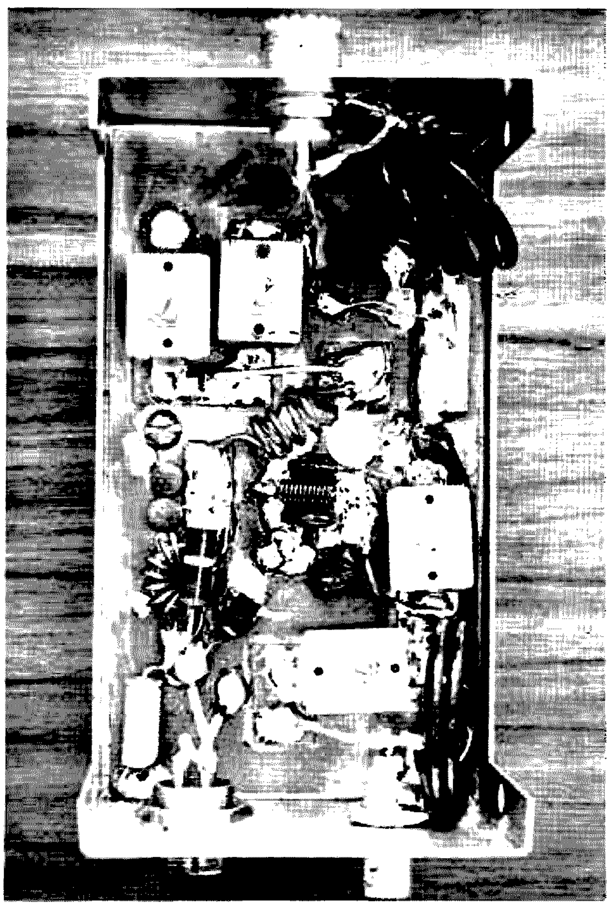

Fig. 2. Photo showing construction of the amplifier. The input is via the BNC connector at the top.

Device	Voltage	Freq.	Power In	Power Out	Gain
2N5591	13.6	150 MHz	2 Watts	10.8 Watts	7.3 dB
			4 Watts	20.5 Watts	7.1 dB
MRF238	13.6	160 MHz	1.5 Watts	19.5 Watts	11.1 dB
			2 Watts	24 Watts	10.8 dB
			3 Watts	30.5 Watts	10.1 dB

Table 1. Comparison of 2N5591 and Motorola MRF238.

Voltage	Power in	Power Out	Gain
13.7	2 Watts	26 Watts	11.1 dB
13.7	1.3 Watts	18 Watts	11.4 dB

Table 2. Performance data.

amplifier.

A small loss is involved with the diode switching.

The amplifier was assembled by using single-sided copper epoxy board and cementing small "islands" of board onto the main board. The main board is 2-7/8" x 5" and the minibox is 3" x 5-1/4" x 2-1/8". A heat sink is mounted to the top of the minibox. The only critical items are L1, L3, and C5. Make sure T1 and T2 are an electrical 1/4 wavelength, approximately 13-1/2" with polyethylene coax (RG-174). All capacitors should have leads as short as possible. The amplifier is usable with inputs of less than 1 to 2.5 Watts.

The price of the 30 Watt MRF238 is $8.55 in unit quantities, which is less than the 25 Watt 2N5591 or 2N6082, another point in its favor.

If all items are bought new, the cost is about $23; however, with a reasonable junk box, it can be constructed for about $12 (the MRF238, a minibox, and miscellaneous items not in the junk box). ■

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Build A General Purpose Preamp

-- uses common components !

For those of us who are engineers, it is relatively easy to crank out a custom circuit to fit every little need. However, most experimenters and hams are not in that category, and, for them, the next best thing is an accumulation of a few good circuits about which they know a lot. This article describes a simple audio amplifier which has high gain, low noise, and excellent stability toward temperature extremes.

While it is very simple and is used in many commercial devices, it can be used in almost all those places where you need a preamp, such as mike boosters, first af amplifier after a detector stage in a receiver, etc.

Referring to Fig. 1, the circuit can be seen as a direct coupled pair of 2N3904 transistors. This transistor is cheap, high gain, fairly low noise, and very easily obtained. The Q2 transistor is hooked up like any ordinary amplifier stage, but the base resistor that normally goes from its base to ground has been replaced with another transistor, Q1. This Q1 transistor varies the bias on Q2, so the circuit is immune to heat effects. The way it's hooked up, if Q2 draws more current, the voltage on R2 rises, turns on Q1 harder via the 100k resistor connected to its base, and cancels out the increased current in Q2. The result is almost no change in current due to temperature variations. The capacitor C2 prevents the ac signal from being fed back and reducing the overall gain. By placing the capacitor as shown, a very small value, which is also small in physical size and cheaper, will permit the amplifier to keep its full gain to low frequencies as well as would be the case for a very large C placed across R2. The values in Fig. 1 will amplify down to about 10 cycles using a physically small capacitor. To make the amplifier roll off at a higher frequency on the low side, reduce C2 to about 1 uF or less, or, alternately, you could reduce the 100k resistor to about 10k. This would make the frequency roll off around 100 cycles and turn the circuit into a speech amplifier rather than a hi-fi type.

The circuit shown in Fig. 1 performs best when driven by a moderate impedance source from 500 Ohms to 3k Ohms impedance. With this kind of source, the gain will be about 250, and the output noise with no signal in will be about 2 millivolts. This is equivalent to an input noise of only 8 microvolts, so the noise is quite low for all but extraordinary uses.

If you wish to drive the circuit with a low impedance source, such as a speaker of 4 to 16 Ohms or a telephone earphone (which makes an excellent high output mike), use the circuit in Fig. 2. Here, the base is tied to ground via a capacitor, and the signal is fed to the emitter of Q1 through a capacitor. This circuit will perform very similarly to Fig. 1, but will have slightly higher gain reaching perhaps 500 and about the same low noise performance.

Ten microfarad capacitors are used throughout because they are small and cheap, and are more than enough to do the job here.

This simple circuit can be made up in a ball smaller than an acorn and put into mikes to give you more gain than you need to drive even the worst transmitter. It also works well when driven by a speaker put out in the yard to let you listen for prowlers at night, when you don't care to get out of a warm bed, but the dog barks like he's on to something. Fed into any hi-fi input, such a preamp will let you hear better than if you were out in the yard. There are many other uses, and most of them will please you because the low noise of this preamp lets you really hear clean audio. ■

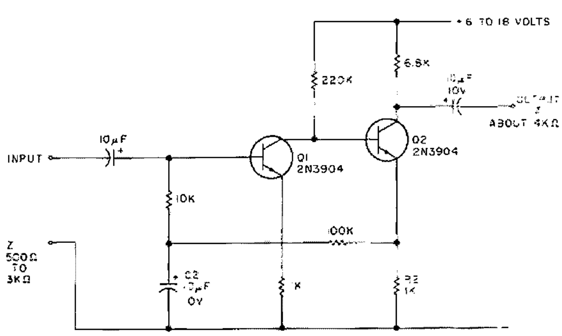

Fig. 1.

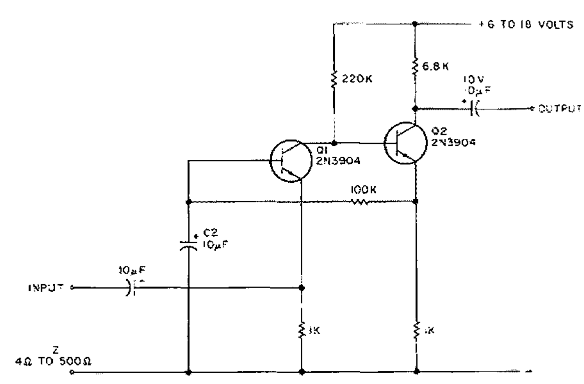

Fig. 2.

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Receive CW With A KIM

-- micro-controlled, of course!

In the January, 1977, issue of *73 Magazine*, WB2DFA presented a fantastic article concerning the use of the KIM-1 microprocessor for the transmission of Morse code. We have used the program repeatedly on the air since that time, and it has been met with never-ending amazement. The KIM was finally given a ham-oriented use. The next step had to be reception of Morse, a formidable project hinged on an entire handful of variables: Morse code was *not* predictable – speeds changed, intra- and inter-character lengths were not constant, word spaces seemed unpredictable, and even sending "style" played a big part. Could it be done? Finally, after much writing, rewriting, hour-long QSOs to solve bugs, and a good deal of hair-pulling, the program worked.

The reader should be cautioned at this point that "perfect" reception is nearly impossible without "perfect" sending. This will rarely be encountered, given noise and the multitude of sounds issuing forth from the CW bands. Suggestions will be offered for copying both hand key and off the air.

The program fits comfortably in the onboard KIM 1K memory. No additional equipment is needed for hand key decoding. Connection to a receiver requires only a simple adapter, which can easily be constructed for under $5.00 with readily available parts. The program allows the option of displaying the decoded Morse on the integral KIM 7-segment LED display or having the output sent to an ASCII TTY or a video terminal. Due to the slow speed of a mechanical printer, only very slow Morse can be decoded. Of course, a high baud rate video terminal will allow the program to run at full speed without getting bogged down in the out-character subroutine. A video terminal usually offers automatic carriage return/line feed at the end of each line. Obviously, these functions are not part of the Morse code and require terminal generation. Using the KIM display allows the decoded material to be displayed in a "Times Square" format, with letters shifting left automatically with the reception of each new letter. The program even offers automatic placement of word space "blanks" between completed words, for easier reading.

Finally, the program here has run equally well on the KIM-1 and also on a 6502-based home brew. It has been tested for several months and, we think, does the best job possible with such an unpredictable code as Morse. Using the program on a KIM is straightforward. Using the program on another 6502-based system would require only changes to call-ups of KIM subroutines and ROM locations. A timer would also be required; the KIM has two built in.

A description of how the program accomplishes its goal is a bit involved. Basically, when pushing "Go," you will see the six digits on the KIM board display random garbage which was in locations 000A-000F when the computer was powered up. About half a second later, the display will shift left one digit, and a blank digit will appear on the right, ready for the first decoded Morse character. After reception has continued for a while, these locations will hold the last six decoded characters. But the microprocessor never sits idle. It is constantly inspecting pin A-8 (PA7) for data input from the hand key or optional receiving adapter. The program loop also checks the onboard timer to see if a 4-millisecond period has elapsed. Each time the timer expires, the loop breaks long enough to increment location 0001. Assuming no code has been received, after about half a second, location 0001 has been incremented up to hex 7F. At this time, the loop breaks again and jumps to the SHIFT LEFT DISPLAY subroutine. Its next move is to the zero page conversion table. The count in location 0007 is used as an offset to select the proper data in the table.

If, as we are assuming, no Morse has actually been received yet, location 0007 will still be at its initialized value, and an error sign will be called up. This data is placed in location 000F, which serves the right-most digit on the KIM board. Then location 0001 is compared to 0005, which was initialized to a value of hex 01. Since 0001

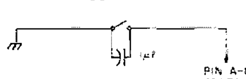

Fig. 1. Connecting a code key to the KIM.

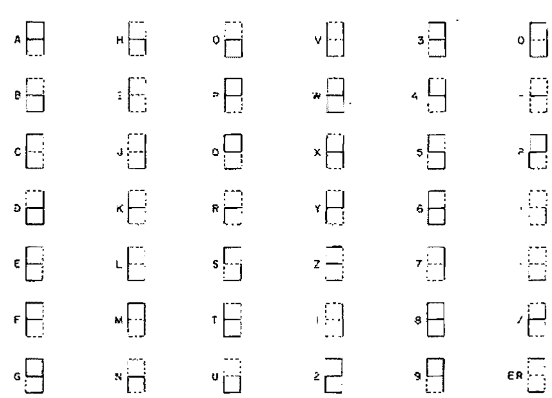

Fig. 2. Decoded Morse code as it will appear on the KIM display.

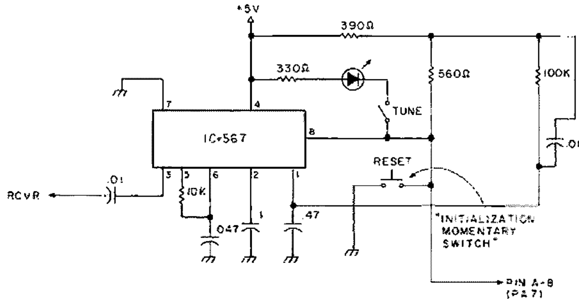

Fig. 3. Tone adapter to use the KIM with a receiver.

will contain a greater count, a second trip through the SHIFT LEFT DISPLAY and the conversion table will be accomplished. This time, the code for turning all display segments "off" will be loaded into 000F. Then the microprocessor reinitializes 0007 and returns to the loop. Also set was 0002, which serves as a flag for the loop to now bypass its checks on the interval timer. Until actual code is received, this final loop will be repeated endlessly. The visible effect on the activity just described is that about one-half second after starting the program, the random data displayed will shift left twice, with the two right-most digits containing an error symbol followed by a blank.

After this has occurred, you will next initialize the code speed. This is done simply by grounding the input pin (A-8), either by holding down the hand key or, if you're using the receiving adapter, by holding down the initialization momentary switch. As soon as the microprocessor discovers that the status of the input pin has changed, the interval timer is put to work again. Holding the key/initialization switch down about one second will allow 0001 to again be incremented up to 7F. Again the loop breaks, but this time a different path is taken because it was learned that the key was indeed "down." Location 0003 is now set equal to location 0001 and will serve as a flag to steer the program through the initialization routine.

Now, as code is entered via the input pin, the program increments location 0001 every 4 milliseconds, to measure the length of time the key is kept down or up. The first key-down is multiplied by two (i.e., shifted left once) and stored in location 0005. Then, it is shifted right two times, which effectively divides the original count by two. This final count gets stored at 0006.

Why get these counts? The microprocessor will use succeeding key-down counts for comparison to those just stored. The processor must decide which was a dot and which was a dash. The first count, by definition, was either less than half the latest count or greater than twice the latest count. If the first count was a dot, initialization is ended. If it was a dash, counts in 0005 and 0006 are updated with the latest count, since proving that the original count was a dash requires that the latest count was of dot length. Initialization, then, requires both dots and dashes so that a comparison can be accomplished. All future counts will be compared to the one now loaded at 0005. Any count less than that in 0005 will be considered a dot; those counts greater will be considered dashes. At this point, all the computer knows is the difference between dots and dashes; we still don't have characters!

So, where does the computer begin to determine that there is intelligence in what it is receiving? The magic begins to occur in location 0007. Every time a dot is received, 0007 is shifted left. Also, for

Character	Zero page Address	7-segment code	Terminal code
A	15	F7	C1
B	28	FC	C2
C	2A	B9	C3
D	1C	DE	C4
E	12	F9	C5
F	22	F1	C6
G	1E	EF	C7
H	20	F4	C8
I	14	B0	C9
J	27	8E	CA
K	1D	F0	CB
L	24	B8	CC
M	17	B7	CD
N	16	D4	CE
O	1F	DC	CF
P	26	F3	D0
Q	2D	EB	D1
R	1A	D0	D2
S	18	AD	D3
T	13	F8	D4
U	19	9C	D5
V	21	BE	D6
W	1B	FE	D7
X	29	F6	D8
Y	2B	F2	D9
Z	2C	C9	DA
1	3F	86	B1
2	37	DB	B2
3	33	CF	B3
4	31	E6	B4
5	30	ED	B5
6	40	FD	B6
7	48	87	B7
8	4C	FF	B8
9	4E	EF	B9
0	4F	BF	B0
-	41	C0	AD
?	5C	D3	BF
,	83	84	AC
.	65	88	AE
/	42	D2	AF
ERROR	11	89	C0
WORD SPACE	10	00	A0

Table 1. How to use the table: Decide whether you want to have output of the decoded Morse on the KIM's 7-segment display or whether you will be using an external terminal (be it TTY or video). If you want:
7-segment Display — Load the appropriate data in the "7-segment code" column at the specified zero page locations. For example, you will be loading data for an "A" by loading "F7" at location ØØ15. Disregard the "Terminal code" column.
Terminal Display/Printout — Load the appropriate data in the "Terminal code" column at the specified zero page locations. For example, you will be loading data for an "A" by loading "C1" at location ØØ15. Disregard the "7-segment code" column. Note: For terminal use, the KIM-1 requires jumpering of pin 21 to pin V on the Application Connector. Installation of an SPST switch between those points allows switching from the KIM's integral display to a terminal for I/O.

each dot detected, a jump to a speed adjustment subroutine can be taken, if desired (described later). Dashes shift 0007 left once and add "1".

"Key-up" counts must also be considered and serve to complicate the decoding of Morse even more. As long as the counts test to be less than that count in 0005, the program assumes a single Morse character is still in the process of being sent. But as soon as any key-up count exceeds the value in 0005, the single character is considered completed. After a check to see that bit 7 in 0007 is not equal

to a one, the program uses this value as an offset to the zero page conversion table. If bit 7 were a one, the program recognizes that the letter received could not have been Morse (no Morse character is 7 elements long!) and displays the error symbol. Note that, in practical use on the air, errors are followed by a string of dots. The computer will advise you of this occurrence!

We have mentioned the data in 0007 as being all-important, as it represents the actual Morse character. Note several points:

1. 0007 will be initialized to hex 01. (This will serve our "error" condition stated above, if this bit gets shifted left to the 7th bit.)

2. Dots will be entered in this location simply by a shift left (effectively entering a zero).

3. Dashes will be entered as ones.

Morse character "A" will end up in 0007 as "0000 0101" in binary form. The "di-dah" appears in the first two places to the right, with the initial "one" being shifted to the third position from the right. This code for an "A" has a decimal value of "5", and the program at location 025F uses this value, offset by 10, to find the code for an "A" at 0015. At this location, a hex F7 has been entered, if you planned on using the KIM display as your output; if you had decided on using a terminal and wanted ASCII output, a hex C1 would have been loaded instead (see Table 1).

Subroutines are used to shift the display memory, scan that data onto the displays, adjust the code speed during actual operation, and provide for the output of the decoded data to a terminal. Any of these subroutines may be deleted by replacing the appropriate JSR instruction with NOPs. The first two subroutines are required, if the integral KIM display is to be used; the third is optional, to allow automatic code speed adjustment. If you do not use this subroutine, the initial code speed will be considered by the computer to be the only code speed, and it will not adjust to speed changes. Obviously, if you are receiving Morse from a station using a keyboard or another computer, this speed adjustment routine will not be needed and would only serve to complicate matters by slowing the program down. The JSRs to these subroutines are located at:

0243 -- SCANDS – puts the decoded data on the KIM display.

0257 – SHIFT LEFT DISPLAY – allows the data to move "Times Square" format across the KIM display.

02AD – ADJUST SPEED – allows the computer to update the code speed it is receiving.

0263 – OUTCHARACTER – allows the computer to output the decoded character to an ASCII terminal.

For instance, let's say we don't want data to be dis-

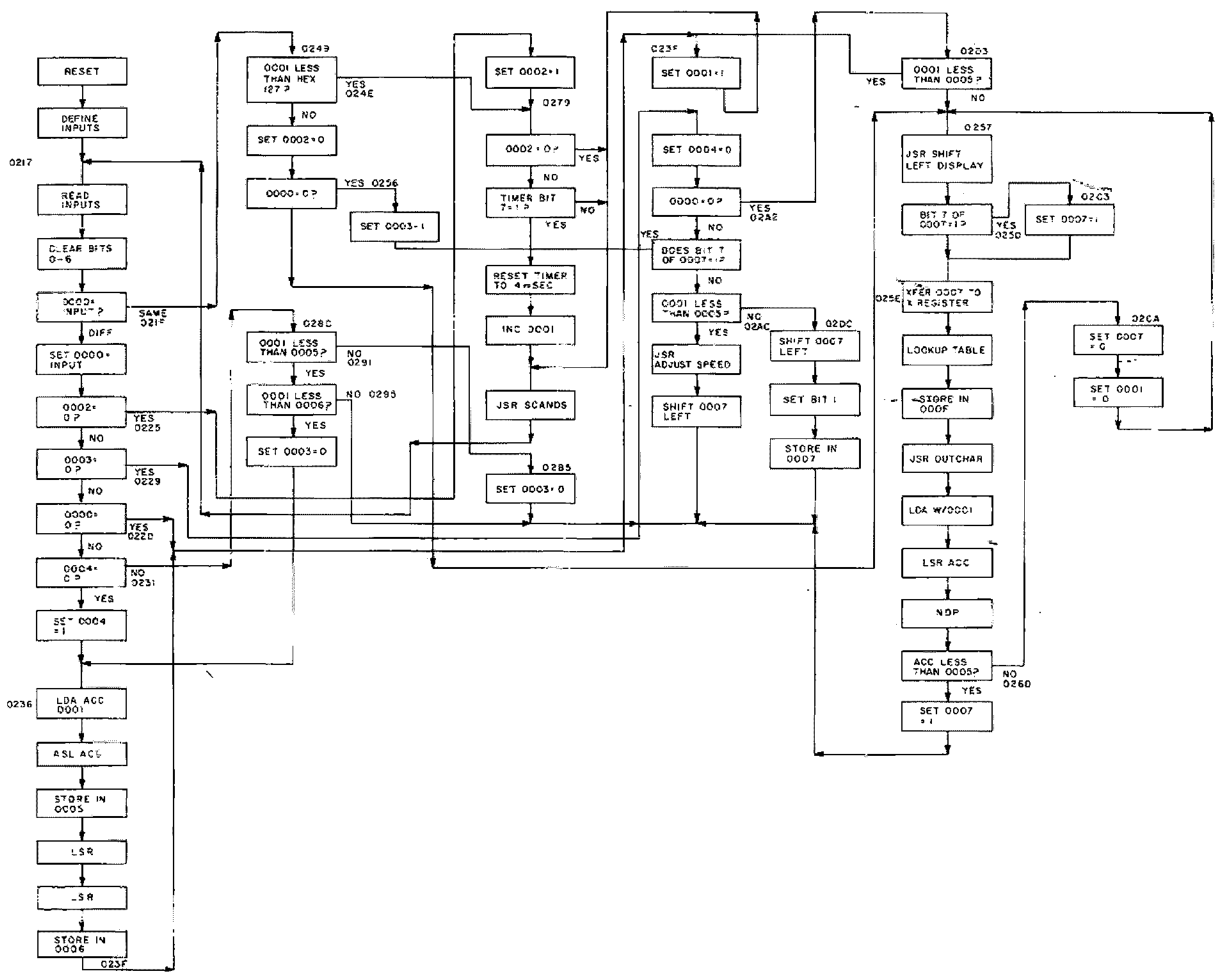

Table 2. This detailed flowchart is intended to give a better idea of operation of the program. Hex addresses are provided at key points.

played on the KIM display, but, instead, we want to use a video terminal. You would delete both the SCANDS and SHIFT LEFT DISPLAY subroutines by removing the JSRs and entering NOPs. Example:

Before
0243 20 0E 03
-
-
-
0257 20 30 03
After
0243 EA EA EA
-
-
-
0257 EA EA EA

Here we have effectively removed the SCANDS and SHIFT LEFT DISPLAY subroutines. Since we have not removed the ADJUST SPEED subroutine or the OUTCHARACTER routine, the resulting program will still adjust to new code speeds and output the decoded data to a terminal. The KIM display will not light. It is pos-

```
Address    Data         Op Code

0200       D8           CLD
0201       58           CLI
0202       A9 00        LDA imm
0204       8D 01 17     STA abs
0207       85 01        STA zp
0209       85 04        STA zp
020B       A9 01        LDA imm
020D       85 07        STA zp
020F       85 05        STA zp
0211       85 02        STA zp
0213       A9 80        LDA imm
0215       85 00        STA zp
0217       AD 00 17     LDA abs
021A       29 80        AND imm
021C       C5 00        CMP zp
021E       F0 29        BEQ
0220       85 00        STA zp
0222       A5 02        LDA zp
0224       F0 4F        BEQ
0226       A5 03        LDA zp
0228       F0 73        BEQ
022A       A5 00        LDA zp
022C       F0 11        BEQ
022E       A5 04        LDA zp
0230       D0 5A        BNE
0232       A9 01        LDA imm
0234       85 04        STA zp
0236       A5 01        LDA zp
0238       0A           ASL acc
0239       85 05        STA zp
023B       4A           LSR acc
023C       4A           LSR acc
023D       85 06        STA zp
023F       A9 01        LDA imm
0241       85 01        STA zp
0243       20 0E 03     JSR
0246       4C 17 02     JMP
0249       A5 01        LDA zp
024B       C9 7F        CMP imm
024D       90 2A        BCC
024F       A9 00        LDA imm
0251       85 02        STA zp
0253       A5 00        LDA zp
0255       F0 65        BEQ
0257       20 30 03     JSR
025A       A5 07        LDA zp
025C       30 65        BMI
025E       AA           TAX
025F       B5 10        LDA zp,X
0261       85 0F        STA zp
0263       20 45 03     JSR
0266       A5 01        LDA zp
0268       4A           LSR acc
0269       EA           NOP          (see article)
026A       C5 05        CMP zp
026C       B0 5C        BCS
026E       A9 01        LDA imm
0270       85 07        STA zp
0272       4C 3F 02     JMP
0275       A9 01        LDA imm
0277       85 02        STA zp
0279       A5 02        LDA zp
027B       F0 C6        BEQ
027D       AD 07 17     LDA abs
0280       10 C1        BPL
0282       A9 04        LDA imm
0284       8D 07 17     STA abs
0287       E6 01        INC zp
0289       4C 43 02     JMP
028C       A5 01        LDA zp
028E       C5 05        CMP zp
0290       B0 23        BCS
0292       C5 06        CMP zp
0294       B0 A9        BCS
0296       A9 00        LDA imm
0298       85 03        STA zp
029A       4C 36 02     JMP
029D       85 04        STA zp
029F       A5 00        LDA zp
02A1       F0 30        BEQ
02A3       A5 07        LDA zp
02A5       30 98        BMI
02A7       A5 01        LDA zp
02A9       C5 05        CMP zp
02AB       BC 2F        BCS
02AD       20 E7 02     JSR
02B0       06 07        ASL zp
02B2       4C 3F 02     JMP
02B5       A9 00        LDA imm
02B7       85 03        STA zp
02B9       4C 3F 02     JMP
02BC       A9 01        LDA imm
02BE       85 03        STA zp
02C0       4C 3F 02     JMP
02C3       A9 01        LDA imm
02C5       85 07        STA zp
02C7       4C 5E 02     JMP
02CA       A9 00        LDA imm
02CC       85 07        STA zp
02CE       85 01        STA zp
02D0       4C 57 02     JMP
02D3       A5 01        LDA zp
02D5       C5 05        CMP zp
02D7       90 0A        BCC
02D9       4C 57 02     JMP
02DC       A5 07        LDA zp
02DE       0A           ASL acc
02DF       09 01        ORA imm
02E1       85 07        STA zp
02E3       4C 3F 02     JMP
02E6       EA           NOP
02E7       A5 01        LDA zp
02E9       0A           ASL acc
02EA       85 09        STA zp
02EC       C5 05        CMP zp
02EE       90 0C        BCC
02F0       E5 05        SBC zp
02F2       4A           LSR acc
02F3       4A           LSR acc
02F4       4A           LSR acc
02F5       18           CLC
02F6       65 05        ADC zp
02F8       85 05        STA zp
02FA       60           RTS
02FB       EA           NOP
02FC       38           SEC
02FD       A5 05        LDA zp
02FF       E5 09        SBC zp
0301       4A           LSR acc
0302       4A           LSR acc
0303       4A           LSR acc
0304       85 08        STA zp
0306       38           SEC
0307       A5 05        LDA zp
0309       E5 08        SBC zp
030B       85 05        STA zp
030D       60           RTS
030E       A9 7F        LDA imm
0310       8D 41 17     STA abs
0313       A0 09        LDY imm
0315       A2 0A        LDX imm
0317       B5 00        LDA zp,X
0319       8D 40 17     STA abs
031C       8C 42 17     STY abs
031F       84 23        STY zp
0321       A0 00        LDY imm
0323       8C 42 17     STY abs
0326       A4 23        LDY imm
0328       C8           INY
0329       C8           INY
032A       E8           INX
032B       E0 10        CMX imm
032D       D0 E8        BNE
032F       60           RTS
0330       A5 0B        LDA zp
0332       85 0A        STA zp
0334       A5 0C        LDA zp
0336       85 0B        STA zp
0338       A5 0D        LDA zp
033A       85 0C        STA zp
033C       A5 0E        LDA zp
033E       85 0D        STA zp
0340       A5 0F        LDA zp
0342       85 0E        STA zp
0344       60           RTS
0345       A5 0F        LDA zp
0347       20 A0 1E     JSR
034A       60           RTS

END
```

Fig. 4. Program listing. KIM-1 Morse code receive program.

sible to run the entire program unchanged, but running the SCANDS without using it would waste valuable time; running the OUTCHARACTER routine, when you're only interested in the KIM display, could be a disaster. As a good, general rule, remove unwanted subroutines with NOPs. Don't waste the computer's time; it has been given enough to do!

A few words about the heretofore unexplained SPEED ADJUST subroutine – this subroutine, if it has not been replaced by NOPs, will be called up each time a dot is received. The subroutine divides the count stored in 0005 by two and compares the result with the current dot value stored in 0001. Any difference is divided by eight and added to, or subtracted from, the count in 0005. This new value, then, has gradually been adjusted to a new code speed. Obviously, the computer will not accurately handle great single jumps in code speed but does well with substantial changes if they are gradual. Without this subroutine, the initial count in 0005 becomes the dot comparison and cannot change. There is, as usual, one catch to trying to "cover all corners": Occasional bursts of static and noise can easily fool the subroutine into raising the expected code speed. In this case, a string of "Ts" will be displayed. Reinitialization is easy, though. Hold the initialization momentary switch down for about a second. The computer will "start over" in its search for code speed.

Ready to try it? Load the program, the character lookup table (Table 1), and begin by NOPing the OUTCHARACTER subroutine. Connect a hand key to the computer, as in Fig. 1. Although not a major problem, the 0.1 uF capacitor across the key serves to get rid of some switch bounce. Some keys we have used worked fine without it; others seemed to require it. Take a look at Fig. 2, so you have a little idea of what will appear on the KIM display once the program is up and running after several characters.

Since there is no way to display all letters (let alone punctuation!) on a 7-segment LED, we have chosen symbols that seem easiest to identify. Note that an "S" must be distinguished from a "5", an "O" from a "Ø", and even a "T" from a "7". Once you have gotten used to the oddballs, you'll recognize them right away. On a terminal, of course, you'll get standard characters (with the exception of ERROR, which will print as an "@").

If you've gotten this far, set up address 0200, and press "G". Hold the tape key down about a second, then simply begin sending. The first few characters will produce garbage until the computer determines your average dot and dash. Then, you'll see proper Morse being displayed. You'll soon discover how well you're sending. Articulate! The computer and other OM will appreciate it! Try sending the entire alphabet one letter at a time. Pause between each and you'll see a word space placed on the display between your letters. This is an ideal way to get used to the odd characters and to see which letters you don't send very well.

After becoming thoroughly familiar with the program's operation, you will probably want to try it connected to a receiver. The schematic in Fig. 3 offers one suggestion which works amazingly well for its low cost and simplicity. Connect pin 3 of the 567 through the .01 capacitor to your headphone jack. Don't forget to run a ground from the jack to ground on this adapter board. The 567 will be looking for a frequency of about 2100 Hz. This is simply to allow the same adapter to work for RTTY (we're working on it). You won't be able to use a CW filter, since this frequency will be outside its bandpass. When you tune in a CW signal, flip the "tune" switch on. The LED will light when the 567 hears the proper tone. Adjust your receiver from the highest frequency the LED will still light with, to the lowest. Set your receiver in the middle. The circuit is designed to have pin 8 ground when it decodes the proper tone. The 567 will thereby simulate key-up and key-down for the computer. Again, a common ground must be shared between the adapter and the computer. Begin by trying to copy a clean-sending station, one that is on a fairly open frequency, and one that is sending moderate speed (13 wpm is fine). Again, set up address 0200 and hit "G", and then, after a second or so, press the initialization momentary switch down on the adapter board. Let go after a second, and the computer will begin to decode. It is advisable to have the "tune" switch off after you have tuned up.

Should you be troubled by too many word spaces being displayed on slow CW, add a second LSR to the program at 0269. A NOP has been placed there as a space filler. The second LSR instruction lengthens the time that must pass before the computer enters a word space.

In retrospect, a program this simple (anything that fits in less than 1K can't be too involved) cannot be expected to produce perfectly decoded Morse. Your initial patience will be required until you "get the feel" of how the computer is accomplishing this task. The program is not infallible, as it's being required to decode a language overflowing with variables. It does, however, a very respectable job given these conditions. This is at least another step in bringing ham radio and computers together; the future will be what we make it. ■

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Build This SSTV Pattern Generator

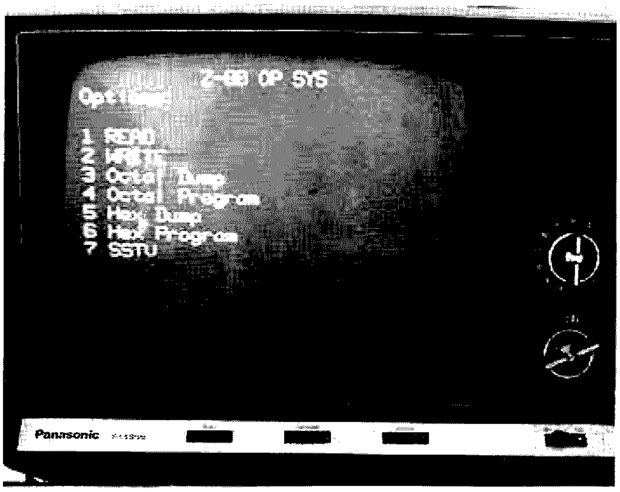
-- now, if only the FCC...


The microcomputer. The large box on the right contains the Digital Group Z-80 system and power supply.

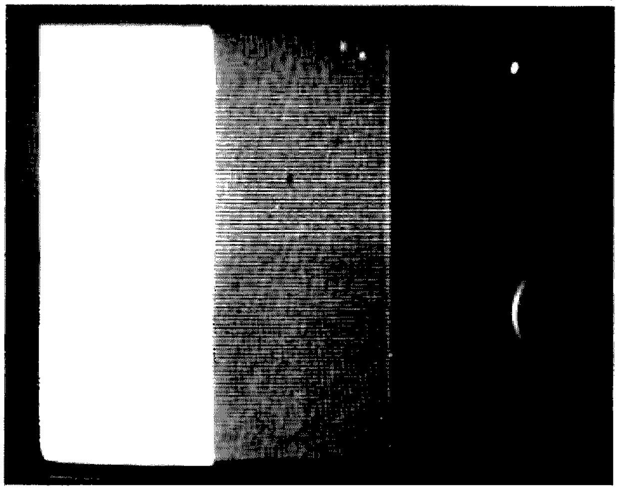
I went directly to programming in BASIC after completing the construction of a Digital Group Z-80 system from a kit. I postponed machine language programming until recently, in order to experience the games and other slow speed applications available in BASIC. I've been interested in slow scan television for the past couple of years, and the generation of a slow scan video signal appeared to be a logical place to get my feet wet in machine language programming. The following program is what resulted. I think you'll find it interesting.

Slow Scan Video Signals

It takes about 7.5 seconds to generate a single frame in the slow scan format currently used by radio amateurs. Each frame begins immediately following a vertical synchronization pulse. This pulse consists of a burst of 1200 Hz oscillations and lasts 30 milliseconds. This is equivalent to 36 cycles, with each cycle lasting 833 microseconds. Each frame consists of 128 lines, and each line starts with a horizontal synchronization pulse which lasts 5 milliseconds. The frequency is 1200 Hz, and the burst, therefore, consists of 6 cycles, lasting 833 microseconds each. Following each horizontal synchronization pulse, there are approximately 60 milliseconds available for the information required to generate one of 128 lines in each frame. The line information consists of oscillations from 1500 Hz to 2300 Hz, with 1500 Hz representing black and 2300 Hz representing white. The line data for an intermediate grey tone only would, therefore, consist of 60 milliseconds of 1900 Hz oscillations, or 114 cycles, each 526 microseconds in length. The fre-



Option list showing the addition of the seventh option.



A 3-bar grey scale.

quency range required to generate a slow scan signal is, therefore, 1100 Hz, between 1200 Hz and 2300 Hz. The generation of these frequencies should be well within the capability of a CPU clocked at 2.5 MHz.

Square Wave Generator

The first requirement is for a machine language subroutine which can generate audio frequency oscillations. Three possibilities were considered:

1. The program would simply generate an 8-bit word, which it would output to one of the available output ports. This word would be used by external hardware in the form of a digital to analog converter and a voltage controlled oscillator, to produce a sine wave of the appropriate frequency. The pro and con are simple software and complex hardware.
2. The program would generate sine waves using only a digital to analog converter at the output port. This would not be a true sine wave, but would consist of discrete steps of voltage changes at the output of the D/A. Each step would require the outputting of a different digital word under software control. Using this approach, the software is relatively complex, and an external D/A is still required.
3. The program would generate audio frequency square waves at the lsb of any output port by simply outputting 01 and 00 alternately. The advantages are simple software, with little or no external hardware required. The disadvantage is that a square wave is generated instead of a sine wave. If sine waves are required, however, low pass filter hardware could easily filter the high frequency component of the output, yielding a sine wave.

The latter was chosen because most SSTV monitors will accept square waves quite successfully. The subroutine, which generates the square wave output, begins at program address 06 78(16) and works as follows.

Prior to calling the subroutine, two numbers are entered into registers H and L. The number which is loaded into register H is a timing constant. It will determine the length of each half cycle and, therefore, the frequency of the generated square wave. The second number, which is entered into register L, is the number of pulses to be generated. The combination of frequency and number of oscillations defines burst duration and function (synchronization pulse or line information data). The square wave generator in the program first outputs 01(16) to output port one. It then loads the timing number, which we previously entered into register H, into the accumulator. The timing number is then sequentially decremented with a check for zero after each reduction by one. On zero, the program jumps to memory location 06 84(16), where a 00(16) is outputted to port one. The lsb of port one, therefore, drops from about (+) 5 volts to 0 volts. The same timing number from register H is then reloaded into the accumulator, and the decrementing procedure begins again. When the contents of the accumulator equal zero, one complete cycle has been generated. The number of cycles number in register L is then decremented by one, and a check is made to see if it is equal to zero. If it's not equal to zero, then another cycle is generated by jumping back to the top of the subroutine. If the number of cycles number is equal to zero, then a jump is made to the return from subroutine statement in memory location 06 99(16).

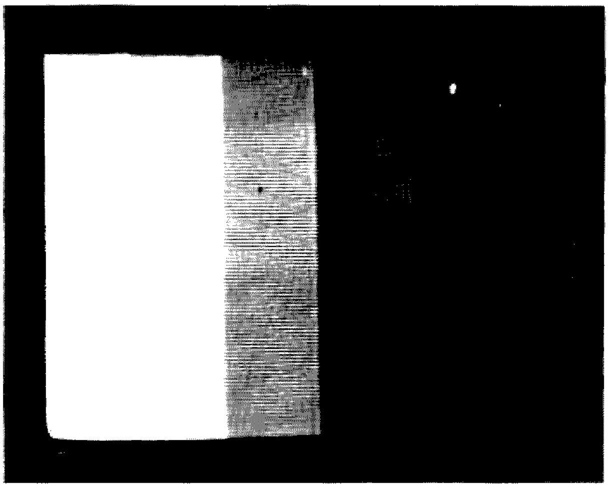
The Timing Constant

Using the square wave generator just described, the numbers which were loaded into register H to determine frequency turned out to be 2B(16) for the 1200 Hz synchronization pulses and 22(16) to 16(16) for the 1500 to 2300 Hz grey shade information. Since 22(16) minus 16(16) equals thirteen, there are 13 different shades of grey which can be generated using this system. One of the patterns generated by this program is a thirteen-bar grey scale.

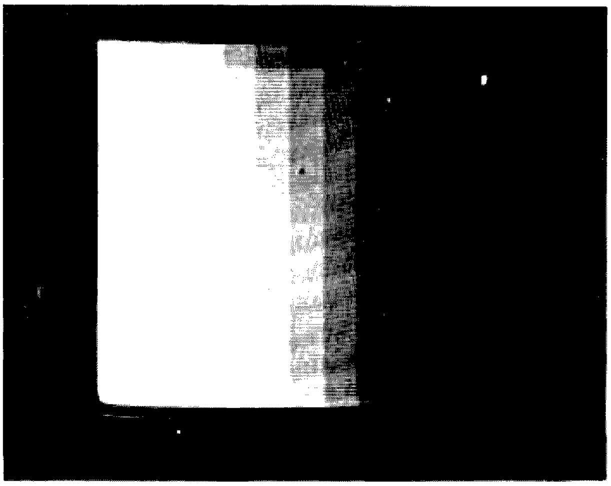
Program Execution

Generally, the generation of the slow scan signal takes place in the following sequence:

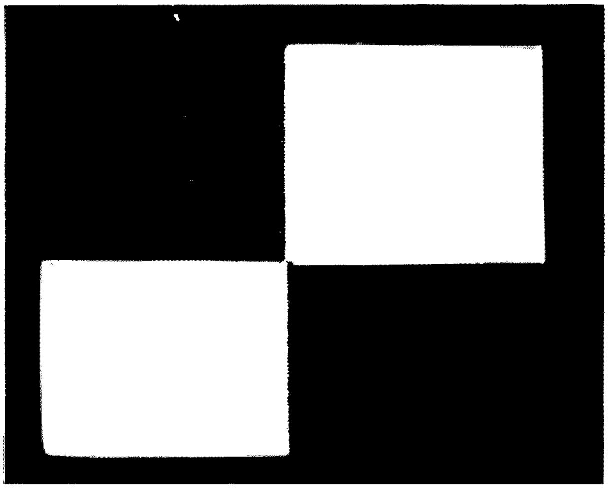
1. First a vertical synchronization pulse is generated by loading 2B(16) into H and 26(16) into L and then calling the square wave oscillator subroutine.
2. Next, the line data subroutine at 06 C6(16) is called. This routine first determines which line data sequence is to be used, then vectors to one of 9 routines. Each routine systematically loads H and L and calls the square wave generator subroutine as many as 13 times to generate the information for a single line.
3. A horizontal synchronization pulse is generated by loading 2B(16) into H and 06(16) into L and calling the square wave oscillator subroutine.
4. The line data subroutine at 06 C6(16) is again called to output line data for line number 2.
5. The sequence of horizontal synchronization pulse



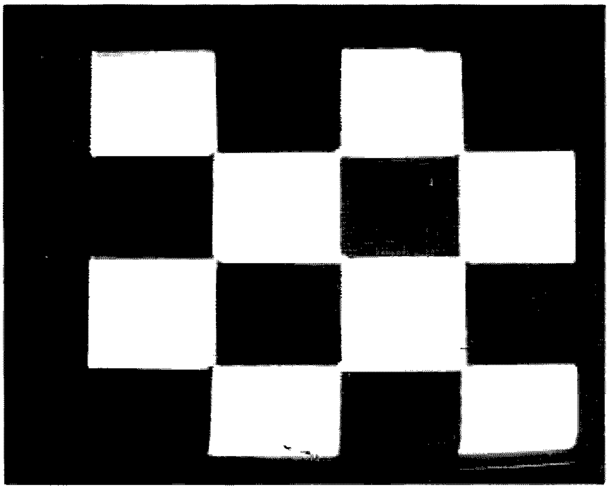
A 5-bar grey scale.



A 13-bar grey scale.



A 2 x 2 alternating checkerboard.



A 4 x 4 checkerboard.

followed by line data is repeated until 128 lines have been generated.

6. The vertical synchronization pulse is repeated after restoring register E to 128 or 80(16), and the next frame begins.

Specifically, I have used the operating system supplied with the computer to implement the program. The operating system consists of cassette read, write and dump and program routines, in both hexadecimal and octal number systems. This is a good place to relate a feature of the Digital Group Operating System which is particularly valuable in debugging machine language programs. By simply inserting an F7(16) into any memory address in the program, you can stop the program and examine the status of all registers in the CPU, and any memory location can be examined or altered. When the system encounters the F7, it stops and displays register status, including all flag status, and it waits for further instructions. I used that feature repeatedly in developing this program, and it's a tremendous debugging tool.

An addition was easily made to the options list, which provided a seventh option of SSTV, as you can see in the photograph. Entering seven results in the message "HOW MANY BARS" being written on the screen. The routine which does this uses a couple of subroutines located in the operating system. As you go through the program listing, any address less than 06 00(16) is in the operating system. If you adapt this program to another system, these subroutines will obviously have to be supplied or the call and function deleted. The remarks in the listing provide function information. The slow scan test pattern generator portions of the program, however, do not utilize the operating system, and, by getting the correct number in address 06 C5 (16), you can select one of nine line data routines. The selections available are:

B1. 4 x 4 checkerboard pattern.
B2. A split screen, with black on the left side, white on the right side.
B3. A 3-bar grey scale.
B4. A 4-bar grey scale.
B5. A 5-bar grey scale.
B6. A 6-bar grey scale.
B7. A 7-bar grey scale.
B8. A 2 x 2 checkerboard, which alternates black and white areas with each frame.
B9. A 13-bar grey scale.

All instructions used in the program are common to both Z-80 and 8080 chips. Instruction execution time may be a minor problem, if the program is implemented on an 8080 system. The number of grey tones which can be generated may be reduced. I have it running on a Z-80 system with a clock frequency of 2.5 MHz.

Results

The output from the lsb port one was connected to

the tape input of a Robot 300 slow to fast scan converter. The patterns were then displayed on a 9-inch black and white fast scan receiver. The scan converter accepted the square waves nicely, and, therefore, no filtering was implemented. The system is capable of resolving the 13 grey tones, when displaying the 13-bar pattern, and the corners of the checkerboard patterns line up quite well. The vertical lines are reasonably straight, and, overall, the generator appears to be doing the job it was intended to do.

Conclusion

Presented is a machine language program which is easily adapted to any Z-80 based microcomputer system. The program generates 9 different slow scan test patterns as square wave oscillations appearing at the lsb of one of the microcomputer's output ports.

Generating these patterns using only hardware would be a monumental task, while producing new patterns with a microcomputer is simply a matter of altering a few software instructions. ■

Reference

1. *Slow Scan Television Handbook*, Don C. Miller W9NTP and Ralph Taggart WB8DQT, 73 Inc., 1972.

Program listing.

```
06 C0  C3
06 01  57
06 02  06
06 57  CD     Call subroutine
06 58  9A
06 59  06
06 5A  06     Load B with 0
06 5B  00
06 5C  1E     Load E with 128(10)
06 5D  80
06 5E  26     Load H with time constant for 1200 hz
06 5F  2B
06 60  2E     Load L with 38(10) = number of cycles for
06 61  26     vertical sync pulse
06 62  CD     Call square wave generator subroutine to
06 63  78     generate vertical sync pulse
06 64  06
06 65  CD     Call subroutine to generate line data
06 66  C6
06 67  06
06 68  26     Load H with 1200 hz freq. constant
06 69  2B
06 6A  2E     Load L with 06 to get 6 cycles of
06 6B  06     1200 hz for horizontal sync pulse
06 6C  CD     Generate horizontal sync. pulse
06 6D  78
06 6E  06
06 6F  7B     Load contents of E into Accumulator
06 70  3D     Decrement accumulator
06 71  CA     Jump on zero to reset number of lines
06 72  5C     per frame and restart new frame
06 73  06
06 74  5F     Load accumulator into E
06 75  C3     Jump to line information subroutine
06 76  65
06 77  06
06 78  3E     Square wave generator subroutine
06 79  01     Load A with one
06 7A  D3     Output to port one
06 7B  01
06 7C  7C     Load A with H
06 7D  3D     Decrement A
06 7E  CA     Jump on zero to generate second
06 7F  84     half of each cycle
06 80  06
06 81  C3     Jump back to decrement again
06 82  7D
06 83  06
06 84  3E     Load A with zero
06 85  00
06 86  D3     Output A to port 1
06 87  01
06 88  7C     Load A with H
06 89  3D     Decrement A
06 8A  CA     Jump on zero
06 8B  90     to 06 90
06 8C  06
06 8D  C3     Jump unconditionally to decrement A
06 8E  89
06 8F  06
06 90  7D     Load A with L
06 91  3D     Decrement A
06 92  CA     Jump on zero to return from call
06 93  99
06 94  06
06 95  6F     Load A with L
06 96  C3     Jump to beginning of subroutine to
06 97  78     add another cycle
06 98  06
06 99  C9     Return from call
06 9A  06     Load B with 06
06 9B  06
06 9C  0E     Load C with B7
06 9D  B7
06 9E  0A     Load A with contents of memory location BC
06 9F  00     Call Print Character subroutine which is
06 A0  CD     part of the operating system
06 A1  FA
06 A2  00
06 A3  0C     Increment C
06 A4  79     Load A with C
06 A5  FE     Compare
06 A6  C5
06 A7  CA     Jump on zero to   stop   printing
06 A8  AD     message
06 A9  06
06 AA  C3     Jump to continue printing message
06 AB  9E
06 AC  06
```

06	AD	CD	Call keyboard monitor routine in
06	AE	A8	operating system
06	AF	01	
06	B0	32	Load input into address 06 C5
06	B1	C5	
06	B2	06	
06	B3	CD	Call print character subroutine in
06	B4	FA	operating system
06	B5	00	
06	B6	C9	Return from call
06	B7	C8	H
06	B8	CF	O
06	B9	D7	W
06	BA	01	Print one blank
06	BB	CD	M
06	BC	C1	A
06	BD	CE	N
06	BE	D9	Y
06	BF	01	Print one blank
06	C0	C2	B
06	C1	C1	A
06	C2	D2	R
06	C3	D3	S
06	C4	01	Print one blank
06	C5		Data; Contains inputted selection
06	C6	3A	
06	C7	C5	Load A with number of bars (contents of
06	C8	06	06 C5)
06	C9	FE	Compare with 02
06	CA	B2	
06	CB	CA	Jump on zero to two bar subroutine
06	CC	F9	
06	CD	06	
06	CE	FE	Compare with 03
06	CF	B3	
06	D0	CA	Jump on zero to three bar subroutine
06	D1	08	
06	D2	07	
06	D3	FE	Compare with 04
06	D4	B4	
06	D5	CA	Jump on zero to 4 bar subroutine
06	D6	1F	
06	D7	07	
06	D8	FE	Compare with five
06	D9	B5	
06	DA	CA	Jump on zero to five bar subroutine
06	DB	3C	
06	DC	07	
06	DD	FE	Compare with 06
06	DE	B6	
06	DF	CA	Jump on zero to six bar subroutine
06	E0	60	
06	E1	07	
06	E2	FE	Compare with 07
06	E3	B7	
06	E4	CA	Jump on zero to 7 bar subroutine

06	E5	8B	
06	E6	07	
06	E7	FE	Compare with 09
06	E8	B9	
06	E9	CA	Jump on zero to 13 bar subroutine
06	EA	BD	
06	EB	07	
06	EC	FE	Compare with 01
06	ED	B1	
06	EE	CA	Jump on zero to 4x4 checkerboard
06	EF	19	
06	F0	08	
06	F1	FE	Compare with 08
06	F2	B8	
06	F3	CA	Jump on zero to alternating 2x2 checkerboard
06	F4	63	
06	F5	08	
06	F6	C3	Jump to beginning to regenerate request
06	F7	57	for input
06	F8	06	
06	F9	26	Beginning of two bar line routine
06	FA	22	
06	FB	2E	
06	FC	2D	
06	FD	CD	
06	FE	78	
06	FF	06	
07	00	26	
07	01	16	
07	02	2B	
07	03	45	
07	04	CD	
07	05	78	
07	06	06	
07	07	C9	Return from 2 bar subroutine
07	08	26	Begin 3 bar line routine
07	09	22	
07	0A	2E	
07	0B	1E	
07	0C	CD	
07	0D	78	
07	0E	06	
07	0F	26	
07	10	1C	
07	11	00	NOP
07	12	2E	
07	13	26	
07	14	CD	
07	15	78	
07	16	06	
07	17	26	
07	18	16	
07	19	2B	
07	1A	2E	
07	1B	CD	
07	1C	78	

```
07 1D  06
07 1E  C9    Return from 3 bar subroutine
07 1F  26    Begin 4 bar line routine
07 20  22
07 21  2E
07 22  17
07 23  CD
07 24  78
07 25  06
07 26  26
07 27  1E
07 28  2E
07 29  1A
07 2A  CD
07 2B  78
07 2C  06
07 2D  26
07 2E  1A
07 2F  2E
07 30  1F
07 31  CD
07 32  78
07 33  06
07 34  26
07 35  16
07 36  2E
07 37  23
07 38  CD
07 39  78
07 3A  06
07 3B  C9    Return
07 3C  26    Begin 5 bar subroutine
07 3D  22
07 3E  2E
07 3F  12
07 40  CD
07 41  78
07 42  06
07 43  26
07 44  1F
07 45  2E
07 46  14
07 47  CD
07 48  78
07 49  06
07 4A  26
07 4B  1C
07 4C  2E
07 4D  17
07 4E  CD
07 4F  78
07 50  06
07 51  26
07 52  19
07 53  2E
07 54  19
07 55  CD
07 56  78
07 57  06
07 58  26
07 59  16
07 5A  2E
07 5B  1C
07 5C  CD
07 5D  78
07 5E  06
07 5F  C9    Return from 5 bar subroutine
07 60  26    Begin 6 bar line subroutine
07 61  22
07 62  2E
07 63  16
07 64  CD
07 65  78
07 66  06
07 67  26
07 68  1F
07 69  2E
07 6A  11
07 6B  CD
07 6C  78
07 6D  06
07 6E  26
07 6F  1D
07 70  2E
07 71  12
07 72  CD
07 73  78
07 74  06
07 75  26
07 76  1B
07 77  2E
07 78  14
07 79  CD
07 7A  78
07 7B  06
07 7C  26
07 7D  19
07 7E  2E
07 7F  15
07 80  CD
07 81  78
07 82  06
07 83  26
07 84  16
07 85  2E
07 86  17
07 87  CD
07 88  78
07 89  06
07 8A  C9    Return fro m 6 bar line subroutine
07 8B  26    Begin 7 bar line subroutine
07 8C  22
```

07 8D	2E	07 A9	2E		07 C5	21	07 E1	1D
07 8E	0F	07 AA	11		07 C6	2E	07 E2	2E
07 8F	CD	07 AB	CD		07 C7	07	07 E3	08
07 90	78	07 AC	78		07 C8	CD	07 E4	CD
07 91	06	07 AD	06		07 C9	78	07 E5	78
07 92	26	07 AE	26		07 CA	06	07 E6	06
07 93	20	07 AF	18		07 CB	26	07 E7	26
07 94	2E	07 B0	2E		07 CC	20	07 E8	1C
07 95	0C	07 B1	13		07 CD	2E	07 E9	2E
07 96	CD	07 B2	CD		07 CE	08	07 EA	09
07 97	78	07 B3	78		07 CF	CD	07 EB	CD
07 98	06	07 B4	06		07 D0	78	07 EC	78
07 99	26	07 B5	26		07 D1	06	07 ED	06
07 9A	1E	07 B6	16		07 D2	26	07 EE	26
07 9B	2E	07 B7	2E		07 D3	1F	07 EF	1B
07 9C	0F	07 B8	14		07 D4	2E	07 F0	2E
07 9D	CD	07 B9	CD		07 D5	08	07 F1	09
07 9E	78	07 BA	78		07 D6	CD	07 F2	CD
07 9F	06	07 BB	06		07 D7	78	07 F3	78
07 A0	26	07 BC	C9	Return from 7 bar line subroutine	07 D8	06	07 F4	06
07 A1	1C	07 BD	26	Begin 13 bar line subroutine	07 D9	26	07 F5	26
07 A2	2E	07 BE	22		07 DA	1E	07 F6	1A
07 A3	10	07 BF	2E		07 DB	2E	07 F7	2E
07 A4	CD	07 C0	07		07 DC	08	07 F8	09
07 A5	78	07 C1	CD		07 DD	CD	07 F9	CD
07 A6	06	07 C2	78		07 DE	78	07 FA	78
07 A7	26	07 C3	06		07 DF	06	07 FB	06
07 A8	1A	07 C4	26		07 E0	26	07 FC	26

```
07 FD  19
07 FE  2E
07 FF  0A
08 00  CD
08 01  78
08 02  06
08 03  26
08 04  18
08 05  2E
08 06  0A
08 07  CD
08 08  78
08 09  06
08 0A  26
08 0B  17
08 0C  2E
08 0D  0A
08 0E  CD
08 0F  78
08 10  06
08 11  26
08 12  16
08 13  2E
08 14  0B
08 15  CD
08 16  78
08 17  06
08 18  C9    Return from 13 bar line subroutine
08 19  04    Increment B
08 1A  3E    Load 32(10) into A
08 1B  20
08 1C  90    Subtract B from A
08 1D  FA    Jump on sign negative
08 1E  3D
08 1F  08
08 20  26
08 21  22
08 22  2E
08 23  17
08 24  CD
08 25  78
08 26  06
08 27  26
08 28  16
08 29  2E
08 2A  23
08 2B  CD
08 2C  78
08 2D  06
08 2E  26
08 2F  22
08 30  2E
08 31  17
08 32  CD
08 33  78
08 34  06
08 35  26
08 36  16
08 37  2E
08 38  23
08 39  CD
08 3A  78
08 3B  06
08 3C  C9
08 3D  26
08 3E  16
08 3F  2E
08 40  22
08 41  CD
08 42  78
08 43  06
08 44  26
08 45  22
08 46  2E
08 47  17
08 48  CD
08 49  78
08 4A  06
08 4B  26
08 4C  16
08 4D  2E
08 4E  23
08 4F  CD
08 50  78
08 51  06
08 52  26
08 53  22
08 54  2E
08 55  17
08 56  CD
08 57  78
08 58  06
08 59  3E    Load 64(10) into A
08 5A  40
08 5B  B8    Compare with B
08 5C  CA    Jump on zero to 08 60 to set B to zero
08 5D  60
08 5E  08
08 5F  C9    Return
08 60  06    Load zero into B
08 61  00
08 62  C9    Return
08 63  04    Increment B; Begin 2x2 alternating board
08 64  3E    Load 64(10) into A
08 65  40
08 66  90    Subtract B from A
08 67  FA    Jump on sign negative to 08 79
08 68  79
08 69  08
08 6A  26
08 6B  16
08 6C  2E
```

```
08 6D  45
08 6E  CD
08 6F  78
08 70  06
08 71  26
08 72  22
08 73  2E
08 74  2E
08 75  CD
08 76  78
08 77  06
08 78  C9
08 79  26
08 7A  22
08 7B  2E
08 7C  2E
08 7D  CD
08 7E  78
08 7F  06
08 80  26
08 81  16
08 82  2E
08 83  45
08 84  CD
08 85  78
08 86  06
08 87  C9     Return from 2x2 alternating board
              subroutine
```

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Super Baud Bumper

-- for your SWTP 6800

I was frustrated by the time that was required to load and punch 110 baud programs on my SWTPC 6800 computer using an ASR 33 as an I/O. So I took a long look at the alternatives offered by SWTPC in the computer documentation. Southwest had apparently settled for a maximum speed of 300 baud, using Kansas City Standard audio cassettes. This would allow loading a basic length program in five minutes, instead of the fifteen minutes required at 110 baud. This would be a significant improvement, but, since you're faced with procurement of additional equipment anyway, why not shoot for something faster?

A careful review of the SWTPC 6800 system revealed that baud rates up to 1200 baud were presently being generated in the system and, in fact, were bused and clearly identified on the mother board and the CPU board. The next step was to settle on an I/O for the higher baud rate, because the ASR 33 couldn't hack it. SWTPC's TV typewriter, with the optional baud rate generator, appeared to be the least expensive route to obtaining an I/O with a 1200 baud capability. Then the only bottleneck in the system appeared to be the serial control interface board (MP-C) in the computer, which doesn't pick up the higher baud rates from the mother board. Alas, why did SWTPC pass up the opportunity to provide the user with full baud rate control (110 to 1200 baud) throughout the system? With the TV terminal, I now had 110, 150, 300, 600, and 1200 baud capability, with the exception of the bottleneck at the serial control interface board.

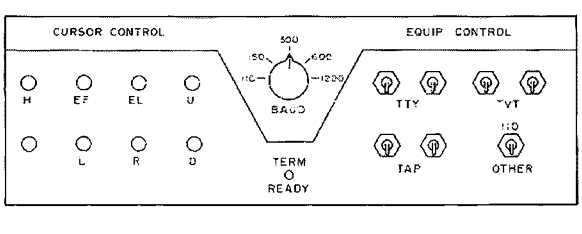

Fig. 1. Panel layout. H = home up cursor to start of page; EL = erase screen to end of line; EF = erase screen from cursor location on; U = move cursor up; D = move cursor down; L = move cursor left; and R = move cursor right.

Investigation of the system design and subsequent discussions with some of the helpful folks at SWTPC indicated that probably nothing would be lost in trying, except the effort. Hoping that all advice was sound and that I wouldn't smoke the system, I began the project. The following paragraphs outline the steps I took and the results I achieved. They are in sufficient detail to guide anyone through the conversion.

Step one was to develop a convenient switching system to permit:

1. Changing of the baud rates, at the computer serial control interface board and at the TV terminal, simultaneously.
2. Interconnecting the tape recorder, the Teletype™, the TV terminal, and the computer; and
3. Control of which pieces of equipment were on line at any given time for maximum flexibility in operations.

To accomplish the modifications at minimum disruption to the up and going system, I decided to provide switches on the control panel already in use at the TV terminal. The control panel already provided cursor control switching for the terminal. A neat little two-pole, five-position rotary switch was procured, which permits separate simultaneous switching of baud rates at the TV terminal and at the serial control interface board on the computer. Fig. 1 shows the panel layout for anyone who would like to cold copy what has proven to be very efficient. The seven momentary contact push-button switches on the left are for the cursor controls.

Space is provided for an additional switch or indicator at the lower left of the panel, if a need should develop later. The two-pole, five-position rotary baud rate selector switch is located in the upper center, with a terminal ready indicator LED located below it. On the right side, six single-pole, single-throw toggle switches provide selective control of the Teletype, the TV terminal, and the tape recorder. Each peripheral is controlled with two single-pole, single-throw switches. This arrangement provides split bus control and permits input and/or output selection of the peripheral units desired. A single-pole, double-throw is shown in the right-hand corner, which controls the baud rate selection at point C on the serial control interface board. Changing point C from low to high controls the number of stop bits at the computer. A subsequent improvement has deleted this control by replacing the two-pole, five-position baud rate selector switch with a three-pole, five-position switch. Wiring of the cursor control push-button switches is described in the TV typewriter documentation and won't be addressed here. Fig. 2(a) shows the wiring diagram for the two-pole, five-position baud rate selector switch and separate single-pole, double-throw switch. Fig. 2(b) shows the three-pole baud rate selector switch, which also automatically switches the baud rate selection at point C on the

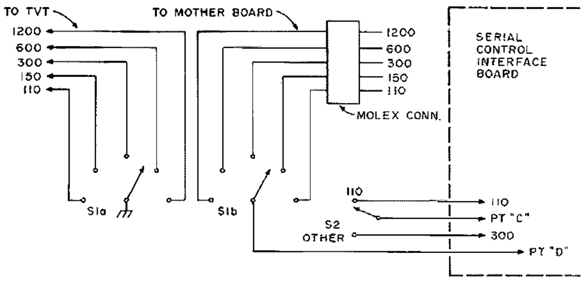

Fig. 2(a).

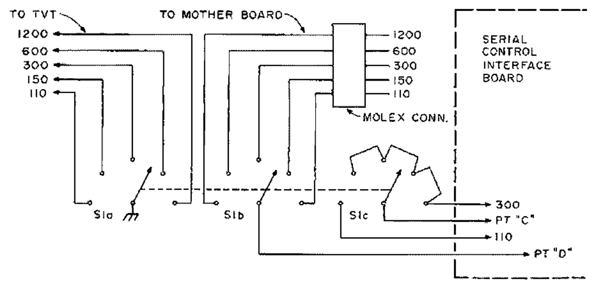

Fig. 2(b). Note that switch S2 is not used in this scheme.

serial control interface board.

The peripheral unit selection switches are straightforward on-off control of the input and output of the RS232 data to and from the units. A wiring diagram for the switching is shown in Fig. 3. Additional peripheral devices can be controlled by additional pairs of switches on the control panel.

The actual connections that were made to the computer and the terminal will be described for those who may be hesitant to experiment. A step by step test out will also be described. The only drawback is the additional wiring that runs from the computer and the terminal to the switches. A neat installation can be had with average care.

Step 1. Locate a convenient place for the control panel. A word of caution: Limit the length of the wires from the baud rate selector switch to the computer to an absolute minimum. You are dealing with digital devices, and long leads leaving printed circuit boards invite problems. I experienced none, but the possibility always exists.

Step 2. Lay out the switching control that best suits your needs. The panel layout in Fig. 1 can be used, if it suits you, or you can come up with your own. There is nothing critical in the layout, only convenience. Mount the switches in the control panel.

Step 3. Solder one set of leads on the baud rate selector switch, S1a. It's suggested that you color code the leads for troubleshooting convenience. Five leads go from switch S1a directly to JS-1 on the serial interface or UART board of the TV typewriter. Connections are shown in Table 1. A sixth lead from the wiper of the switch goes to ground, because grounding activates the baud rate selected by the switch. See Fig. 2(a) or 2(b), depending on which switching arrangement you used.

Step 4. Solder the second set of leads on the second pole of the baud rate selector switch, S1b, using the same color code as used in Step 3. Solder a female molex connector, that matches the pins on the mother board, to the computer end of these leads. This connector can be plugged onto any vacant set of pins from the baud rate buses on the mother board. The molex connector is available from Southwest Technical Products Company, if you can't find it locally. The sixth lead from the wiper of the second pole of the baud rate selector switch, S1b, goes to point "D" on the serial control interface board of the SWTPC 6800. There are no connections to "110" and "300" adjacent to point "D" on the serial control interface board. Be sure to remove any jumpers you may have installed at these points. These two sets of leads should be bundled or six-conductor cable should be used, to provide a neat installation. See Fig. 2(a) or 2(b).

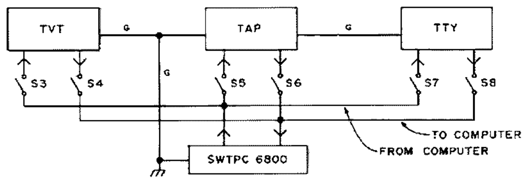

Fig. 3.

Step 5. From switch S2 in Fig. 2(a), connect three wires to the switch. These wires all go from switch S2 on the control panel to the serial control interface board of the computer, so consider bundling them with wires in step 4 for neatness. The center pin of the switch is connected to point "C". The 100 baud speed side of the switch goes to "110" adjacent to point "C", and the "other" side of the switch provides all other baud rates and is connected to "300" adjacent to point "C" of the serial control interface board.

Step 6. Connect the computer side of switches S3, S5 and S7 together. This forms the "output from computer" bus. Connect the computer side of switches S4, S6 and S8 together. This forms the "input to computer" bus. You have now established common input and output buses for the computer. Connect switch S3 to the input side and switch S4 to the output side of the TV terminal (TVT). Connect switches S5 to the input side and S6 to the output side of the tape recorder (TAP). Connect switches S7 to the input side and S8 to the output side of the Teletype (TTY). The grounds for all peripheral devices and the computer are connected together, as shown by line G in Fig. 3.

Step 7. If you want the terminal ready LED, connect the anode of the LED to the terminal ready connection, which is pin 2 of JS-1 on the TV terminal. The cathode of the LED should be grounded through a 250Ω, ¼ Watt resistor. The terminal ready line is limited to sensing and to a 5 mA current, so don't forget the resistor.

Now, if you have carefully checked your connections, you are ready to check out your conversion job. At this point, you probably have abandoned the step by step procedure and have changed things around to suit yourself and that's fine. I did, too, remember! But, for the more timid, I will go ahead with a checkout procedure. These tests assume that you have the optional baud rate generator in your TV terminal and that you have a digital tape recorder (or. have borrowed one). The tests don't have to be performed in any particular order. Depending on the peripherals you have connected, the checkout must be arranged to suit your conditions.

In all cases, the input to computer side of the RS232 connections from the peripherals should show a negative voltage when the peripheral is switched on. Check each one individually at the input to computer bus to assure proper connection. If you don't get a negative volt-

Baud rate	JS-1
110	pin no. 9
150	pin no. 10
300	pin no. 11
600	pin no. 12
1200	pin no. 3

Table 1.

age, try reversing the leads from the peripheral you are testing.

Test 1. Open switches S3, S4, S5 and S6. Close switches S7 and S8. Set baud selector switch to 110 baud. Set switch S2 to "110". This arrangement connects only the Teletype to the computer. Test your Mikbug™ memory address functions — they should work normally. If they don't, you have probably reversed the leads from the Teletype to S7 and S8, so try reversing them. If you are satisfied at this point, load a machine language program such as tic-tac-toe or blackjack into the computer via the paper tape reader on the Teletype. Open switches S5, S6, S7 and S8. Close switches S3 and S4. Set switch S2 to "OTHER." Set baud selector to 1200 baud. Type in "S9" and "G" on the TV terminal, and the program should be initiated at 1200 baud. Check the remaining baud rates, 600 to 150, on the TV terminal. Change S2 to "110", and check the 110 baud rate out. If this step has checked out, go to test 2. About the only problem you would encounter is reversal of leads from switches S5 and S6 to the tape recorder.

Test 2. Open switches S5, S7 and S8. Close switches S3, S4 and S6. Set baud rate selector switch to 1200 baud. Set switch S2 to "OTHER." This arrangement connects the "from computer" side of the tape recorder and the TV terminal to the computer, and it sets up for a print-punch operation, which will transfer the program resident in the computer to the tape recorder. After you have the program dumped to tape, turn the computer off to clear the program from memory. Power the computer back up. Using the TV terminal at 1200 baud, type "L" to initiate the program load function. Open switches S3, S4, S5, S7 and S8. Close switch S6. Load the program from tape into the computer. Open switches S5, S6, S7 and S8. Close switches S3 and S4. Initiate the program at 1200 baud by typing "S9" and "G". Go through the above listed procedures for baud rates of 150 through 600. Then set S1 and S2 to "110", and check out the 110 baud rate for dumping and loading of programs.

Test 3. If steps 1 and 2 were successful, let's proceed. So far we have checked out the Teletype, the TV terminal, and the tape recorder, individually. Now it's time to try split bus operation. Set the baud rate selector switch and switch S2 to 110 baud.

Open switches S4, S5 and S6. Close switches S3, S7 and S8. We now should be able to input data from the Teletype keyboard and output data on the Teletype and TV terminal, simultaneously. Try it and see. This will only work at 110 baud, because that's the limiting speed of the Teletype. Experiment with the other functions.

There are obviously other tests you could run, but, if tests 1 through 3 were okay, you should now have a system that has reduced load and print-punch time by a factor of 12, if you were using 110 baud, and by a factor of 4, if you were using 300 baud. Quite an improvement, wouldn't you say? We set out to provide faster loading of the SWTPC 6800, and we succeeded!

Once again, if you are reasonably careful you probably will have no problems. Too long leads from the baud rate switch to the computer could cause problems, but check for wiring errors, switch setup errors, and/or reversed wiring before you blame lead length. I hope this gives others as much fun as it's given us. I would like to see what control panel and switching arrangements you come up with, so how about dropping me a line and sending me a picture? ■

QRZ -- P-K4!

-- relax with ham chess

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Avid chess players will recognize P-K4 as the opening Bobby Fischer uses in the majority of his chess games. What's your favorite, and have you tried it on ham radio? There is plenty of radio chess going on in the ham bands. If you like chess, why not join in? You don't have to be an expert, you just have to like the game. Combining two interests makes them even more enjoyable.

OK, you say, I like chess. Where can I find a game on the radio? First of all, here are some frequencies where chess players can be found: Midcars, 7258 kHz; Eastcars, 7255 kHz; and Westcars, 7255 kHz are service groups which operate most of the daylight hours. Check in and ask if any chess players are on the frequency. When you make contact arrange to QSY and start your game. If you don't make contact ask the service control to list your request or just monitor for a while until someone else checks in and asks for a chess game.

Another frequency to monitor, starting about noon, is 7235 kHz. There is a pretty regular group on every day, and they will welcome some fresh talent. Evenings, after 7 pm, try around 3990 kHz and 3928 kHz for two other informal, friendly gatherings.

Now for some tips on beating the dipoles for opponents on your own. Firstly, bring up the subject during your usual QSOs. It's surprising how many hams you will find who know how to play and might be interested in a game. If they don't have time immediately, try to arrange a schedule. Check in any traffic net, and make a request for chess players. Always move off frequency quickly. Decide beforehand where you want to move so you will not hold up the net. Contact any local amateur radio club. Leave your phone number with the officers, and ask them to inquire of their membership whether anyone would like to set up a schedule. Put out a call on 2 meter FM repeaters. Again, always arrange to QSY quickly when you make contact with a player. Ask your opponents if they know of anyone else interested in playing radio chess. Keep at it, and soon you'll have a good list to choose from.

Now for some hints about actual play. It may be a little hard to maintain concentration because of noise or QRM. Remember, this is for fun, so enjoy it and don't fret about losing a game or two. You'll find a great variety of skill in the various challengers, so if you are up against an excellent player, don't prolong a game when you are down one or more pieces. Resign and start over rather than try to make him mate you. He's more apt to be willing to play you again.

Always score the game, that is, write down the moves. This helps if you have a mix-up and want to straighten out the board. Say

Rus W9CQD playing radio chess.

your moves twice and always acknowledge the other fellow's moves. In radio chess you have the opportunity to move the pieces around to see how a particular position looks, and it is easy to forget to move a piece back to the right square. Try to avoid this if you can. You certainly would not be allowed to do it if you were playing across the board. It becomes a bad habit as well as leading to messing up the board.

Don't be afraid to play because you don't know chess notation. It can be learned in a few minutes. Ask an experienced player to explain it or check any elementary chess book at your local library. Try not to talk to your opponent while he is contemplating his move. Sometimes it helps to keep the frequency clear if two or three games are going on at the same time. It may be a little hectic at the beginning, but after the moves start slowing down, you'll be able to maintain the frequency since someone will be making a move more frequently than if only two were playing, and it won't seem like the frequency is clear. Explain to polite hams who ask if the frequency is in use that you are playing chess and are quiet between moves.

Don't rule out CW for your games. They can be just as rewarding as phone. Also, look out for the ladies. They play, too, and some are excellent players.

When you get established, why not go for PAS – Played All States? DX hounds will find overseas players, though the bands may not hold up for the length of the game. You may want to adjourn a lengthy game and finish another day, another reason to write down the moves. No reason not to try SSTV or RTTY either.

And who knows? When you get a winning streak going, try for a phone patch to Bobby Fischer. ■

Digital Timer Goes Mobile

- - battery power keeps it trucking !

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Having built the frequency counter written up by Thomas Harper and published in the August '73 issue of *73 Magazine*, three alarm clocks from the 50250 chip outward and five of the 5314 kits, I was captivated by the flying numbers, and it was easy to convince myself that I needed a time period counter in my service truck.

So I built up out of 7400 series ICs a 3 digit timer to count the time I was on a service call. This worked quite well until the engine of the truck was started during the counting period. Then the readouts would maybe show correct time interval or maybe not. So back to the old think tank and, lo, the perfect interval counter was born.

An order was sent off to S.D. Sales for their current clock kit using a 50250 chip and a 60 Hz CMOS timebase, which was the one being advertised at the time. The two kits were assembled and mounted in a small 10¼ cm wide by 4 cm high by 11 cm long metal box hinged to a base at the lower rear corners. Two switches were installed in the bottom of the box. A push-button switch as used in a table lamp turned the 12 volts from the car battery on and off at a touch of the top of the metal box. At the same time a microswitch made up of two miniature micros fastened together and operated by a common push-button served to momentarily connect the hours-set and minute-set pins of the clock chip to the positive supply voltage which then would start the seconds counting. This interval timer has been in use for a couple months now and has not been caught giving a false reading.

When power is interrupted, a 50250 clock chip will return to either 12:00:00 or all zeros, depending on whether it is used as 12 hour time with a 60 Hz timebase or 24 hour time with a 50 Hz timebase. Some day I will get a CMOS 50 Hz timebase and go for the 24 hour format. At the present, starting at 12:00:00 is a bit awkward, especially around noon time.

Why didn't the original timer work? My best guess is that since the 7400 series ICs needed 5 volts, which were obtained through a 309 regulator IC which requires at least 10 volts for stable regulation, then probably the starter pulled the voltage down to or near this point and caused the confusion.

The clock chip and timebase use 12 volt supply direct and are quite tolerant of low voltage.

A cabinet to house a project such as this always presents as much problem as the circuitry, to me at least. What really took place there was that during the first lash-up and test period I found a box made of thin cardboard that just fit the circuit boards. The timebase was wrapped in crumpled newspaper and shoved down in this cardboard box. Then came the main circuit board with the clock chip on it, and the readout board was last with

Photo by Wally Blackburn K7SEG

the readout board plugging the whole box top and the switches dangling. This lash-up was tied to the steering post and put through the smoke test in this unfinished condition. When it looked like everything would work, a metal box was made to just cover the cardboard box; a hole drilled through this received the push-push power switch, which in turn held the works in the metal box. Another hole permitted the power wires to be led out and the two microswitches to be wired outside of the box.

The choice of switches is a determining factor in the placement of the microswitches and the lever arrangement. In this case the two microswitches were lightly hinged to the box by putting small screws in the plate of the switch pair and the push-buttons of the switches up against the box. The wires are stiff enough to provide the necessary force to close the switches. If the larger microswitches requiring more force to trip them were used, it would be necessary to provide a spring to supply this force, as a push-push switch needs an overrun on the stroke to trip it. The hours and minutes switch can be closed first, but has to give down enough for the push-push switch to turn the power on.

The current available 50250 clock chip seems to have turned into a 50252, possibly an updated version. There may be other clock chips which will work, but remember the requirement: The readouts must go to zero when the power switch is opened and closed again. Many of the clock chips will show some random number which, of course, is unsatisfactory.

A one finger push down toward the base will start this timer counting the seconds, and another push will turn the whole thing off again. ■

73 Magazine *Staff*

Straining the Wind

- - simple wind speed indicator

This article describes a simple wind speed indicator which can be built very inexpensively and is complete within itself. It can be constructed as just a fun project or can have a serious application in functioning as an alarm indicator to indicate that a certain wind speed is being exceeded and a beam should be lowered. For those who desire to build a more precise anemometer, refer to the article "Inherit the Wind," *73* for March, 1976. It describes a very good home brew wind speed indicator. Its advantages are accuracy and the detection of low wind speeds. It requires a bit of circuitry, a power supply and a frequency counter as an indicator. The wind speed article described in this article is far from that elaborate, however; it requires no power supply, is a self-contained unit, and can serve the basic purpose of "saving your beam."

The heart of any wind speed indicator is a device that will generate and/or transmit a voltage proportional to the speed at which the wind vanes are rotating. Quite by accident, it was discovered that the dc motors found in cassette tape players make excellent little dc voltage generators when their shaft is externally rotated. These motors are inexpensive but relatively well-made as a mass-produced item. Their bearings are good enough that they should last for several years of service and of low enough friction that a moderate size wind vane will start the shaft turning in anything more than a gentle breeze. They can be purchased from various surplus outlets for a few dollars, or almost any serviceman will have a few available from discarded cassette tape players. Don't confuse this type of motor, however, with the "cheapie" dc motors used in toys. The latter type of motor will work also as a dc voltage generator, but will last only a short while in continuous rotational service.

The motor-turned-generator can be secured to a mast with a large hose clamp, or a much neater mast mounting arrangement can be made using a bell-type reducing joint. The latter can be found in plumbing supply houses. They are meant to join pipes with fairly great thread diameter changes. Usually one can be found which will mate with a desired mast diameter, and the large end of the bell joint then forms a cup into which the dc generator can be snugly fitted and glued into place.

The construction of the wind vanes can be as simple or as elaborate as one desires. The overall dimensions shown in Fig. 1 yielded good results with winds ranging from a bit more than a light breeze to gale force winds. The principal requirement is that the vanes turn in one direction only or else the generator will not always produce a voltage of the same polarity. To ensure this, some sort of cup or cone assembly is needed at the end of each vane. The assembly shown in Fig. 1 is about as simple as one can get. The center piece of the vane assembly is a plastic cover from a large glass jar. It serves two purposes. One is to act as a central mounting piece for the vanes, and it also serves, because of its shape, as a weather cover for the upper part of the generator. The generator used had a pulley permanently attached to the shaft, and apparently most all cassette motors come this way. The end of the pulley was filed flat and then the jar cover fastened to it with epoxy cement. The individual vanes are simply plastic sauce strainers found in a household goods store. The strainer holes are sealed up by painting them, and the handle end is secured to the jar cover by some screws. The whole assembly does look a bit funny, to say the least, but it works. It can be made a bit more professional-looking by a good overall aluminum spray painting. Also, once it is up in the air, the simple components of its construction are no longer as obvious.

The generator voltage is transferred by regular line cord to a remote indicator. The remote indicator can be a simple meter or something more elaborate, like a digital readout. The generator will turn fast enough to easily activate a microampere meter even over long transfer line lengths. In very high winds, enough voltage will be generated to activate an LED. Fig. 2 shows a remote indicator circuit using a 150 uA meter. An adjustment potentiometer allows the meter to be set for full scale with a strong wind blowing. The optoisolator circuit (an LED and a switching transistor in an IC package) can be used to switch on a buzzer or bell when a particularly high wind gust is sensed. The main value of this feature is that one can be alerted, usually during the night, of the presence of a high wind condition. The meter can be approximately calibrated in wind speed values by comparing its reading to locally broadcast weather reports under various wind conditions. ■

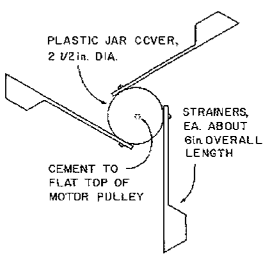

Fig. 1. Advanced design wind vane assembly.

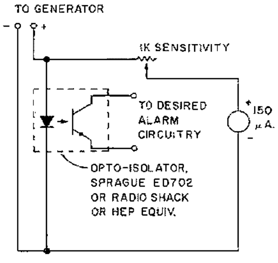

Fig. 2. Remote indicator. Alarm circuitry might be a 6 volt battery in series with a Mallory Sonalert, for example.

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Find That Meter Resistance

-- with this simple bridge

There comes a time in every ham's life when he must seek that unknown meter resistance. Here's a simple solution to that age-old problem. The schematic is shown in Fig. 1. It's equivalent circuit is shown in Figs. 2(a) and 2(b).

In Fig. 2(b), R2 is equal to R2, and R_{BP} is the equivalent parallel resistance of branch 1 and branch 2. Neglecting R_{BP}, the current through R2 would be 1.5 (E)/ 1500 (R) = .001 A or 1 mA, the full-scale reading of most meters. Thus, when we reinsert R_{BP}, we know that the current is less than 1 mA. This keeps the current through each branch (Fig. 1) less than 1 mA, protecting both meters.

In Figs. 1 and 2(a), when the resistance of branch one is equal to the resistance of branch two, the currents through both are equal. Thus, you know that when the reading on the meter under test and the current reading on your meter are equal, the resistances of the two branches are equal.

The resistance of branch one is equal to the resistance of M1 (which *must* be known) plus R1, a potentiometer with a calibrated dial. If we select Rx so that it is equal to R_{M1}, then, when R1 is equal to $R_{M\text{-test}}$, the resistances of the branches are equal. If the resistances of each branch are equal, the currents through them are equal.

To find the meter resistance, one must plug in the meter under test and rotate R1 until the currents through both meters are equal. Then we know that R1 = $R_{M\text{-test}}$ and its resistance can be read directly off the calibrated dial.

The smaller the value of potentiometer R1, the more accurate is the measurement of $R_{M\text{-test}}$. This is because the dial can be calibrated in smaller units.

As an option, a more accurate circuit is shown in Fig. 3. A rotary switch can select different values of resistance to be added to R1. Thus, R1 can be made as small as you wish. $R_{M\text{-test}}$ is now equal to R1 plus the switched-in resistance.

Let's say you wanted to measure a meter's resistance using only R1 (Fig. 1). If your dial was calibrated with 100 notches, the result would be 5 Ohms per notch. If we use the circuit in Fig. 3, the potentiometer is only 200 Ohms, leaving 2 Ohms per notch on the same calibrated dial. Thus, we see how there is more accuracy in a circuit such as the one shown in Fig. 3.

I would suggest that you choose a meter with a low resistance. Also, if you prefer, you can use an ohmmeter to read the resistance of R1, thus saving yourself the trouble of finding a calibrated dial.

As you can see, the circuit is a flexible one and can be customized by the builder. All that is needed is a pen, paper and E = IR. ■

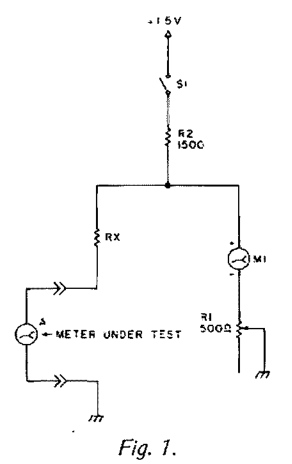

Fig. 1.

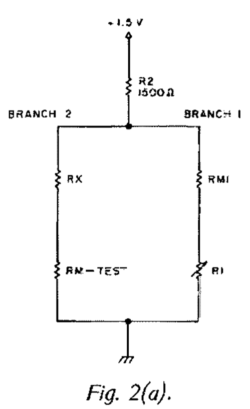

Fig. 2(a).

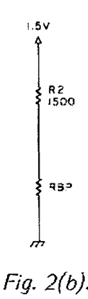

Fig. 2(b).

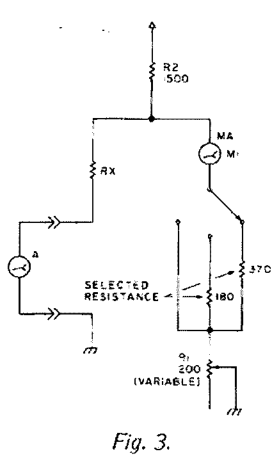

Fig. 3.

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Canada

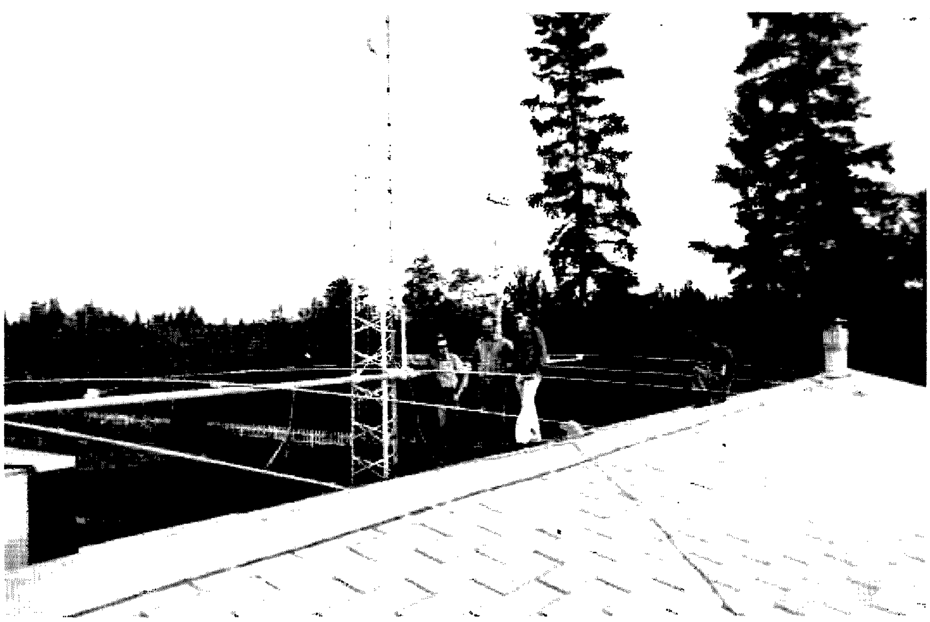
VE6 DXer Tells All!

-- what to do all winter

During the fall of 1971, I took the opportunity to transfer from VE6 land to VE8 land to work in what was at that time the largest national park in the world, a total of 17,300 square miles of wilderness.

Wood Buffalo National Park straddles the boundary between the Province of Alberta and the Northwest Territories. The park holds the distinction of having the largest herd of free-roaming bison in the world and the nesting site of the endangered whooping crane.

We arrived in the small community of Fort Smith, N.W.T., with an approximate population of 2,500, on January 12, 1972; it was -40° C. After traveling for 1400 miles on winter roads with a house cat and a back seat full of house plants which were still alive, it was a godsend to be at our new home. It was a land not very well known by the average North American, let alone the average radio ham.



From left to right: VE8NS, VE8LG and VE8RZ.

The area is located in the northwest extremity of the Great Northern Plains, well within the Boreal Forest Region. It is a land of sharp contrasts, 24-hour daylight, a semiarid region with 10-12 inches of precipitation per year, and hordes of mosquitoes and black flies that could drive a human being crazy in hours. It's a land of northern lights, -50° C., dog teams, hunting and trapping still a way of life, short winter days, and ice crystals to brighten the way.

At the time of my arrival, Terry Keime VE8OK was an avid DXer. I enjoyed the bands from this QTH. VE8s were in demand, which made DXing interesting. With the eventual arrival of VE8OO and VE8RO on the same block, would you believe we had QRM alley in VE8 land? There it was in full bloom. I checked out the ham population, and, according to the list, there were 82 licensed operators, with approximately 20 active hams. And three of them were on the same block.

Time was the pacifier until the opportunity presented itself – a move to the other side of town. Now was my chance to get away from rf burns on everything I touched.

Once we were settled in, with beds on the floor and boxes piled everywhere, my thoughts turned towards an antenna structure. The days were becoming shorter and colder rapidly. The concrete base was poured by candlelight, and prayers were said for a warm weekend, just one good weekend to put up the structure. God was willing, and the antenna was on top with hours to spare. The following week proved how unpredictable the weather can be – snow and wind with minus 10° C. (It's a smug feeling to have all the outside work done.) The antenna performed as expected,

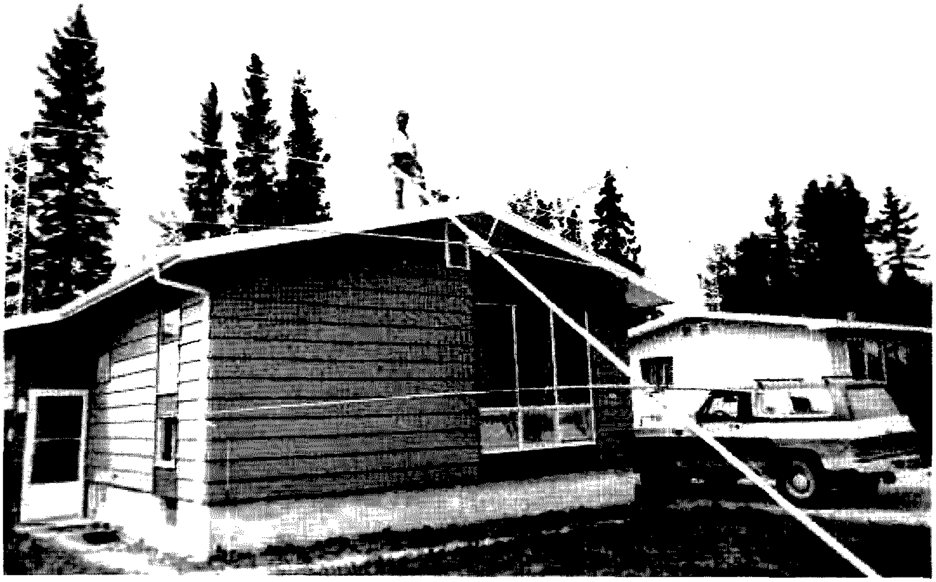
loaded well, and all that was left was to pile up the DX.

But my rule of the roost was soon to be shattered with the arrival of an old friend, Gerry VE8LG, a graduate from an electronics school and now a radio inspector with the Department of Communications in Fort Smith, N.W.T. The die was cast. Gerry was moving in next door! How is this possible with 2 million square miles of VE8 land? Two DXers squeezed into an area of 1,000 square feet made me wonder at the mathematical odds and shake my head.

Once the initial shock was over and I became somewhat rational, we discussed old times, invariably getting around to amateur radio. A plot was formed. VE8LG had intentions of purchasing a Wilson 520 (for the uninitiated, the Wilson 420 has 4 elements on a 30' boom; the 520 has 5 elements on a 40' boom) and a self-supporting 64' tower to support the beam (with a Ham II rotator to turn it). The entire construction procedure went well and 5 elements were soon up.

The area of residence of VE8NS and VE8LG was taking on an air of space age mystery. In the space of 100', two 64' towers and one 40' tower, supporting a Wilson 520, 420, and 415, and an inverted vee for 40 and 80, were serving two amateur radio stations – the VE8LG Kenwood twins and the VE8NS TR-3 Drake line. We were rather amused whenever people or vehicles passed by. Invariably they slowed down to look at all the flying aluminum and shake their heads, with quizzical looks as if to say, "What is going on here?" Thank goodness for rather nonstringent town bylaws, or we would not have been allowed to proceed.

Tests were started immediately, and, as expected, the beam performed according to specifications. We decided to hook both transmission lines to an antenna switch. Since VE8NS' beam was only 50' away, it presented no problem to extend a coax a little bit.



VE8NS contemplating the job.

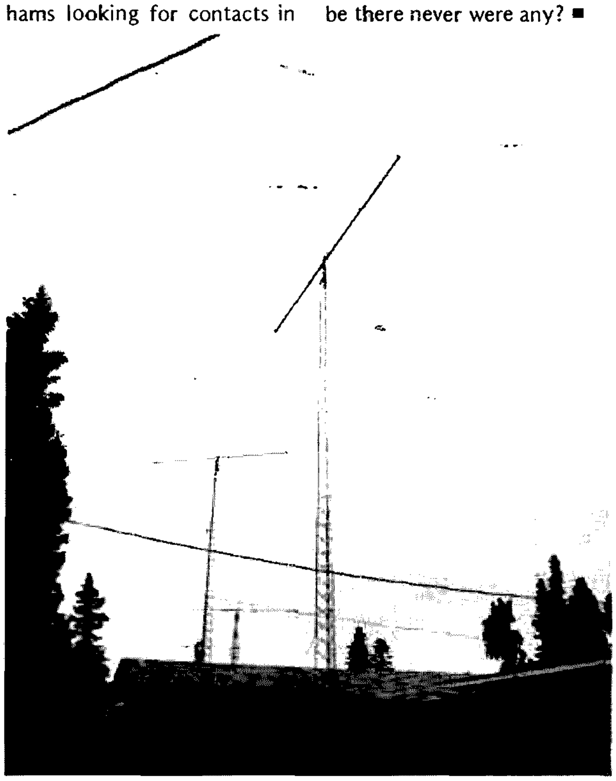
The results from the experiment were confusing. With both beams pointing to Europe, transmitted signal strengths were basically the same in all cases. However, on received signals the 520 beam registered as much as 3 S-units over the 420 beam. In some cases we were unable to copy signals on the 420 beam which were an S2 on the 520 beam.

With beams pointing toward ZL-VK land, again we were in for a surprise. ZLs were consistently giving better reports from the 420 beam than from the 520 beam, by as much as 1 S-unit. At no time were the transmitted signals better on the 520 beam. Received signals were better by as much as 3 S-units on the 520 beam. Perhaps further experiments will be carried out to determine whether adjustments to both beams may change the present pattern. However, the experiments were a lot of fun. Maybe the old adage, "the bigger the better," does not hold true in this case.

It is impossible to work on the same band. However, with 15m openings, VE8NS is able to operate with minimum QRM. If all the bands are out, then work is continued on the 2 accu-keyers, with one working and one more to go. But that's another story.

A matter of interest to hams looking for contacts in zone 1 VE8 land – VE8RZ, VE8LG, VE8OV and VE8NS are active on 20, both CW and SSB. VE8NS is the QSL bureau manager for VE8 land.

A thought just occurred to me, I haven't noticed any rf burns at this QTH. Could it be there never were any? ■



From front to back: the Wilson 520, the Wilson 415, and the Wilson 420.

New Products

from page 22

meter), and a laminated vswr chart. The price for this equipment is $298.

The test set is cushion-fit assembled in a durable, MIL-spec polyethylene case with space for seven plug-in elements, which determine power and frequency ranges. The carrying case and vswr chart are complimentary with the kit.

A customized luggage-style transit case has also been announced. Model 4300-070 has space for a Model 43 wattmeter, 15 plug-in elements, and additional accessories. Cushion inserts for other configurations can be designed for quantity requirements.

Price: 4300-064 test set $298, plug-in elements $36-75. Delivery: 4 weeks ARO from *Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon) OH 44139.*

GARY MODEL 120 DMM CALIBRATOR IMPRESSIONS

"What good is my new, super accurate digital multimeter if I can't calibrate it?" you might ask, after purchasing such a device. Not a bad question, and considering the popularity of digital meters these days, it is a question that should be addressed.

DMMs are capable of extreme accuracy, which is of not much use when no method of initially calibrating the device is available. The Gary McClellan Company, a manufacturer of DMM kits, has provided the solution to the problem with their Model 120 DMM calibrator.

You may recall that last month I reviewed the Gary McClellan 103 DMM kit, the $29 special. I needed to calibrate that device, as well as my trusty analog meter. McClellan responded by providing the 120 calibrator to review.

The 120 calibrator uses an internal IC to provide voltage references of .1 volt at .2%, 1.0 volt at .2%, and 10.0 volts at .1%. Additionally, resistance references from 100 Ohms to 1 megohm are provided with similar accuracy. The calibrator is housed in a small plastic case with "banana" jacks for output connectors. A push-button enables the device when required, thus saving the internal 18-volt battery, consisting of two 9-volt transistor batteries.

As expected, operating the 120 calibrator is as easy as pushing the enable button. The meter or DMM to be calibrated is set to the appropriate range and adjusted while firing the calibrator. For the first time, I was really confident of the accuracy of my meter. The calibrator is so compact and easy to use that it can be used at a moment's notice — I keep mine directly behind my old VTVM for periodic checks. The decade voltage references also allow meters to be checked for linearity.

All things considered, the McClellan 120 DMM calibrator is a useful piece of test gear — usable by anyone with a DMM or VTVM, which includes just about everyone!

The Model 120 calibrator is priced at $34.95 factory built. *Gary McClellan and Company, Box 2085, 1001 W. Imperial Hiway, La Habra CA 90631.*

John Molnar WA3ETD
Executive Editor

THE SNOOP LOOP

Sencore, manufacturers of high quality test equipment, has made available a closed loop for signal pickup and frequency measurements, without connecting to the circuit. The Snoop Loop is simple in construction, as it connects directly to a 50 Ohm input cable for direct application to the new Sencore FC45 frequency counter or the PR47 UHF prescaler. The Snoop Loop works equally well on other 50 Ohm input frequency counters, as it enables the user to "hold back" from any of the high power sources, without actually connecting to the source, as it protects the frequency counter and the operator. Then, too, the PL207 Snoop Loop can be used to "snoop back" all along the signal path all the way back to low level circuits and be placed directly over oscillator coils, for example, without upsetting the operating frequency of the oscillator. The Snoop Loop model PL207, at $9.95, can be purchased from any Sencore distributor, or directly from the Sencore service department in Sioux Falls. *Sencore, 3200 Sencore Drive, Sioux Falls SD 57107, (605) 339-0100.*

POLICE RADAR DETECTOR IN KIT FORM

Now, for the first time, the proven "Bird Dog" police radar detector is offered in kit form. The Bird Dog has been proven by thousands of truckers and motorists over millions of miles. The Bird Dog was designed for long range, troublefree, hands off, reliable operation. Actual tests and reports from truckers and professional motorists show the Bird Dog to detect moving police radar as far away as 2½ to 3 miles. A unit with this type of sensitivity alerts the motorist of police radar long before the police radar has the motorist in sight. In actual comparative tests, the Bird Dog is equal in sensitivity to the top three radar detectors now on the market.

The Bird Dog is usually located on

Continued on page 189

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Rome NY 13440

-- this one's for the Wilson

Remote Speaker Mike for Your HT

I received my Wilson 1402SM HT a few weeks ago and immediately started having a ball mobiling, both on foot and in the car. In using it while in the car, I connected it to the rooftop 5/8 wave antenna. It was a bit awkward to use however, holding it up to my face and using it "a la a great big microphone." The microphone, located close to the bottom on the Wilson instead of the customary position about 3/4 of the way up, didn't help any. In using it while I was walking, I found it embarrassing seeing people driving by and turning to stare as I either held it to my ear in order to hear adequately, or positioning it next to my mouth for transmitting. I'm no youngster so I can't qualify as a kid playing Dick Tracy. I decided that a remote speaker/microphone was an absolute must. A quick check with the ads revealed that I'd have had to come up with $24.00 for a new one. It might as well have been $240.00 as far as my pocketbook was concerned. That left me no choice but to try to home brew one. With my huge junk box I didn't anticipate any parts problem. I live alone in a big house trailer. My friends say that I live in a huge junk box. My junk box served me well, as I had all of the necessary "junk." In my local area, you can duplicate my unit for about $1.50 if you have an old mike to start with. We have a fantastic electronics surplus outlet here for the necessary "junk." It is most unfortunate that he does not handle mail orders.

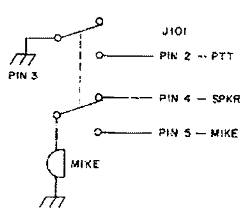

Fig. 1. Using mike as speaker.

At first I tried a dynamic microphone itself as both a speaker and as a microphone. See Fig. 1 for details. Actually, the element was a Shure Brothers controlled-magnetic transducer. It worked, but the "speaker" output was quite low. The output compared to a transistor radio earpiece. I next tried various true dynamic microphone elements of different shapes and sizes. I found one that had usable output, at least while in the trailer, but left much to be desired as a microphone. It made me sound as if I was talking with my head in a barrel. I added a high pass filter between the element and the speech amplifier input, to pre-emphasize the highs. See Fig. 2. The tone quality improved significantly, but the output suffered to the point of requiring my yelling into the mike. I changed the filter configuration to that as shown in Fig. 3, and it sounded normal. I did, however, vary the resistance value so that the deviation level was normal as well. This worked out reasonably well except that, needless to say, in a noisy environment, the "speaker" output was somewhat low and the unit had to be held up to one's ear as with an earphone. Another drawback was that the internal speaker would still "squawk," and consequently I could not operate in quiet environments, i.e., restaurants, libraries, hospitals, etc. Operating mobile on foot didn't work out too well either. I had the unit snapped to my belt and under my jacket, as it was cold out. This necessitated using the "mike" as an earphone continuously as I could not hear the internal speaker at all. Boy, does your arm ever get tired after awhile. Using it in the car wasn't acceptable either. The audio (from the internal speaker) was not loud enough to overcome the din of a noisy truck passing by and I couldn't continually hold the "mike" to my ear and still perform prerequisite driving functions. Oh well, back to the drafting board.

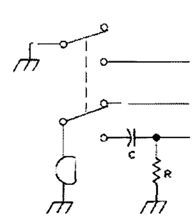

Fig. 2. Using mike with filter.

I then attempted using a small (1½") speaker both as a mike and speaker – the inverse of what I had tried previously. This worked out very satisfactorily as a speaker but not as a mike. Once again it sounded as if I was talking while I had my head in a barrel. The circuit was the same as that of Fig. 1, except that the element was a speaker. Since the deviation was low as well, I added a micro-miniature transistor output transformer to the mike input circuit for proper impedance matching. See Fig. 4. This increased the output to the point of overdeviating. The quality remained bassy. I added a high pass filter as with the dynamic element and got it sounding "hi-fi." The final circuit is shown in Fig. 5.

I can now drape the "mike" over my shoulder, either while using it in the car or while walking with it and it works fine. The audio level is more than adequate to override extraneous noises. The audio level control is now set so low that the raucous racket previously emanating from the internal speaker is now the equivalent of a stout whisper. I used a standard communication hand mike case for my unit. I held the speaker in place using silicone rubber (bathtub caulk). I replaced the push to

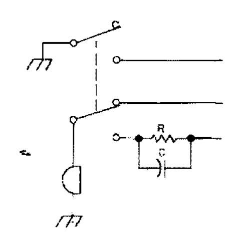

Fig. 3. A better filter for transmitting . . .

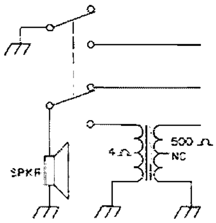

Fig. 4. This one hears well . . .

talk switch (it was only dpst) with a miniature push-button panel mount switch. My speaker/microphone works like a charm, and I've had nothing but compliments regarding how nice it sounds.

If you're wondering why I didn't try a separate miniature microphone, the answer is simply that my junk box did not produce one. I'm glad now that it did not. I did entertain the thought of a separate standard size microphone but could not squeeze one into the mike case along with the speaker.

This means of accentuating the highs (pre-emphasis) to make the microphone sound "human" applies to any microphone element. I even tried it with a carbon mike and now its quality can't be told from a communications type crystal, ceramic or dynamic microphone. Try it with a cheap (home tape recorder type) dynamic and make it sound "hi-fi." The values have to be altered to satisfy the characteristics of your speech amplifier and to compensate for the particular microphone element that you're using. ■

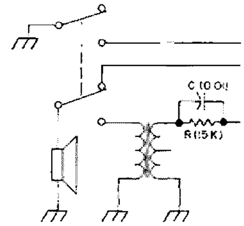

Fig. 5. Eureka! The finished unit.

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Canoga Park CA 91307

Split Your IC-22S

-- adding splinter frequencies

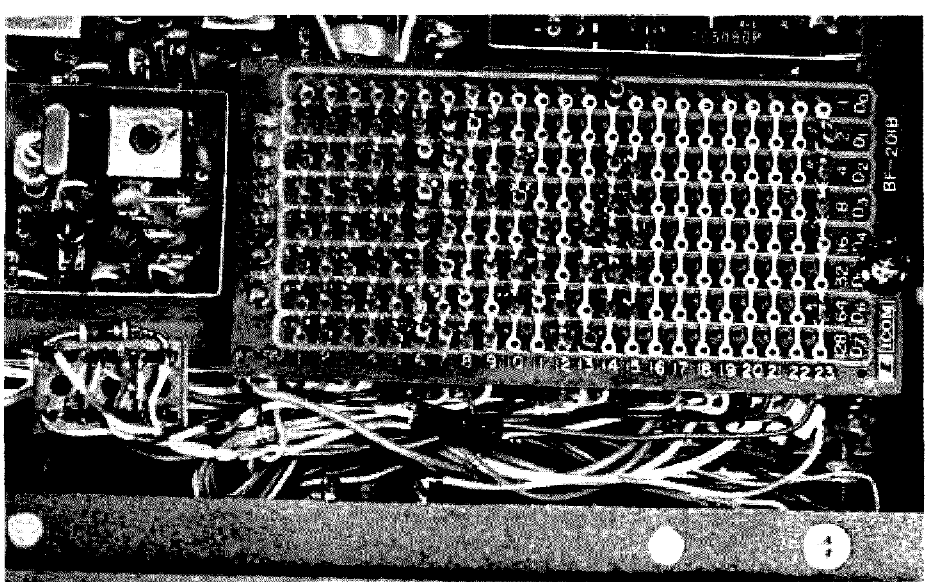
The IC-22S has brought the versatility of a synthesized 2 meter transceiver finally within the reach of those without unlimited funding, apparently by avoiding thumbwheel switches, digital displays, and the circuitry that these devices require. However, it has a limitation shared by most of the new synthesized rigs — it is restricted to operating on a 600 kHz split. In most localities this is no problem, but here in Los Angeles one of the most popular repeaters uses an odd split, receiving on 147.435 MHz and transmitting on 146.40 MHz. Numerous other communities also have this problem.

The IC-22S uses a diode matrix to program its frequency synthesizer for the lower of the two frequencies to be used. The selector switch selects a particular set of diodes. The output of the diode matrix goes to a digital adder circuit which adds 600 kHz (a binary 101000, where the least significant bit represents 15 kHz) when the higher frequency is called for. To modify this circuit would be a tedious job and, in all likelihood, would make it difficult to restore the circuit to its original state should in-warranty service be required. What must be done, then, is to use a different set of diodes for the second frequency.

When I first studied the circuit, I was disappointed to see that the voltage levels used were 0 and 9 volts, which eliminated the use of TTL devices. I was just about to settle for using a relay, but the thought of using a relay in a solid state device left me cold because of the threat of damage caused by transients from the coil. Nine volt relays aren't too easy to find, either. Then I noticed that the logic following the diode matrix was all CMOS, which operates on a supply voltage of anywhere from 3 to 15 volts. My problems were over.

In this circuit (Fig. 1), a CD4001 CMOS quad NOR gate chip provides all the gating necessary. The two inputs are the line from the selector switch and the "dp" line. The "dp," or duplex line, enables the adder circuit and here is used to enable the second set of diodes and disable the first. Both sets are disabled when the channel selector switch is not in the special position. The two outputs go to what I call the "normal" and the "abnormal" diodes. The normal diodes select the frequency to be used when the "dp" line is false (0 V), and the abnormal diodes select the frequency to be used when the "dp" line is true (9 V). In my particular case, because it is desirable to be able to receive on the repeater input for T-hunts or when there is interference on the output, I use the *duplex A* position. This position enables the adder logic ("dp" line true) in the receive mode. Therefore the diodes for receive (146.40 here) must be programmed for 600 kHz lower, or 145.80. Although this frequency is supposedly out of the range of the synthesizer, it doesn't really matter because the adder circuit intervenes before the 145.80 information ever reaches the synthesizer. There is plenty of range in the diode arrangement to program 600 kHz below even 146.01 MHz. Switching the function switch to the *simplex* position allows both receive and transmit on the *normal* frequency.

Construction is fairly simple. I wired everything on the back of a 14 pin IC socket, which fits very nicely between the volume control and the synthesizer board. I didn't fasten the IC socket to anything but just let it float



IC-22S modification. Note pigtailed connection to existing wire to switch in center and new IC socket with sleeve removed at left.

on its wires. This allows removing the diode board and new circuitry as one unit for programming. To insulate the IC socket, I slipped over it a paper tube made from package sealing tape — that's the stuff you have to lick. It tasted dreadful but did the job. The normal diodes occupy the position corresponding to the switch position to be used. At the end of the diode board, adjacent to diode position 22, is an unused position just made to order for the abnormal diodes. To get to the lead coming from the selector switch, unsolder it from the diode board and replace it with the "normal" lead. The positions of the 9 volt and "dp" lines are marked on the board. The only thing missing on the diode board is a ground, and this is available on the meter.

The only problem encountered was rf occasionally getting into the new circuitry and causing loss of lock.

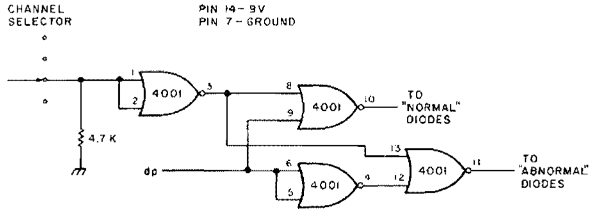


Fig. 1.

Presumably some bypassing would have prevented this, but it was found that there was no trouble whenever the antenna was not actually mounted directly on the radio.

It's great that repeater splits are as standardized as they are, but for those which aren't, this is an easy, inexpensive solution. ■

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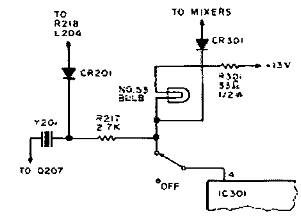

Fig. 1.

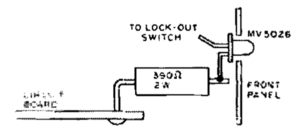

Fig. 2.

Remote Monitor for Your Scanner

--complete with lights

This article covers a circuit modification made to a Regency model TMR-8H/LM scanner monitor which replaces the channel indicator bulbs with light emitting diodes and includes the construction of a remote active channel indicator. Material cost for this project is quite reasonable and, depending upon the condition of the shack junk box, should amount to less than $5.00. Light emitting diodes are type MV5026, red, priced at 5/$1.00 just about everywhere. Other than the LEDs, the only parts needed are nine 390 Ohm 2 Watt resistors and a junk box speaker. The technique described should work equally well with other brands of scanners as the circuitry is simple and straightforward.

The scanner in question is (rather permanently) installed in the basement workshop shared by me and my retired fireman father. Most of the fireman's workshop time is spent in pursuit of his hobby at a power jigsaw. Obviously, when the scanner locks on a channel, far too much energy must be expended to turn around and look fifteen feet to see which channel is active. To eliminate this problem, an assembly containing a remote speaker and eight light emitting diode indicators was constructed and mounted on the wall in front of the saw. A labelmaker was used to affix the channel assignments adjacent to the proper LED indicators.

The remote indicators are wired in parallel with the indicators in the receiver. Fig. 1 shows the circuit diagram of the existing control circuitry for one channel.

IC301 is a power NAND gate which when activated by the scan decode circuitry functions such that its appropriate output (such as pin 4 in the figure) becomes a current sink effectively grounding pin 4. As well as activating the channel crystal Y201, the programming circuitry diode CR301 selects the appropriate high or low band mixer and at the same time must sink 120 mA just to light the channel indicator bulb. Not wishing to see if the additional 35 mA drawn by the remote LED in parallel with the No. 53 bulb would be the straw that broke the camel's back, it was decided to replace the bulbs with LEDs.

It is claimed by some scanner-owning visitors that with the LED indicators on the receiver, the locked channel is easier to determine at a quick glance because of the more point source light characteristics of the device.

To install the LEDs is as simple as replacing each light assembly. After removing the bulb assembly, it is necessary to use some method of supporting the diodes. This turned out to be mechanically simple though electrically redundant. As shown in Fig. 2, one end of a 390 Ohm 2 Watt resistor was connected to the +13 V B+ line on the circuit board.

The body of the resistor was positioned facing the opening in the front panel. The anode of the LED was then carefully soldered to the panel end of the resistor while the cathode was soldered to the appropriate contact on the channel lockout switch (same point as the removed bulb). The LED was aligned in the panel opening and that's all there is to it.

The remote installation is quite simple. A cable or wire bundle or whatever you choose to call it is required, and contains a pair of wires for the remote speaker. These may be connected directly to the remote speaker terminals on the rear of the receiver chassis. The cable which can be routed through an existing opening in the rear of the case must also contain an extension of the +13 V B+ line and a control wire for each channel indicator. These control wires are connected to the respective channel lockout switch previously described. Rather than be restricted by a hard-wired cable, I mounted a jack on the back of the chassis and a plug on the cable. (This would be up to individual

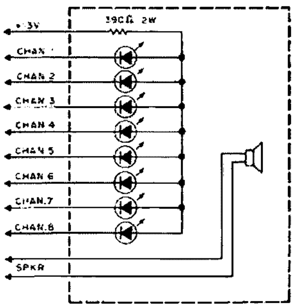

Fig. 3. All LEDs MV5026.

preference.) A circuit diagram of the remote unit is shown in Fig. 3.

Construction of the remote unit can take just about any form which is consistent with your abilities as a carpenter, cabinetmaker, sheetmetal worker or tin knocker. Mine is quite simple, being made out of some kind of fibrous pressboard material which makes friction fitting of the LEDs possible as a method of securing. A Dymo-maker was used to label the appropriate cities and towns beside each indicator using the "clever" scheme of red tape for fire departments and blue tape for police departments.

Having an installation such as this in the same area as the receiver might seem like overkill; however, it could be located upstairs in the kitchen, den or headboard of the bed. Mounted at the end of a hall, it could give one the feeling of being on final approach to an airport runway at night.

In conclusion, the intent here was to start the reader thinking of ideas for custom scanner installations. Putting the receiver on a good outside antenna usually pretty much dictates where the radio must be mounted and left. This restriction, however, should not dictate where you must be to listen to the local activity. ■

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Electronics Study Guide

-- remember when...?

There's no doubt about it. Some of the most delightful observations about electronic communication have been scrawled on tablet paper by grade school youngsters. Having taught in public schools for nineteen years, I'm sure of it. Take these historical explanations, for example.

Question: "When was the radio invented?" Answer: "On page 24."

"The radio was invented in the pre-me times."

"The Romans did not have radios. They used smoke signals in both the A.C. and D.C. times."

Kids have a knack for discarding everything but what they consider to be the most essential information. One boy brusquely wrapped up all of man's yearnings, struggles and triumphs in this eight word package: "Progress was from electricity to radios to now."

Here's a remark as charming as childhood itself: "I was thinking the radio was invented before the telegraph. When I learned different, all the thoughts I was going to say went in a swallow down my throat."

Another tiny historian concluded: "The Dark Ages lasted until the invention of electricity."

Through the years, the grade schooler's fund of knowledge has proved to be a glittering gold mine of wit and unconscious wisdom, often unhampered by hard facts. Each new subject seems to be a fertile new field for off-base interpretation and lopsided logic. Digging into facts about Marconi produced such notable nuggets as these:

"Marconi was born in 1874, supposably on his birthday."

"It took much hard work for Marconi to think out how to invent the radio. He had to keep thinking around the clock, twelve days a week."

"In just a few short years he became a sensation overnight."

"He expired in 1937 and later died from this."

Last year a bright-eyed little radio enthusiast came up with this endorsement: "Every time I think how the radio gives us so much fun, I have joy feels all over."

A skeptical classmate of hers absorbed all the statistics regarding the number of ham radio operators in America, but got his skepticism across in one crushing statement: "The total amount of ham operators in America today is more for saying than believing."

It must run in the family. Two years later his younger sister reported: "The number of ham operators we have today is an adsurbly large fact of a number."

The subject of hams has stumped many eager young scholars. Here are three more futile but imaginative explanations:

"Ham operators look something like people."

"They are one of the chief by-products of electricity."

"The meaning of them has a very short memory in my mind."

The elementary school youngster's mind seems to be a vast storehouse of miscellaneous misinformation — half true, half false and wholly delightful. His fund of knowledge about electricity includes such fascinating items as these:

"Electricity has been with us forever and maybe even longer."

"Would the average person be able to keep up with the news if it was not for electricity? The chances are 999 out of a hundred."

"In electricity, opposites attract and vice versa."

"If you see lightning, no you don't. You see electricity."

"From now on, I will put both gladness and wonder in my same thought about electricity."

Here's one I've been trying to figure out for five years: "You should always capitalize the word electricity unless it is not the first word in the sentence."

This next little girl seemed to be giving it all she had when she wrote: "Correct my being wrung, but tell me true or false. Do negative charges go through electrons or through protons? I wrecked my brain trying to think which."

But I'm afraid others are more nonchalant in their pursuit of knowledge: "Protons are bigger than electrons in case I ever want to know."

Psychologists tell us that half learning a fact incorrectly is often the first step to learning it right. So let's be philosophical as we buzz through these fractured facts about electrons and protons:

"100 electrons equal 1 radio program."

"When the switch is on, electrons are constantly bumping into each other inside the wire. There is really quite an overpopulation of electrons."

"Once I saw in an educational cartoon about how electrons move. Electrons are very interesting folks. All their ways are hurry ways."

"Electrons carry the negative charge while protons take the affirmative."

"Electrons are the same as protons only just the opposite."

"I think I admire the electron more than anything else about electricity because it weighs only about one over 2000th as much as a proton but can still hold its own."

Obviously, one of the fringe benefits of being an elementary school teacher is the possibility that the next paper I read will contain a wrong answer that is twice as witty or thought-provoking as the expected one. Sometimes they don't know and they know they don't know, but that doesn't keep their answers from being charming:

"Ideas about how radios work have advanced to the point where they are no longer understandable."

"Did I pass the test about how to get a ham radio operator's license and why not?"

"I have found radios to be easier to listen to than to tell how they work."

Take three small boys, mix

them up thoroughly with several pounds of strange facts, then shake them up with an examination and you have the perfect formula for instant confusion. Here's what I mean:

"The way vacuum tubes work, as I understand it, is not very well understood."

"Many questions have been aroused in my mind about vacuum tubes. As a mattery fact, the main trouble with vacuum tubes is that they give more questions than answers."

"In electricity, positives are attracted by negatives for the reason of search me."

Judging from the size of the handwriting, this next tyke was under the influence of John Hancock when he took time out to report (with the aid of a bright purple Crayola): "When they asked my brother if he would like to watch a ham operator, he rolled his eyes and flashed his teeth and said sure."

Often a grownup can only envy the simplicity of a child's way of expression, as is the case of the lass who remarked: "When I learned we were going to see a movie about ham operators all over the world, I told my feet to quiet down but they felt too Saturday to listen."

In their world of uncertainty, once they know a fact for certain, they hang on to it tenaciously, e.g.: "Another name for the radio is radiotelephony, but I think I will just stick with the first name and learn it good."

Children, like mountain climbers, must always make sure that their grasp on a fact is firm, even though they want to leap far beyond. Otherwise, they may find themselves trapped on a mental ledge called a boner. There is usually at least an element of truth in the most absurd answer. Sometimes they aren't wrong at all. It's just the way they put it that's so funny:

"Radio has a plural known as mass communication."

"Water scientists have figured out how to change river currents into electric currents."

"The best thing live wires are good for is running away from."

"Quite a bit of the world's supply of electricity goes into the making of ham radios."

"Many things about electronic communication that were once thought to be science fiction now actually are."

Members of the grade school set certainly have their own opinions, and few are hesitant to express them:

"All the stuff inside a ham radio is so twisted and complicated it is really not good for anything but being the stuff inside a ham radio."

"Electronics is the study of how to get electricity without lightning."

Then I don't suppose I'll ever forget this remark by another boy: "Last month I found out how a radio works by taking it apart. I both found out and got in trouble."

And you can't argue with the young fellow who reported: "When currents at 110 to 120 volts go through, them radios start making sounds. So would anybody."

When members of the grade school set turn their attention to the subject of vacuum tubes, youngsterisms come as thick as chalk dust. Just what is a vacuum? Here are five answers, fresh from the minds of nine-year-olds:

"Vacuums are made up mostly of nothings."

"A vacuum is an empty place with nothing in it."

"Vacuums are not anythings. We only mention them to let them know we know they're there."

"There is no air in vacuums. That means there is nothing. Try to think of it. It is easier to think of anything than nothing."

"A vacuum tube contains nothing. All of its parts are outside of itself."

Another lad wrote of this frustrating experience: "I figured out how a vacuum tube works twice but I forgot it three times."

One of his classmates reported: "When I learned how empty vacuum tubes are, I would have fainted if I knew how."

If you're at all hazy about other parts in a radio, hang on. These next thoughts will leave you only slightly worse off than before:

"An electron tube can be heated two different ways. Either Fahrenheit or Centipede."

"When you turn a radio on, the tubes get hot. The hotter anything gets, the faster the molecules in it move. Like if a person sits on something hot, his molecules tell him to get up quick."

"In finding out that radio tubes get hot, the fun is not in the fingers."

"Transistors are what cause many radios to play. Transistors are a small but important occupation."

"We now have radios that can run on either standard or daylight time."

One of my students last year had many tussles with his spelling book. When he finished writing one particular sentence, the battleground looked like this: "Termanuls do not agree with themselves spelingly and pruncingly."

With apologies to Mr. Webster, I would like to present a pocket-size dictionary of pint-size definitions, compiled from school children's reports. Should any of them prompt Webster to turn over in his grave, he would have to do so with a smile:

"Axually, a *choke coil* is not as dangerous as its name sounds."

"*Electromagnets* are what you get from mixing electricity and magnets together."

"Think of a *volt*. Then yippee, because now you have had the same thought as Voltaire, after who this thought was named."

Another lad had the right information, but the wrong answer: "There are some things about electricity we are still not sure of. These things are called *whats.*"

If the kids don't know all the answers, they can always do what their parents once did — try to slide by on a guess or two:

"A *radio telescope* is a thing you can hear programs by looking through it."

"*Current electricity* is electricity that is currently in use."

Kids are so full of questions, they can't possibly wait for someone to tell them all the answers. That's why they plunge recklessly ahead on their own, like so:

"Sound travels better in water than in air because in water the molecules are much closer apart."

"I have noticed that if a portable radio is turned in different directions, the station talks loudest behind its back."

"Although air is hollow it is not just for looking through. It is also for having radio waves running through it and trying to answer questions about."

"Radio waves would not be all that important to study if it were not for ears."

"Someone in here said that FM has shorter waves than shortwave radios. Is this so? I think it is because I think I was the one that said it." (If you can't believe yourself these days, who can you believe?)

An obviously more confident young man proclaimed: "Much has been said about how radio waves travel. Radio waves are both hearable and talkable."

Another moppet was going great, until the last word: "I believe the radio is one of the most important inventions of all time. Of course my father works at a radio station, so I may be a little pregnant."

That's one young writer who would have done fine if she had just stopped while she was ahead (which is good advice for grownup writers, too). ■

Low Cost Tone Decoder

-- for repeater control

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The usefulness of the Bell touchtone™ system for remote control, and especially for remote control of repeaters, is well known. The cost of touchtone decoders is quite low now, chiefly because of the Signetics 567 tone decoder

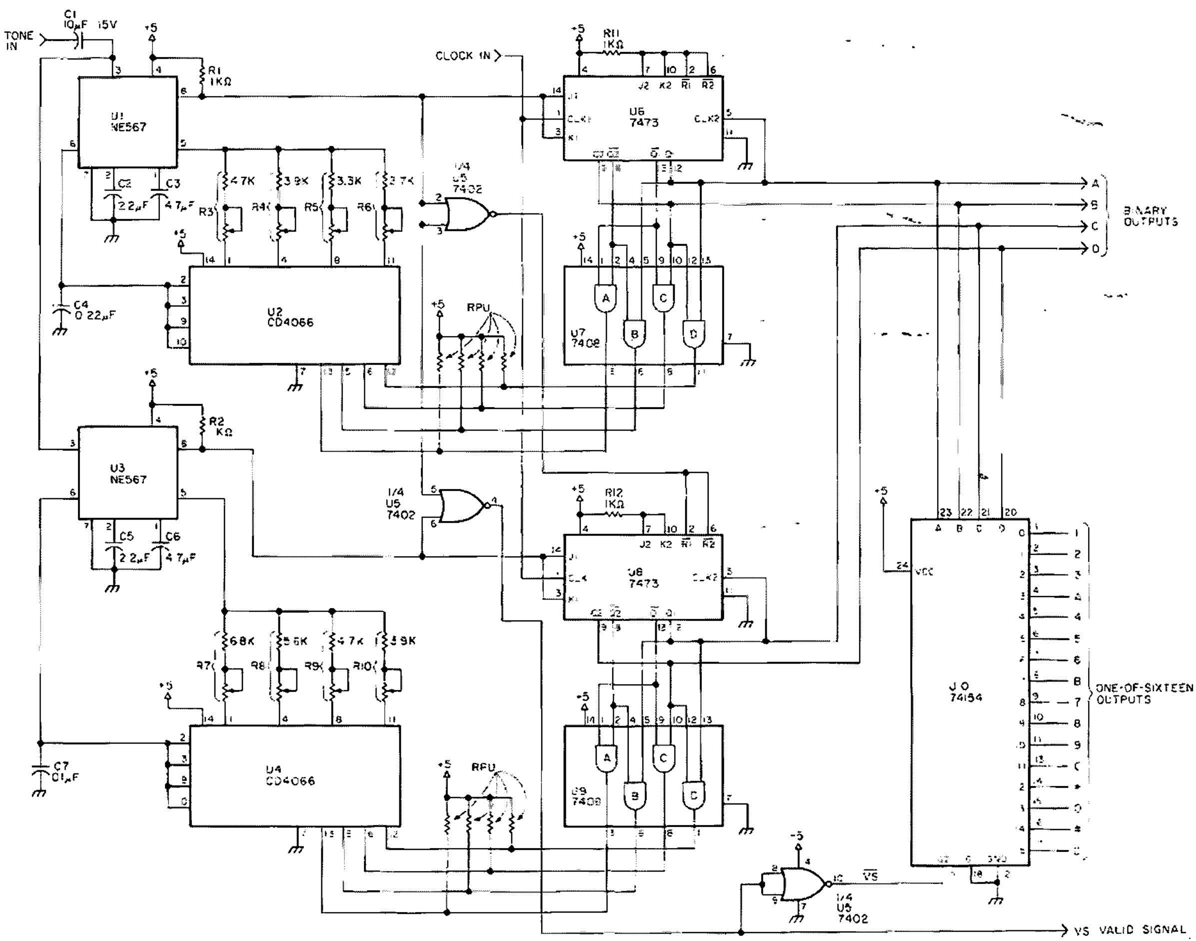

Fig. 1. Decoder circuit.

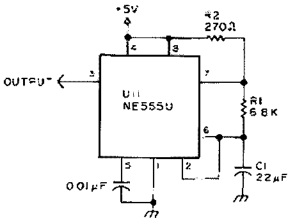

Fig. 2. Basic clock circuit.

IC. However, you still need eight of these ICs for a full 16 button system, if you use the standard method as described in *Signetics Databook.*[4]

A scanning decoder can get by with only two tone decoder ICs. It can become so complex, though, that any cost saving is wiped out. I decided that a scanning decoder would be simple enough to be worthwhile. My version is similar to the one described in reference 3. It uses a pair of 567s, a 555 timer, 2 CMOS quad switches, and 6 TTL ICs. All of these ICs are readily available from suppliers who advertise in *73.* The total cost of the ICs should be under 10 dollars. In addition, the decoder uses a handful of resistors and capacitors.

Circuit Operation

Fig. 1 shows a schematic diagram of the decoder. The eight tones used in the Bell system are divided into two groups. The low group tones – 697, 770, 852, and 941 Hz – are referred to as L1, L2, L3, and L4. H1, H2, H3, and H4 are the high group tones, respectively – 1209, 1336, 1477, and 1633 Hz.

U1 decodes tones in the low group. Its frequency of operation is determined by C4 and one of the resistors R3-R6. The resistors are connected in succession by U2, a CMOS quad switch. The state of U6, a dual flip-flop, is decoded by U7 into four control lines. One of the lines is always high, closing one of the individual switches in U2. The frequency of U3, the high group decoder, is switched the same way.

With no tone present, U8 is held reset while U6 is continuously clocked. When a pair of tones appears, as soon as U1 is switched to the proper frequency, U1-8 goes low. U6 is held in its current state, and U8 is allowed to clock. Then when U3 has decoded the high tone of the pair, its output goes low. U8 stops clocking and the valid signal line goes high. This indicates that the detection process is complete.

The flip-flop outputs are combined into a four-bit binary representation of the tone code. This four-bit word also goes to a 74154, which gives a low on the selected one-of-sixteen output. When the valid signal line is low, U10 is disabled – all outputs high.

Construction

There are no special problems in constructing the unit. Layout is not critical, and the wiring is not extremely complex, so a PC board is not essential. Follow the normal precautions in handling the CMOS ICs, and do not omit the eight pullup resistors (labeled RPU in Fig. 1). They protect the CMOS gates if the 7408s are removed for any reason. IC sockets make troubleshooting a lot easier, but are not necessary.

Some Notes on Design

The basic timer circuit (Fig. 2) is derived from reference 4. The values of R1 and C1 give a frequency in the neighborhood of 4 Hz. R2 is chosen for a duty cycle of 50%.

Fig. 3 shows some changes to the clock circuit, which make troubleshooting and alignment a lot less of a hassle. First, in order to set the frequency control resistors, it's best to defeat the cycling action and leave the proper CMOS switch permanently on. This is the purpose of S1. It converts the 555 from astable to monostable operation. Then, each time S2 is pressed, the 555

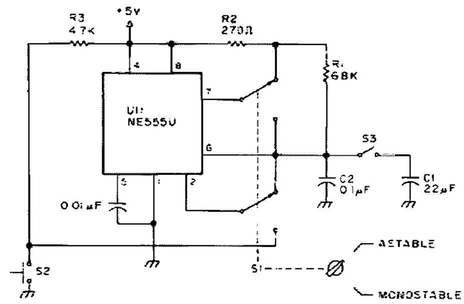

Fig. 3. Modified clock circuit.

produces a single pulse, and the state of the flip-flop advances by 1. To complete this revision, add a switch to ground pin 8 of U1. Some LED indicators driven from the four output lines are also handy. S3 simply lets the timer run fast enough so that the waveforms are easily viewed on a scope.

If, unlike me, you don't like to add a lot of extra hardware just to ease setup, you can get the same results with a couple of jumpers. The method is explained in the section on alignment.

The eight pullup resistors can be any convenient value between 10 kilohms and 1 megohm.

I used multi-turn pots to set the frequencies of U1 and U3. Assuming C4 and C7 are exactly 0.22 and 0.1 uF, you can calculate the resistance values from an equation in reference 4. These values are shown in Table 1. I used 5 kilohm pots in series with fixed 10% resistors. If you choose to set the frequencies with combinations of fixed resistors (more work but less strain on the budget), Table 1 gives you starting points. Note that the values given don't take into account the series resistance of the CMOS switches. There are two types of switches you can use: The CD4016 costs less, but I recommend the CD4066 because of its lower "on" resistance. You might also want to use more accurate capacitors for C4 and C7.

In a standard decoder as shown in reference 4, the ICs will lock up very quickly. Lockup times less than 0.1 second are easily achieved. With a scanning decoder, however, you cannot count on decoding a pair of tones in less than 8 clock periods. It takes this long for both counters to cycle through their four possible states. Each clock period must be long enough for the vco to settle down, then lock onto the tone. Because of this, there is little need to optimize the lockup time, and the design is simpler. You only need to be sure that the detection bands for the various tones do not overlap. Bandwidth is reduced by increasing the values of C2 and C5, and C3 and C6. I found that the values shown in Fig. 1 gave a narrow enough bandwidth. You may find that the high group bands overlap, especially H3 and H4. If so, change resistor values to move the bands apart. A high input level will increase bandwidth. Keep it as low as possible.

Alignment

A good audio generator – one with an output level control and an accurate frequency dial – is needed to align the decoder. You'll find that a scope and a frequency counter will be very useful.

I'm going to assume that you've built the circuit on "anyboard" without using IC sockets or any of the frills described in the section on design notes. I'll also assume that you used fixed resistors for R3-R10. If you use pots, the procedure is almost the same.

After checking for wiring errors, apply power and

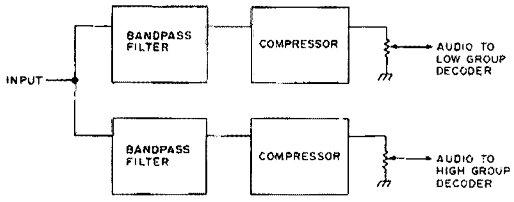

Fig. 4. Block diagram of input conditioning scheme.

measure the current. The decoder should draw about 250 mA. Be sure that U11 is producing a square wave at about 4 Hz. Then check that U6 is clocking normally and that pins 13, 5, 6, and 12 of U2 go high in succession. Now connect a jumper to U1-8, and touch the other end to ground. This will stop U6, leaving one switch of U2 closed. The trick is to get U2-13 high, closing the switch for the L1 resistor. This will take a few tries.

Once you have U2-13 high, leave U1-8 grounded and connect a decade box from U1-5 to U2-1. Set it to the value given in Table 1 for the L1 resistor. Connect an audio generator to the tone input. Set the frequency to 700 Hz and the level to 0.2 V rms. Remove the jumper. U1-8 should remain low. If it does not, adjust the decade box as necessary until it goes low. Remember to wait 1 second (four clock periods) between resistance changes. To fine tune the value, approach it from above and below and note the values where U1-8 just goes low. Set the decade box halfway between them. Now lower the audio level to about 50 mV rms. It's best to use the lowest level that will activate the decoder. Repeat the fine tuning process. This gives you the final value for R3. Select R4, R5, and R6 the same way, connecting the decade box in series with the proper switch each time. Now ground U1-8 permanently with the jumper. U4 should start switching. Use another jumper from U3-8 to ground to set the proper switch of U4 on, and select R7-R10. Wire the resistors into the circuit and remove the jumpers.

Check decoder operation by setting the generator to various low group frequencies. The circuit should hold in the proper state each time. Ground U1-8 and check the high group decoder.

If you have access to a frequency counter with a high input impedance, you can use an alternate method to set up the decoder. Connect the counter to pin 6 of U1 or U3. Select resistors so that the vco runs at the tone frequency in each case. This method saves some time and makes it easier to set single-turn pots.

This completes the alignment. Use a touchtone pad to check that the binary and one-of-sixteen outputs are corrrect as shown in Table 2. The decoder is now ready for operation. There are some pitfalls to avoid in making it work in your system, however.

Interfacing the Decoder

The ideal input signal is a pair of sine waves. Most touchtone pads use digital techniques to generate the tones and do not produce sine waves. With these signals, the decoder needs a higher level than it would with sine waves and does not respond quite as quickly. Due to line losses or receiver audio response, the tones of a pair may not be equal in amplitude. Also, noise and distortion can cause false outputs. The best prevention for these problems is to use bandpass filters followed by compressors for both the low group and high group tones. The block diagram of such a system is shown in Fig. 4. These problems are discussed in more detail in references 1 and 2. A delay circuit like that shown in reference 2 can help prevent falsing. Of course, if you want to drive loads drawing more than a few mA, you will need transistors and perhaps relays.

Finally, take a look at Table 2. As you can see, because of the way the touchtone keyboard is organized, my decoder cannot produce true BCD outputs. The keys are encoded and decoded in rows from top to bottom: 1, 2, 3, A, and so on. There are possibilities in using a touchtone pad to control a home computer, but it would take some code conversion hardware.

Conclusion

The scanning touchtone decoder I've described uses a small number of ICs and requires only a single 5-volt supply. While it is slower than the standard type of decoder, it is reliable and uses readily available parts. It compares favorably in price with the standard decoder. It has fairly good immunity to noise and distortion and is easily protected if these are a problem. Keep its limitations in mind and you will get good service out of it. ■

Tone frequency	Capacitance (chosen)	Resistance (calculated)
697 Hz	0.22 uF	7.174k Ohms
770 Hz	0.22 uF	6.494k Ohms
852 Hz	0.22 uF	5.869k Ohms
941 Hz	0.22 uF	5.313k Ohms
1209 Hz	0.1 uF	9.098k Ohms
1336 Hz	0.1 uF	8.234k Ohms
1477 Hz	0.1 uF	7.448k Ohms
1633 Hz	0.1 uF	6.736k Ohms

Table 1. Calculated values for resistors R3 to R10.

Touchtone Key	Tones Used	BCD Codes	Decoder Outputs Binary	Hexadecimal
1	L1, H1	0001	0000	0
2	L1, H2	0010	0001	1
3	L1, H3	0011	0010	2
4	L2, H1	0100	0100	4
5	L2, H2	0101	0101	5
6	L2, H3	0110	0110	6
7	L3, H1	0111	1000	8
8	L3, H2	1000	1001	9
9	L3, H3	1001	1010	A
0	L4, H2	0000	1101	D
*	L4, H1	none	1100	C
#	L4, H3	none	1110	E
A	L1, H4	none	0011	3
B	L2, H4	none	0111	7
C	L3, H4	none	1011	B
D	L4, H4	none	1111	F

Table 2. Comparison of BCD code and decoder output code.

References

1. "Autocall 76," C. W. Andreasen WA6JMM, *73 Magazine*, June 1976, pp. 52-54.
2. "Toward a More Perfect Touchtone Decoder," J. H. Everhart WA3VXH, *73 Magazine*, Nov. 1976, pp. 178-181.
3. "A Scanning Touchtone Digit and Word Decoder," Carl F. Buhrer W1GNP, *QST Magazine*, Jan. 1976, pp. 34-37.
4. *Signetics Databook*, 1972 or later edition.

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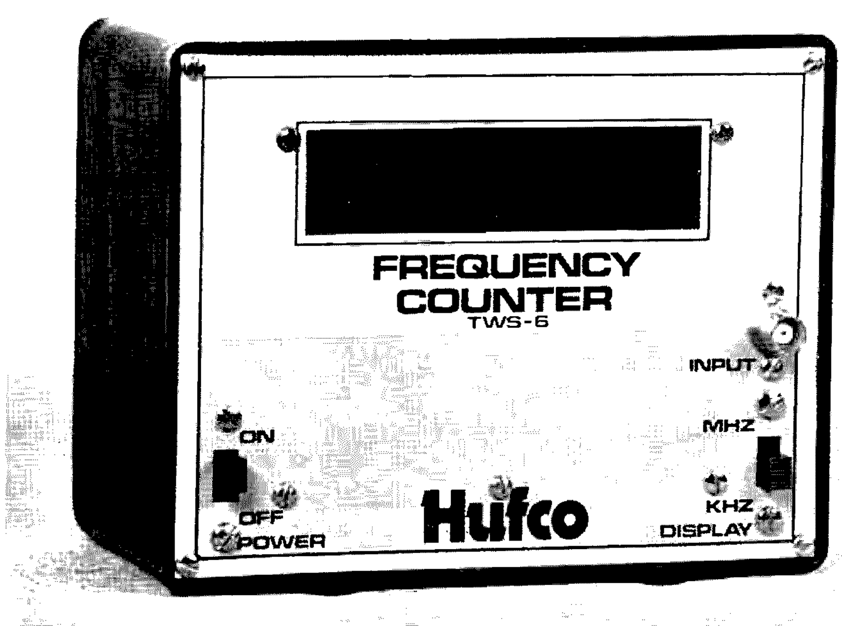
Hufco Counter Kit

-- report from a happy user



Fundamentally, basically, and first of all, I'm cheap. If there is a cheaper or less expensive way of doing something, I'll try it. Perhaps that's why the Hufco "Easy $25 Counter Kit" caught my eye (my eyes are located in my wallet).

After painfully shelling out the coin and placing my order in the mail, I settled down for a long wait. Wonder of all wonders, within a week I received an acknowledgment of my order and a note that it would be six weeks for delivery (who *ever* acknowledges orders nowadays?). Included with the note was a list of the parts required for the kit so I could start "acquiring" the parts.

Perhaps this is the time to explain that this is a rather unique "kit" in that it does not include any parts . . . just the PC boards, a precut cabinet for the counter, and an instruction manual.

Through the abundance of an overstuffed junk box and the cultivation of friends, most of the parts were gradually collected. One traumatic experience was having to order the XAN362 readouts. The only readouts suitable were installed in a friend's clock, and he adamantly refused to part with them (cheap!).

After six weeks of waiting, the counter didn't come, but I did receive a nice letter explaining about the delay -- UPS strikes, delayed shipments from suppliers, etc. I also received a complimentary copy of their new publication *Channel 51*. This rather well done magazine is obviously aimed at CBers who wish to convert to ham radio. This gesture made the following weeks of waiting more palatable, just knowing that someone somewhere knew that I had an order coming.

Sure enough, one day a package arrived, and I was able to inspect my new TWS-006 counter kit. The cabinet was extremely well built with a nice silk screened front panel reminiscent in color of the old Heathkit

brown and beige.

The PC boards were the biggest surprise. I had expected rather rough boards at that price. Not so.

These were double-sided boards with plated-through holes. Clear sharp traces gave plenty of room for even the klutziest soldering iron mechanic. The component placement is clearly screened on the boards, and the one small mistake (a reversed index mark for one of the 7447s) is clearly called to your attention in the manual.

While the manual itself is not quite what I'd call Heathkit quality, it is adequate to insure correct assembly. It not only gives a step-by-step procedure for assembly and interconnections, it also gives a good presentation of the theory of operation and a method of troubleshooting in case of any malfunction. Various options are discussed, including adding a prescaler for VHF or UHF operation. I ended up purchasing their prescaler board ($4.00) for future addition.

The only drawbacks I ran into during construction are quite minor. The resistors used for the layout must have been 1/8 Watt units since my 1/4 Watt resistors were somewhat oversized. This resulted in a less than picture perfect board when finished, with leads wrapped back under components. Also, I'd like to know where they found 3/8" diameter 1000 uF capacitors on their silk screen layout. Mine are larger, but by extending leads, I was able to fit them in. These are all cosmetic complaints and don't affect the assembly of the unit.

The actual smoke testing of the unit was very disappointing ... it worked. I couldn't believe it ... I just plugged it in, and it worked ... very anticlimactic. Other than adjusting the trimmer for exact frequency, there were no other adjustments or tuning required. Unless you've built a lot of kits before, you can't realize just how frustrating this can be. Half of the fun of kits is in troubleshooting the darn things after you've built them. I remember one clock kit that was over six months of fun ... but that's another story.

The unit isn't the most sensitive I've ever seen, but it's not that bad either. I was able to trip it at less than full output from my Measurements Model 80 signal generator all the way up to 57 MHz. By picking and selecting 74LS90 ICs for the first three decades, I was able to bring the sensitivity down somewhat, but even as-is it is quite usable. I was able to read my 25 Watt CW transmitter on 21 MHz from across the room with just a clip lead as a probe.

Accuracy seems to be as good as six digits will allow. It counts the crystal output from my BC-221 as 2.00001 with the last digit varying from 1 to 2 to 0 on alternate counts. Warmup does not seem to affect it at all.

Options that I plan to add to my counter are nicads for portable operation and the prescaler as soon as I can scrounge up a 95H90 chip for it. The company also offers an optional input which features the ability to "withstand the full unloaded output from a transceiver on 28 MHz for 20 minutes." Since I already have a dummy load, and rarely load my transmitter into my counter, I don't plan on adding this option. Oh yes, it also increases the sensitivity to some extent or something like that.

In conclusion, I would recommend this counter to anyone who has a need for a *cheap* counter, or to anyone who is *cheap* and needs a counter. Seriously, it performs as well or better than commercial counters costing several times as much. If you have a well stocked junk box (or a friend who has one), you can bring the cost of this counter kit to well under $40 and still have the convenience of a well designed kit. ■

...de W2NSD/1

NEVER SAY DIE

EDITORIAL BY WAYNE GREEN

from page 6

pass along your experience through the pages of *73* ... write.

One of the reasons ham equipment has been in such short supply has been the drain of sales to HF CBers. Many of the ham dealers are selling Yaesu and Kenwood transceivers to CB dealers (usually after converting the rig to work on the 27 MHz band). These dealers sell the rig to a CBer at the full list price (or more), often complete with an amplifier.

A few dealers make every effort to see that this ham gear does not end up in a CB shack — with Tufts Electronics being one of the leaders in this crusade. The manufacturers and importers of ham gear are unable to stop selling to the dealers who are abusing us, due to restraint-of-trade laws. There has been a move to get dealers to demand proof of a ham ticket before making a sale, but this won't cure anything, because the dealers who are selling ham gear for CB use know damned well what they are doing and are not about to stop as long as they can make an extra buck this way. If you can figure out any workable scheme to make it unprofitable to sell to CBers, then you'll have a good plan to stop this practice.

In the meanwhile, let's be vigilant and keep the CBers from twisting the dials of their transceivers to a ham band. What they do on the 27 MHz band is honestly none of our business at present — and we may be better off in the long run because they have established such a strong foothold there. What if the ITU (WARC) conference actually turns out as most of the knowledgeable hams of the world are predicting ... with the loss of all HF ham bands? In that case, the 27 MHz HF CB band may be the *only* HF "ham" band we've got left.

THIRD ANNUAL INDUSTRY MEETING

The 1978 ham manufacturers and dealers conference will be held in Aspen, Colorado, from January 8th to 15th. In addition to the usual breakfast and dinner meetings which have made this yearly conference such a success, there will be three forum workshops. Chuck Martin, the owner of Tufts Electronics, will conduct a workshop on things store managers should know, such as how to sell ham equipment, how to develop a comprehensive line of equipment to sell, and how to drum up a lot of local business using catalogs, newspaper advertising, radio, and television.

There will also be a workshop on how to write ads, catalogs, and other sales literature. This will also include a comprehensive workshop on media selection and planning: how to plan your advertising budget, how to select an ad agency, and how to save substantially on your advertising. This workshop could well pay for the entire conference.

Each of the workshops will probably take two evenings due to the comprehensiveness of the material. Even the old-timers will find a lot of value in these workshops.

There will be a forum devoted to crystal ball-gazing — second-guessing the future so you can take maximum advantage of what is going to happen next year.

The conference will be convening at the Continental in Aspen — it's a little tacky, but it does have a nice heated pool and a sauna, and it is right in the heart of town. Accommodations go early, so if you want to take advantage of this third annual ham industry workshop, better make your reservations with the hotel. There may even be snow this year.

SOME OPENINGS AT 73

It should be no news that *73* is growing — and so is *Kilobaud*. This means that we need more people to work on the magazines and the other plans afoot. We do have a need for some hams with experience in writing and construction to help test new equipment and write it up ... to work on books ... help with articles ... etc. This is something that really has to be done right here in New Hampshire, which is one of the nicest places in the country to live.

We also need help in working on microcomputers ... testing programs and selling them ... checking out the newest equipment ... things like that. A ham with a lot of experience in FORTRAN IV would find some interesting work. We also need help in support jobs such as management, marketing, sales, etc.

We're looking for people with intelligence, with some background, who don't smoke, and who are willing to go all out to become tops in their jobs. The pay is reasonable, and can be most rewarding if an outstanding job is done. Working for a small firm such as this gives you an excellent opportunity to grow and learn ... something you just can't get in a larger business.

All you have to do is look at some of the *73* graduates ... one is editor of a well-known magazine ... another

Continued on page 185

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A Single Tone Can Do It

-- simple tone control system

In the process of putting together a repeater of my own, I found that I wanted to perform a simple ON/OFF auxiliary function via the repeater input. In my case, it happened to be turning an aural frequency indicator on or off, but the function could be almost anything. From previous experience with such a used control in another location, I decided on the use of two single tones – one to turn the function on and one to turn it back off. Armed with this idea, I dug into my data books, experimented a little, and arrived at the circuit described in this article.

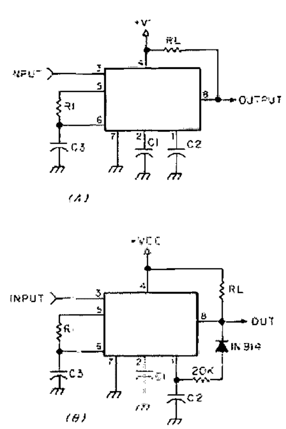


Fig. 1. (a) Basic 567 decoder circuit. Resistor R1 and capacitor C3 set the basic operating frequency or detection frequency. C1 and C2 are loop filters and their values affect response time and detection bandwidth. (b) Latching circuit, feeding the output (pin 8) back to the input of the final stage (pin 1). The latch can be released by pulling pin 1 to Vcc momentarily.

Circuit Operation

The basic 567 decoder circuit is shown in Fig. 1(a). By feeding the output back to the last stage at pin 1 (output filter), the output can be latched on. The circuit can then be unlatched simply by pulling pin 1 high momentarily. A general purpose PNP transistor can be hooked-up to do that task.

I then added another 567 decoder to get the unlatch signal. The output of this decoder turns on the PNP transistor just mentioned, thus unlatching the circuit.

The complete circuit is shown in Fig. 2. With the values shown, the decoders should tune over most of the normal single tone range. Depending on the length of tone burst available, the values of C3, 4, 6, and 7 might have to be adjusted slightly if the decoder does not respond fast enough.

Adjustment

When wiring is complete and checked, then power can be applied and the circuit checked out. A frequency counter or accurately calibrated scope is necessary to adjust the center frequency of the 567 decoders. Attach the counter or scope to pin 5 of U1 and then adjust R1 for the desired "ON" frequency. In my case, I used 1800 Hz. Now put the counter (scope) on pin 5 of U2 and adjust R4 for the desired "OFF" tone. Again, in my case, I used 1950 Hz.

Now connect whatever load you intend to use to pin 8. I have shown a relay since that is the most common usage. Connect an audio generator to the input and apply about 100 mV of 1800 Hz audio. The relay (load) should activate and should remain activated when the tone is removed. Now set the audio generator to the

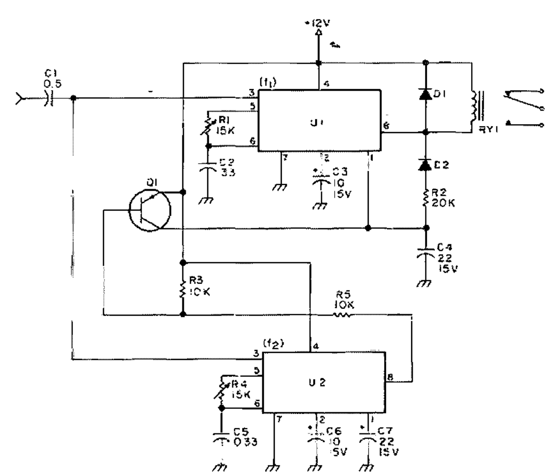
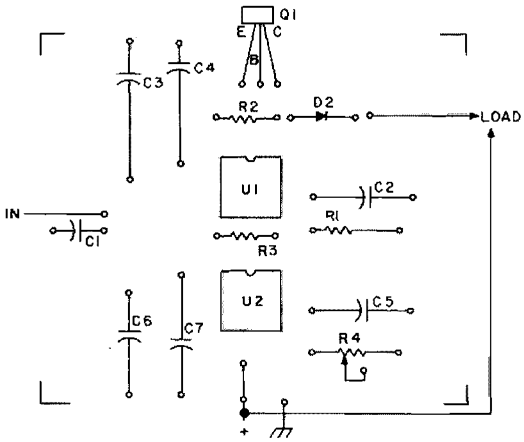


Fig. 2. Complete schematic of the two tone latching decoder.

A



B

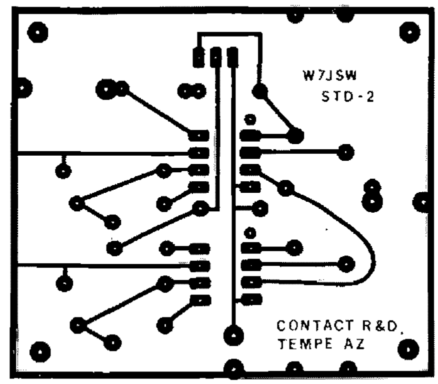


Fig. 3. (a) Parts layout for the prototype printed circuit board. This is the parts side of the board; the copper is on the other side. (b) Full size PC pattern for the prototype circuit board. Production boards, available from CONTACT, Inc., 35 W. Fairmont Dr., Tempe AZ 85281, will probably be slightly larger to make parts placement easier.

"OFF" frequency (1950) and apply that to the input. If all goes well, the load should de-activate.

Operation

I have my decoder operating from a 12 volt line and I am using a 24 volt relay as the load. The repeater receiver audio is fed to the audio input and I use the relay contacts to turn my tone frequency indicator on/off. The only thing you have to watch pretty closely is the input level to the 567s. The best operating point is about 150 mV. More will cause falsing and less won't operate too reliably.

Conclusion

A layout for a printed circuit board and the parts arrangement are shown in Fig. 3. The board is available from CONTACT, 35 W. Fairmont Dr., Tempe AZ 85281, for $5.00 ppd.

With cross-banding now approved, I may put one of these circuits on one of our local repeaters to provide a user accessible cross-link between 450 and 2 meters. Good luck and write if you have questions, but with today's postal rates, please enclose an SASE if you want a reply. ■

Parts List

C1 – 0.5 uF
C2, C5 – 0.33 uF
C3, C6 – 10 uF/15 V
C4, C7 – 22 uF/15 V
D1, D2 – 1N4001
R1, R4 – 15k PC trimmer
R2 – 20k ¼ W, 10%
R3 – 10k ¼ W, 10%
Q1 – 2N3905/3906/ MPS6521/2N2222, etc.
U1, U2 – 567 decoder
RY1 – Relay to suit Vcc used

EDITORIAL BY WAYNE GREEN

from page 183

is the ad manager of a new magazine and is reportedly pulling down over $100,000 a year . . . another has his own magazine now, which is worth over $1 million . . . etc. The line forms to the left.

NEW IDEAS NEEDED

Despite the sudden growth of amateur radio as a result of the club programs to get in new licensees, attendance at hamfests seems to have been dropping off. How come, with more hams than ever before, we have fewer going to hamfests?

There are probably several reasons . . . such as the high cost of getting into hamfests . . . a lack of any real promotion of many of the events, with more dependence on prizes than anything else to draw attendance. The recent ARRL event at Hartford, home base for the League, is a case in point. The show was well-organized, and promoted in *QST* . . . yet the turnout was disappointing. The $6.50 entrance fee was cited by many as prohibitive for the youngsters . . . and, indeed, there were very few kids running around the show. Most of the fellows I saw were chaps I have known for thirty or forty years.

You really can't expect to get $6.50 from kids to see a dozen or so exhibits (mostly by dealers trying hard to sell gear) plus a talk by Dannals. Oh, add $20 if you want to take in the dinner.

We need ideas. If you have some ideas that have worked with a hamfest in your area, why not put them down on paper and send them along so the rest of us can benefit? We'll try to get all the good schemes published in *73*.

CB TO TEN

Owners of Standard Horizon 29 CB rigs can rejoice, for Standard has a dandy ten meter conversion for the set. If you have the 23-channel set, as I have, you can get a 40-channel switch from your local Standard dealer and get 40 channels on ten meters.

Standard has a conversion sheet available, "Procedure for 10 Meter Conversion of Horizon 29." This gives the details of where to cut the foil on the board and what parts to add and change. The changes are minimal.

The result is a rig which works on ten meters, starting at 28,965 and going up in the same increments as the CB channel spacing to 29,405 MHz. That's just two MHz above the 11 meter channel frequencies . . . and that change makes a lot of sense. If you start much lower, you run into the higher powered sideband stations in the lower 350 kHz of the phone band.

Give a call on 28,965 on Sundays at 1000 PDT and you'll probably get an answer from the bunch out in L.A. on the channel . . . if the band is open.

MORE ARTICLES

Perhaps you'd like to see more microcomputer articles in *73* . . . well, write 'em. In *Kilobaud*, I am exploring the advantages of getting into this new field and how to do it in my editorials . . . but you can't do much in microcomputing if you don't know anything about microcomputers. Let's see a lot more articles on microcomputing for *73* . . . and it doesn't hurt to bring ham applications into the act.

MARY PLEADS WITH YOU!

A few readers, despite every effort to make reader service simple, have been screwing things up. The worst complaint from Mary, the lovely gal who handles our reader service, is that there are dozens of readers who are *not* sending in their cards. Yes, I know this is difficult to believe, since you all know how much store advertisers put in getting requests for literature. They put even more store in your buying, of course, so don't let reading literature stop you from buying.

The other gripe is that a few readers are making a mess of the card with crosses and blotches. Mary says to circle the number, not obliterate it . . . puleeze! Mary also requests that you sign your name and address clearly . . . and if you're not sure, please ask someone.

THAT AUGUST QST!

If you are in the Maryland, D.C., Northern Virginia, Western Pennsylvania, or Western New York areas, be sure you don't miss getting your August subscription copy of *QST*. That's your August subscription copy, not one from a store . . . don't miss it.

John M. Franke WA4WDL
Apt. 225
1006 Westmoreland Ave.
Norfolk VA 23508

Eye On the Weather?

-- following weather satellites

Interest in the geosynchronous weather satellites is increasing rapidly. Many fine articles have appeared on the construction of receivers, converters and displays. Plotting charts are available for the low orbit satellites. But very little information is available on locating the geosynchronous satellites. This article presents a method of calculating the azimuth and elevation angles needed to point your antenna and, also, an alternate graphical technique.

To aim your antenna, you need the following information:

1. Your latitude and longitude.
2. The longitude of the satellite subpoint.

The result of the computations will be the desired elevation and azimuth. Elevation is the number of degrees the antenna must be tilted above the horizon. Azimuth is the bearing angle the antenna should be turned from true north.

Let us first calculate the azimuth angle. To do this, construct a great circle route which passes through your location and the satellite subpoint. The latitude of all geosynchronous satellites is zero degrees. This great circle is used to determine, first, the distance from the satellite subpoint to your location and, then, the desired azimuth angle. Fig. 1 shows the navigation triangle from which the distance to the subpoint, D, and the azimuth angle, A, is determined. From Bowditch[1] we find that:

$$\mathrm{Hav}\,D = \mathrm{Hav}(|LO1-LO2|)\cos(L1)\cos(L2) + \mathrm{Hav}(|L1-L2|)$$

Where:
Hav D is ½[1-cos(D)];
L1 is your latitude;
L2 is the subpoint latitude (zero);
LO1 is your longitude, degrees west; and
LO2 is the subpoint longitude, degrees west.

This equation was developed for navigation using Napier's Laws for spherical triangles and, hence, is strange in appearance. However, making the necessary substitutions we find:

$$\cos(D) = \cos(L1)\cos(LO1-LO2)$$

From this, it is easy to find D. D is expressed in degrees. Having found D we can now determine A, the azimuth angle, by: Hav A = sec(L1) csc(D) [Hav(90° - L2) - Hav(|D - 90° + L1|)].

This equation can be simplified for geosynchronous satellites to:

$$\cos(A) = 1 - \frac{\sin(L1 + D)}{\cos(L1)\sin(D)}$$

If the subpoint longitude is less than your longitude, the azimuth angle is A. If the subpoint longitude is greater than your longitude, subtract A from 360° to obtain the azimuth angle.

If you are still with me, the elevation angle is calculated next. A drawing of the great circle path is laid out in Fig. 2. The desired elevation angle is labeled B. Here we have a triangle with two known sides, and the angle between them is known. One side is equal to the Earth's radius, 3,440 miles. The other side is equal to the sum of the Earth's radius and the satellite's altitude, 22,300 miles. Using the law of cosines:

$$B = 90^\circ - D - \arctan\left(\frac{3440\sin(D)}{25740 - 3440\cos(D)}\right)$$

Let's examine some hypothetical cases of a station at 37° N. latitude and 76° W. longitude, desiring to receive ATS-1 at 149° W. longitude and ATS-3 at 70° W. longitude.

ATS-1:

$$\cos(D) = \cos(37^\circ)\cos(-73^\circ) = .798 \times .292 = .233$$

$$D = 76.5^\circ$$

$$\cos(A) = 1 - \frac{\sin(113.5^\circ)}{\cos(37^\circ)\sin(D)} = 1 - \frac{.917}{.798 \times .972} = -.182$$

$$A = 100.5^\circ$$

But ATS-1's longitude is larger than the station's longitude, so:

$$\text{Azimuth angle} = 360^\circ - 100.5^\circ = 259.5^\circ$$

$$B = 90^\circ - 76.5^\circ - \arctan\left(\frac{3440\sin(76.5^\circ)}{25740 - 3440\cos(76.5^\circ)}\right)$$

$$B = 90^\circ - 76.5^\circ -$$

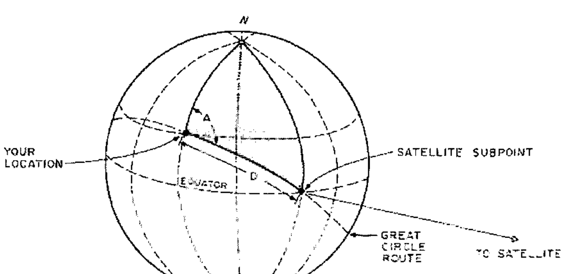


Fig. 1. Navigation triangle formed by your location, the North Pole, and the satellite subpoint.

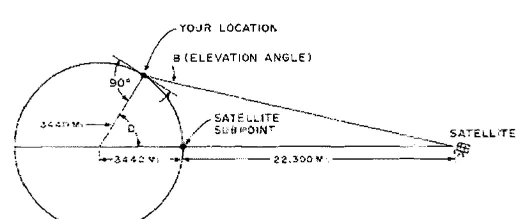


Fig. 2. Geometry used for calculating the elevation angle.

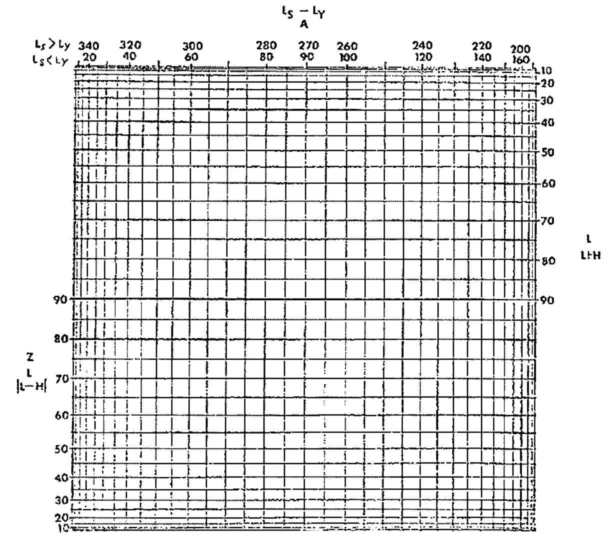


Fig. 3. Simplified d'Ocagne chart. All scales are expressed in degrees. L_S = satellite subpoint longitude; L_Y = your longitude; A = azimuth angle; Z = zenith angle; L = your latitude; and H = 90° - Z.

$$\arctan\left(\frac{3440 \times .972}{25740 - 3440 \times .233}\right) =$$

90° - 76.5° - 7.6°

Elevation angle = 5.9°

ATS-3:

cos(D) =

cos (37°) cos(6°) =

.798 x .994 =

.793

D = 37.5°

cos(A) =

$$1 - \frac{\sin(74.5°)}{\cos(37°)\sin(37.5°)} =$$

$$1 - \frac{.963}{.798 \times .609} = -.982$$

Azimuth angle = 168°

B = 90° -37.5° -

$$\arctan\left(\frac{3440 \sin(37.5°)}{25740 - 3440\cos(37.5°)}\right)$$

B = 90° -37.5° -

$$\arctan\left(\frac{3440 \times .609}{25740 - 3440 \times .793}\right) =$$

90° - 37.5° - 5.2°

Elevation angle = 47.3°

While the mathematical approach is precise and accurate, a much simpler graphical technique can be used with little loss in accuracy. Fig. 3 is a simplified d'Ocagne diagram from Bowditch, which can be used to solve spherical triangle problems by drawing straight lines and doing simple subtraction and addition. Each axis has been divided according to the haversine of the angles. The scales in Fig. 3 are simplified to reduce confusion. The graph applies only to stations in the Northern Hemisphere.

The use of the graph is best explained with examples. Taking the same examples as before, ATS-1 and ATS-3, let us proceed.

Step 1: Mark your latitude on both the left and right vertical scales. Connect the two marks with a straight line.

Step 2: Subtract your longitude from the satellite subpoint longitude, L_S - L_Y. If the result is positive, proceed to step 3. If the result is negative, add 360° to the result to get a positive angle between 0° and 360°. If $|L_S - L_Y|$ is greater than 90°, the satellite is below your horizon and cannot be received.

Step 3: Take the result of step 2 and make a mark on the top axis. Drop a vertical line from this point to the line drawn in step 1. From where the two lines cross, draw a horizontal line to the left scale and note the reading, Z. This value of Z can be converted to the elevation angle B by Table 1. If Z is greater than 80°, the satellite is below your horizon and cannot be received.

Step 4: Subtract the value Z from 90°. The result is labeled H for convenience.

Step 5: Subtract H from your latitude. Ignore the sign of the result. Mark the result on the left vertical scale. Similarly, add H to your latitude, and mark the right scale accordingly. Connect the two marks with a straight line.

Step 6: Where the line from step 5 crosses the 90° horizontal line, extend a line vertically to the top scale. If the satellite subpoint longitude is greater than your longitude, use the upper scale. If not, read the lower scale. The reading is the desired azimuth angle. The elevation angle was obtained from Table 1 in step 3.

The worksheets for ATS-1 and ATS-3 (see Figs. 4 and 5) demonstrate that the errors are typically less than one degree. I find this graphical method to be much faster and easier on the brain than the exact mathematical method, and the errors are much less than the beamwidth of practical antennas.

Aligning the actual antenna mount, in order to use this data, can be difficult. There are two methods I find useful to calibrate the azimuth scale. The elevation scale is easily aligned using a spirit level.

The first, and simplest, method is to use the North Star, Polaris. Rigging a sight on the mount and bore sighting the mount with Polaris at night will bring the mount to an azimuth angle of 0° ± ½°. However, every time I have attempted to use this method I have found a tree, house, or even a mountain between me and Polaris.

The alternate technique requires a copy of the *Nautical Almanac* and the ability to see the noon position of the sun. A *Nautical Almanac* can be purchased at most marine outlets, or a copy is usually available at a local library. When you open the almanac, it appears to be a vast array of tables. Each page pair covers three days. The column we are interested in is labeled "Sun." Under this heading are two subheadings, "Dec." and "GHA". "Dec." is an abbreviation for declination, which is not of importance for our work. GHA is an abbreviation for Greenwich Hour Angle. GHA is the longitude of the solar subpoint. "Dec." is the latitude of the solar subpoint.

Assuming you are in the continental United States, when the sun's GHA is equal to your latitude, the sun is directly south, or at your 180° azimuth position. To the right of the GHA column is a GMT column. To use the almanac, look down the GHA column for the date of interest until you find a GHA near or equal to your longitude. If the GHA matches your longitude, the corresponding GMT is the time when the sun is directly south of your location. If not, you must interpolate. Note that a difference of one hour in GMT corresponds to a change

Z	B Elevation Angle (degrees)
0	90.0
2	87.7
4	85.4
6	83.0
8	80.8
10	78.5
12	76.2
14	73.9
16	71.6
18	69.3
20	67.0
22	64.7
24	62.5
26	60.2
28	57.9
30	55.7
32	53.4
34	51.2
36	49.0
38	46.7
40	44.5
42	42.3
44	40.1
46	38.0
48	35.8
50	33.6
52	31.5
54	29.3
56	27.2
58	25.0
60	22.9
62	20.8
64	18.7
66	16.6
68	14.6
70	12.5
72	10.4
74	8.4
76	6.4
78	4.3
80	2.3

Table 1. Antenna elevation angles for Z values from 0° to 80°.

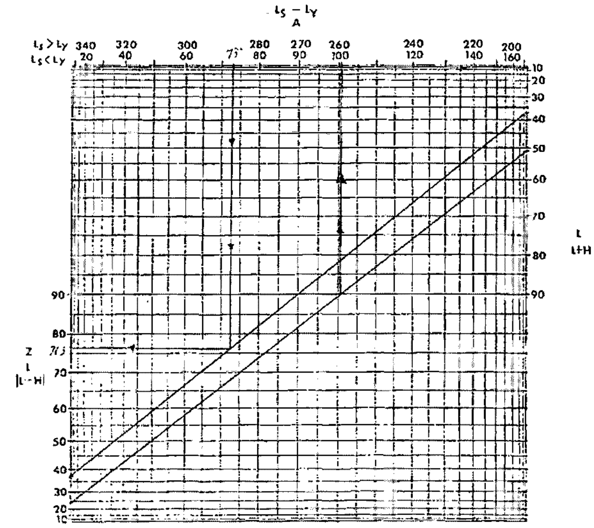


Fig. 4. ATS-1 worksheet. QTH is 37° N., 76° W. Satellite is 0° N., 149° W. L = 37°; L_S - L_Y = 149° - 76° = 73°; Z ≈ 76.5°; H = 90° - Z = 13.5°; |L - H| = 24°; L + H = 51°; A ≈ 259° (259.5° calculated); B (from table) = 5.9° (5.9° calculated).

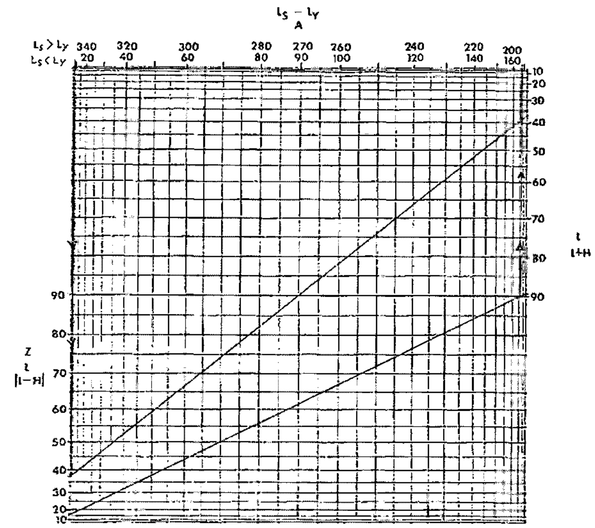


Fig. 5. ATS-3 worksheet. QTH is 37° N., 76° W. Satellite is 0° N., 70° W. L = 37°; L_S - L_Y = 70° - 76° = -6° = 354°; Z ≈ 37.5°; H = 90° - Z = 52.5°; |L - H| = 15.5°; L + H = 89.5°; A ≈ 167° (168° calculated); B (from table) = 47.5° (47.4° calculated).

of 15° in GHA. Taking the largest GHA less than your longitude, note the GMT. Subtract the GHA from your longitude. Divide this difference by 15°, and multiply the result by 60 minutes (time, not angle). This product is the number of minutes which must be added to the noted GMT to obtain the exact time when the sun will be due south. Fasten a stick on your antenna mount parallel to the antenna axis. When the calculated time arrives, point the stick at the sun by watching the stick's shadow (never look directly at the sun). Your azimuth scale can now be set to 180°. By the way, an error of one minute in time is an error of only ¼° in azimuth. ■

Reference

[1] Bowditch, Nathaniel, *American Practical Navigator,* H.O. Publication Number 9, US Government Printing Office, Washington, 1966.

Social Events

CLEARWATER BEACH FL
NOV 19-20

The Florida Gulf Coast Amateur Radio Council is holding its 2nd annual convention on November 19 and 20, 1977 at the Sheraton Sand Key Hotel on Clearwater Beach FL. Official attendance at our last affair was placed in excess of 2200, and this year we expect to double that number as we increase the number of activities and size of the convention. For more information contact: Florida Gulf Coast Amateur Radio Council Inc., PO Box 157, Clearwater FL 33517.

MASSILLON OH
NOV 20

The Massillon ARC 16th Annual Hamfest and Auction will be held Sunday, November 20, 1977, at a new location: Towne Plaza Shopping Center in downtown Massillon, Ohio. Unlimited parking. Major prizes given away. Starts 9 am – admission $1.50 at door. Mobile check-in 146.52 simplex. For brochure and map write to MARC, PO Box 73, Massillon OH 44646.

ELLICOTT CITY MD
NOV 27

The Columbia Amateur Radio Association (CARA) will hold its CARA Hamfest on November 27, 1977, at the Ellicott City Armory in Ellicott City, Maryland. Program includes exhibits, flea market, prizes, and refreshments. All indoors. No tailgating. Talk-in on 147.99/39, 146.16/76, 146.52/52. For more info contact CARA, PO Box 850, Columbia MD 21044.

OAK PARK MI
NOV 27

The Oak Park High School Electronics Club is presenting a Swap and Shop on Thanksgiving Sunday, November 27, 1977, at Oak Park High School, Oak Park, Michigan 48237. Refreshments and door prizes. Donation, $1.00. Table, $1.00.

FORT WAYNE IN
JAN 22

The annual Fort Wayne Winter Hamfest will be held on January 22 at Shiloh Hall, north of Fort Wayne, from 8 am until 4 pm local time. Early parking is available and 28/88 and 52/52 will be monitored. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC/ARTS). Admission is $2.00 at the door. Table space is available at $1.50 per half table (about 4 feet).

New Products

from page 168

the vehicle dash panel with the microwave horn "peeping" through the windshield. The power plug simply plugs into the cigarette lighter. It is designed to operate from the 12 volt battery with either positive or negative ground with low power consumption. The electronics is housed in a handsome 5-1/4" x 4" x 3-1/8" high steel cabinet with a black textured finish.

The operator controls are intentionally limited to a single three-position switch with the following functions: 1) system test; 2) radar detection, visual indication only; 3) radar detection, simultaneous audio and visual alarm. The Bird Dog has thus been designed to eliminate the troublesome, and usually unsatisfactory, gain adjustment control knob found on competitive units. The elimination of this gain adjustment also enhances the unit for out-of-sight mounting if the user so desires, such as under the hood with the microwave horn "peeping" through the grille opening.

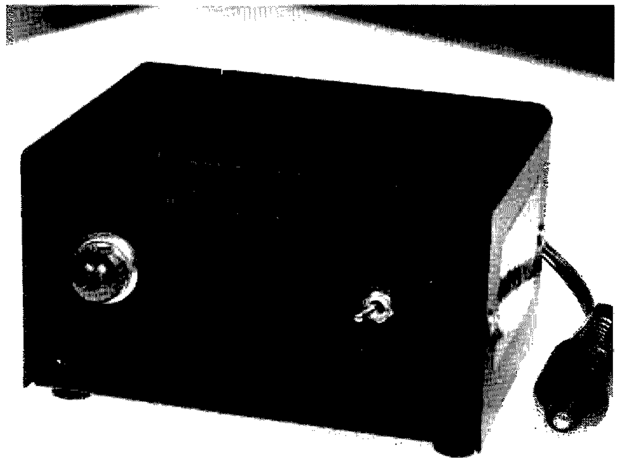
The unit features a high gain, die-cast, aluminum microwave horn and rf cavity tuned to 10.525 GHz. A pair of microwave diodes are located in the cavity, one for modulation of the continuous rf carrier and the other for detection of the low-level radar signal.

The detector diode drives a low noise, low level, metal package, linear integrated circuit amplifier. The low noise and metal package along with other appropriate filtering and shielding virtually eliminate false triggering from spurious sources. The output circuit consists of a phase locked loop integrated circuit package whose bandwidth is controlled to ±5% of the local oscillator to virtually eliminate any unwanted frequencies beyond the range of the phase locked loop's local oscillator. The output driver drives both an audible buzzer and a red jeweled indicator light.

The kit assembly is simple and no special training is required. The kit can be completely assembled in one evening.

The Bird Dog kit, including a set of detailed plans for construction, sells for $49.95, or, if you prefer, $74.95 for a preassembled and fully tested unit, plus $2.00 for postage and handling. A set of detailed construction plans can be purchased separately for $5.95 and is discounted from your purchase price when you purchase a Bird Dog kit.

The Bird Dog is available through *Micro Electronics, 1921 I-85 South, Charlotte NC 28208, telephone (704) 392-1705.*



The Bird Dog.

NEW AND IMPROVED ELECTRONIC KEYER FROM HAM RADIO CENTER

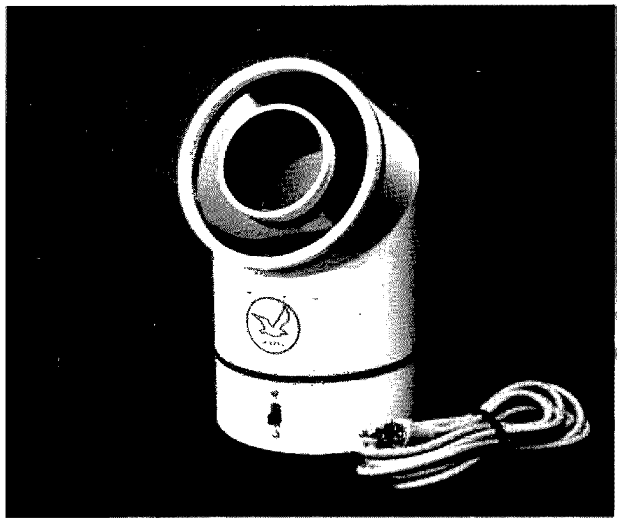
Years of experience in the manufacturing of amateur radio equipment (the famous Ham Keys) are what is behind Ham Radio Center's new and improved electronic keyer . . . Model HK-5A.

Outside, it features a trimmer cabinet color-keyed to match most modern amateur radio equipment, with all front-mounted controls (speed, weight, tone, and volume) and jacks for external paddle and/or keyer, plus external power. Inside, this battery-operated unit has an iambic circuit for squeeze keying, self-completing dots and dashes, a dot memory, built-in tone monitor and grid block, and direct keying. Batteries *not* included. Also, it can be used as a code practice oscillator with a straight key.

For more information about Model HK-5A, write *Ham Radio Center, Inc., 8340-42 Olive Boulevard, P.O. Box 28271, St. Louis MO 63132,* or call (toll free) 1-800-325-3636.

CW SPEAKER SYSTEM USES ACOUSTIC FILTER

Skytec of Ukiah, California, is offering a loudspeaker unit designed expressly for CW. Employing a unique acoustic chamber resonator, the Skytec CW-1 combines good "single frequency" selectivity with a nice tone shaping characteristic.



The Skytech CW-1.

By filtering right at the audio output to the room, the unit suppresses hum, hiss, ringing, and miscellaneous noises left in the audio by most receivers. The CW-1 adds a remarkable degree of selectivity to receivers without a sharp electronic filter, and it gives the best of receivers the most pleasant, "just right" tone output and bandpass for long QSOs, net operating, and band scanning, Skytec says.

Priced at $19.95, the 3½" by 6½", 2-pound unit is shipped with a connecting cable. A front switch provides for bypassing the audio to the regular station speaker for other than CW reception. *Skytec, Box 535, Talmage CA 95481.*

The Model HK-5A keyer.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	7	7	3	3	3	3	7	7	14	14	14
ARGENTINA	7A	7	7	7	7	7	14	14A	21	21	21	14A
AUSTRALIA	14	7B	7B	7B	7B	7B	7B	14	14	14	14	14A
CANAL ZONE	7A	7	7	7	7	7	14	21	21	21	21	14
ENGLAND	7	7	7	3A	7	7B	14	14A	14A	14	7B	7
HAWAII	14	7A	7	7	7	7	7	7B	7A	21	21	14A
INDIA	7	7	7B	7B	7B	7B	14	14	7B	7B	7	7
JAPAN	14	7B	7B	7B	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	14A	14A	14
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7B	7B	7B	7A
PUERTO RICO	7	7	7	7	7	3A	14	14	14A	14A	14	14
SOUTH AFRICA	7	7	7	7	7B	7A	14	21	21	21	14	14
U.S.S.R.	7	7	3A	3A	7	7B	14	14	14	7B	7B	7
WEST COAST	14	7A	7	7	7	7	7	14	14	21	21	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	7	7	14	14A	14
ARGENTINA	14	7A	7	7	7	7	7A	21	21	21	21	21
AUSTRALIA	14A	14	7B	7B	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7A	21	21	21	21	21
ENGLAND	7	7	7	3A	7	7	7B	14	14	14	7B	7B
HAWAII	14A	14	7	7	7	7	7	7	7A	21	21	21
INDIA	7	7	7B	7B	7B	7B	3B	7A	7A	7B	7B	7B
JAPAN	14	7B	7B	7	7	7	3A	7	7	7B	7B	14
MEXICO	14	7	7	7	7	3	3	7A	14	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	3A	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7A	14A	21	21	14A	14
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21	21	14	14
U.S.S.R.	7	7	3A	3A	7	7	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7B	7	7	7	7B	14	21	21	21	21
AUSTRALIA	21	14A	14	7B	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	7A	7	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	3A	7	7	7B	7B	14	14	7B	7B
HAWAII	21	14A	7A	7	7	7	7	7	7A	21	21	21
INDIA	14B	14	7B	3B	3B	7B	3B	7	7	7	7	7B
JAPAN	14A	14	7B	7B	7	7	7	3A	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7A	21	14A	14A	14
PHILIPPINES	14A	14	7B	7B	7B	7B	7B	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7A	21	21	14	14
U.S.S.R.	7	7	7	3A	3A	3A	3A	14	14	7B	7B	7B
EAST COAST	14	7A	7	7	7	7	7	14	14	21	21	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
FG = Fair to Good
P = Poor

1977			NOVEMBER			1977
SUN	MON	TUE	WED	THU	FRI	SAT
		1 F	2 F	3 F	4 P	5 P
6 P	7 F	8 F	9 P	10 P	11 F	12 FG
13 FG	14 FG	15 F	16 F	17 F	18 FG	19 FG
20 FG	21 FG	22 FG	23 FG	24 F	25 P	26 F
27 F	28 F	29 F	30 F			

DECEMBER 1977
$2.00

73 AMATEUR RADIO

73

#207 DEC 1977

COVER: Bust of Guglielmo Marconi at his original station location in South Wellfleet MA (see page 6). Photo by W2NSD/1.

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EDITORIAL BY WAYNE GREEN

from page 6

CB IN PERSPECTIVE

While a lot of amateurs are still uptight over CBers and their often wanton ways, others are busy welcoming the cream of the CB crop into amateur radio. About 80% of the new hams are coming from the CB ranks, a heavy percentage of those being the highly illegal HFers. Oddly enough, despite all sorts of warnings of disaster, the new hams are doing quite well.

But what about the manufacturers? We are now seeing more and more of the CB firms turning to amateur radio . . . how come? In this case we can laugh, for the CB industry went to a lot of expense and trouble to almost mortally wound itself.

Back in the glorious days when everything was back-ordered and the manufacturers were more worried about completion of construction of their new plants than anything else, the bigwigs of the biz did invest some money toward making their future even rosier than it then appeared. They could see the 23 channels then available rapidly filling up and there being not only a need for more channels on 27 MHz, but also a need for two to five megahertz for further CB development, as millions of people got into the act.

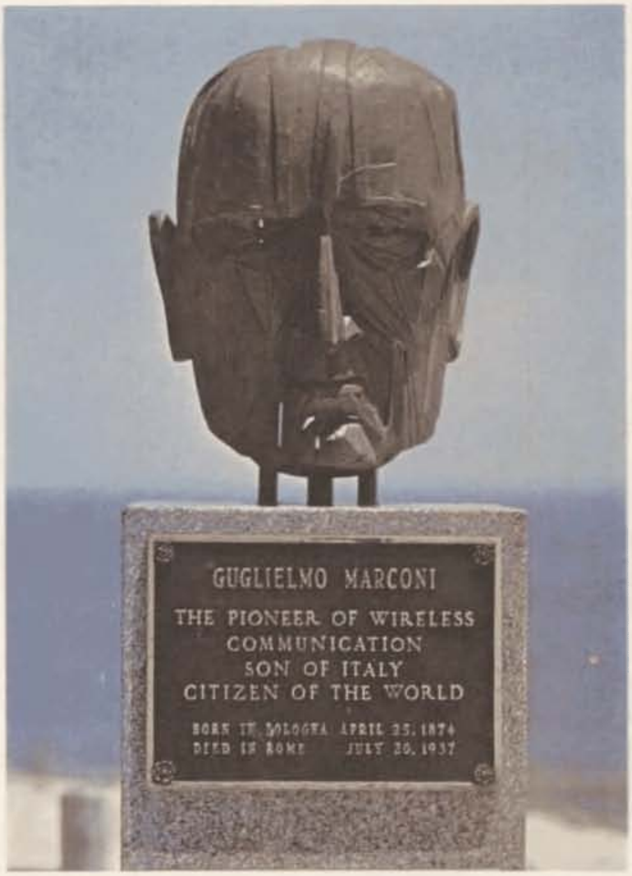
The "donations" went to their lobby in Washington. Here the money was spent to put the pressure on the FCC for new bands and for 27 MHz expansion. When they ran into resistance from the FCC, they then went via the OTP (White House) to force the FCC to capitulate. It's actually a bit more sordid than that, but you get the idea.

Through TV, movies, records, and a lot of newspaper and magazine publicity, the pressure was kept on to keep CB growing . . . and it did. Then the plan to expand the 27 MHz band went through the usual FCC heel dragging, which amateurs are all too familiar with, and suddenly the country was faced with the choice of buying a CB set which would be virtually worthless in six months or else waiting six months for the new 40-channel sets. Sales of CB sets just about stopped, while the factories in Japan kept grinding out the 23-channel sets to further bulge already-bulging warehouses in the U.S.

By the time the 40-channel sets could be purchased, the steam had gone out of the market and the demand for the new sets never really materialized. That lesson having been learned, the pressures for opening a new CB in the VHF or UHF bands cooled quickly. Of course, the lack of pressure has not stopped the FCC from its considerations in this line . . . these things move like a glacier and are as difficult to stop. One of the last things CB manufacturers and dealers need now is a new Citizens Band.

One publisher, anxious to start a new "Communicator" magazine, did manage to pull the FCC to a halt by writing in a nationally-syndicated CB column that the new band would soon be announced. The FCC took this as a challenge and tabled the whole matter. They are not about to be pressured like that.

My plan to encourage ham clubs to institute Novice classes has worked well, and the result has been a substantial growth in amateurs . . . enough so the need for a Communicator class of license is no longer important. The two reasons for the Communicator proposal were to pro-



Memorial bust of Marconi at the station site.

Continued on page 41

Oscar Orbits

Oscar 6 Orbital Information Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W	Oscar 7 Orbital Information Orbit	Date (Dec)	Time (GMT)	Longitude of Eq Crossing °W
N 23448	1	0030:40	72.5	13923 A	1	0120:03	75.2
NA 23459 BTN	2	0125:35	86.3	13935 B	2	0019:23	60.1
N 23471	3	0025:31	71.3	13948 A	3	0113:40	73.7
NA 23484 BTN	4	0120:27	85.0	13960 B	4	0013:01	58.5
N 23496	5	0020:23	70.0	13973 A	5	0107:18	72.1
NA 23509 BTN	6	0115:19	83.8	13985 B	6	0006:39	56.9
NA 23521 BTN	7	0015:15	68.8	13998 AX	7	0100:56	70.6
N 23534	8	0110:10	82.6	14010 B	8	0000:16	55.4
NA 23546 BTN	9	0010:06	67.6	14023 A	9	0054:34	69.0
N 23559	10	0105:02	81.3	14036 B	10	0148:51	82.5
NA 23571 BTN	11	0004:58	66.3	14048 A	11	0048:11	67.4
N 23584	12	0059:53	80.1	14061 BQ	12	0142:29	81.0
NA 23597 BTN	13	0154:49	93.8	14073 A	13	0041:49	65.8
NA 23609 BTN	14	0054:45	78.8	14086 BX	14	0136:06	79.4
N 23622	15	0149:41	92.6	14098 A	15	0035:27	64.3
NA 23634 BTN	16	0049:37	77.6	14111 B	16	0129:44	77.8
N 23647	17	0144:32	91.3	14123 A	17	0029:05	62.7
NA 23659 BTN	18	0044:28	76.3	14136 B	18	0123:22	76.3
N 23672	19	0139:24	90.1	14148 A	19	0022:43	61.1
NA 23684 BTN	20	0039:20	75.1	14161 B	20	0117:00	74.7
NA 23697 BTN	21	0134:15	88.9	14173 AX	21	0016:20	59.6
N 23709	22	0034:11	73.9	14186 B	22	0110:38	73.1
NA 23722 BTN	23	0129:07	87.6	14198 A	23	0009:58	58.0
N 23734	24	0029:03	72.6	14211 B	24	0104:15	71.6
NA 23747 BTN	25	0123:59	86.4	14223 A	25	0003:36	56.4
N 23759	26	0023:55	71.4	14236 BQ	26	0057:53	70.0
NA 23772 BTN	27	0118:50	85.1	14249 A	27	0152:10	83.6
NA 23784 BTN	28	0018:46	70.1	14261 BX	28	0051:31	68.4
N 23797	29	0113:42	83.9	14274 A	29	0145:48	82.0
NA 23809 BTN	30	0013:38	68.9	14286 B	30	0045:09	66.9
N 23822	31	0108:33	82.6	14299 A	31	0139:26	80.4

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.90-146.00 MHz; Output 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz.

OSCAR 7 Mode A: Input 145.85-145.95 MHz; Output 29.40-29.50 MHz.

Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days.

LETTERS

W6LS

I have not seen a Caveat Emptor section in *73 Magazine* for a long time. If you no longer print ads, ignore the two typed below. However, if you still conduct this service, please print the following ads:

CQ and QST 1950-1975 issues for sale. Send SASE if ordering 73, Ham Radio, *or other CQ and QST issues. One dollar minimum order, and all issues cost 25¢ each, including USA shipping. Send chronological list and full payment to W6LS, 2814 Empire, Burbank CA 91504.*

Certificate for proven two-way radio contacts with amateurs in all ten USA call areas. Award suitable to frame, and proven achievements added on request. SASE brings TAD data sheet from W6LS, 2814 Empire, Burbank CA 91504.

As you may remember, our club has operated a used amateur radio magazines service for more than a decade. It was your donation of *73 Magazines* that enabled us to start this project. We have shipped more than 3000 issues in one month, and we seldom send less than 300 magazines during a month. Our magazine service is appreciated by amateurs, and we have filled requests from every state and about 40 countries. We often receive very kind comments from amateurs who are happy to receive needed issues. Our club is a nonprofit organization, and we regularly donate "income" to worthwhile causes associated with the amateur radio service. As is indicated in our ad, our supplies of *73* and *Ham Radio* issues are always limited, and we have actually been completely out of them several times in the last few years.

We hope you understand that you and your staff are welcome to drop in at W6LS for unannounced visits whenever you are in our area. We are open weekday evenings 4:30-5:30 pm and 7:30-9:30 pm. Actually, W6LS is open and active at least 30 hours per week. Please extend our invitation to your staff. We are pleased to see Bill Pasternak whenever he attends an event at W6LS, and that is usually a couple of times per year.

W6LS is still as active as ever. We help license about 300 amateurs per year in the courses our members teach, including about 150 at W6LS. We actively support amateur-related activities, such as communications for Walk-A-Thons and Bike-A-Thons. We have hosted repeater conferences the last few years, along with meetings of other special interest groups such as SOWP, QCWA, OOTC, Ten-Ten International, Southern California Antique Radio Society, Southern California Radio Teletype, MARS groups, and others. We continue to be active in community affairs, such as through our hosting of the annual volunteers recognition day (Sunday, 25 September 1977) for the Burbank Red Cross. W6LS is also collecting donations of aluminum in 1977, and spending the income to buy refreshments for Red Cross blood donors in Burbank. Our 12th annual convention drew a little more than 3000 attendees, and we have reached the point where we are considering a move to larger quarters. W6LS has served as the receiving point for the ARRL California Incoming DX QSL Bureau during the last few years, and it runs smoothly now with plenty of help. W6LS sorts received SASEs and DX cards according to the first letter in the callsign suffix, and we ship packages to individual suffix sorters, who are members of other clubs in our Los Angeles Area Council of Amateur Radio Clubs. We are so deeply involved in several major projects that our clubroom looks like a combination storage room and junk shop.

I have taken up Herb Brier's (W9AD) old battle to help new amateurs through the Novice column in *CQ Magazine*. As you may recall, I have a lot of interest in the problems faced by new amateurs in general and Novices in particular. I hope to provide them with some help via this column, although I realize it may not last long (since the FCC is making noises about eliminating the Novice class of license).

I established an amateur radio operating award to provide a bit more incentive to new amateurs and to honor our beagle dog (Tad) who spent more time at W6LS than most members while he was alive. The Ten American Districts certificate is increasingly popular with new amateurs, and I have already issued almost 1200 of them to amateurs in all states and about 50 countries.

William Walsh W6DDB
LERC Amateur Radio Club/W6LS
Burbank CA

Hi, Bill . . . congratulations on the column in CQ . . . and sorry we are out of the classified business these days. We'll try to be sure to say hello on our next trip out your way . . . keep up the good work with Novice classes. — Ed.

HOT TICKET

I'm an air conditioning engineer who's worked the past year in Iran, where it's been 102° F. for the past month. I've been a ham for about seven years, and have had callsigns OD5GT and FØAZK. I now operate here in Tehran with callsign EP2GT. We also have a radio club here with about 60 members. Some of these members receive *73* by air mail from their American companies, so I've been able to keep up a bit on ham radio activities through your fine publication.

Bill Schlapfer EP2GT
Tehran, Iran

BRAVO

Bravo for your October editorial, "Can The QCWA Save Amateur Radio?"

I am in accordance with you 100% — this fine organization, above any other, could do the job that ham radio sadly needs.

I, regretfully, am not a member, but am joining as soon as possible. Having been in ham radio about 50 years, I guess I'm about due.

I understand that such an illustrious gentleman as Leo Meyerson has recently been elected as a regional director. Along with many good men in just about every walk of life, who do not seek monetary gain and show no discrimination toward old or new, who else should represent us except (as I have mentioned previously) Wayne Green? . . .

Paddy Labato W8DLU
Cleveland OH

REAL PROBLEMS

Regarding the recent announcement of the Rule and Order on FCC docket #21033: I would like you to consider supporting an addition to this controversial issue (at least in the midwest).

As I am not a Tech, I feel that I am less biased on the subject than most Techs are — but I still feel strongly that the potential problems need immediate consideration and action.

I am very disturbed by the talk in the weak signal portions of our VHF bands of a so-called "war." Now, as in many times in the past, is the time for cooperation between all concerned, not "war." Quoting a recently overheard comment on 145.1 MHz, "I'll throw my kW on the first repeater input down here." War is a two-way affair, and FMs have kWs also.

In general, FMers and low band operators whom I have discussed this with realize that DXing, EME, RTTY, TV and satellites use some of the VHF spectrum, but they don't know how much or where. They have been very receptive and sympathetic to our potential problems, and would support gentlemen's agreements and/or proposals to the FCC to prevent the potential problems.

My personal feeling is that the Rule and Order makes sense, except that it did not go far enough. Gentlemen's agreements can solve the problems of 220 MHz and up if they are made known and are respected by all parties concerned with the use of these bands. Two meters, as I see it, is where the problem lies. No good argument can be made that FM users and repeater operators didn't need the extra 1 MHz given on 2 — the problem is going to be that the 300 kHz that are usable by the Tech class for AM, SSB, CW, TV, RTTY, facsimile, and EME from 145.5 to 145.8 MHz is not going to be enough. General class license holders and above do far more work in the area above 145.0 MHz at present than in the 144 MHz portion, due to the tremendous activity generated by the Tech class. You go where the action is.

As I see it, the only answer is to open up the lower portion of 2 meters to Techs. The 500 kHz from 144 to 144.5 are probably adequate, when combined with the 300 kHz from 145.5 to 145.8, to handle all modes and uses. The bottom 100 or 50 kHz could and probably should be reserved for A1 only.

If the bottom of 2 is not opened to the Techs, I foresee some real problems for all users of the band.

Jerry G. Shepherd WB9YPW
Hoffman Est IL

EARNING

I just finished reading the letter from Mark A. Clark WB4CSK in the September *73*. He may be "just a kid," but he has the attitude of a mature adult and I agree with his feelings 100%. There is no excuse for lowering ticket requirements to gain strength in numbers.

I am working toward my Novice now, and I want the satisfaction of *earning* it. I'm a CBer, somewhat disappointed with CB, and it's my observation that if 90% of the CB operators knew more than how to key the mike and talk, we would have much less trouble with RFI, overmodulation, splatter, and crude manners.

Amateur radio doesn't need this kind of membership.

Dave Dunsmoor KAHB1022
Wahpeton ND

PACING

I have recently become a subscriber to your magazine, after belonging to the ARRL for more years than I care to remember.

I enclose a letter which I wrote to *QST* and which was returned to me with a copy of an old *American Medical Journal* article which merely stated the well-known facts that some later pacemakers have better shielding than some earlier models.

I had hoped that my experience might at least stay on file for the benefit of others who have the problem. Since receiving my letter back, I have withdrawn my permission for *QST* to use my experiences.

Perhaps I had better say that when

Continued on page 32

FCC Math

John F. Leahy WB6CKN
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Gonzales CA 93926

In this installment, we'll leisurely play around with Ohm's Law and tie up some loose ends from Part 1.

First, to Ohm's Law. Probably the simplest statement is: voltage = current x resistance. In symbols, E = IR (remember, it's not necessary to put a multiplication sign between letters). And what it means is that the instantaneous voltage or pressure across a purely resistant circuit equals the amount of current flowing times the resistance offered to that flow. I used the words "instantaneous" and "purely resistant" to take care of ac as well as dc circuitry. The further you get into electronics, the more you see of such bothersome little distinctions. Things are just never simple!

Let's now do some algebraic wiggling like we did in Part 1. If E = IR (back to playing with number equations if necessary), then I = E/R and R = E/I. Which is to say that the current in a purely resistive circuit equals the voltage (pressure) divided by the resistance (the greater the voltage and the less the resistance, the more the current, just like a hose carrying water), and the resistance in the circuit equals the voltage divided by the current (the greater the voltage and the less the current, the greater the resistance must be).

Now an example: Suppose you wanted to develop 5 volts across a resistor that carried 25 milliamps (mA) of current. What size resistor would you need? Here we're looking for the R of our formula. A good way to remember the Ohm's Law formulas is simply to note that E, voltage, is always on top, never on the bottom of the fraction. R = E/I, then, is the form we want here. But there's a problem. The formula works for Ohms, volts and Amps (Amperes), whereas here we have *milliamps*. Using the proper units is always a critical factor in these problems, as it is in any measurement situation. You might be 6 feet tall. You most certainly are not 6 inches tall. The number (6 in this case) means nothing unless it's hooked up with the correct unit of measurement. So in our problem milliamps are no good if we want our answer in Ohms (but, as we shall see, they are fine if we want our answer in kilohms).

But this again brings up the subject of prefixes, which is quite a subject indeed. Milli and kilo (and the mega we saw in our last lesson) are examples. They are hooked onto the front of a unit word and completely change the size of that unit. Milli, for example, means thousan*dths*, kilo means thousan*ds*, mega means millions. So 25 mA is 25 thousandths of an Amp (0.025 A). Notice how much shorter the phrase *25 milliamps* is than the phrase *25 thousandths of an Amp*. Also note that with 0.025 you're into decimals, whereas with 25 you are not. Learning to work with prefixes, abbreviations and other shortcuts is mighty important in electronics computations, unless you don't mind taking up lots of space and time in computations that could be done with dispatch.

But to finish our problems, we now know that 25 milliamps is 0.025 Amps, something that we can plug into our formula even if we have not yet learned shortcut ways of handling decimals. R = E/I becomes R = 5/0.025 for our problem. Dividing bottom into top, we get 200. So 200 Ohms is the resistance we want.

Let's check our work. To do so, we'll again use Ohm's Law, but the configuration E = IR. If we've done our work correctly, 5 volts should equal 25 mA times 200 Ohms. Multiply 0.025 x 200 and, sure enough, up comes 5. We must have done things the right way.

Before we jump back into prefixes and decimals to tie things together for this installment of our series, let's take further note of units of measurement, since, as we've already seen, keeping these units straight in our work is pretty important. Notice how we multiplied Amps and Ohms together to get volts! Wow, all different units! That often happens with multiplication and division. The units of measurement of the answer may be entirely different from those of the problem. That's not true of addition and subtraction. If I add so many Ohms plus so many Ohms, I'll get Ohms in my answer. If I subtract so many volts from so many volts, I'll get volts in my answer. The reason you get different units with division and multiplication is that units cancel just like numbers cancel: $\cancel{5} \times 7/\cancel{5} \times 9 = 7/9$. The fives cancel. Or else one unit of measurement is defined in terms of other units so that they can be interchanged with those other units and you're still dealing with the same reality. The thing to remember is that units are handled *logically* in computations. With addition and subtraction, you'll get the same units in the answer as you had in the problem. With multiplication and division, you'll drop some units or get new units, but the units you dropped were canceled out and the new units were just "hidden" in the original units because of the *definition* of those original units. An example: Drive a car at 55 miles per hour for 3 hours and you've gone 165 miles. What happened to the hours? Here's what happened: 55 miles/hour x 3 hours = 165 miles hours/hour. The hours canceled because they were in top and bottom. Note also that when you say *per*, you mean divide. 55 miles per hour means 55 miles/1 hour. That may seem strange, but it all works out very nice and logically.

Another example. 7 miles equals 36,960 feet. How's that? Miles and feet are totally different units! Here's what you didn't see. There are 5,280 feet *per* mile. So we have 7 miles times 5,280 feet/1 mile. The miles cancel and we get 36,960 feet. That kind of thing goes on all the time in electronics. You just take the disappearance and reappearance of units for granted when a multiplication or division is involved.

Now some decimal stuff. There's just no way of avoiding it, though we have skirted around it so far. Perhaps 99% of computations in electronics require good working knowledge of our decimal system.

A decimal system is a *ten* system (from the Latin *decem*, meaning ten). Every time you move to the left, you multiply by ten; every time you move to the right, you divide by ten. In the number 777.7, the left-hand 7 is ten times bigger than the 7 to its right. That one, in turn, is ten times bigger than the one to its right, and so on. 777.7 means 7 hundreds + 7 tens + 7 ones +7 tenths, 700 + 70 + 7 + 7/10.

Naming numbers in our decimal system can be kind of tricky, because there's a variety of ways, all meaning the same thing. 7,700 can be named seven thousand seven hundred, or seventy-seven hundred. 0.025 is normally named 25 thousandths, though it means 2 hundredths and 5 thousandths. Look at the fraction equivalent, and you can see why. 2/100 + 5/1000 = 20/1000 + 5/1000 = 25/1000. Normally numbers smaller than one are named by the last digit to the right. 0.7 (by the way, a zero is usually stuck in before the decimal point just to make sure everyone understands it *is* a decimal point we are dealing with and not a period or something, and that there are no other digits to the left of the decimal) is seven tenths, because the 7 is in the tenths column. 0.93250 is nine-thousand three-hundred and twenty-five ten-thousandths, because the 5 is in the ten-thousandths column (you don't consider zeros to the right of that last non-zero digit, 5 in this case). 0.035 is thirty-five thousandths because the 5 is in the thousandths column. Using prefixes: 325 milliamps (remember, milli means thousandths) is 0.325 A. The 5 goes in the thousandths column because it is the digit to the right. 37 kilohms (remember, kilo means thousands) is 37,000. The 7 is the digit to the right and so goes into the thousands column. You'll notice I snuck one in there. 37 kilohms is not smaller than one! Prefixed numbers follow the rule whether larger or smaller than one.

Fig. 1 shows an unwieldly number, 86,732,174,626.908761435 (that's 86 billion, etc.), with the names of each column written above, just in case you're not familiar with those names. If you wish to test your knowledge, you might try translating that monstrous number completely into words. (Check yourself against the note at the end of this piece.)

You will no doubt recall that the rules for adding and subtracting decimals are pretty simple. You just keep the decimal points directly above and below one another. 3.025 volts + 765 volts + 0.00096 volts becomes:

3.025 V
765 V
+ 0.00096 V

You can fill in zeros if you want. And note that 765 has an invisible decimal point to its right. Any number in our system has that invisible point if none is showing, and you have to make it visible when doing computations. So you might do the problem:

003.02500 V
765.00000 V
+ 000.00096 V
768.02596 volts

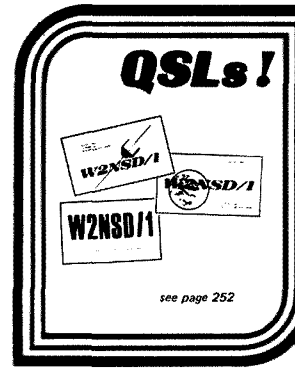
Notice how those decimals are kept in a straight line.

Subtractions are done pretty much as you might expect. 28.966 milliamps - 0.00046 milliamps becomes:

28.96600 mA
- 00.00046 mA
28.96554 milliamps

ten-billions	billions		hundred-millions	ten-millions	millions		hundred-thousands	ten-thousands	thousands		hundreds	tens	ones		tenths	hundredths	thousandths	ten-thousandths	hundred-thousandths	millionths	ten-millionths	hundred-millionths	billionths
8	6	,	7	3	2	,	1	7	4	,	6	2	6	.	9	0	8	7	6	1	4	3	5

Fig. 1.



Abbreviation	Prefix	Size	Examples
p	pico	trillionths	7 pF means 7 picofarads, 0.000000000007 farads
			5 ps means 5 picoseconds, 0.000000000005 seconds
n	nano	billionths	1 ns means 1 nanosecond, 0.000000001 seconds
			3 nF means 3 nanofarads, 0.000000003 farads
μ	micro	millionths	8 μF means 8 microfarads, 0.000008 farads
			9 μs means 9 microseconds, 0.000009 seconds
			6 μV means 6 microvolts, 0.000006 volts
			4 μH means 4 microhenrys, 0.000004 Henrys
m	milli	thousandths	2 mA means 2 milliamps, 0.002 Amps (Amperes)
			5 mV means 5 millivolts, 0.005 volts
			7 mW means 7 milliwatts, 0.007 Watts
			3 mH means 3 millihenrys, 0.003 Henrys
			1 ms means 1 millisecond, 0.001 second
c	centi	hundredths	6 cm means 6 centimeters, 0.06 meters
k	kilo	thousands	9 km means 9 kilometers, 9000 meters
			8 kV means 8 kilovolts, 8000 volts
			4 kW means 4 kilowatts, 4000 Watts
			2 kΩ means 2 kilohms, 2000 Ohms
			3 k$ means 3 kilobucks, $3000!
M	mega	millions	5 MΩ means 5 megohms, 5,000,000 Ohms
			7 MW means 7 megawatts, 7,000,000 Watts
			6 MV means 6 megavolts, 6,000,000 volts

Table 1. Common abbreviations and prefixes.

Note the zeros we threw into both those problems. It's often quite helpful to throw in or take out zeros like that. (Of course, you can't do it in the middle of a number or between the decimal point and some other digits. 706 is not the same as 76. 0.009 is not the same as 0.9. 73,000 is not the same as 73!) Only zeros at the extreme right or left can receive that kind of treatment.

Multiplying decimals is simple enough. Just multiply as though there were no decimal point, then count up the number of decimal places in both the numbers you multiplied and add those two counts. That's how many places are in the answer. Example: 0.000037 Amps x 26,000 Ohms might be done simply:

```
 26,000
   x 37
 182000
 78000
 962000
```

There are no decimal places in 26,000, but there are 6 in 0.000037. So there will be 0 + 6, or 6 places in our answer. It becomes 0.962000, or, dropping those unnecessary zeros to the right, simply 0.962. (Of course, you have to count the 6 places while the zeros are still there.) If that was an Ohm's Law problem, our answer is 0.962 volts.

Decimal division is more difficult. We'll do a couple problems and state the rule at the same time. Problem: 18.73 volts ÷ 6.9 milliamps (remember, that's 0.0069 Amps).

```
0.0069)18.73
```


(1) 00069.
Rule: Move the decimal point of the divisor (the number you are dividing by) all the way to the right.
(2) 69.
Rule: Drop the unnecessary zeros.
(3) 69
Rule: Let the decimal point become invisible.
(4) 187300.
Rule: Move the decimal point of the dividend (the number you are dividing into) the same number of places to the right as you did for the divisor. Add as many zeros to the right as necessary to do this.
(5) 69)187300.
Rule: Put the problem together with these new numbers and set a decimal point for the answer directly above the point in the dividend.

```
        2714.4
(6)  69)187300.0
        138
(7)      493
         483
(8)       100
           69
           310
           276
            340
            276
             64
```

Rule: Paying no further attention to the decimal point, proceed with the division as you would with any other division, putting each digit of the answer above the last digit to the right of the digit or digits you just divided into.

Rule: If necessary to get a decent-sized answer, add zeros to the right of the decimal point in the dividend. (We added one here, even though it was not necessary.)

Rule: If applicable, fill in the space between the decimal point and the first digit to the right with zeros. (This does not apply here, but will in the next problem.)

In the above problem, we stopped dividing after getting one decimal place in our answer. Actually, we could have stopped a lot sooner. Remember (Part I) that you seldom need more than 2- or 3-digit accuracy in electronics. If this was an Ohm's Law problem, an answer of 2700 Ohms would be plenty accurate in most cases.

Let's try another problem, in order to see where the last rule applies: 12.6 volts ÷ 47 kilohms (remember, that's 47,000 Ohms).

```
47,000)12.6
```

(5) 47000)12.6
Rules: Notice that rules 1, 2, 3, and 4 do not apply, since the decimal point is already to the right in 47,000. This brings us to 5, 6 and 7. And note that to apply 6, we first must use rule 7.
(7) 47000)12.600000
Rule: To get 3-digit accuracy, we have to add 5 zeros to the 12.6.

```
(6)               268
     47000)12.600000
             9 4000
             3 20000
             2 82000
               380000
               376000
                 4000
```

Rule: Note where that first digit of the answer goes (above the last digit to the right that you are dividing into that first-step). Very important! Also important: Keep digits directly above or below the correct digits in the subtraction process. That helps avoid errors.
(8) .000268
Rule: If you didn't leave that space for the 3 zeros, your answer would be incorrect.

Our Ohm's Law answer is 0.000268 Amps, which is 0.268 milliamps or 268 microamps.

These divisions can get mighty hairy. That's why next time we'll get into some pretty clever methods for handling divisions and a lot of things that are simply too difficult otherwise.

This brings us finally to abbreviations and prefixes. Look over the Table 1 above rather carefully. There are other abbreviations and prefixes, but these are the common ones. It'll be quite useful to have these stashed away in your mind for future reference.

Now try this exercise. Check yourself against the work and answers at the end of the column.
(1) Solve for the unknown using Ohm's Law:
(a) 750 V, 330 mA, R = ?
(b) 470 Ω, 11 mA, E = ?
(c) 18 V, 2200 Ω, I = ?
(2) In the same way that we did 777.7, break down this number: 17.352.

Note

Answer: Eight-six billion seven hundred thirty-two million one hundred seventy-four thousand six hundred twenty-six *and* nine hundred eight million seven hundred sixty-one thousand four hundred thirty-five billionths!

Work and Answers to Exercises

(1) (a) $R = \frac{750}{.330}$

```
       2,272
330)750,000
    660
     900
     660
     2400
     2310
       900
       660
       240
```

It's best to round answer out to 2300 Ohms.

(b) E = 470 x 0.011

```
 470
 x11
 470
470
5170
```

There are 3 decimal places in 0.011, so the answer is 5.170 or 5.17 volts.

(c) $I = \frac{18}{2200}$

```
       .00818
2200)18.00000
     17 600
        4000
        2200
        18000
        17600
          400
```

Answer: 0.00818 Amps or 8.18 mA.

(2) 1 ten + 7 ones + 3 tenths + 5 hundredths + 2 thousandths, or

$$10 + 7 + \frac{3}{10} + \frac{5}{100} + \frac{2}{1000}$$

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
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Ham curiosity being what it is, I'm sure any of you with HF receivers have chanced across funny-sounding signals on the low end of 80 or 20. By now, you should be aware that the "tweedle-tweedle-dee" you hear is FSK RTTY. This month we shall investigate, in general terms, methods of decoding transmitted RTTY.

To begin with, recall that there are two methods of transmitting RTTY presently in use: FSK and AFSK. When operating AFSK, you are presented with two audio tones, on standard frequencies (2975 Hz and 2125 Hz), regardless of the rf carrier frequency. FSK, however, presents two rf "tones" which, while their relationship is standard (850 Hz or 170 Hz apart), may be any of an infinite number of discrete frequencies.

Logically, our first task is to convert the FSK into something standardized for decoding – AFSK! *Fig. 1* illustrates how one obtains the proper frequencies. Note that the FSK is tuned much in the manner of lower sideband, but that the bfo frequency is set to reproduce the 2 kHz tones rather than speech. For those of you with crystal bfos (such as the Heathkits), a third bfo rock should be used to provide the appropriate offset.

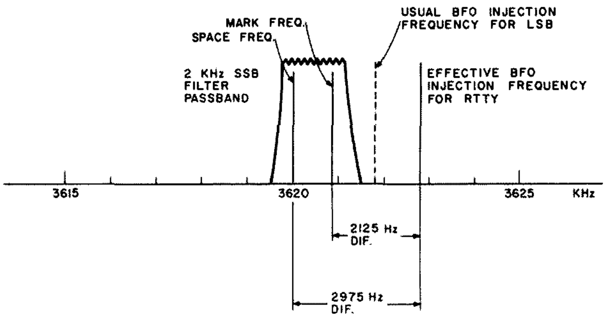


Fig. 1.

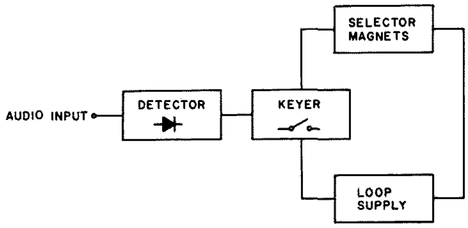


Fig. 2.

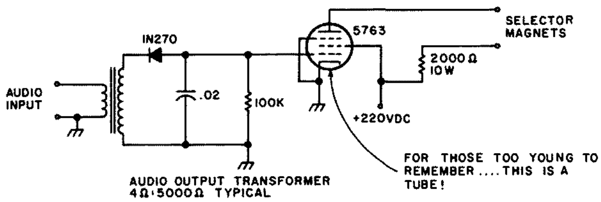


Fig. 3.

By the way, receiving schemes are available which convert not to audio, but to the receiver i-f frequency, typically 455 kHz, and demodulate from there. These systems are analogous to those covered here, but will not be specifically discussed.

So, how do you get the "tweedle-dee" to key your Model 15? Let's take a giant step backward. Remember ON-OFF keying? I told you that would come *in* usefull *Look* at the block diagram in Fig. 2. A tone arriving at the input is "detected," i.e., rectified, and applied to a keying stage. The keying stage is an electronic switch that is closed in the absence of a signal, but opens when such a signal is input. Feeding an ON-OFF keyed space signal into this primitive converter would produce a usable output, or, by keying a relay to invert the signal, on-off mark keying could be used.

Of course, we don't use ON-OFF keying, though, so what can we do? The simplest thing is to tune the HF receiver bfo so that the mark frequency is zero beat. The audio is then an 850 Hz (or 170 Hz) ON-OFF keyed space tone, and can be decoded by the practical circuit shown in Fig. 3. This is one of the circuits constructed and used at WA3AJR during the mid-1960s.

A more advanced approach is to use this basic circuit twice, on both the mark and space signals. By using filters tuned to the appropriate frequencies, each tone may be directed through a detector, and to keyers which would alternate polarity for mark and space. A special relay, called a "polar relay," can be driven off this alternating signal to key the loop. This scheme became known as the "W2PAT" converter, after its daddy, and is block-diagrammed in Fig. 4. With a "combiner" stage added to dispense with the polar relay and key the loop directly, this circuit remains an easy-to-understand way to get into RTTY reception.

Upon this foundation comes a whole raft of demodulator designs. Thoughts and concepts such as limiter vs. limiterless detectors, AM vs. FM techniques, and multiple other refinements have been debated. Additional circuits, such as autostart or character recognition, have been tossed about. Lately, an entire new generation of converters based on phase locked loop technology has arisen. Still, the vast majority of hams active on RTTY got their start on circuits such as covered this month. Only after one understands the fundamentals can one branch out into new areas. We'll explore some of *those* branches *another* time.

A card from Don Griffith WBØNOU was received, asking for a more detailed explanation of "space." Let's see what I can do.

Consider a wire with a voltage on it. This voltage can be either on or off. We will call the "on" state "1" and the "off" state "0". Now, if we start to turn the voltage on and off in a coded sequence, such as the Baudot teletype code, the line will demonstrate a pattern of rapidly changing 1s and 0s. *By convention*, it has become customary to call the "1" "mark" and the "0" "space." Although I used ON-OFF voltages in this example, it could have been OFF-ON keying, positive and negative, high and low, or changes in ac or rf frequency. The words "mark" and "space" denote a logic state difference, just as do "1" and "0". "Space" has *nothing* to do with the "space" character on a teletype. Any system in which a signal is coded as two states could have a "mark" and "space," even Morse code!

An overview of transmitting circuits is up for next time. Meanwhile, if anyone has specific points or questions for future columns, please send them to me at the above address, or in care of *73*.

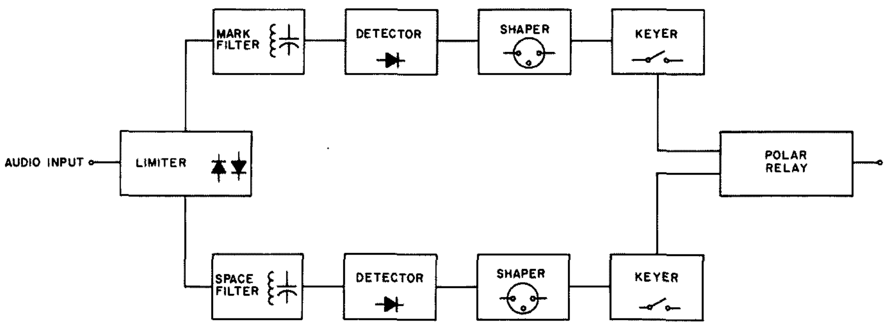


Fig. 4.

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

ARRL 160 METER CONTEST

Starts: 2200 GMT Friday,
December 2
Ends: 1600 GMT Sunday,
December 4

The 7th annual ARRL 160 Meter Contest is open to all amateurs on CW only. Multi-operator work is permitted and scores will be listed separately in the results, but they will not be eligible for certificates.

EXCHANGE:

RST and ARRL section or country.

SCORING:

QSOs with amateurs in an ARRL section count 2 points; QSOs with amateurs not in an ARRL section are worth 5 points. DX to DX QSOs do not count. Multiplier is the total number of ARRL sections (74), VE8, and foreign countries worked.

AWARDS:

Certificates will be awarded for section and non-W/VE country high scores. Division high scores will have their section award endorsed with an appropriate seal.

FORMS:

It is suggested that contest forms be obtained from the ARRL, 225 Main St., Newington CT 06111. Check sheets are not required, but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last year's contest. For complete rules, see the November issue of QST.

CONNECTICUT QSO PARTY

Starts: 2000 GMT Saturday,
December 3
Ends: 0200 GMT Monday,
December 5
Rest Period: 0500 to 1200 GMT
December 4

The Candlewood ARA has moved its 15th CT QSO party from the traditional first of May to the first weekend of December in an effort to find a time when band conditions are favorable and when other events are minimal. Phone and CW are considered to be the same contest. Stations may be worked once on each band and mode. Out-of-state portables and mobiles operating in CT are requested to identify themselves as such. Counties certificates will be awarded to each station working all 8 CT counties.

EXCHANGE:

QSO number, RS(T), and ARRL section or CT county.

FREQUENCIES:

SSB – 3925, 7250, 14300, 21375, 28540.

CW – 40 kHz up from bottom of each band.

SCORING:

Non-CT stations multiply total number of CT QSOs by number of CT counties worked (8 max.). CT stations multiply total number of QSOs by number of ARRL sections and provinces. Additional DX contacts count for QSO points, but only one DX multiplier is allowed overall. Q1QI, the club station, will be operating CW on odd hours, and SSB on even hours, and counts as 5 QSOs on each band and mode.

ENTRIES:

Logs must show category, date, time (GMT), calls, numbers, bands, QSO points, and claimed scores. Enclose a large SASE for results. Send logs, postmarked by Jan. 15, to CARA, c/o Fred Porter W1VH, 169 Carmen Hill Rd. Nr. 2, New Milford CT 06776.

TOPS CW CONTEST

Starts: 1800 GMT
Saturday, December 3
Ends: 1800 GMT
Sunday, December 4

General call is "CQ QMF." Entry classes for single/multi-operator. Use 3.5 to 3.6 MHz band only; use low end of band for DX-CW only!

EXCHANGE:

RST and serial number from 001.

SCORING:

Contacts with own country = 1 point; each call area in W/K, VE/VO, VK, and UA count as separate countries. Contacts with stations in same continent count 2 points, other continents = 5 points. Contacts with HQ station GW8WJ or GW6AQ count 25 points. Total score is total number of QSO points times number of prefixes worked (as per WPX award rules).

ENTRIES:

Send logs to Peter Lumb G3IRM, 14 Linton Gardens, Bury Saint Edmunds, Suffolk IP33 2DZ, United Kingdom.

How about some US participation this year? There wasn't a single entry from North America last year!

ALEXANDER VOLTA RTTY DX CONTEST

Starts: 1200 GMT Saturday,
December 3
Ends: 1200 GMT Sunday,
December 4

Two-way RTTY contacts between stations of the same country are not valid. All 2-way RTTY contacts with stations in one's own zone will count 2 points; those outside one's own zone count for points in accordance with the exchange points table. All 2-way RTTY contacts made on 7 MHz are worth double; those on 3.5 or 28 MHz are worth triple points. Stations may only be worked once per band. A multiplier of one is given for each country contacted on each band. Total score is total exchange points times the total number of multipliers times the total the total number of QSOs. Italian bonus points are added last – 1000 points for each I/IS/IT contact on all bands. Note: Each US, Canadian, and Australian District will be considered a separate country! Exchange consists of message number, RST, and zone. Use one log per band. Log forms, score sheets and exchange points table are available for IRCs. Logs must be received before Jan. 20, 1978, to qualify (advisable to use air mail). Send logs and score sheets to: A. V. RTTY DX Contest Committee, SSB & RTTY Club, PO Box 144, 22100 Como, Italy.

This contest is open to SWL RTTYers as well, and the same rules apply as used for transmitting stations; a separate results table will be made for these entries. Contest awards include callbooks, plaques, books, etc. In addition, points and positions achieved in this contest will be valid for inclusion in the "World RTTY Championship" for 1977.

Club station I2LLO will transmit a special message for 10 minutes at 2350 GMT Saturday, December 3, on 21.100 MHz at 300 Watts 170 Hz FSK, 45 baud. A special prize will be forwarded each amateur submitting a copy of the message transmitted.

ARRL 10 METER CONTEST

Starts: 1200 GMT Saturday,
December 10
Ends: 2359 GMT Sunday,
December 11

The contest is open to all amateurs worldwide. All QSOs must take place on 10 meters, and OSCAR QSOs are valid. Each station can be worked on phone-to-phone and CW-to-CW, and anyone can work anyone. All CW contacts must be made between 28.0 and 28.5 MHz, unless working through OSCAR. When operating on 10 meters, please avoid the OSCAR downlink frequencies.

CLASSES:

Entries will be classified as either single- or multiple-operator stations. Multiple-transmitter stations are not allowed.

EXCHANGE:

All W/VE stations will send RS(T) and state or province. Others will send RS(T) and consecutive serial number starting with 001. Stations that are not land-based will send RS(T) and ITU Region (1, 2 or 3). The District of Columbia is counted as part of Maryland.

SCORING:

Each completed QSO counts 2 points, or 4 points if with a W or K Novice. The multiplier is the sum of the total number of states, Canadian call areas (max. 9), ARRL countries (not US or Canada), and ITU regions from non-land-based stations. Final score is the sum of the QSO points times the total multiplier.

AWARDS:

A certificate will be awarded to the highest scoring single-operator station in each section, Canadian call area, and foreign country. Region awards for non-land-based stations, and awards for multi-operator and Novice stations will be issued if warranted.

FORMS:

It is suggested that contest forms be obtained before the contest from the ARRL, 225 Main St., Newington CT 06111; include an SASE. Check sheets are not required, but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last year's contest. For complete rules, see the November issue of QST.

HUNGARIAN DX CONTEST

Starts: 1600 GMT Saturday,
December 10
Ends: 1600 GMT Sunday,
December 11
(Unofficial)

The contest is sponsored by the Hungarian Radioamateur Society and is open to any licensed radio amateur. All amateur bands from 80 to 10 meters may be used on CW only. General call is "TEST HA," while Hungarians will give "TEST WW." Entries may be in any of the following classes: single op, single band; single op, multi-band; or multi-op, multi-band.

CALENDAR

Dec 3-4	**ARRL 160 Meter Contest**
	TOPS CW Contest
	Alexander Volta RTTY Contest
	EA Phone Contest
Dec 3-5	**Connecticut QSO Party**
Dec 10-11	**ARRL 10 Meter Contest**
	EA CW Contest
	HA DX Contest
Dec 17-18	**SOWP CW Christmas party**
Dec 31	**Straight Key Night**
. . . 1978 . . .	
Jan 14	**Hunting Lions in the Air Contest**
Feb 11-12	**Ten-Ten International Net Winter QSO Party**
Aug 19-20	**NJ QSO Party**

EXCHANGE:

RST and continuous serial number from 001. After their signal report, Hungarian stations will give a two-letter code for their location (county) as follows: BA, BP, BE, BN, BO, CS, FE, GY, HA, HE, KO, NO, PE, SA, SO, SZ, TO, VA, VE, ZA.

SCORING:

Each HA QSO counts 1 point. The same station may be worked only once per band. Each different HA county worked counts 1 multiplier point per band. Final score is total QSO points times sum of multiplier points from each band.

ENTRIES:

Logs must be made in usual form with summary sheet and signed declaration. They should be mailed within 6 weeks after the contest to: Radio Amateur League of Budapest, H-1553 Budapest, P.O. Box 2, Hungary.

AWARDS:

Certificates to first place station from each country in each class or section. Additional places if warranted.

1977 CW CHRISTMAS PARTY

The Society of Wireless Pioneers (SOWP) is planning a membership Christmas on-the-air CW QSO Party for the weekend of December 17 and 18, 1977. The party will cover the full GMT period to allow members around the world to participate. This will be the second Christmas on-the-air party held by the Society.

The purpose of the affair will be to give members an opportunity to meet on the air and to exchange Season's Greetings. There will be no formal exchange requirements and no need for members to submit logs, etc.

All members with amateur licenses are being encouraged to take part. The call will be CQ SOWP. While there will be no certificates or other awards given, everyone who takes part will be a winner by having an opportunity to renew old friendships, establish new ones, and continue a camaraderie developed over the years.

Suggested frequencies for the party are 55 kHz up from the low end of each amateur band. Additional information about this party and the Society can be obtained from the Party Coordinator, Bill Willmot K4TF, 1630 Venus Street, Merritt Island, Florida 32952.

ARRL STRAIGHT KEY NIGHT
0100-0700 GMT Sunday, January 1

Check *QST* for any changes in the rules!

Basically, rules require the use of a straight key only. Send "SKN" instead of "RST" during QSOs, to help identify contest stations. On 80-40-20 meters, try 060 to 080 kHz up from the bottom edge of the band. On Novice bands, try 10 kHz up from the bottom of the Novice band. After the contest period, send a list of calls of the stations contacted during the contest period, plus your vote for the best fist heard. Please mail entries as soon as possible to the ARRL, 225 Main Street, Newington CT 06111.

WORKED ALL NEW ENGLAND AWARD

For working stations in each of the 6 New England states on 50 MHz band or higher. Endorsements on request for all ATV, SSB, CW, OSCAR, etc. All contacts must be on or after Jan. 1, 1976. W/K1 stations work two stations from each state, other work only one station in each state. Send log consisting of date, time, call, name, and state, along with check or money order for $1.50 (DX send 2 IRCs) to: Worked All New England Award, Ronald Pariseau, Chairman, R1 Box 213A, Thompson CT 06277. Make checks payable to Ron Pariseau, Chairman.

TRI-STATE CERTIFICATE

Award is for working stations in the Tri-States of Connecticut, Massachusetts, and Rhode Island. Contacts must be made on or after Jan. 1, 1977. W/K1 stations must work three stations from each state; other call areas and DX stations work one station from each state. QSLs must be in your possession, but need not be sent with application. Cards may, however, be requested later. Log will consist of date, time, call, name, state. The award is open to all amateurs on all bands; hand-written endorsements are available on request. Send logs and $2.00 check or money order to: Tri-State Amateur Radio Club, Award Committee, Box 213A R1, Thompson CT 06277.

RESULTS

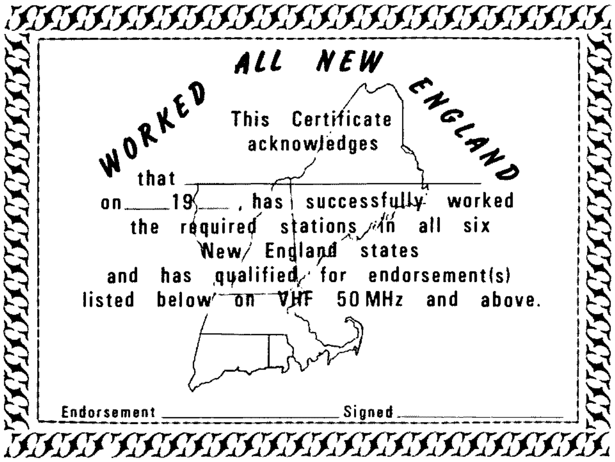
RESULTS OF THE TEN-TEN INTERNATIONAL NET SUMMER QSO PARTY — JULY 16-17, 1977

Single Op stations:

U.S. District		
1	W1MR	346/655
	WA1QHS	260/493
2	WA2YYT	548/1013
	K2FW	525/967
3	W3RJ	1041/1871
	WA3YRM	800/1460
4	K4XS	1046/1897
	WB4CHK	716/1316
5	WA5JDU	555/1057
	W5RRR	404/777
6	WA6LLW	350/641
	W6ED	336/638
7	WB7NCD	448/825
	WB7AEB	414/772
8	WB8FAG	507/937
	WB8EDG	253/485
9	WA9IXF	418/784
	WA9PQY	284/539
Ø	WBØQHV	719/1335
	KØJN	632/1178
Multi-Op:		
	W9NIN	501/925
VE District		
1	VE1ASU	122/229
2	VE2DZO	252/445
	VE2ADZ	109/206
3	VE3HHS	125/233
	VE3JHA	69/134
4	VE4VV	197/371
	VE4OY	116/221
6	VE6BCC	73/139
7	VE7CMK	223/414
	VE3CXL/7	39/74
DX		
	ZF1AK	105/199
	KP4DQN	20/39
	LU7FAG	86/162
	LU6DMZ	45/84
	DK5UG	11/16
	JH3BJG	2/4
	JR3GDY	1/2
	VK4JP	52/62
CW Winners:		
	W5SQW	72/93
	WB4NWG	23/29
	N9DP	8/10

Chapter Winners:

Colorado 10-10	6942/13425
White House	6347/12144
Gateway	5599/10819
Bay Area	5634/10653
Devil's Triangle	4121/7769
Mo-Kan Tenners	3338/6366
CATT	3304/6293
North Georgia	2588/4815
So. California	2458/4636
LIARS	2366/4513



RESULTS

RESULTS OF 1977 NJ QSO PARTY

NJ winners:

Bergen	WA2GMO	2,970
Burlington	N2MM	30,690
Cape May	W2VMX	546
Essex	K2TA	12,208
Gloucester	N2CQ	5,292
Hunterdon	W2GD	16,400
Middlesex	WA2NPP	64,253
Monmouth	WB2GXR	17,697
Morris	WA2EPK	8,360
Ocean	WB2VWW	9,328
Passaic	N2SU	16,352
Somerset	WA2EJZ	1,586
Sussex	WB2KBH	10,896
Union	WB2FUE	2,187

Top out-of-state scores:

K3UEI	E. PA	3,171
W2TND/1	NH	2,000
W6ZT/3	W. PA	1,748
W2FVS	NYC-LI	1,674

New Products

SINGLE CMOS CHIP MAKES INEXPENSIVE 3-3/4 DIGIT PANEL METER

A new addition to the National Semiconductor data conversion line is the "ADD3701," a single CMOS integrated circuit which requires only a display, an external voltage reference, and a digit driver to form a complete 3-3/4 digit DVM (digital voltmeter) that reads up to 3.999 units.

Manufactured using standard CMOS technology, the ADD3701 is an extended-range version of National's "ADD3501" 3½ digit DVM introduced earlier this year, with readings up to 1.999. The additional range of the new DVM chip expands the applications of the device into areas where a reading of 1.999 isn't high enough, such as weight measurement on bathroom scales and measurement of degrees of rotation or temperature.

The ADD3701 utilizes a single five-volt supply to drive a multiplexed seven-segment output directly, and features differential input protection to 200 volts. Overrange condition is displayed by "+OFL" or "-OFL" indication, depending upon whether the input voltage is positive or negative.

The 3701 also features auto-polarity and an on-chip clock that eliminates the need for an external signal timing circuit. This internal oscillator can be set by an external RC network, or the oscillator can be driven from an external frequency source.

When using the external RC network, a square wave output is available. It is important to note that great care has been taken to synchronize digit miltiplexing with the A/D conversion timing, to eliminate noise from power supply transients.

A pulse modulation analog-to-digital conversion method is used, requiring no external precision components. The seven-segment outputs are capable of delivering up to 40 milliamps per segment, making the ADD3701 ideally suited to drive 0.5-inch and 0.7-inch common cathode LED displays. The price of the model "ADD3701CCN" is S11.95 when purchased in lots of 100. Delivery is from stock. *National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051.*

THIRD HAND

That's what you need when you are working on PC boards — they just won't hold still. One of our readers out in Hawaii came up with a little clamp arrangement (which is being marketed by a firm in California) called the 3rd Hand. You clamp one part of it to your table, anything from 3/4" to 1½" thick, and then clamp the other part of the gadget to the PC board. There is a piano hinge between the two parts so you can flip the PC board over and work on both sides.

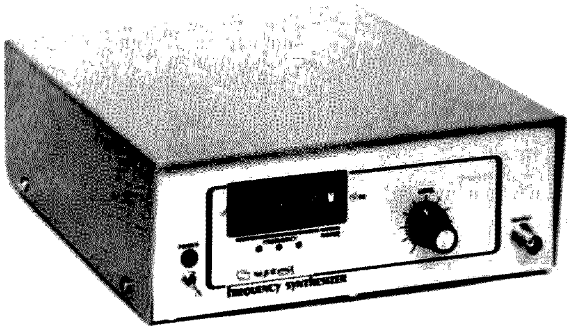
It sells for S6.95 plus postage, tax, etc. *3rd Hand, Box 60579, Sacramento CA 95860.*

TERMINAL STRIPS FOR PC BOARDS

The TS series of terminal strips provides solderless termination of wire leads via positive screw-activated clamping action. Strips are available with 4, 8, or 12 positions, and accommodate wire sizes 14-30 AWG (1, 8-0, 25mm). Pins are silver-plated brass, .040 inch (1mm) diameter, on .200 inch (5mm) centers. Features include unbreakable polyamid bodies and consecutively numbered terminals. Rated 10 Amps at 300 V. In stock for immediate delivery from *O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx, New York 10475.*

SYNTEST SI-101 FREQUENCY SYNTHESIZER

The Syntest Corporation Model SI-101 frequency synthesizer provides excellent general purpose performance at low cost. Typical applications for the Syntest SI-101 instrument include use as a calibration standard for test instrumentation, as a precision programmable clock for systems use, and for the alignment of active filters.



Syntest's Model SI-101 frequency synthesizer.

The Model SI-101 features 4½ digits of resolution from 0.1 Hz to 16 MHz. A high stability internal reference oscillator, ±10 PPM over the temperature range 0-50° C, and fast programming highlight this versatile instrument. The synthesizer provides a continuously adjustable 50 Ohm TTL output. The unit is completely solid state and incorporates a rugged power supply for high reliability.

Power requirements are 115 or 230 V ac, rear panel switch selectable, at 5 W maximum consumption. The SI-101 is housed in an attractive 8.50" W x 3.20" H x 9.00" D enclosure.

An industry standard RETMA rack mount adaptor, as well as a ±1 PPM reference oscillator, are offered as options. Custom configurations are available from the factory.

Price of the Syntest SI-101 frequency synthesizer is $459.00 in unit quantities and availability is stock to 30 days. *Syntest, 169 Millham Street, Marlboro MA 01752.*

NEW 1978 RADIO SHACK CATALOG #289 ISSUED

The new 1978 Radio Shack Catalog, the company's 30th consecutive issue, is now available from Radio Shack stores and dealers, nationwide.

The 164-page catalog includes 100 full-color pages describing the company's exclusive line of products for home entertainment, hobbyists, CBers, and experimenters.

An insert card in the catalog introduces Radio Shack's new TRS-80 Microcomputer System, which, according to Radio Shack president Lewis Kornfeld, is "the most important product ever offered by Radio Shack."

"The TRS-80's importance," Kornfeld stated, "goes far beyond the mere design, construction, and sale of the fine piece of electronic merchandise. Primarily, it signifies the dawn of the microcomputer age in respect to availability and affordability to ordinary people, schools, and businesses every-

National Semiconductor's ADD3701 single CMOS chip.

where, even for personal use and entertainment.

"Secondarily, the TRS-80 should convince millions of folks that Radio Shack is a technological company as well as a marketing company."

The new catalog also includes coupons offering two Supertapes, either reel-to-reel, 8-track cartridge, or cassette, for the price of one, two P-Box kits for the price of one, and any of the company's project boards for half price.

Among the new items introduced in the catalog are 40-channel Realistic CB two-way radios and a selection of electronic calculators ranging in price from $8.88 to $109.95 for a rechargeable printing calculator with full memory.

The new catalog also lists hundreds of specialized electronics items, parts and accessories, tools, tubes, semiconductors, wire and cable, intercoms, microphones, timers, batteries, and a complete library of Radio Shack's own books on electronics and related subjects.

Radio Shack's 1978 Catalog #289 is available free on request from Radio Shack stores and dealers, nationwide.

Radio Shack, a division of Tandy Corporation (NYSE), has more than 6,000 stores and dealers in all 50 states and Canada, and nearly 500 stores overseas operating under the name Tandy International Electronics. *Tandy Corporation, 2617 West Seventh Street, Fort Worth TX 76107.*

CLEGG COMMUNICATIONS PROFILE

It was a nice day in early May, a nice day to take a ride from Valley Stream, New York, where I was staying, to a more pleasant place. Early in the morning, I drove into Brooklyn to pick up Larry, who had agreed to leave his homemade computer for the day and act as my photographer on this assignment. Our destination some 90 miles away – Lancaster, Pennsylvania, the home of Clegg Communications and the man behind the name, Mr. Edward T. Clegg W3LOY.

The three-hour ride from Brooklyn gave us a chance to reminisce about the old days, the time when VHF meant six meter AM, a time when Clegg reigned supreme. I can remember it as if it were yesterday, though it's now over 16 years ago. I remember my very first transceiver – a rather pretty gray and white box that ran 7 Watts at 100% modulation and featured a super sensitive state-of-the-art (of that day) receiver that gave the popular receiver/converter combinations a good run for the money. I remember placing this little box atop Larry's SX-28 and Techcraft converter to make a comparison. I can even picture the expressions on our faces when we found that the transceiver could hear as well as the Techcraft SX-28 combo. Not a very scientific test, I will admit, but for a pair of teenagers, it was all we needed to be convinced. The radio we literally fell in love with was known as the 99er, and it came from the man we would soon see. The Clegg 99er – a radio that set the industry and six meters both on their proverbial ears, especially when it came on the market at a price that was half of anything comparable.

The 99er was not the first radio from Clegg, nor was it to be the last. Fact is, Ed Clegg was designing and marketing VHF communication equipment for amateur use well before most of the competition considered it fashionable. The 99er was my first personal exposure to the famous "Clegg line," a line of amateur VHF equipment that down through the years has always managed to stay a jump or two ahead of competitors. There was the Thor VI – 60 Watts AM with a VFO that automatically tracked the transmitter to the receiver (commonplace today in HF and VHF SSB, but this was the early sixties and six AM). SSB came to six in the mid-sixties, and one of the first entries was the Venus and its matching Apollo linear amplifier. And who can ever forget the Cadillac of VHF – the radio twins that meant you were on the top – the Clegg Zeus transmitter and matching Interceptor receiver.

When we found FM and two meters, Clegg had already discovered it. The AM 22er gave way quickly to the 22er FM, which eventually itself gave way to the first fully synthesized radio to hit the US marketplace – the famous FM-27, 27A, and 27B. These radios, five to seven years old, still bring a pretty penny at resale time. The FM-27 series of radios was designed to last as long as two meters lasts, regardless of what band plan or split may be in use. It would work anywhere, and that sold it. Soon though, in many cities, two meters was bulging at the seams with activity. What to do? Move up, up to 220 MHz. Again, Clegg was first with his FM-21, a radio that used but one crystal to get both the transmit and receive channels. The FM-21 that . . . we're here . . . the time has flown.

Not one to tarry, Larry set to work photographing everyone and everything in sight while I sat down to eyeball with Ed. We spoke of many things – pending rulemaking, the ARMA organization that Ed is a member of, and finally, the current line of equipment. No matter how much or how little you have to spend, there is a radio in the Clegg line to fill your need. AM has given way to FM, and the entire line shows this. Two meters? We start with the MK-3 – fifteen Watts and twelve channels in a neat little box that comes complete with mic, mic hanger, and mounting bracket. The receiver is double conversion and the price is well under the $200 mark.

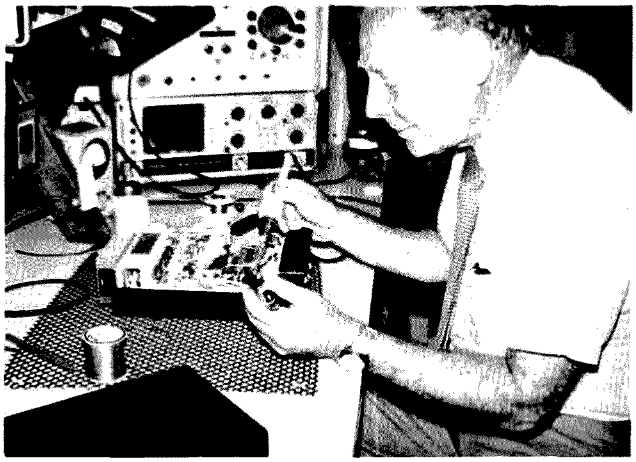
Want to be able to work any channel you desire and never have to purchase a crystal? Clegg has two radios that will meet your criteria. At around the $350 mark, there is the FM-28. For your money, you get full 144 to 148 MHz coverage, LED readout, 600 kHz up/down for repeater use, option of other offsets, 5 kHz split ability for repeaters on tertiary channels, and one of the best sounding transmitters found on the air these days.

Top of the Clegg 2 meter line is the FM-DX, a radio that has become a legend in its own time. Fully digitally synthesized with 40 Watts out and coverage from 143.5 to 148.5 MHz, letting the owner work MARS services if he is so associated, along with every other feature that the avid two meter FM enthusiast might want (except a built-in tone pad), the FM-DX is a radio appreciated by many discriminating amateurs. It's not inexpensive, but even at its approximate $600 price, it's well worth the money. Those amateurs who own the FM-DX will settle for nothing else. That says a lot in itself.

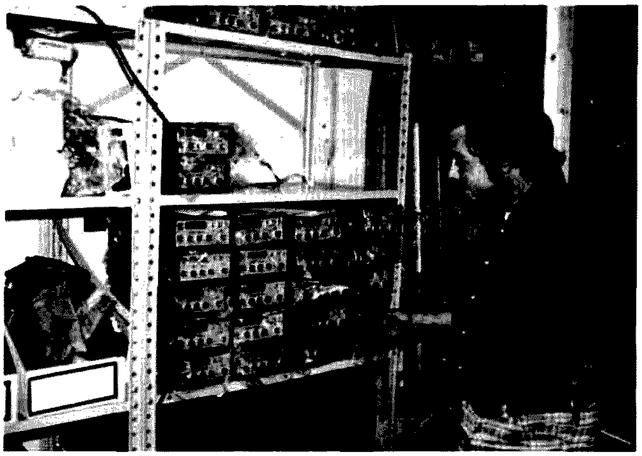
Not that two meters is the only interest of Ed Clegg and his company. Two meters in many places is getting really crowded. With an eye to the future, about five years ago Clegg was the first on the market with a 220 MHz radio designed and priced for the

Continued on page 55

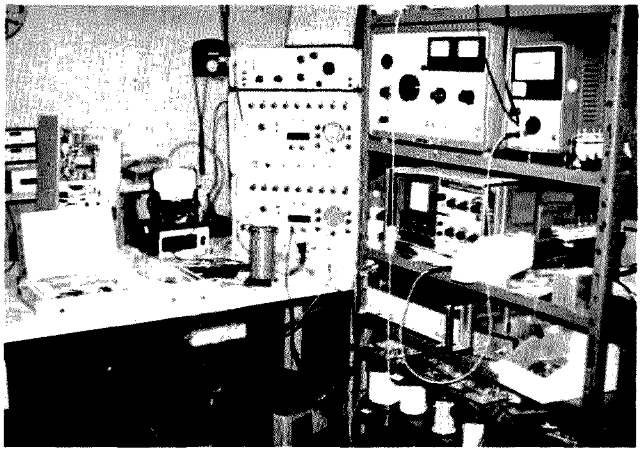
Photos by Larry Levy WA2INM



Ed Clegg – servicing what he sells.



WA6ITF eyes the world's largest collection of FM-DXs, all ready for delivery.



One of the complete service facilities at Clegg's Lancaster PA factory.

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

The news about 21033 first reached this area at about 7:30 pm on the evening of September 23, in the form of a telephone call from Jay O'Brien W6GO to Jim Hendershot WA6VQP, current SCRA chairman. It took everyone quite by surprise.

THE BIG CHANGE IS ON TWO

Probably of most significance to the average ham is the deregulation of a second subband on two meters for relay communication. This does not mean that repeaters *must* be placed in the segment from 144.5 to 145.5 MHz. Rather, it gives us the *option* to do so if we wish. In deregulating this new subband, the FCC has alarmed many of the amateurs who specialize in other aspects of VHF, such as SSB, EME experimentation, and local AM rag chewing. Needless to say, these people have been less than enthusiastic about this change, and in some areas organized non-FM groups have already declared "war" on any attempt to channelize this portion of two meters and assign repeaters to it. While no FM group wants such a confrontation to develop, it is likely to happen in some places.

Coordinators probably face their biggest challenge yet. Not only must they deal with the needs of those amateurs involved in relay communication, but they also will have to come to terms with non-relay-oriented groups. Remember, during the early days of coordination, councils were dealing for the most part with spectrum that was usually vacant and unused.

Groups of amateurs involved in non-relay communication have banded together over recent years in an effort to preserve their special interests and help foster the growth of such interests. A well-known and successful Texas organization of this kind is Sidewinders-On-Two. Here in Southern California, we now have a local chapter of SWOT, and this organization has been growing. To do well, the coordinator of today must deal with the needs of the non-relay-oriented amateurs on a basis equal to that of those involved in FM relay communication.

TWO METER BAND PLANS

In the five days since the deregulation, several potential band plans have been proposed. There is the right-side-up 20 kHz plan with built-in protection for non-FM interests, already adopted by the Northern Amateur Relay Council at a meeting on 9/25/77, at least two 30 kHz plans following the system used between 146 to 148 MHz (with the only difference between the two being which way the 15 kHz splits will go), and, finally, the proposal that 100 kHz translators, rather than repeaters, should be coordinated within that spectrum so as to be compatible with existing and future activity. Only the NARC 20 kHz plan and the translator idea take any great pains to protect the interest of already existing activity. The other plans seem to look out mainly for the welfare of those involved in repeaters.

As outlined by Jay O'Brien W6GO, here is the NARC plan, along with their reasons for adopting it: There would be twenty repeater channels with 600 kHz input-output spacing. 144.9 through 145.1 MHz would be left open for direct (simplex) communication of any kind. Repeater inputs would be 144.51 through 144.89 MHz. Repeater outputs would be 145.11 through 145.49 MHz. Channel spacing would be 20 kHz.

Rationale: 1) since the FCC did not allow the Technician SSB activity to relocate to 144.0 MHz, the present activity at 145.0 MHz is respected by the provision of the 200 kHz non-FM band; 2) channel spacing was selected to provide 20 completely usable channels spaced 20 kHz, instead of 26 unsatisfactory channels spaced 15 kHz – they were persuaded not to repeat the 15 kHz spacing error made in the 146 to 148 MHz band; 3) input low was chosen to place possible intermodulation products in the repeater band rather than in the 144.0 to 144.5 or 145.5 to 146 MHz segments.

As far as "band plans" go, this is the first to be adopted by any coordination group. It's a good one technologically-speaking, and tries to serve the needs of the non-FMer. To date, it's the only one that has met with any degree of acceptance from the non-FM amateur community.

While NARC went out of its way to give protection to non-FM interests, not everyone has. For instance, a plan similar to the NARC plan calls for the same 20 repeaters, the same 200 kHz in/out separation, and the same 20 kHz spacing between systems – but it also specifically channelizes 144.9 to 145.1 again on a 20-kHz-between-channels basis for FM point-to-point communication *only*. This is a selfish attitude, and one that any sane coordinator must avoid like the plague. Adoption of channelized FM operation in the 144.9 to 145.1 spectrum would lead to wars.

There has been but one good 30 kHz plan to date. It calls for 30 kHz between systems, 600 kHz between input and output, inverted 15 kHz channels for additional repeaters, and a non-FM simplex band between inputs and outputs. The major problem with this is twofold. First, while yielding a total of 26 possible additional repeater pairs, past experience has proven that 15 kHz splits, even when inverted, are marginal at best. The 15 kHz split was born out of necessity in the 146 to 148 MHz spectrum, when we ran out of 30 kHz pairs. The east coast went right-side-up, placing the selectivity burden on the user's receiver, while out west we went inverted, feeling that it was easier for repeaters to solve these problems than for thousands of users. Time has proven us right, and even the ARRL now endorses the inverted plan. However, since we have a chance to do it right this time, why not do it right? 30 kHz with 15 kHz splits gives quantity, but wouldn't we do better with 20 quality systems?

THE LINEAR TRANSLATOR ISSUE

Do we really need more 2m FM repeaters? Here in Southern California, and in some Texas circles as well, consideration is being given to the implementation of coordinated 100 kHz linear translators compatible with any and all modes of operation that any amateur might want to use. Unlike with channelized repeater operation, translators permit an amateur to "roam free," VFO-controlled, to locate the person or persons he may choose to QSO with.

In essence, a translator is a wide band repeater that has the ability to "repeat" individual signals it hears in one given segment of spectrum, on an individual basis, to a specific point within another given segment of spectrum. A good example of this is the OSCAR satellites. These spacecraft contain translators which listen on 430 MHz or two meters and "repeat" *individual signals* heard back to Earth on either two meters or 10 meters, depending upon the mode in which the OSCAR is functioned.

Translators in the amateur service have previously been crossband, like OSCAR. Are in-band translators possible for a 600 kHz separation between input and output? Experts disagree. It would be a challenge worthy of amateur radio pioneers.

220: TWO METERS, YOU'RE NOT ALONE!

While this deregulation will not affect 220 in many places for a while, here in Southern California we are already into multiple coordinations in that band. For some time, the SCRA has been under pressure to start the coordination of repeaters below 222.30 MHz. There has also been an opposing pressure from non-repeater groups such as the Los Angeles 220 Association. So where do we put all the link and control channels wanted on 220? There is no room on 450 for them, and there is already a lot of money tied up in equipment. Southern California already has over 300 repeaters operational on 146 and 220. Just how many more systems are needed, anyhow? Every week, the SCRA gets at least a half dozen requests for repeater frequencies on 146 or 220. Most of these requests are for wide coverage systems rather than the local type (which are really what are needed). Where do you put them? What do you say to them? When will it end?

On 220, simplex is alive and well in the form of the 220 Rag and Tech Net. These chaps are determined to perpetrate the current SCRA band plan. They make no bones about it; they will not accept further relay operations, other than remote base stations which are compatible with simplex. At present, they are about equal in number to the repeater enthusiasts, and just as technologically competent. The SCRA and 220 simplexers have been getting along well with each other so far. This may be an area in which the translator concept might work. This problem is already in the hands of Tom Rutherford's SCRA 220 Technical Committee and the delegates of the 220 simplex group.

WHERE'S 450 IN ALL THIS?

With the emphasis on two meters and 220, the simultaneous deregulation of 420 to 450 MHz has been lost in all this. What about 450? What will happen there? The Southern California Repeater and Remote Base Association, which coordinates the 420 to 450 MHz spectrum, has issued no comment to date. The unofficial input indicates that little will change. UHF relay enthusiasts seem quite elated at the deregulation aspects of portable and mobile operation of auxiliary link stations, as this is important to successful remote base system operation. Otherwise, local UHF people involved in relay communication have been very silent on the entire issue.

GOODBYE WR

I can still remember the verbal abuse aimed at the FCC in the early '70s when we found out that we had to get a special WR call for our repeaters. We hated them at first . . . but . . . lo and behold . . . now that the time has come to place them to rest . . . what's this? . . . abuse again!

THE FINAL WRAPUP

Obviously, this has been written in great haste. It's been based upon personal contacts with amateurs around the nation as well as here in California. If it seems to dwell on what California faces and how it's meeting the new challenge that is inherent to this deregulation, it's only because California really typifies what is probably happening nationwide. Since I am part of it, it is easier to be accurate in writing about it. I am sure that in these pages, now and in coming months, you will be reading much about the feelings of others on all that has transpired.

If I seem down on repeater expansion, it's only because I really wonder just how many repeaters any one area needs to serve its amateur population.

Perhaps it's time that we amateurs take another step forward and do something truly constructive, something that amateurs generations from now will look back upon with pride. Whether it be translators or some other exotic device not dreamed of yet, the FCC has given the amateur of 1977 a chance to be again looked upon as the technological communication leader. It's in our hands.

FCC

DOCKET 21033

1. Repeater, auxiliary link and control stations eliminated.
   - Immediate freeze on filing repeater, auxiliary link and control station license applications.
   - Applications for new repeaters on file dismissed.
2. Portable and mobile operation of auxiliary links approved.
3. No more "WR" callsigns for stations in repeater operation.
4. Stations operating as repeaters have to identify with the word "repeater" on phone or the letters "RPT" on CW, in addition to the station callsign.
5. Stations operating as auxiliary links have to identify with the word "auxiliary" on phone or the letters "AUX" on CW, in addition to the station callsign.
6. ID interval increased from 5 to 10 minutes.
7. Transmissions from open-access automatically-controlled repeaters need no longer be monitored or recorded.
8. 144.5-145.5 MHz and all frequencies above 220 MHz made available for repeaters (except 435-438 MHz).
9. Technicians given privileges on 144.5-145.0 MHz.
10. No action on priority in frequency use, erp.

PART 97—AMATEUR RADIO SERVICE

Simplifying the Licensing and Operation of Complex Systems of Stations and Modifying Repeater Subbands in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is revising its amateur radio rules to eliminate separate licenses for repeater, auxiliary link, and control stations. We are also allocating additional frequencies for amateur repeater operation, and we are making minor revisions of the rules concerning logging and identification for stations in repeater operation and remotely controlled stations. Adoption of these rules will afford amateur licensees greater flexibility in their operations.

SUPPLEMENTARY INFORMATION: In the matter of Deregulation of Part 97 of the Commission's Rules to simplify the licensing and operation of complex systems and stations and modify repeater subbands in the Amateur Radio Service (Docket 21033, RM-2664, RM-2780). Report and Order (Proceeding Terminated).

Adopted: September 21, 1977.

Released: September 27, 1977.

WHAT IS THE BACKGROUND OF THIS PROCEEDING?

1. In a Notice of Inquiry and Notice of Proposed Rule Making in Docket 21033 released January 6, 1977, 42 FR 2089 (1977), the Commission acted partially in response to rule making petitions RM-2664 and RM-2780, submitted by Messrs. Gordon Schlesinger and William F. Kelsey and The Middle Atlantic FM and Repeater Council (T-MARC), respectively, and partially on its own motion. The Commission proposed substantial revisions to Part 97 of its Rules, 47 CFR 97.1, et. seq., concerning the licensing and operation of repeater, auxiliary link, and control stations in the Amateur Radio Service. Other proposals concerned the licensing and operation of remotely controlled stations in the Amateur Service. Comments on our proposals were due no later than April 1, 1977. Reply comments were due no later than April 15, 1977. The deadline for the submission of reply comments was subsequently extended by the Chief of the Commission's Safety and Special Radio Services Bureau to April 29, 1977. We are now prepared to take action on our proposals in this proceeding.

WHAT WERE THE COMMISSION'S SPECIFIC PROPOSALS?

2. In our Notice of Inquiry and Notice of Proposed Rule Making in this proceeding, we made a number of proposals concerning the licensing and operation of complex systems of stations in the Amateur Service, which, if adopted in their entirety, would have had a significant impact on amateur licensing. Briefly summarized, our proposals in Docket 21033 were as follows:

a. We proposed to eliminate separate licenses for repeater, auxiliary link, and control stations. Operations now conducted by such stations would be permitted all remaining amateur stations without prior Commission approval under new forms of station operation to be known as "repeater operation" and "auxiliary operation".

b. We proposed no longer to require that an applicant wishing to operate a radio remotely controlled station obtain prior Commission authorization.

c. We proposed to permit portable and mobile operation by stations in auxiliary operation. (Auxiliary link stations are presently restricted to operation from a fixed location.)

d. We proposed to discontinue the issuance, in most instances, of call signs with "WR" prefixes to stations in repeater operation.

e. We proposed to require that stations in repeater and auxiliary operation transmit distinctive station identifications.

f. We proposed to increase the minimum interval at which stations in repeater operation must identify from five to ten minutes.

g. We proposed to delete the current requirement that transmissions from stations in repeater operation under automatic control either be recorded or monitored in real time by a duty control operator.

h. We proposed to require that the logs of all remotely controlled stations contain a list of all authorized control operators.

i. We proposed to require that a photocopy of the remotely controlled station license and a list of authorized control operators be posted conspicuously at the remotely controlled transmitter site and the station location of each control operator and be carried by each control operator operating a remotely controlled station from a portable or mobile control point.

j. We proposed to require that the antenna or mast associated with a remotely controlled transmitter bear a durable tag, marked with the remotely controlled station call sign, and the name of the station licensee and all authorized control operators.

k. We proposed to make all authorized amateur frequencies, except 435 to 438 MHz, available for repeater and auxiliary operation.

l. We proposed a new rule stating that a station occupying a frequency has priority in its use over other stations, and that all frequencies in the Amateur Service must be shared.

m. Finally, we requested comments concerning present and future anticipated interference patterns, the adequacy of current techniques for keeping interference to a minimum, and the adequacy of present voluntary spectrum management systems. We also asked for comments concerning the utility of the limitations on the effective radiated power (ERP) of stations in repeater operation contained in Section 97.67 of the Rules.

WHY DID WE MAKE THESE PROPOSALS?

3. Our purpose in issuing the Notice of Proposed Rule Making in this proceeding was to continue the relaxation of amateur regulations governing the licensing and operation of complex systems of stations. We stated in our Notice that since adoption in 1972 of regulations governing the licensing and operation of repeater and associated stations, (Report and Order, Docket 18803, 37 FCC 2d 225 (1972)), we have become increasingly convinced that amateur licensees could develop and operate complex systems of stations with a minimum of Commission regulation. Accordingly, in 1974 we began reducing the unnecessary burdens imposed on licensees of repeater and associated stations. In a series of rulemaking proceedings, we deleted the requirements that certain technical data be submitted with applications for repeater and remotely controlled stations and relaxed the rules to permit the linking, automatic control, and crossband operation of repeater stations. This proceeding is, in part, an attempt to provide amateur operators even greater flexibility in their operations and to create a more favorable regulatory atmosphere for the Amateur Radio Service.

WHO COMMENTED ON OUR PROPOSALS?

4. We received 86 timely comments in response to our Notice of Proposed Rule Making. Of these, 24 were submitted by clubs or other organizations. We received two timely reply comments. Twenty-four comments and one reply comment were received too late to be considered in this proceeding.[1] A list of those submitting timely comments in response to our Notice is contained in Appendix I.

WHAT DID THOSE COMMENTING ON OUR PROPOSALS SAY?

5. The number of comments we received makes it impossible to discuss each comment individually. Each comment has been read and carefully evaluated by the Commission's staff, however. Most of the comments received supported some aspects of our proposals but opposed others. In general, opposition was greatest to the major proposals. The less significant proposals were generally favored. In capsule form, the comments on our proposals were along these lines—

a. Most respondents argued that separate licenses for repeater stations should be retained. To eliminate separate repeater station licenses would, it was alleged, encourage "pirate" or "fly-by-night" repeater stations, and, in the words of T-MARC, permit "any amateur to, on a moment's notice, decide [sic] to operate as a repeater." Comments, The Mid-Atlantic FM and Repeater Council at 1. Others stated that operation of a repeater station is a serious and often expensive matter, and that effective spectrum management planning and coordination require that an amateur be placed on notice, by means of a separate repeater station license application, that "something more than the grant of a simple application is required." Comments, American Radio Relay League, Incorporated (ARRL) at 15.[2] On the other hand, our proposal to delete separate licenses for auxiliary link and control stations and create another form of amateur operation known as "auxiliary operation" met with general approval. Few comments specifically addressed the proposed deletion of the requirement that authorization from the Commission be obtained before remote control operation is undertaken, but of those that did, most approved.

b. Our proposal to permit auxiliary operation from control points in portable and mobile operation was nearly unanimously accepted. Operators of remotely controlled base stations were particularly enthusiastic, because adoption of this proposal would permit them to operate their remotely controlled stations from portable and mobile locations, a practice not currently allowed.

c. Most of our respondents wished to retain distinctive call signs for stations in repeater operation and requested that the practice of issuing call signs prefixed by the letters "WR" to such stations be continued, whether or not such stations are actually licensed as repeater stations. The ARRL, among others, argued that a distinctive call sign for a station in repeater operation is necessary to let those monitoring know a station in repeater operation is on the frequency. Because most comments favored distinctive call signs for stations in repeater operation, they opposed any other form of special identification for stations in repeater operation, although there was some support for requiring a station in auxiliary operation to transmit a distinctive identification. Our proposal to increase from five to ten minutes the minimum interoperation to transmit a distinctive identification must identify was widely supported in the comments.

d. The vast majority of our respondents urged the Commission to adopt the proposal to delete the requirement that transmissions from open access automatically controlled stations in repeater operation either be recorded or monitored in real time. Many of the comments went further, however, and offered a suggestion outside the scope of this proceeding, namely, that stations in repeater operation be exempted from the third party traffic logging requirements of Section 97.103(b)(2) of the Rules. Not to modify third party traffic logging requirements for open access automatically controlled stations in repeater operation would, in the words of the ARRL, "render the Commission's proposed relaxation * * * a nullity in terms of practical application * * *." Reply Comments, ARRL at 6.

e. Our proposals to modify slightly the logging requirements for remotely controlled stations, to require the posting of certain information at the remotely controlled transmitter site, and to require that a durable tag bearing certain data be attached to the remotely controlled transmitter antenna were relatively uncontroversial. Opposition was expressed to the durable tag proposal, however. The Northern Amateur Relay Council (NARC) of California, for example, stated that such tags are easily stolen or lost and that a requirement of this sort would be an unfair burden on licensees operating stations at truly "remote" locations.

f. Our proposal to make all amateur frequencies available for repeater and auxiliary operation was the subject of intense criticism by nearly all respondents. Although a few groups, such as NARC, welcomed the opportunity to experiment with the possibilities such a relaxation would have offered, the vast majority of the comments opposed such a radical change. Virtually all those commenting opposed any expansion of the repeater subbands below 28 MHz. They stated that there is no demonstrated need for repeater operation in the high frequency range, and that such an expansion would create many more problems than the increased flexibility in repeater operation would justify. Similarly, the majority of those submitting comments opposed making all very high frequency (VHF) and ultra high frequency (UHF) bands available for repeater operation. Concern was especially acute over opening all frequencies in the two meter band (144-148 MHz) to repeater operation. Respondents such as the Radio Amateur Satellite Corporation (AMSAT) stated that certain amateur activity in the two meter band must be provided protection from repeater operation. This activity, which typically involves the reception of weak signals, is said to be incompatible with channelized repeater operation. Many other respondents, such as T-MARC, agreed that weak signal work must be protected but argued that there is a definite need for additional two meter frequencies for repeater operation. The ARRL said that it may well be desirable to increase the allocation for repeater operation in the amateur two meter band but urged that any such expansion be the subject of a separate rule making proceeding.

g. Our proposed new rule concerning priority in usage of a frequency was overwhelmingly opposed. Most respondents said the proposed rule was inherently (if necessarily) vague and that its adoption would create more problems than it would solve. The general belief appeared to be that existing rules and practices are working reasonably well, and that, absent a compelling indication to the contrary, the Commission should take no action in this area at the present time.

h. In response to our inquiries concerning the adequacy of the current system of voluntary spectrum management and the necessity for the limitations on the effective radiated power of stations in repeater operation contained in Section 97.67 of the Rules, we received many informative and helpful responses. These comments indicated, generally, a widespread dissatisfaction with the ERP limitations on repeater operation, as well as a belief that the Amateur Service's voluntary spectrum management system functions with considerable effectiveness in most instances.

WHAT RULES ARE WE ADOPTING AND WHY?

6. After a careful analysis of our proposals and the comments submitted in response to our proposals, we have decided that the public interest will be best served by the following action—

a. We are eliminating separate re-

[1] The Commission's practice of informally accepting comments in rule making proceedings after the comment due date was recently held to be a violation of Section 1.415 of the Rules. *Home Box Office, Inc. v. Federal Communications Commission*, —— F.2d —— (D.C. Cir. 1977).

[2] The ARRL's Comments in this proceeding were filed late but were accompanied by a Motion to Accept Late Filed Comments. We are granting the ARRL's Motion.

peater, auxiliary link, and control station licenses, as proposed. Operations now conducted by such stations will be authorized other stations without prior Commission approval under new forms of amateur operation to be known as "repeater operation" and "auxiliary operation." We believe the contention that elimination of separate repeater station licenses will encourage "fly-by-night" repeater operation is frivolous. As the Iowa Repeater Council noted in its Comments, "[r]epeaters are expensive. They take a lot of hard work * * *." Comments, Iowa Repeater Council at 6. We doubt very much whether anyone willing to expend the time and effort necessary to place a station in repeater operation will do so on the spur of the moment. We simply do not believe that the incidence of so-called "ego-trip" repeaters will be any greater under the new rules than it is presently. The assertion made by T-MARC (and others) that elimination of separate licenses for stations in repeater operation will permit a licensee to decide "on a moment's notice" to engage in repeater operation is no more tenable now than it was before the adoption of rules for repeater stations in Docket 18803 in 1972. (Moreover, as NARC observed in its comments, absence of a repeater station license does not necessarily inhibit repeater operation under the existing rules. A licensee wishing to put a repeater station in operation need only find the licensee of an existing repeater station willing to share the responsibility of repeater operation from a portable location. The first licensee then operates a portable repeater station under the authority of the existing repeater station license.)

Further, processing and issuing repeater, auxiliary link, and control station licenses is much more complex than processing and issuing simple primary station licenses. Different data bases must be maintained, and FCC staff must be detailed to perform these specific functions. In sum, although repeater stations are relatively few, in comparison with the population of the Amateur Radio Service as a whole, their impact on the processing of other amateur licenses is far out of proportion to their number. Elimination of separate repeater, auxiliary link and control stations will enable us to provide the public with better service in other, more important areas, such as the processing of Novice Class and other classes of operator license applications.

Accordingly, beginning with the effective date of this Report and Order, no more licenses for repeater, auxiliary link, or control stations will be issued. Existing repeater, auxiliary link, and control stations may continue to be operated until expiration of their station licenses. Such licenses will not be renewed. Further, in order to continue the efficient processing of other amateur radio license applications, effective with the adoption of this Report and Order by the Commission we are imposing a "freeze" on the filing of applications for new, modified or renewed repeater, auxiliary link, and control station license applications. The freeze will continue until the date the regulations adopted in the Report and Order become effective.

We find that the public interest will be best served if the applications for new repeater station licenses presently on file are dismissed, and we hereby do so. Pending applications for renewed repeater station licenses or modified repeater station licenses will be processed, however.

b. *We are authorizing auxiliary operation from control points in portable and mobile operation.* This amendment, which was unopposed by the comments, will afford operators of remotely controlled stations much greater flexibility in their operations. It will permit operators of remotely controlled stations to operate their stations as they would locally controlled stations, without many of the previous restrictions placed on them.[3]

c. *We are discontinuing our practice of issuing call signs prefixed by the letters "WR" to stations in repeater operation.* We do not believe "WR"-prefixed call signs are a necessary aspect of repeater operation in the Amateur Service, any more now than they were before the regulations adopted in Docket 18803. We are aware, however, of the desire of many of those submitting comments in this proceeding, such as the ARRL, for rules ensuring that those monitoring a frequency know there is a station in repeater operation using that frequency. For this reason, we are adopting regulations as proposed requiring distinctive identification for stations in repeater and auxiliary operation. Stations in repeater operation will be required to transmit the letters "RPT" after the station call sign if identifying by telegraphy, or the word "repeater" if identifying by telephony. Stations in auxiliary operation will be required to transmit the letters "AUX" after the station call sign if identifying by telegraphy, or the word "auxiliary if identifying by telephony. Finally, there was no opposition to our proposal to incease from five to ten minutes the minimum interval at which stations in repeater operation must identify, and we are adopting it as proposed.

d. *We are eliminating as proposed the requirement that transmissions from open access automatically controlled stations in repeater operation be either monitored in real time or recorded.* There was no opposition in the comments to our proposed relaxation. Our purpose in adopting this regulation originally was simply to ensure that licensees posses adequate means to determine whether their automatically controlled stations were being operated properly. Licensees of such stations continue to be responsible for the propef operation of their stations, but we believe we should provide amateurs with sufficient flexibility to enable them to determine compliance with our regulations in other ways. In addition, several respondents asked that the regulation be extended to exempt stations in repeater operation from third party traffic logging requirements entirely. Of course, our proposal to delete the monitoring/recording requirement had nothing whatsoever to do with third party traffic logging requirements, nor did we intend it to have. Although we do wish to relieve our licensees of unnecessary burdens, such as the monitoring/recording requirement, we do not believe at this time that stations in repeater operation should be exempt from third party traffic logging requirements. We recognize that as a practical matter many stations in repeater operation will continue to have to record their transmissions to ensure compliance with the third party traffic logging requirements. We also recognize these requirements may be a burden on certain stations in repeater operation, particularly those with telephone interconnection ("autopatch") capabilities. In our 1973 Report and Order in Docket 18803, however, amateur licensees were warned about use of autopatch equipment in violation of Section 97.114 of the rules, to facilitate the regular business affairs of any party. Since 1972, autopatch abuse has become, if anything, more widespread. The Amateur Radio Service is not now, and has never been, a common carrier, and third party traffic of all types must, under normal circumstances, constitute a very small part of amateur activity. We again warn the Amateur Service of unlawful use of telephone interconnection facilities and stress that unless voluntary compliance with our third party traffic regulations increases significantly, we may have to take action to curb the transmission of all third party traffic in the Amateur Radio Service. We are therefore eliminating the monitoring/recording requirement contained in Section 97.111(g)(2) of the rules but are retaining all existing third party traffic regulations.

e. *We are requiring that a photocopy of the remotely controlled station license be posted in a conspicuous place at the remotely controlled transmitter site and placed in the log of the station of each authorized control operator of the remotely controlled station.* We will also require that the name and telephone number of the station licensee and at least one control operator be posted in a conspicuous place at the remotely controlled transmitter location. We are aware that many licensees consider requirements of this sort to be unjustifiable burdens, but we believe it essential that there be adequate procedures to ensure that the Commission is able to contact the licensee or control operators of a remotely controlled station in the event of station malfunction. We agree with respondents, such as NARC, that in our proposal to require attachment of a durable tag containing certain information to the antenna or antenna feedline of a remotely controlled station would serve no useful purpose, and we decline to adopt it. Our proposal to require the log of a remotely controlled station to contain a list of authorized control operators was generally supported in the comments, and we are adopting it as proposed.

f. *We are making an additional one megahertz of spectrum available for repeater operation in the amateur two meter band.* It is clear from the comments that amateurs engage in a wide variety of activities and that repeater operation is but one of these activities. It is also clear that many amateurs believe their activities must be protected from possible encroachment by stations in repeater operation. For this reason, we will not adopt our proposal to make al amateur frequencies available for repeater and auxiliary operation. The pervasive opposition to our proposed relaxation convinces us that the Amateur Service is not fully prepared to assume responsibility for complete management of its own spectrum. We are therefore not allocating any additional frequencies for repeater operation or auxiliary operation below 144 MHz. Many comments, however, stated that there is a definite, immediate need for additional frequencies for repeater operation in the two meter band and above. At the suggestion of T-MARC, we are allocating an additional one megahertz of spectrum, 144.5 to 145.5 MHz, for repeater operation. We are also increasing Technician Class operator privileges to include 144.5–145.0 MHz, to permit Technician Class licensees to take advantage of the new allocation for repeater operation. We believe this additional allocation will meet the future need for frequencies in the two meter band for repeater operation, while providing adequate protection for weak signal and other activity in that frequency range. We do not agree with the ARRL that this allocation requires a new rule making proceeding. In our Notice of Proposed Rule Making in this proceeding we proposed to make the entire two meter band available for repeater operation. Our licensees were put on notice that we were actively considering additional frequencies for repeater operation in the two meter band. The claim that adequate notice has not been given that 144.5–145.5 MHz might be allocated for repeater operation cannot be supported. We are also making all amateur frequencies above 220 MHz, except 435–438 MHz, available for both repeater and auxiliary operation.[4] There was little, if any, opposition to an increase in the frequencies available for repeater operation above the two meter band, and we believe that in making all amateur frequencies above 220 MHz available for repeater and auxiliary operation we are providing amateur licensees with a great deal of flexibility while at the same time continuing to protect the "weak signal" two meter activity. We will continue to evaluate the spectrum requirements for repeater and auxiliary operation, however.

g. *We are taking no action at this time on our proposed new rule concerning priority in usage of amateur frequencies.* We may, however, take action at some time in the future if certain spectrum management problems within the amateur community are not settled by the amateurs themselves. As detailed in a recent Public Notice on this subject, we are increasingly concerned about malicious interference to, and from, certain amateur service 'monitoring nets'. If amateurs cannot solve these conflicts and others arising from competing demands for spectrum, then the Commission must consider additional regulations to resolve these matters. We are also not taking any action at this time on changing repeater ERP limits. Any action in this area will be done in a separate rulemaking proceeding.

7. Accordingly, *it is ordered*, pursuant to authority contained in Sections 4(i), 5(e), and 303 of the Communications Act of 1934, as amended, That Part 97 of the Commission's Rules is amended as set forth below effective November 4, 1977. *It is further ordered*, That all pending applications for new repeater station licenses in the Amateur Radio Service are dismissed. *It is further ordered*, That the Motion to Accept Late Filed Comments submitted by the American Radio Relay League, Incorporated is granted, and that the Motion to Accept Late Filed Reply Comments submitted by the Empire Radio Club is granted. *It is further ordered*, That to the extent RM-2664 and RM-2780 have not been granted herein, they are denied. *It is further ordered*, That this proceeding is terminated.

(Secs. 4, 5, 303, 48 Stat., as amended, 1066, 1068, 1082; 47 U.S.C. 154, 155, 303.)

FEDERAL COMMUNICATIONS COMMISSION,[5]
VINCENT J. MULLINS,
Secretary.

STATEMENT OF COMMISSIONER MARGITA E. WHITE CONCURRING IN PART AND DISSENTING IN PART

As a strong proponent of deregulation, I feel it is important that I explain why in this particular instance I find it necessary to disagree with the Commission's decision to no longer require separate licensing of repeater stations. It should be noted, however, that I do concur in the remainder of the Commission's proposals to deregulate Part 97 of the Commission's rules.

I was impressed, after reading the comments in this proceeding personally, that almost all the comments opposed the elimination of separate repeater station licenses. The Commission believes that the contentions of various repeater organisations including T-MARC, petitioner in RM-2780, that elimination of separate repeater station licenses will encourage more casual and haphazard operation are frivolous. I respectfully disagree. The elimination of separate repeater station licenses will make the voluntary coordination, frequency management, and voluntary enforcement of repeater operation much more difficult, thus increasing the probability of increasing interference—a probability recognized by several repeater associations as well as by the American Radio Relay League (ARRL).

The Commission is adopting the proposed rules to decrease the administrative burden associated with the processing and issuing of separate repeater station licenses. However, this burden which I do not view as substantial, since presently there are only approximately 3,000 authorized repeater stations and recently only about an average of two applications a day are received for repeater stations, must be weighed against the likelihood of increased Commission involvement in enforcement problems. It is quite likely that the potential enforcement problems will prove to be more costly than the savings to be gained by elimination of the separate processing of repeater station licenses. Moreover, I agree with the ARRL comment that by requiring a separate application for a repeater station license "the applicant is placed on notice that something more than the grant of a simple application is required." Comments, ARRL, p. 15. I also believe that repeater licensees have a special responsibility to serve the public interest and the requirement of a separate license places the licensee on notice and assists in keeping the licensee accountable.

Therefore, for the above reasons, I dissent.

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[3] We do not believe separate regulations for so-called "remote base" stations are necessary or desirable at this time. As long as the auxiliary functions of such stations comply with the regulations for auxiliary operation, remote bases may be operated in the same manner as other amateur stations.

[4] Our decision to make the entire 420–450 MHz amateur band, except 435–438 MHz, available for repeater operation moots the "blanket" waiver granted by the Chief, Safety and Special Radio Services Bureau to permit fast-scan amateur television repeater operation in that band. That waiver is hereby terminated.

[5] By the Commission: Chairman Wiley concurring in the result; Commissioner Quello dissenting; Commissioner White concurring in part and dissenting in part and issuing a statement.

Reprinted from the Federal Register.

AMSAT

LOCAL AMATEUR RADIO OPERATOR ELECTED ARRL SECTION COMMUNICATIONS MANAGER FOR LA COUNTY

Stan S. Brokl of Sunland, known to his amateur radio colleagues as K6YYQ, has just added another laurel to his crown. He was elected Section Communications Manager for Los Angeles County for the American Radio Relay League, the largest amateur radio enthusiasts' organization. The League acts as spokesman for a large segment of the nearly a third of a million FCC-licensed amateur radio operators in the United States.

Stan is a senior engineering assistant at the Jet Propulsion Laboratory in Pasadena. He has been an amateur operator for twenty-two years. Among his earlier laurels were his presidency of the JPL Amateur Radio Club during 1976 and his handling of the transmission of the JPL Viking Lander pictures of the surface of Mars to the amateur radio world via slow scan TV. In many parts of the world, these pictures were the only ones received from the surface of Mars. He is also the vice chairman of the Los Angeles Council of Amateur Radio Clubs.

The American Radio Relay League, in addition to its activity as spokesman for the amateur radio communications community, has a variety of activities in which amateurs participate. For some of these, awards are granted, such as for working all states, or working all continents. The ARRL is also involved in emergency communications when the need arises. The activity is called Amateur Radio Emergency Service (ARES), which handles communications in emergencies such as floods, earthquakes, or other catastrophic occurrences when normal communications media fail. Radio amateur operators are equipped to provide such communications with their battery-powered and mobile radios.

In an interview, Stan was asked what his job was as SCM. He told us, "The SCM is the only elected official in the ARRL *operating* program. That is, programs involving "on-the-air" activities. He fosters communication networks, makes appointments of qualified amateurs to various communications functions, and generally provides the leadership for the section."

One of Stan's plans is to expand the ARES activity to place it in readiness for any emergency that should arise. He pointed out that ARES differs from the Radio Amateur Civil Emergency Service (RACES) in that the latter is operated locally by the LA County Sheriff's Disaster Communications Service to maintain communications in the public service area where officialdom must be in communication with its headquarters and the emergency services. On the other hand, ARES provides what Stan called "people-to-people communications."

Stanley S. Brokl K6YYQ was recently elected SCM for the ARRL LA section. He is shown here examining an OSCAR display at the JPL library. The turntable shows the four interior panels of OSCAR 7.

DECEMBER FLIGHT TEST OF AMSAT/JAMSAT SATELLITE TRANSPONDER

The Radio Amateur Satellite Corporation (AMSAT) has obtained the cooperation of a number of amateur radio clubs up and down the state of California in flying the AMSAT-OSCAR D 2-meter-to-70-centimeter (146 to 345 MHz) amateur radio satellite transponder for a test to provide amateurs throughout the state an opportunity to test their gear and to familiarize themselves with the techniques and procedures to be used in operating the transponder during its orbital phase as AMSAT-OSCAR 8, mode J. The flight will take place December 3, 1977. An aircraft containing the transponder will fly a course starting from Van Nuys Airport near Los Angeles to San Diego, Santa Barbara, San Francisco, Stockton, Fresno, Bakersfield, and back to Van Nuys.

This will be the fourth flight test of an amateur radio communications satellite transponder since the AMSAT-OSCAR 6 2-meter-to-10-meter was flown on the east coast in May, 1971, by members of the AMSAT Washington group. In September, 1971, the Jet Propulsion Laboratory Amateur Radio Club ran a flight test similar to the one to be run in December on the 2-to-10-meter transponder. JPL ARC was also involved in a flight test of the 432.15 MHz to 145.95 MHz "Umsetzer" (built by AMSAT Deutschland) which became the mode B transponder of OSCAR 7. The latter flight test was run in September, 1973.

A great many amateur operators participated in these earlier flight tests, learning the ropes, so to speak, about operating through an amateur satellite transponder under closely similar conditions to those which would occur in orbit.

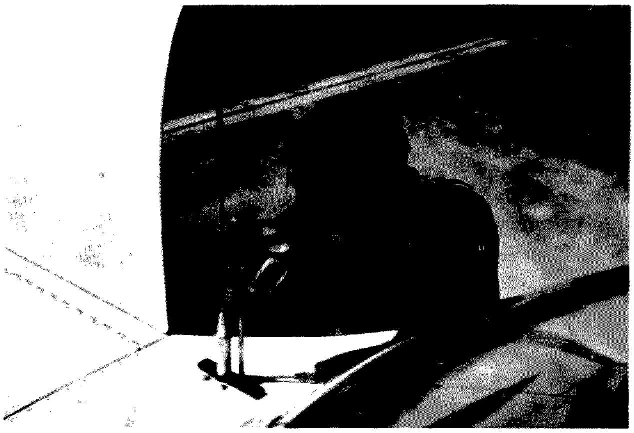
Activity through the transponder is encouraged during the December 3rd flight, and a commemorative QSL will be sent to all amateurs who send in a report of stations worked or heard. The aircraft call in flight will be WA3NDS.

During the flight, a liaison net will be maintained at about 7230 kHz, using the call W6VIO.

The test flight is cosponsored by the amateur radio clubs of Jet Propulsion Laboratory, Hughes, TRW, and Project OSCAR, as well as several other California amateur organizations.

One major purpose of the flight is to assist radio amateurs in adjusting their equipment for operation on the new amateur satellite frequencies above 435 MHz, the only available frequencies in the 420-450 MHz band open to satellite use under the ITU regulations. A secondary purpose is to determine the mutual interference potential between AMSAT-OSCAR D and amateur TV enthusiasts operating above 435 MHz. Launch of the AO-D amateur radio communications satellite is scheduled for February 17, 1978.

Reports should be sent to Skip Reymann W6PAJ, at Post Office Box 374, San Dimas, California 91773.



Dick Ulrich K6KCY puts finishing touches on the 10 meter whip for the OSCAR 7 test flight in 1973. Dick will participate in the flight test of the AMSAT/JAMSAT spacecraft in December.

LETTERS

from page 17

GE and various doctors would not give me any suggestions, I was lucky enough to get in touch with a man in the School of Aerospace Medicine, who told me of their extensive experiments with electromagnetic radiation and pacemakers, including 15 models of the GE, which proved them particularly susceptible. It is true that their experiments were not on a ham frequency, but their frequency was near enough the 20 meter band to be *significant.* It was *here* that I got suggestions for the grounded cage I built.

Possibly you may have occasion to pass along my experiences, or to improve upon them.

F. L. Wiltrout W9VFG
Elkhart IN

Technical Editor, *QST*
225 Main Street
Newington CT 06111

Dear Sir:

Some time ago, I wrote you that I had a General Electric pacemaker installed, and that when I attempted to make a transmission the radiation cut it out. I asked if you knew of any articles in ham publications or otherwise which might help me get on the air. Your reply was negative.

I have since read newspaper articles to the effect that CBers, using illegal amplifiers, were interfering not only with pacemakers, but also with hearing aids.

I solved the problem in a somewhat awkward manner, and I would like to pass along my experiences, thinking that they would be a basis for further refinement.

To begin with, I use a Drake TR-4 and a Heathkit SB230 linear, feeding an old Hy-Gain 20, 15, and 10 meter beam with coax. I have a switch arrangement to go from the beam to a Heathkit dummy load.

Using an inexpensive field strength meter, with the aid of my son (who is also a ham), I found that the field strength varied according to which way the beam was headed — that even on the ground forty feet from the beam, with the beam headed in my direction, the pacemaker acted up. I could tell when the rig was on transmit merely by feeling my pulse.

The next step was to take readings when the rig was on the dummy load. There was no reading whatsoever even when the meter was set on top of the rig. (Incidentally, the swr is down to one to one.)

My son and I then constructed a sort of cage, five feet high and three feet wide and deep, with both top and bottom, of perforated aluminum sheet, covered by a layer of copper wire. This was attached to a good outside ground. The microphone with switch was run into the cage, and I was back on the air! There was no field strength reading in the cage while transmitting. It is a little awkward reaching out the door to tune in stations, but you can't have everything. The rig itself can be tuned up on the dummy load.

So far I have tried only 20 and 40 meters, the latter on an inverted V, without the linear.

This is the old principle of the Faraday Cage, discovered in England many years ago, and hardly mentioned in the *Handbook.*

It occurs to me that the transceiver itself could be moved into the cage for greater operating convenience.

You can understand why I am reluctant to do too much experimenting personally when it might stop my heart.

Perhaps a more simple solution could be found, like putting some kind of shield on the roof underneath the beam, or on the ceiling of the shack.

Anyway, perhaps one of your bright young men might be willing to take my experiments and build on them. They are welcome to use my observations and experience.

F. L. Wiltrout W9VFG
216 West High Street
Elkhart IN 46514

SUPER PAT

Although in the past I've not been in entire agreement with most of your editorials, I will say this much — I've written several letters praising your study guides (which you've never printed). Well, here comes a super pat on your back with a request following.

On August 29, 1977, my employment required that I obtain a 2nd Class Radiotelegraph license. The first thought in my head was, "Oh-oh, a supervised code exam at 20 and 16 wpm," so I got out your 20+ tape — the one with all the weird characters — and listened to it for ½ hour every day for 17 days. (Keep in mind that I've been inactive for 3 years now.) Come the 29th in Detroit, the examiner put 20 wpm on and I really was shocked — it sounded like about 15 wpm! I swear I could have sharpened my pencil in between groups. No kidding! I even copied 35 wpm almost solid after listening to that tape — the same tape that, by the way, at first I spent 10 minutes of each half hour cursing. I now have a 2nd Class Radiotelephone, a 2nd Class Radiotelegraph, and an Advanced ham license, which I can say were duck soup to get after using your study guides and tapes. Now I will be going to Marquette to take the First Class Radiotelephone, the Extra Class, and the Radar Endorsement.

By the way, I'll be going for my 1st Class Radiotelegraph in a few months — do you have a 25+ wpm tape I can purchase?

Kenneth M. Cubilo, Jr. WB8DOI
Rogers City MI

Sure, $4.00. — Ed.

BE A LEGAL JAMMER

We would like to invite a couple of hams around the world for communication backup, and they can take all their equipment. We would give them 1/3 off the total cruise cost.

Captain Mike Burke
Windjammer Cruises
PO Box 120
Miami Beach FL 33139

FEATHER

Just wanted to drop you a note and put another feather in your cap. Last June, I purchased your 21+ wpm tape. When I received it, I played it for about five minutes. I then ignored the tape until the first of September. I practiced your tape an average of 45 minutes a day for 3 weeks. On September 21, I went to the FCC and took the exam. I aced the code test. I didn't have time to sleep in between characters, but I did copy comfortably the 20 wpm. I could copy your tape about 98% — let's face it, a code group like "kee ie" is something else. If you can't copy the group, it does teach you not to be flustered by missing a character or small group of characters.

Once again, thanks — and be proud of those feathers and cap. I will be forwarding my callsign change when I get my 2x2 call.

Kevin C. Potter WA6DNW
Arcadia CA

M.O.M.

With Christmas again rapidly approaching, we at Military Overseas Mail are concerned about the many thousands of our military personnel who will be away from their homes and families during the holiday season. For many of these young men and women, this will be the first Christmas away from home.

Readers of *73 Magazine* can help make this holiday season a little less lonely and a little more enjoyable for many of these young people by joining in the collection of Christmas mail sponsored by Military Overseas Mail. This is an ideal project for school classes, clubs, and other groups as well as individuals and families. For more information, please send an SASE to Military Overseas Mail, Box 4330, Arlington VA 22204, and mention that you read about M.O.M. in *73 Magazine.* Thank you.

Lee Spencer
Arlington VA

Tracking the Hamburglar

HIJACKED: Heathkit 2 meter transceiver HW-2036, series no. 03719, Heathkit Micoder HD-1982, series no. 00622, from my company car on October 10, 1977, at about 16:35 CDT, 1713 Webster St., Omaha, Nebraska. My ham call and social security no. 482-62-4198 are engraved in the chassis of the radio. A reward will be offered to the individual who returns the radio to me. Tom O. Mikkelsen WAØPOD, 902 Avenue G., Council Bluffs, Iowa 51501, (712) 323-8036; (office) Motorola Communications, 11045 I St., Omaha, Nebraska 68137, (402) 331-7709.

RIPPED OFF: Atlas 350XL with DDG-XL digital dial, s/n 877025, and ac power supply for the Atlas, s/n 877104 DS. Taken on October 1, 1977. Jay A. Leonard W5TSM, Rt. 1 Box 32A, Pottsville AR 72858.

RIPPED OFF: Regency HR-2B transceiver, 2 meter, 12 channel. Serial no. 49-04353. 1 – 94-94, 2 – 34-94 3 – 52-52, 4 – 13-73, 5 – 19-79, 6 – 96-36, 7 – 16-76, 8 – 04-64, 9 – 25-85, 10 – police, 11 – 46-46, 12 – sheriff. Carl R. Willis K8DKO, 464 Forest Street, Mansfield OH 44903, call collect (419) 524-2367.

TAKEN: Drake ML2, s/n 11546. Stoken from: Tom Fraser WAØQQT, Colorado Springs, Colorado. (303) 635-8911, ext. 3874. Frequencies installed: 34-94, 94-94, 16-76, 07-67, 22-82, 25-85.

Corrections

Please note a correction to my article, "Track OSCAR With Your SR-52" (November, p. 58). Lines 20-21, column 4, page 59, should read: "in register 13. Steps 018 to *038* solve equation 1 and".

Art Burke W6UIX
San Diego CA

Compare the Atlas 350-XL with other transceivers . . .

TYPE	ALL SOLID STATE			HYBRID (VACUUM TUBE P.A.)			
MODEL	ATLAS 350-XL	TEN TEC	YAESU FT-301	DRAKE TR4-CW	HY-GAIN 3750	KENWOOD TS-820	TEMPO 2020
INPUT POWER	350 WATTS	200	200	300	200	200	180
BANDS	10-160M	10-80M 160M OPT	10-160M	10-80M	10-160M	10-160M	10-80M

. . . and see why it's your best buy!

Above is a chart comparing leading HF Transceivers that fall in approximately the same price range as the Atlas 350-XL. The Drake TR4-CW is least expensive, while the HY-Gain 3750 is the highest. Rated power input (SSB) and bands covered are listed in the chart, but below is a discussion on a number of other interesting comparisons which will help you choose the right transceiver for your station.

1. STATE-OF-THE-ART, ALL SOLID STATE

The first 3 transceivers listed above are all solid state. The real designs of the future! Having manufactured and sold over 12,000 of our little 210x/215x's, we can attest to the high performance and reliability of all solid state design. Tubes for the driver and P.A., with their tuning circuits and high voltage power supplies are rapidly becoming obsolete. As a result their resale value will be declining.

2.POWER RATING.

The higher power rating on the 350-XL provides you with a comfortable edge over the others. Running barefoot you can easily ride over the competition. If you're driving a linear you don't have to strain for every bit of drive from the transceiver. It can loaf along with ease. The 350 watt input rating is really very conservative. Typical input power runs upwards of 400 to 450 watts without flat-topping. Considerably more than the others.

3. BAND COVERAGE

Not only does the 350-XL cover the 10 through 160 meter bands (including all of 10 meters in four 500 kHz segments), but one of its exclusive features is that you can install up to 10 auxiliary 500 kHz ranges anywhere from 2 to 5 MHz, and from 6 to 23 MHz. This gives you great flexibility for MARS operation and possible future amateur bands. Crystals for Auxiliary Ranges are installed internally. In addition, the 350-XL provides reception of WWV at 5, 10, and 15 MHz, without having to add any auxiliary range crystals.

4. DIGITAL FREQUENCY READOUT

On the 350-XL, the optional Digital Dial can be installed, and you still retain the conventional analog dial, with the option of switching the digital dial off if you wish. With the Ten-Tec or Yaesu 301, you lose the analog dial if you purchase the digital dial model, making you totally dependent on the digital dial.

5. FULL BREAK-IN CW

Only two rigs offer this feature; the Atlas 350-XL and the Ten-Tec ! The others are all "semi-break-in". And the Atlas includes CW sidetone with pitch and volume adjustments.

6. NARROW BAND CW FILTER

This is another standard feature in the Atlas, optional on the Ten-Tec , Yaesu, and Kenwood. Ours is an I.F. filter with 500 Hz bandwidth, and shape factor of better than 3 to 1.

7. A.F. NOTCH FILTER

This 350-XL standard feature permits nulling out heterodynes and other interference. The Yaesu, Hy-Gain and Kenwood include a similar feature.

8.SPEECH COMPRESSION

The standard Atlas ALC system provides up to 20 dB of R.F. compression which increases your talk power and at the same time reduces "flat-topping" and splatter. An optional speech processor to provide up to 20 dB additional A.F. compression will be available soon for installation in the AC supply. The Hy-Gain, Kenwood, and Yaesu also provide some form of speech processing.

9. AUXILIARY VFO

All of the rigs listed offer an optional second VFO for split frequency operation. But Atlas is the only one with an Auxiliary VFO that is not an add-on box. The Atlas Auxiliary VFO plugs right into a space provided in the upper right hand corner of the front panel. Although miniature in size it tunes the same 500 kHz as the primary VFO, and does it smoothly with coarse and fine controls that have 10:1 planetary drives. Green, yellow, and red LEO's let you know which VFO you have set up for receiving and transmitting. Very neat, and all self-contained.

An option to the Model 305 Auxiliary VFO is the Model 311 crystal oscillator that provides up to 12 crystal controlled channels. It also plugs into the front panel just like the 305. Vernier controls provide fine tuning of the crystal frequency.

10. MOBILE/PORTABLE OPERATION

The Atlas, Ten-Tec , and Yaesu, being solid state, are unique in that they will operate mobile or portable directly from a 12-14 volt DC battery. Also, the solid state rigs are considerably smaller and lighter weight than the hybrid rigs. The Atlas is unique in having a very handy plug-in mobile bracket for the 350-XL that makes it a simple matter to plug-in and go mobile.

11. OTHER 350-XL STANDARD

FEATURES include R.I.T., VOX, Crystal Calibration, ANL, and Noise Blanker.

Compare the Atlas 350-XL SSB-CW Transceiver with the others, and we think you'll agrea the Atlas has everything you'll ever need in a transceiver. And it's made in America.

And let us not forget to mention Our Customer Service which is second to none. Just ask the ham who owns one.

Model 350-XL (less options) . . . $995.
Model DD6-XL Digital Dial . . . . $229.
Model 305 Auxiliary VFO . . . . . $155.

MADE IN AMERICA

We're very proud that every Atlas transceiver is made right here in America, (as are the Ten-Tec and Drake). We think the American worker, and eur employees in particular, are the mast talented, industrious people in the world. The quality and versatility of our transceivers are proof of this.

And by using this American quality workmanship, advanced value engineering in design and manufacture, and rigid quality control, the Atlas transceiver is not only competitively priced with the imports, but is actually a better value!

Merry Christmas and Holiday Greetings from all the gang at Atlas!

ATLAS RADIO INC.
417 Via Del Monte, Oceanside, CA 92054
Phone (714) 433-1983
Special Customer Service Direct Line
(714) 433-9591

A16

J. Tom Badgett K4MDK
1917 Washington Street
Bluefield WV 24701

Inside Ten-Tec
-- QRP innovators

It started with a telephone call in 1969. Al Kahn, former president of Electro-Voice, rang up Jack Burchfield, a design engineer for Bogan in New Jersey. Kahn had moved from Michigan to Sevierville, Tennessee, after he left Electro-Voice, and he wanted to get back into the mainstream.


Dick Frey K4XU/W1FCC is Ten-Tec's chief engineer. The Century 21 is his design, and he's obviously proud of it. "It works great on the bands," Dick beams, and says he's finally doing the job he's always wanted to do. That seems to be the spirit throughout the Ten-Tec operation.

"Hey, Jack, come on down, and let's do something," he suggested in that first telephone call. To hear Jack Burchfield tell it, a second request wasn't needed. He had so much confidence in the man he had worked with when he himself was at E-V, that Jack immediately packed up his family and moved south to Tennessee.

Both admit that Ten-Tec, Incorporated, a company now well-known for its solid state ham gear, wasn't formed in the conventional manner. Once they got together in Sevierville, the pair set about adding some kind of manufacturing business to their tool and die shop already under construction. Hi-fi gear came to mind first, since both had a number of years of experience in the field.

Al says they rejected that idea pretty quickly because, "We both were sort of tired of it. After the pioneering days were over, the fun went

out of it." They agreed, instead, that they should pioneer some form of amateur radio equipment for the beginner. And the Power Mite line of solid state transmitter and receiver modules was born.

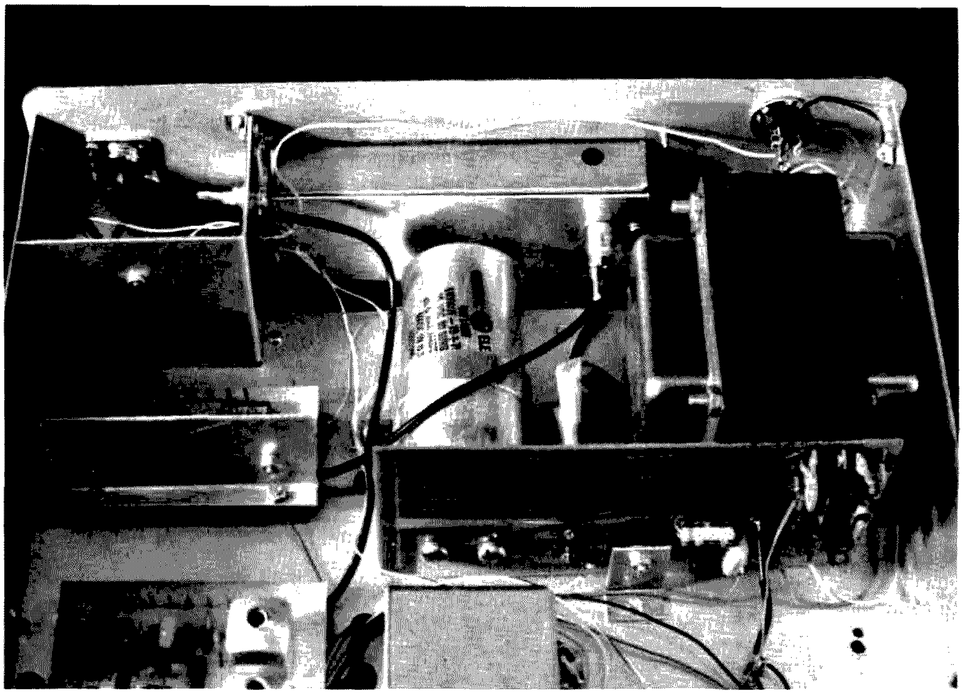
Low-power, low-priced solid state kits for the amateur market was an idea whose time just hadn't come, however. Ten-Tec sold fewer than five thousand of the units, and the ones they did sell went not to the beginner but to the guy with the S-line and the two letter call.

"If a Novice is going to work anybody with two Watts, he'd better have everything just about perfect," Jack said. "So most of the equipment went to the ham who wanted the challenge and to the QRP group."

Whatever the reason, sales volumes weren't high enough to support the young company, even though the multi-thousand square foot plant was paid for before production started. There were two founding principles they weren't ready to give up, though: low power and solid state design. The Argonaut was the next logical step, and acceptance was a little more general, even though it still ran only five Watts. This was in 1971. There were four more years of slim times before this guts-formed company became a force large enough to be reckoned with in the ham radio market.

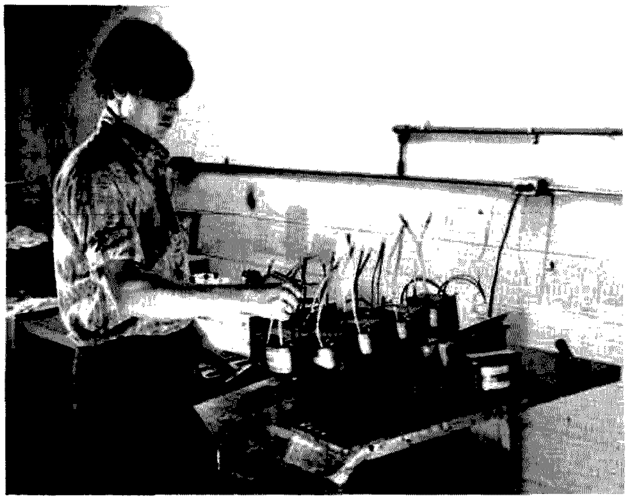
"We're making money now," board chairman Kahn says. "We turned the corner with the Triton."

One reason for the slow financial success may have been the company's strict dedication to treating the ham fairly. After the Triton came out, for example, it was decided that some design changes should be made. But before marketing the new unit, Ten-Tec made sure all the dealers knew a new design was on the way, and they instructed their dealers to tell Triton purchasers a new box was coming.

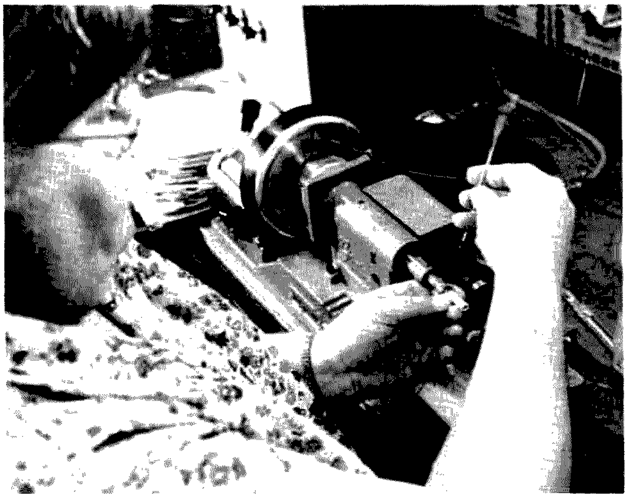


Reminiscent of Ten-Tec's earliest beginnings, this latest design — a solid state CW transceiver — began with a telephone call. Ten-Tec founder Al Kahn K4FW says he got three calls in quick succession from people wanting a reasonably priced station for large Novice classes. The Century 21 was the result — all solid state, broadband tuning, 70 Watts input, direct conversion receiver. Complete with built-in power supply, the unit is selling for $289.00. This is a prototype, but it's all there. Nothing is missing, even though there seems to be lots of room left over inside.

Ten-Tec President Jack Burchfield K5JU (left, standing) and Board Chairman Al Kahn K4FW (right, standing) watch as a technician gives one of the new digital Triton IVs an on-the-air check.



Even the power transformers for Ten-Tec equipment are wound at the Sevierville TN plant. A machine automatically inserts laminations in the transformer windings, then the whole affair is dipped in a sealant and put on a rack to harden.



This coil winder is a Ten-Tec innovation. The machine is attached to a digital turns-counter, which also is programmed to stop the winder after the proper number of turns has been applied to the form. It saves time and cuts down on errors.

The familiar red and black Ten-Tec logo ready to go on a Triton IV, or Argonaut, or keyer, or Century 21, or power supply, or . . .

"It probably cost us $25,000 to $30,000 to do it that way," Al says, "but we did it knowingly and it was the right move."

Design standards are strict, too. Until recently, Jack Burchfield was chief engineer as well as company president, and, with ten or fifteen years in the audio business, he naturally put some of that experience into the Triton – less than two per cent audio distortion, for example. Too, he says, computer predictions show a useful life on the solid state finals of 25 years. (In thousands of Tritons shipped, only 5 final transistors have failed.) Each vfo board is individually compensated for temperature stability after it is built. Toroids, coils, cabinets, chassis, circuit boards, dial mechanisms, transformers – they're all built under one roof in Sevierville, Tennessee.

What's the ham market like today? Challenging, Jack and Al agree, and changing. A ham doesn't have to be an engineer anymore to have functional equipment, and, Jack believes, more and more people are getting into ham radio "to talk to people, not to tinker." That's one reason Ten-Tec is offering sophisticated gear that's easy to operate – broadband tuning, for example, and instant break-in.

Supplying the ham market is a little like trying to please all the people all the time. It means keeping up with changing technology, but, moreover, staying abreast with what the buyer wants. To that end, a digital readout version of the Triton IV already is moving down the production line. Right behind it is a solid state, CW-only transceiver, which eventually will grow into a complete station package – keyer, tuner, antenna. A kilowatt solid state linear is on the back burner.

The Ten-Tec company presents an unusual dichotomy – state-of-the-art hardware and old-fashioned philosophy. Even though starting with all solid state equipment probably slowed the company's development, Al and Jack are adamant that whatever they design will use no tubes. They're putting those modern circuit designs in almost futuristic enclosures.

They work hard, on the other hand, to maintain a small-company, personal approach to the business as they grow. Even with $3 million in sales projected next year, there seems to be no worry about the company losing its personality.

"We did it at Electro-Voice," Al reflects. "It's just got to start at the top and go down."

Wherever it starts, the feeling is there. The people throughout the plant obviously take pride in their work. They're proud of the Ten-Tec equipment they're turning out. They seem to know a great deal about the work they perform, and there's a comradeship among all the staff that's heartening in these days when most people seem reticent in their relationships.

It's encouraging, too, to hear a ham equipment supplier promise to supply state-of-the-art gear based on a good engineering design, maintain a five-year warranty on the product, and answer every query and comment on the equipment.

Ham radio is growing and so are most companies supplying these new hobbyists. The hams at Ten-Tec have a move-carefully attitude – partly because they're not sure what direction ham radio may take in the future. But Al Kahn is sure of one thing: "Whatever you're doing, do it the best you can, and don't try to move into greener pastures until you can nail down your present job."

That idea pervades the Sevierville plant. It's as if everybody is walking around with a mouthful of nails and a big hammer. ■

Eric Shalkhauser W9CI
527 Spring Creek Road
Washington IL 61571

The History of Ham Radio

-- part V

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

The first amateur radio get-together of any size was the St. Louis Midwest Convention in December of 1920, shortly after our licenses became available in 1919. No sooner had the enthusiasm at the St. Louis gathering died down, than the ARRL Board of Directors proposed a national convention.

In these early years after World War I, there was so much newness in everything connected with wireless, and there were so many original and worthwhile ideas to be aired, that no mere Morse code contact was sufficient. Voice communication had not as yet entered our amateur wireless channels. Amateurs were on the verge of many new developments. Major Armstrong had announced his "single" signal regenerative and then his superregenerative receiver designs. There were new circuits to be tested in the transmitter field, including the Colpitts, the Meissner, the Hartley, and the Heising, among others.

Amateurs wanted to be informed. They found themselves in new technical surroundings. So, for the first time, citizens of the United States and Canada, all interested in privately-owned and operated radio communication, decided to come together from far and near to a big first national convention.

The first gathering of the clan took place from August 30 to September 3, 1921, at the Edgewater Beach Hotel, located on the shore of Lake Michigan in Illinois. History relates that, following the success achieved at this first national convention, it was ordained that two succeeding ARRL national conventions were also to be held at the Edgewater Beach Hotel in Chicago at two year intervals – September 11 to 15, 1923, and August 18 to 23, 1925.

There was no telling what impact these get-togethers would have on the future destiny of amateur radio. Great effort and meticulous preparations were made for months in advance to insure success. Everyone connected with the preparations hoped that this first national meeting would find attendance coming from the far reaches of the States and Dominion, representing all districts.

The midwest location proved to be a most stragetic and advantageous choice. The Edgewater Beach Hotel was at the far north edge of Chicago, away from heavy traffic, with R.H.G. Mathews' 9ZN station located just to the north on the lake shore, spurting two tall station towers, a multiwire antenna, and up-to-date equipment in his spacious shack. All agreed that this was an ideal spot to congregate.

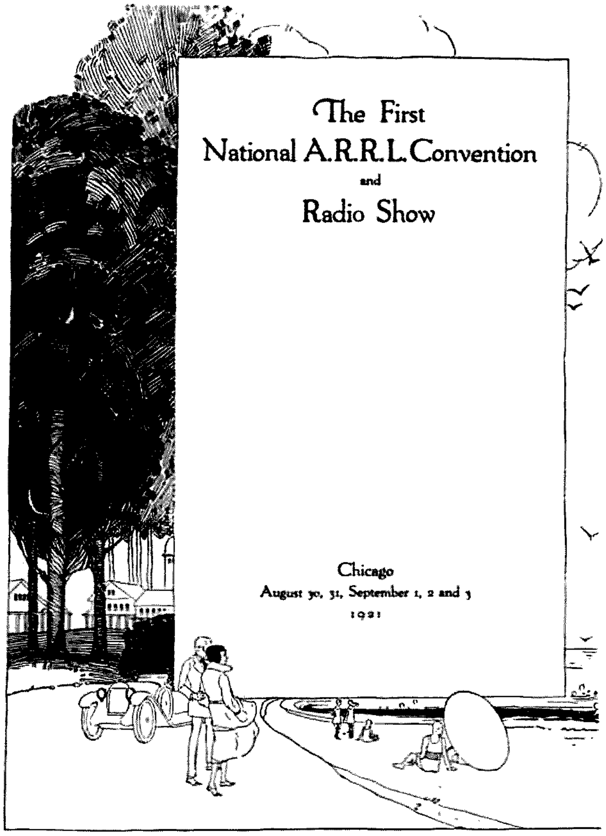
The convention committee had booked a large arena, the Chicago Broadway Armory, located within walking distance of the hotel. About fifty manufacturers and dealers in ham radio gear of all description displayed and demonstrated their products. For the first time, amateurs had an opportunity to talk shop with those people who had kept amateur radio alive through their advertising in *QST*, *Radio Amateur News*, *Wireless Age*, catalogues, and other literature. This was a ham's paradise!

The convention hall, where all the sessions took place, was a beehive of activity. There was no letup in making personal contacts, exchanging QSLs, and discussing many subjects slated on the agenda.

The First Day

The ARRL President, Hiram Percy Maxim, addressed the members with an inspiring talk concerning the aims and accomplishments which amateur radio had achieved in the relatively few years of the ARRL's organization. In his introductory remarks, the founder of the League had the following to say:

"As we meet and open this great convention, it is indeed



The Convention

THRU the many years of amateur radio there has developed an increasing desire to meet the other fellows that are, like yourself, interested in radio communication either as a pastime or business. And now comes a time when your wishes shall be gratified.

For, in Chicago on August 30, 31, September 1, 2 and 3, 1921, the American Radio Relay League will hold a First National Convention and Radio Show, which everyone is cordially invited to attend.

Chicago is itself a wonderful summer resort, offering every opportunity in any sport or diversion. You will never regret having spent part of your vacation here. The details of the convention are exceedingly comprehensive and every minute of the convention will be taken up with interesting and educational conference and lectures, being in all a most complete and co-ordinated program. Mornings, afternoons and evenings are fully arranged for, so that you will remember this convention as some of the most enjoyable days of your life.

There will be people that you know and many that you do not know that will be present from every district and city in this great United States. Probably the most important feature of the convention will be the huge banquet on the night of September 3rd, and there should be none failing to attend. Everybody from the Young Squirt up to President Harding will be there to pass you the sugar and tell you what a record station he or she is going to have this season.

The first day will be given over entirely to the arrival, registration and locating of the many delegates. The program will start promptly at ten A. M. August 31st, so you should arrange to be in Chicago some time during the previous day, August 30th.

We have arranged to accommodate you at the finest hotels in the city, very close to all activities, at rates from two dollars per day up.

From the moment that each delegate arrives, and they should not forget to bring the ladies, until their departure, the utmost of consideration will be devoted to their safety, comfort and pleasure.

Convention delegates will be admitted to the meetings, lectures, sportive expeditions and the Radio Show without any charge.

Banquet charges will be five dollars per plate, and reservations should be made immediately with convention reservation manager,

N. C. BOS
118 No. LaSalle Street
Chicago, Illinois

(Make all remittances payable to Chicago Executive Radio Council)

The Radio Show

THE manufacturers and dealers' exhibit at the First National Radio Show, which is to be held in conjunction with the convention, will be the most spectacular conglomeration of modern radio equipment that has ever been put on display under one roof. This gorgeous and pompous affair will be well worth the trip itself.

The Broadway Armory, the most modern and largest exhibit and convention building in Chicago, will be used entirely for this great show.

Divided into model exhibit booths and beautifully decorated in one accord, it will equal in splendor any of the successful automobile shows. The magnitude of the affair is positively stupendous.

It will indeed be a great thing for the manufacturer and dealer, as it is held at a time that marks the opening of a new and more active radio season. Business conditions are rapidly improving and a very successful season is predicted.

In addition to publicity thru radio publications, circulars and placards, the daily newspapers with circulation over the million mark will be employed to advertise the show. This should result in a daily attendance of anywhere from three to eight thousand of interested people. The results to the advertisers, both direct and indirect, will be unprecedented.

This is not a money making proposition and the booths are being sold on approximately a pro-rata basis. The convention delegates will be admitted without charge, and the general public will pay an admission fee. Permanent passes will be issued to exhibitors. The show will open at the same time as the convention, ten A. M. August 31st, and everything must be in readiness the day before.

Here are some reasons why every manufacturer and dealer should be an exhibitor: It is the biggest affair that has ever been promoted in the age of radio. It comes at a time that marks the opening of the regular radio season. There will probably be over ten thousand people reviewing the apparatus. By personal contact with the field which he is selling he may gain good will. The exhibit cost is low and the results will be big.

Your competitor may have an exhibit and if you do not—well, think it over.

There will be every accommodation available for the exhibitor, delegates and the general public. The Armory is conveniently located near the three hotels at which the majority of the delegates will stop. There are also excellent amateur stations near by which will supply both spark and phone transmission for the reception of exhibitors.

It will be a long while before such opportunities as are here offered will again be presented.

a historic event . . . In years to come, much will be said about what we do here at this first convention. We are striking out into the unknown, and even the smaller actions which we take here during the next few days will weigh heavily in the future, for they will establish precedents and standards . . . Let us not forget that we are pioneers, blazing a way many are to follow. Our responsibility is great, and we must so regard it. It is one thing to repeat what has already been done, but it is another altogether different thing to do what has never been done before. What you see before you here today has never happened in the affairs of man. Not only is it a great pioneer effort in radio history, but it is a great pioneer effort in political history. We American and Canadian citizens assembled in this room represent pioneers in the development of something totally revolutionary in the art of communication. The like of what we are doing and proposing had never crossed the brain of man a short ten years ago. We already have a privately-owned, absolutely free continentwide means of instantaneous communication and no man may say we shall not make it worldwide." (What prophetic statements emerged from this gathering of dedicated and enthusiastic men!)

"It is no small distinction," our President went on to say, "to be one of those who make history."

General and Technical Sessions

There would be no point in listing the names of the high and low notables in attendance. They were all present. The program committee had topics scheduled for discussion pertaining to club organization, interference control, observations of laws, legislative matters, message handling, and many technical subjects.

Charles H. Steward, member of the ARRL legislative committee, reviewed pending legislation, a matter which required constant attention. Seven bills under debate in Congress at that particular time related to sub-

jects concerning radio control, radio regulation, and enforcement. Observations made at this meeting were that: "If just two of these bills go through in their present form, the wavelengths, power, and decrement are then subject to control of the Commission, and they keep us champing around from one wavelength to another, increasing and decreasing the power available for amateurs. Constant vigilance is of vital importance to insure the amateur's place in the radio spectrum."

Probably the topic which drew top attention during the convention, and which was subject to heightened debate, proved to be the controversial question of power factor in ham transmitter circuits. As one reporter remarked afterward, "Without a doubt, this debate was the main attraction at the convention."

There were staunch supporters of the two main participants in the discussion, and it did not take long before sides were chosen. At the outset, Ellery W. Stone from the west and W. B. West 8AEZ were the antagonists in this struggle for definition and thoroughness of detail for presentation of facts.

Said Mr. Stone: "Power factor is unity in any ac circuit in which inductive and capacitive reactances cancel."

Said Mr. West (ignoring inductance and capacitance): "I confine my views in the matter to the relation of real Watts to apparent Watts."

This confrontation went on for hours, with other participants joining, until all agreed that it appeared that the confusion lay in the definition of power factor. There was no common understanding reached by the two parties. So it was decided, on the spot, to submit the question to the radio section of the Bureau of Standards, Washington, D.C. The statement submitted to the Bureau read as follows:

"For information of National Convention of ARRL, please wire our expense immediately: In a freely oscillating radio circuit, and in a forced oscillating circuit tuned to resonance with the impressed frequency, if the inductive and capacitive reactances are equal in magnitude and opposite in sense, is the power factor unity? One side contends that, according to present alternating current theory, the power factor is unity, and reactances are equal and opposite. Other side contends that resonance is that condition in circuit which causes power factor to automatically assume that degree necessary for the complete dissipation of the power applied to the circuit."

Within hours after the telegram was forwarded to the Bureau, the reply came back . . . with the answer which, in essence, left both sides very much up in the air. Supporters of both Mr. West and Mr. Stone hailed the outcome of the reply as complete vindication of their respective sides. Even a committee thereupon appointed to review the entire discussion finally ended up by stating that they are not reasoning from the same premise. Most of those in attendance finally concluded by these vague decisions that another subject could be more productive and down to earth and headed for other meetings.

Of great interest to ama-

January, 1920 QST 27

QST January, 19..

RADIO 9ZN

Radio 9ZN, the station of the Central Division Manager, is located at 5525 Sheridan Road, Chicago, Ill., on the shore of Lake Michigan.

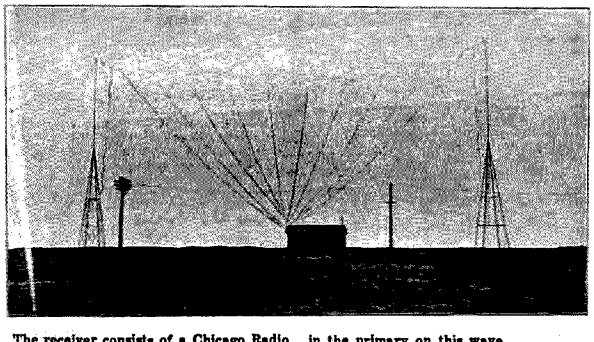
The station consists of a two room, one story frame building situated midway between the two towers supporting the antenna. The building, towers and plane of the antenna are in a north-and-south line, at a distance of 60 feet from the edge of the lake. Because of this location, the station is clear of practically all high buildings and obstructions in all directions.

The aerial is 95 feet high, over all, the towers being of steel, 50 feet high, and the masts being also of steel, 45 feet in height. The towers are 150 feet apart, the ten wires composing the antenna being spaced equally within this distance, in the well-known vertical fan fashion. The aerial wires are 7 strand No. 22 tinned copper wire, the top cable being 7 strand No. 18 phosphor bronze, with three 10½ inch Electrose insulators at each end. The loose end wire attached to the tower sides of the insulators are to provide downhauls for the cable should the serial give way.

The ground system of the station is perhaps one of the principal reasons for its success. It is composed of two banks of wires, one consisting of 20 wires (No. 14 bare copper) each 30 feet long, buried radially from the station, and the other consisting of 8 wires (7 strand No. 22 copper) each 150 feet long, buried similarly. In addition, two wires, each 100 feet long are submerged in the lake, and a number of 6 foot rods are driven into the ground about the station.

Power is provided by a 4 K.W. special power line, shown in the illustration. Telephone is also provided, the number being Sunnyside 10153.

Hy-Rad rotary gap. The rotary gap is contained within a double walled padded box, just behind the marble panel, on which are mounted the radiation ammeter, power variation switch, power ammeter and main switch, the transformer being directly beneath the gap box. The oil condenser is immediately to the right of the switchboard, and consists of 1200 square inches of tinfoil separated by ⅜ inch plate glass immersed in transformer oil. The oscillation transformer is made of 1" x 1/16" brass ribbon and is mounted as shown. The full condenser is used for the 425 meter wave, but only a part is used on 200 meters, the amount being such that only one turn of inductance is used



The receiver consists of a Chicago Radio Laboratory Paragon RA-6 short wave regenerative receiver and Amplifigon type AGN-2 audion control and two step amplifier. An Audiotron tube is used for detector, Western Electric VT-1's or Marconi VT's being used as amplifiers. With this receiver are used Baldwin Mica Diaphragm headphones. Practically all the long distance amateur stations are heard with the phones on the table on average nights; many, such as 2CS, 2ZS, 5AF, 8AA, 8ER, 9BT, 9BR, etc., being generally heard at distances up to 100 feet from the headphones. Six hundred meter stations are heard similarly. At present no set is provided for longer waves than 600 meters, but an undamped wave receiver is under construction.

The transmitter consists of a Marconi (United W.T.Co.,) open core 1 K.W. transformer, having a secondary voltage of 30,000, with an oil immersed plate glass condenser, and a Chicago Radio Laboratory in the primary on this wave.

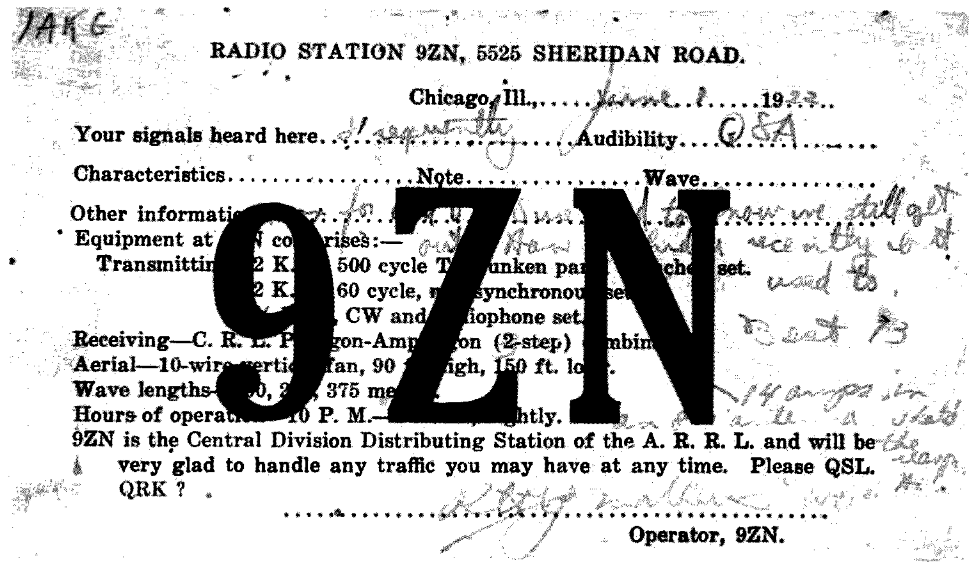
Because of the high fundamental wave length of the aerial (300 meters) all 200 meter transmission and reception are done through series condensers, the transmitting series condenser consisting of 175 square inches of tin foil separated by ⅜" plate glass and immersed in oil. This condenser is located just above the loader, which is used for 425 and 600 meter waves.

The radiation on 200 meters is 8¾ amperes, and on 425 meters is 9 amperes, the 425 being really better than would appear from a direct comparison of these readings, because of the elimination of the series condenser, and also because of the greater carrying ability of this wave.

The 200 meter wave is used ordinarily, with a shift to 425 to avoid interference or to work over greater than average distances. The answering wave of this station is invariably 200 meters, unless otherwise specified by the calling station.

(Concluded on page 35)

teurs who were still purchasing and installing spark gap transmitters was the subject of broadband interference. It was contended that spark gap units were doomed to fade out of ham stations, because the waves they transmitted on the air were not as sharp as a CW wave. It is true that they could be held better in reception and did not have tendencies to jam each other, like the CW signals did. Also, each spark on the band had an individual characteristic that identified it, and what distances could be covered (having 1000 Watts available)! The overall sensitivity and selectivity of circuits was a hindrance. The CW signals were difficult to tune and hold. Wave shifting was usually noticeable. Regenerative receivers had shortcomings, especially since they were asked to be equally effective in bringing in CW, ICW, and the broad spark signals. Receivers lacked adequate control to meet requirements. Being regenerative, they radiated energy and caused considerable interference, especially in more congested areas.



RADIO STATION 9ZN, 5525 SHERIDAN ROAD.

Chicago, Ill.,.....June 1.....1922..

Your signals heard here..frequently.......Audibility...QSA........

Characteristics..............Note..............Wave..............

Other informati...

Equipment at ... comprises:—

Transmitti... 2 K... 500 cycle T...unken pa... set.

2 K... 60 cycle, ...synchronou...

CW and ...iophone set.

Receiving—C. R. L. P...gon-Amp...on (2-step) ...mbin...

Aerial—10-wir... verti... fan, 90 ...igh, 150 ft. lo...

Wave lengths..., 375 me...

Hours of opera... 10 P. M.—...tly.

9ZN is the Central Division Distributing Station of the A. R. R. L. and will be very glad to handle any traffic you may have at any time. Please QSL. QRK ?

....

Operator, 9ZN.

For most signal reception, the oversized loose couplers in station equipment were still serving their major purpose. Domestic and foreign longwave stations were very much on the air with news broadcasts, weather reports, time signals, and general information. Many stations served as sources of code signals for practice — NAA, 2,500 meters; POZ, 12,000 meters; PL, 10,000 meters; and MUU, 14,000 meters, continued on the air for years.

So loose couplers were in constant use by amateurs until, with the introduction of the honeycomb-coil design, units which occupied far less space but had equivalent inductance gradually replaced them. Amateurs also began to convert to shorter and shorter wavelengths with the move to CW and the application of available transmitting tubes. Amateur station layouts began to take on new and revitalized appearances. Power supplies had to be designed and built to accommodate larger tubes for that new requirement of "juice" for the "bottles." In turn, many new receivers were being built using variometers and variocouplers.

As is the case each year, with the coming of fall and colder weather, radio conditions improved, static tapered off, and interest in DX and relay activities increased. So the ARRL Board of Directors decided that a determined effort should be made to span the Atlantic via amateur radio. There had been an earlier try, not organized, that had failed. Undaunted, plans were laid by the ARRL traffic department announcing that all radio amateurs should enter into a series of transmitter tests. Selections would be made to find the best and most far-reaching transmitters to qualify for the proposed undertaking. The following form appeared in *QST*, September, 1921, page 12, directed to all hams:

"Traffic Manager, ARRL, 1045 Main Street, Hartford CT.: Please enter my station as a transmitter in the Trans-atlantic Sending Tests, Dec. 8th to 17th. I will be ready to transmit in the preliminary tests on Nov. 7th to 12th, and if I fail to cover the specified distance in the preliminary tests, I shall relinquish my rights to transmit in the final tests. Name . . . Call . . . St . . . City . . . State . . . Power of transmitter . . . type (CW or spark) . . . greatest distance heard (give three records) . . ."

The stated goal was: "We want the Atlantic Ocean spanned on schedule by an amateur station, and we want definite proof that it has been done." ■

To be continued.

EDITORIAL BY WAYNE GREEN

from page 16

vide amateur radio with growth and to offer a reasonable alternative to CB manufacturers to opening a Citizens Band in the amateur 220 MHz band. Now that history has eliminated the need for a Communicator license, will we be able to stop the FCC?

HAM GEAR FOR HAMS

Somewhere around 300,000 ham transceivers have crossed over into CB hands so far . . . where will it end? The manufacturers and importers of ham rigs estimate that about 75% or more of the new rigs end up in CB hands.

Sure, the use of these transceivers by CBers in their "HF" band, those channels in the 27.5 to 28.0 MHz band, is illegal. But, like the 55 mph speed limit, the enforcement is so slight that most CBers use the band with impunity. On those frequencies, up above the hurly-burly of the "bottom 40," sidebanders sit and make skip contacts with ease. Their ham transceivers and ham power amplifiers, aided by antenna installations which would make a dedicated DXer fidgety with envy, give them a very good taste of hamming.

Most of these chaps are much like the rest of us, a fact attested to by the large number of them who are getting their ham tickets. Recent estimates from a number of ham clubs indicate that almost 90% of the people in ham classes are CBers. Most ham classes have a dropout rate of around 40%, though this depends a lot on factors such as the instructors, the code tapes used, etc. The fact remains that very few of the HFers are among the dropouts. They seem to have a much higher degree of determination to succeed. The estimate is that at least 40% of the newly-licensed hams are now coming from the HF group.

When you figure how relatively small that group is, the number of HFers getting ham licenses is most remarkable. This also may explain why we have so far had only minor trouble with HFers bootlegging in the ham bands. The redneck crowd hasn't

Continued on page 190

R. J. Edmunds WB2BJH
48 Lakeside Trail
Kinnelon NJ 07405

Try BCB DX!

-- when you're tired of twenty

Many amateurs are familiar with DXing the foreign broadcast bands in the short waves, frequently from having DXed them in the process of aiming toward their licenses. There is, however, another area of DXing which offers a far greater challenge to the DXer, although he can no more "work" this DX than he can the international broadcast stations. This is the standard AM broadcast band, from 525-1605 kilohertz.

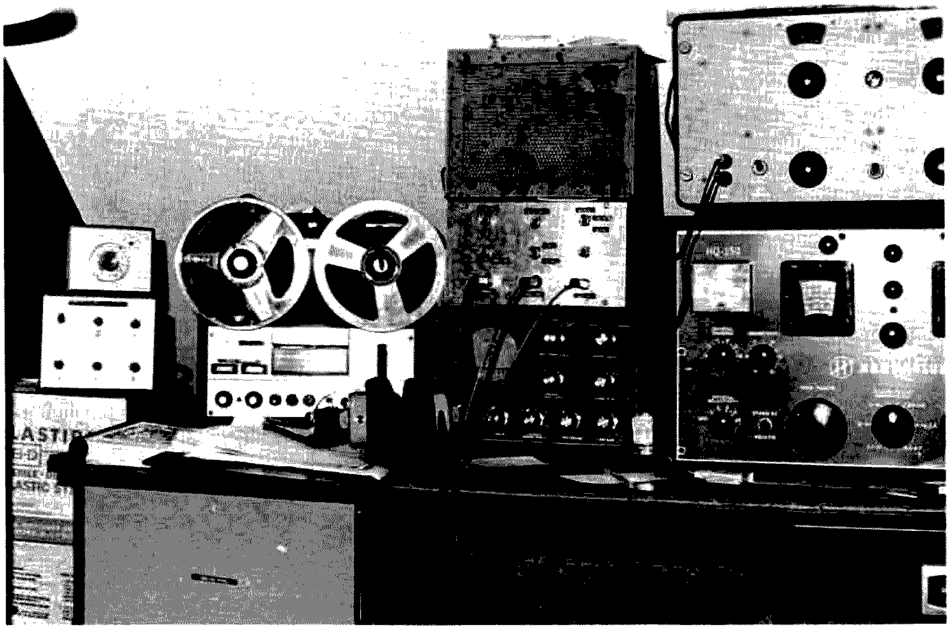
The hobby of listening on this band, like all other forms of radio listening which can be called DX, had its beginnings with amateurs. Before the advent of the commercial broadcasters on AM with which we are most familiar, amateurs pioneered here, too. Many of the oldest broadcast stations are outgrowths of amateur or other experimental operations. The first broadcast licenses were issued, indeed, for experimentation and development. Perhaps one of the most familiar of these is New York's WQXR, 1560 kHz, which was formerly W2XR.

In the old days, there were only a very few frequencies being licensed, due to the small numbers of stations and low powers involved. The present set of frequency allocations came into existence in 1934, when the old Federal Radio Commission became the familiar Federal Communications Commission. Actual commercial broadcasting, with commercial messages being broadcast as a means of revenue, began in 1924 over station WEAF (now WNBC) in New York, which broadcast spots for a Long Island realty company.

The amateur practices of sending reception reports and receiving QSL cards are also found in AM broadcast DX. Many stations will verify receptions with QSL cards or letters, although the practice is by no means as prevalent as it was in the 1920s and '30s. DX nights were common during that time, as most or all domestic stations would leave the air at local midnight on certain days, leaving the bands open for exotic international DX. Many old-time BCB DXers were able to hear and QSL stations in nearly every country which had them.

Today, however, with the over four thousand stations in the United States alone, many boasting extended schedules and higher powers, such a feat is impossible. It is, nonetheless, possible to log more than one hundred countries on the BCB. Country-counting is different from what it is on the amateur bands, and there are no DXpeditions to add to the totals, with the result that there are many fewer "BCB countries" than there are "ham countries."

But why should we DX BCB under these conditions? Perhaps the best answer is because it's there. We could well ask ourselves why we DX any band at all, and the answers would be somewhat similar. BCB offers several challenges to the DXer, including hearing stations which are not intended for long distance, international listeners, but rather for domestic ones; the challenge of beating the local QRM;



The author's shack. Left to right — clock timer with power selection panel; stereo tape recorder; speaker, audio input/output distribution panel, SB-620 spectrum analyzer; variable bandpass audio filter and HQ-150.

and the old familiar countries, state capitals, counties or what-have-you lists. Another aspect of particular importance to beginners and youngsters is the low cost and ready availability of equipment.

Equipment

All it really takes to hear BCB DX is a standard AM radio of medium to good quality, and, perhaps, a hunk of wire strung in the backyard. The best portable BCB DX equipment consists of a transistorized receiver, with a loopstick inside for an antenna, which retails for under $40.00 (the Radio Shack Long Distance TRF).

Of course, the DXer will likely wish to continuously upgrade his equipment, but a very fine setup can be assembled for less than it costs to equip a multiband ham shack with a good set of equipment. Communications receivers from the surplus market, including such makes as Hammarlund, National, Hallicrafters, Drake, or Collins, among others, are often ideal for BCB DX. Many enthusiasts consider the Hammarlund HQ-180 to be among the top receivers, while others opt for the Collins R-390A/URR. Any number of other receivers manufactured by the above companies, as well as military surplus units and current-production Radio Shack models, are also quite suitable.

Antennas are generally a home brew situation, with a four-foot air core altazimuth loop with FET rf amplifier being the ultimate of these. This is perhaps the most popular antenna in use today, although the old standby longwire and tuner is still quite prevalent. One commercially available antenna, developed by a DXer and former corporate engineer, is the Worcester Laboratories' Space Magnet series. This antenna is a ferrite-cored loop with amplifier, available in several models in the $50.00 range from Worcester Electronics Laboratories, Frankfort NY.

There are many other variations of BCB loop antennas available as construction projects, commercially available kits, or assembled units. Many DXers experiment to obtain new designs which combine high directivity, high "Q", and small space consumption to suit their individual needs.

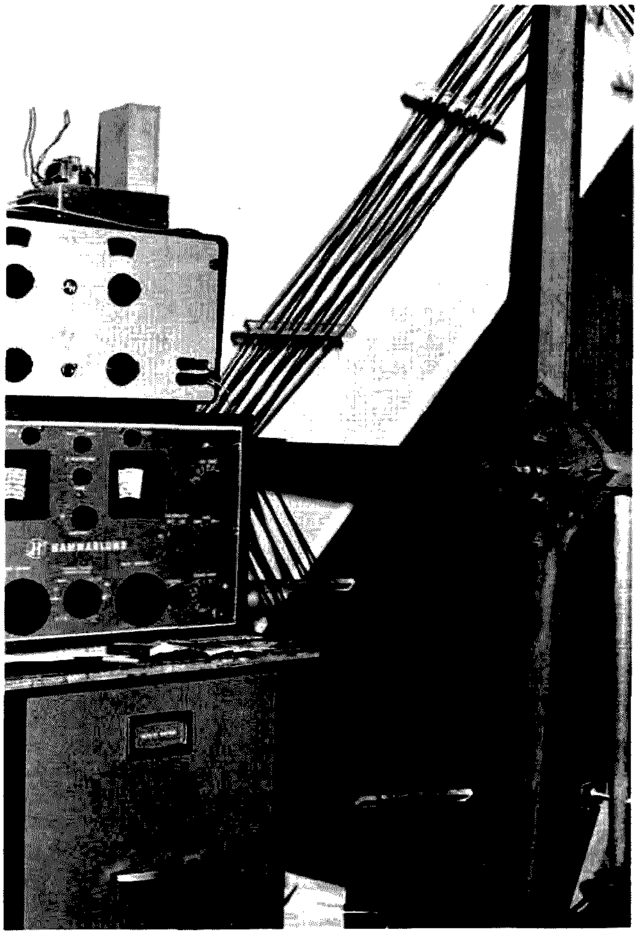
Among the most popular accessories are tape recorders, external Q-multipliers, audio filters, stereo headphones wired for mono, and oscilloscopes or spectrum analyzers. The latter are used primarily for observing signal traces and band scanning for additional signals not immediately audible, as well as for identifying interference and frequency measurement. Most of these, however, are really not necessary.

Getting Started

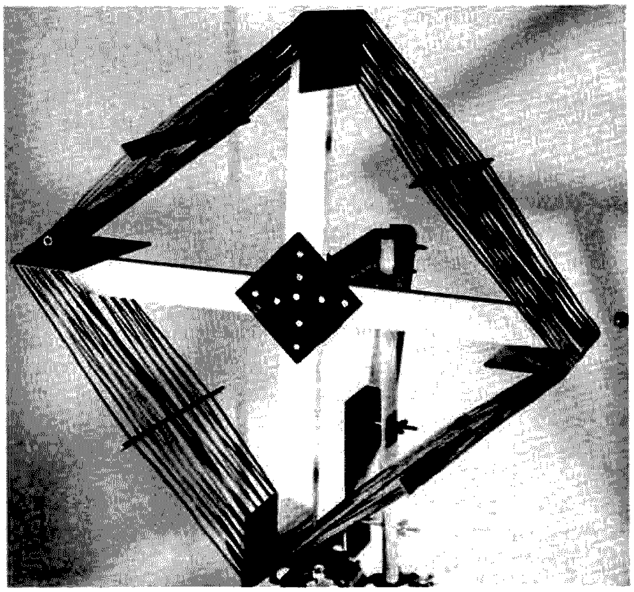
Any new hobby can be confusing to the beginner, and so it is with BCB DX. There are, however, a number of very useful publications to be had. Many of these are published by the two national BCB DX clubs – the National Radio Club, headquartered in Louisville KY, and the International Radio Club of America, in San Francisco. The two clubs were at one time one, but, as is often the case with amateur clubs, a split occurred in 1964, resulting in the two clubs. Both cover the whole continent and primarily the same segments of the hobby, although there are some differences in orientation. The NRC features more publications and a larger membership, as well as a somewhat more technically-oriented outlook.

Each of these clubs publishes a regular bulletin, which is weekly during the winter DX season, and less frequent during the summer. The NRC publishes *DX News*, which has appeared regularly since 1933. It also publishes a domestic station log, night directional antenna pattern book, receiver and antenna manuals, and a large list of article reprints. IRCA publishes a foreign log compiling all reported receptions on an annual basis, as well as a somewhat smaller list of reprints. Both publish introductory booklets. A copy of an explanatory publication and a publication list may be obtained from the NRC by writing to: NRC Membership Center, P.O. Box 118, Poquonock CT 06064. A sample bulletin may be had for 50¢, from the same address. Information on the IRCA may be obtained by writing to Richard Segalas, P.O. Box 26254, San Francisco CA 94126. Another valuable publication is the *World Radio/TV Handbook*, already known to many hams and SWLs.

Most newcomers to the BCB hobby start out with domestic DX (U.S. and Canada) and very little foreign DX. Even a casual listener will be aware that there are many stations throughout the U.S. and Canada which can be heard on even the poorest of equipment, and it naturally follows that the better the equipment and the more DX experience on the band, the more and rarer the DX will be. Much of the BCB DX hobby depends on knowing what to look for and when to look for it. For these reasons, one cannot take the publications too lightly, nor should the aspect of preplanning be



The author's shack. Variable audio filter, HQ-150, and part of 4' altazimuth FET loop. At the extreme top left is a simple fixed low pass audio filter. Not shown are mono-reel tape recorder, cassette recorder, and Nordmende Galaxy Mesa 6000 portable receiver.



A 2' altazimuth loop antenna for use with or without external rf amplifier, modified and built by the author from 4' antenna design.

ignored. Much time is wasted by beginners, who have passed the first plateau of hearing all of the regular and semi-regular stations, but have not yet learned that simply sitting and waiting for DX isn't good enough after that point.

Propagation

The optimum time for BCB DX listening is between midnight and local sunrise, when many stations are off the air, thus reducing interference and allowing DX stations through. In addition, many daytime-only stations test during this so-called "experimental period" and may, thus, be heard at far greater distances than they are normally heard during their regular broadcast schedules. Monday mornings (Sunday nights) generally yield the most silent periods from full-time stations and the most tests from daytimers, and are, therefore, the most worthwhile. Many stations conduct regularly scheduled tests during the experimental period, and lists of many of these are available from the BCB DX clubs.

Many DXers, however, find that listening during these hours conflicts with their normal lifestyle, and so such listening is confined to rare occasions. In this event, the DXer will want to capitalize on the other optimum period for BCB DX, namely the period around local sunset. At this time, propagation conditions are changing due to the sunset, and many daytime stations are leaving the air for that reason. These two factors combine to allow for more distant reception of these stations just before they do leave the air. The FCC has set out specified times for sign-offs and sign-ons of domestic stations, which correspond with their average monthly sunset and sunrise. The resulting pattern is an east to west sequence of sign-offs, thus allowing for stations to sign off leaving stations further west still on, and so on, until a full-timer becomes dominant. On some channels, a DXer may listen and hear one or two new stations signing off in every fifteen-minute sign-off period. Maps detailing the zones of monthly sign-offs (or in some cases, antenna pattern changes or power reductions for full-time stations), as well as the reciprocal times for sign-ons (and increases at sunrise), are also available through the clubs.

Propagation of domestic signals on BCB is generally accomplished by either ground wave, which follows the approximate line of sight, or by sky wave, which is reflected back to Earth in the ionosphere. Sky wave can be broken down into various levels of skip. In the daytime, the "D" and "E" layers of the ionosphere effectively prevent any significant long-distance skip on the medium waves. During the mid-winter period, receptions at distances of up to 1000 miles via ground wave are not uncommon, but, throughout the rest of the year, the average is much less.

At night, the "D" layer disappears, and the "E" layer weakens significantly, thus allowing many signals to travel on to the "F" layer, which really is composed of two layers, known as F1 and F2. During the daytime hours, these layers separate from each other to a greater distance than they are at night, but this fact is not immediately relevant to our discussion. Both "F" layers are capable, as is the "E" layer, under certain circumstances usually associated with geomagnetic disturbances known as "sporadic E," of reflecting signals back to Earth. To be technically correct, the process is really refraction, but the ultimate effect is sufficiently similar to reflection to be so called here. In general, most of the ionospheric reflection observed at BCB frequencies occurs in the F2 layer.

Normally, ground wave is reliable at night, up to a distance of approximately 125 miles. Sky wave is generally the predominant mode of propagation from about 160 miles on up. The area in between is an irregular combination of the two, with neither one dominant. It should be noted that some sky wave components will be present, but masked, at the lower distances, and that the reverse will be true at the lower range of the higher group of distances. A single hop reflection from the F2 layer can propagate a signal over a wide range of distances, up to nearly 2500 miles, depending upon the angle of radiation. A given transmitter will radiate at a multitude of angles, thus allowing it to reach the entire range of distances prescribed herein. Skyline blockage, such as mountains or large man-made structures, can prevent transmission at certain angles by blocking or absorbing the signal at either end of the path.

Long-distance (in excess of 2400 miles) propagation is primarily by multihop paths of F2 reflections. Occasionally, it may be possible for propagation by multimode paths, or other unusual modes, which are beyond the scope of this discussion. Included among these is reflection by nighttime sporadic E.

There are, however, other factors which materially affect BCB signal propagation. The most significant of these is that caused by auroral disturbances of the Earth's atmosphere. At such times, excessive absorption of sky wave signals by ionized particles in the ionosphere takes place and alters the character of reception in some areas. This alteration is geographically dependent, due to the nature of the Earth's magnetic field. It is most strongly noticed in the northeast, due to that area's proximity to the North Magnetic Pole. When this happens, absorption occurs, depending upon the severity of the disturbance, on signals arriving from the north, northeast, and northwest. In severe disturbances, or at higher latitudes, signals from the near southerly directions may also be absorbed.

This process leaves those signals which are ground wave, thus yielding signals from stations at an intermediate distance arriving

solely by ground wave, as well as those sky wave signals arriving from such a distance and/or direction as to escape the absorptive layer. Thus, signals from the south, semi-local, and local signals will predominate. It may be seen, then, that the serious DXer on BCB will frequently be as hampered by an aurora as DXers at higher frequencies are aided by it.

Planning and Recordkeeping for the DXer

Perhaps the most important part of BCB DXing involves planning the DX sessions. As noted earlier, there comes a time when simply turning on the receiver and aimlessly looking about for new stations becomes non-productive. At this point, the DXer should set about compiling realistic target station lists for each time block he plans to listen. Factors to be taken into account are interference, distance, season, and even month. The first two factors are obvious, but the latter two can use some explanation. In BCB DX, winter tends to be the primary time to listen, due to the shorter period the atmosphere is exposed to sunlight, thus allowing a lesser period of ionization to occur. Likewise, a case has been made for better propagation due to cold weather. Antenna radiation patterns are altered somewhat by a covering of snow around the antennas, and large fronts of snowy weather can often affect intermediate-range propagation by sky wave.

The month of the year is a direct factor in the sunrise and sunset times already discussed. Use of the maps of these times for domestic stations, as well as maps depicting actual sunrise and sunset times worldwide, can aid in planning the DX session by allowing you to determine when the signal path is in darkness, which predicts good propagation, or partly in sunlight, which does not. The domestic maps also allow the DXer to determine which stations lie closest to the borderline between one sign-off (or sign-on) block and another. At sunset, those stations closest to the previous block will be more likely to be heard than those closer to the following block, again due to the relative degree of darkness on the path. At sunrise, the reverse is true for sign-on DX. Even this difference of five or ten minutes in actual sunset or sunrise times among stations signing on or off simultaneously can make a significant difference.

Recordkeeping is a major part of planning, and it is also a part of "saving" your DX. Records of monthly sunrise-sunset maps for the most productive domestic frequencies may be reused year after year, as can lists of target stations. Identifying a station with marginal audio may require not only a knowledge of the rudiments, such as call letters, location, and network affiliation, but also a knowledge of programming type, special or local networks, telephone area codes, postal zip codes, sports programming, and program syndications. All of these can be used to shed light on the identity of a station for which you can pin down neither the call letters nor the location.

As noted at the outset, many DXers write for QSL cards, or "verifications of reception." This requires maintaining a log of what is heard, with an emphasis on items of local nature, advertisements, personalities, and phone numbers. This may be done via logging sheets for the long term, and by tape recordings, in order to put the data down on the logging sheets accurately. Tape recordings also allow you to play back partially-readable IDs or tentative IDs for analysis and ultimate identification. Many DXers maintain "ID tapes" which contain the station IDs recorded from DX sessions and rerecorded onto the master tapes. This creates a semi-permanent record of the individual's DX catches and provides a proof of reception as well, although not in the same way as verifications.

kHz	Call	Location
640	KFI	Los Angeles
650	WSM	Nashville
660	WNBC	New York
670	WMAQ	Chicago
680	KNBR	San Francisco
690	CBF	Montreal
700	WLW	Cincinnati
720	WGN	Chicago
740	CBL	Toronto
750	WSB	Atlanta
760	WJR	Detroit
770	WABC	New York
780	WBBM	Chicago
810	WGY	Schenectady, NY
820	WBAP	Fort Worth
830	WCCO	Minneapolis
840	WHAS	Louisville
850	KOA	Denver
860	CJBC	Toronto
870	WWL	New Orleans
880	WCBS	New York
890	WLS	Chicago
1020	KDKA	Pittsburgh
1040	WHO	Des Moines
1070	KNX	Los Angeles
1100	WWWE	Cleveland
1120	KMOX	St. Louis
1160	KSL	Salt Lake City
1180	WHAM	Rochester, NY
1200	WOAI	San Antonio, TX
1210	WCAU	Philadelphia

Table 1. Clear channel stations. All of the above stations broadcast on channels designated as "clear" channels by North American Radio Broadcasting Association agreements. All broadcast with 50,000 Watts and nondirectional antennas on a full-time basis.

What Can You Expect to Hear?

The beginning DXer might best start by trying to log as many stations on each channel as he can by day and by evening before settling down into the "DX prime time." This will weed out the regular stations from the non-regular and will give the DXer a familiarity with the band, so that he need not waste time trying to ID an unneeded station. Following that, one might try to hear all of the 50,000 Watt, class 1A "clear channel" stations, a list of which is shown in Table 1.

If foreign DX is more to the DXer's liking, or domestic DX has become boring, the beginner's goals should be toward Latin America initially, and ultimately, depending upon his geographical location, to transatlantic or transpacific DX. Here, the *World Radio/TV Handbook* is a must, in order to set up target stations, as well as to assist in identifying what is heard. Due to the fluid nature of many of these Latin American stations, as well as some differences caused by the listener's location, no list of widely heard stations will be presented. Such information, as well as information on transatlantic or transpacific DX, can best be obtained by joining one of the aforementioned BCB DX clubs.

By this time, you have either gotten interested in the concept of BCB DXing, or not. If you have, the best advice is to start out with some fairly easy targets, and to contact one or both of the two clubs mentioned. If you feel that you require still more information, again, you should contact one of the clubs, either for their descriptive material or to purchase a copy of their beginners' publications. In the meantime, good DX! ■

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58 Manaolana Place
Hilo HI 96720

Build An Engine Analyzer

-- use your scope!

If you are anything like me, you hate to pay someone else to do something you can do yourself, and that's the way it is with me and my automobile. It has occurred to me that I constantly find myself involved with electronics. Yet here I am, a self-professed expert, and I have no way of taking on the complexities of the common Kettering automobile ignition system. Or do I?

Recently, my daughter, Marie, gave me a beautiful automotive timing light. It's a real peach, with an extremely bright flash, and operates from the car battery system. "Hey neat ... just what I always wanted," and, with that, I ran out to the trusty, rusty Pinto and eagerly hooked up the light to the four-banger gas burner.

The instructions say to hook the red and black wires on the light to the positive and negative terminals of the car battery and then clamp the induction pickup around the number one spark plug wire. Elementary, so far. With the engine running, and being careful to watch that those dangling wires don't drop into the spinning fan blades, I gently squeeze the trigger on the gun and watch the light spring to life. I love gadgets, and this one had all the elements of being some real fun.

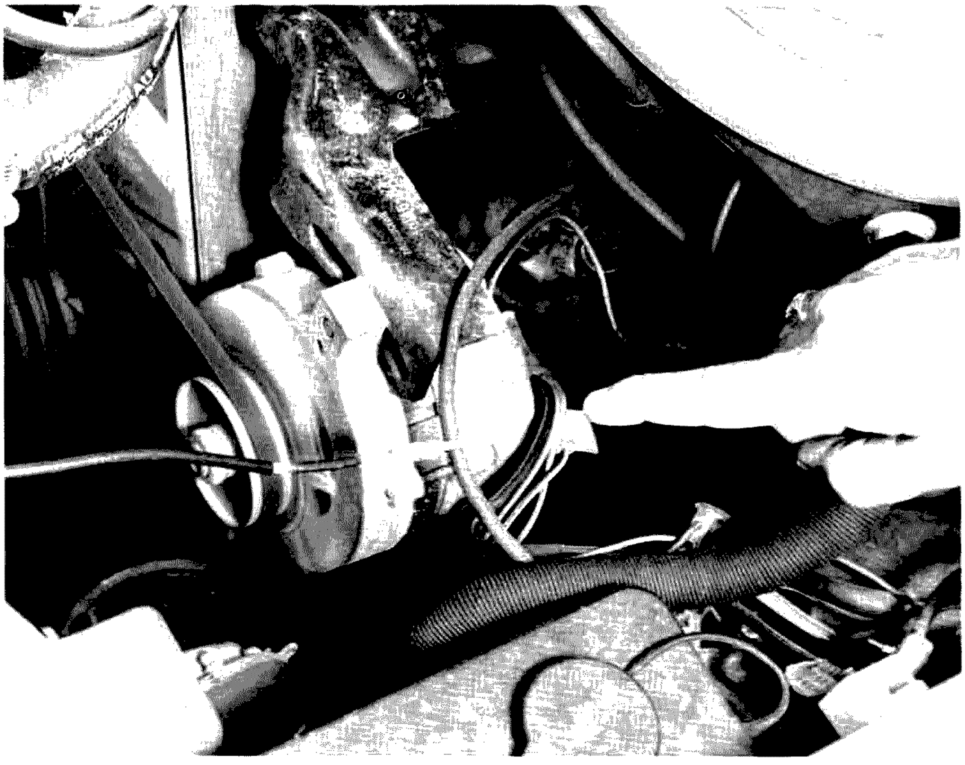

Photo A. This photo shows how the vertical input to the scope is coupled to the high tension lead from the distributor to the coil. Notice that it is only clipped to the insulation and does not make direct connection to the wire.

Now, I have fiddled around some with automotive problems and knew that the timing marks are found on the side of the front pulley. All that has to be done is to rub some chalk into those marks, so you can see them easily, and, with the timing light aimed at the spinning pulley, press the trigger and watch the strobing action, as the number one cylinder fires the timing light.

Somewhere back in my mind, I recalled that I had overlooked a few small details. Let's see . . . yes, the books did tell me that the vacuum advance line to the distributor must be pulled and plugged (I used a 6/32 bolt from the junk box), but wait, what's this? ... "Timing must be adjusted with the engine running at manufacturer's specified rpm. If necessary, use a tachometer to set idle rpm."

Well, I don't have a tachometer. The first thought that went through my mind was to run out and buy one, but that didn't settle well with me. But I needed to figure how many revolutions per minute that little Pinto engine was turning over, and with a fair degree of accuracy.

We've all seen the modern, automotive electronics shops, with their big engine analyzer scopes all nicely calibrated, but who among us is going to rush out and buy one of those? What I do have is a pretty fair B and K model 1461, 10 MHz, triggered oscilloscope, with eighteen calibrated sweep ranges. It seemed to me that that should work, somehow.

The problem was interesting and one that took my thinking through many phases. I began by thinking in terms of how the combustion engine works. It takes a fuel/air mixture into the cylinder on a downstroke, compresses it on the upstroke, where it begins burning the mixture by sparking the plug somewhere before top dead center.

The resultant explosion gives us the power downstroke. Finally, the cylinder on the last upstroke exhausts the by-products of burning. Our problem is to fire the plug at just the correct time on the first upstroke before top dead center and do this timing with the engine running at a specified number of revolutions per minute. The timing light flashing on the timing marks will show us the answer to the first problem, but that rpm problem must still be figured out. Remember, that cylinder fires only once for every *two* engine revolutions.

What we must do is get a good, *stationary* display of all cylinders firing on our scope, so we can measure the duration of all cylinder firings in time. With an externally triggered scope, this is a cinch. Take a clip lead and loosely couple it around the number one spark plug wire. I just use an ordinary clip lead with an alligator clip on one end. Clipping this around the plug wire gives me plenty of induced pulses to easily trigger the scope (see Photo A). Switching to external trigger, the scope will now make one sweep, from left to right across the tube, for every firing of that number one cylinder. Then, by coupling the vertical input of the scope to the high tension lead coming out of the center of the distributor in the same manner (see Photo B), your display will show the firings of all cylinders in exactly the sequence they actually are firing. In the case of the Pinto, it will be, first, number one cylinder, followed by three, four, and finally, number two. It's a simple matter to immediately see if all plugs are firing, and also to see the relative amplitude of the spark voltage to each cylinder. The vertical gain control, along with the vertical positioning control, can be used to bring the voltage peaks of all firings onto the scope face. Just remember, we are only looking at *induced* voltage through the insulation of the spark plug wire. We have not connected our scope directly to any bare wire, as the plug wires can carry well over 10,000 volts of ac. In some cases, it may help to put a 2200 Ohm resistor and .05 capacitor across the input of your scope, to dampen out much of the high frequency information we are not interested in. Some experimentation is called for with the exact values. Nothing is very critical in this department.

Years ago, I learned a remarkable thing that turned out to be a gem of knowledge, and, after having spoken to other people in electronics, was very surprised to learn how few understood this fact. Very simply stated: "Time in seconds is the reciprocal of frequency in Hertz, and frequency in Hertz is the reciprocal of time in seconds." Those of you who knew all along can smile, but those of you who didn't should read and reread that until you understand its exact meaning, because, with this little nugget of knowledge, many mysteries of the oscilloscope become child's play.

Remember, we want to measure engine revolutions in time – specifically, revolutions per minute. Because, as stated above, frequency in Hertz is the reciprocal of time in seconds. All we must do is measure, with the scope, the time for all cylinders to fire, take the reciprocal of this time in seconds to get frequency in Hertz, and then multiply by 120, thereby getting revolutions per minute. (Remember, that cylinder fires once every other revolution; therefore we must multiply by 120 rather than 60.)

If we look at a calibrated sweep oscilloscope, we see that sweep time is usually measured in milliseconds or microseconds per division on the graticule over the face of the tube. All we must do is count the number of divisions, generally centimeters, multiply by the indicated number of milliseconds or microseconds per division of the sweep time scale of the scope, and take the reciprocal to find frequency. At this point, a small calculator is an immense help, unless you like to do long division with a pencil.

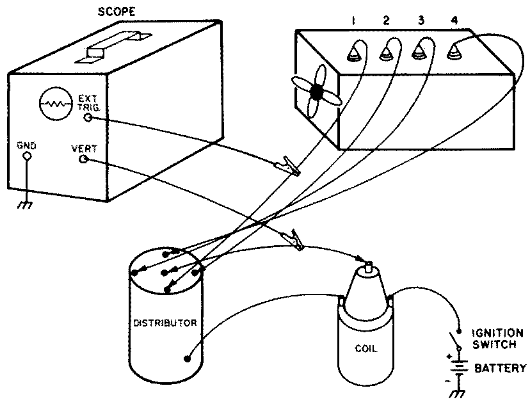

Fig. 1.

As an example, suppose we have connected our scope up as shown in Fig. 1, and we are driving a four-banger. Our sweep time is set for 5 milliseconds per centimeter. As seen in Photo C, the time between firings is 6.6 centimeters. Multiplying this by our sweep time of 5 milliseconds per centimeter, we find that time between firings is 33 milliseconds, or 132 milliseconds for four cylinders. Taking the reciprocal of 132 milliseconds and multiplying by 120 reveals our engine revolutions to be 909 revolutions per minute. For those of you who hate

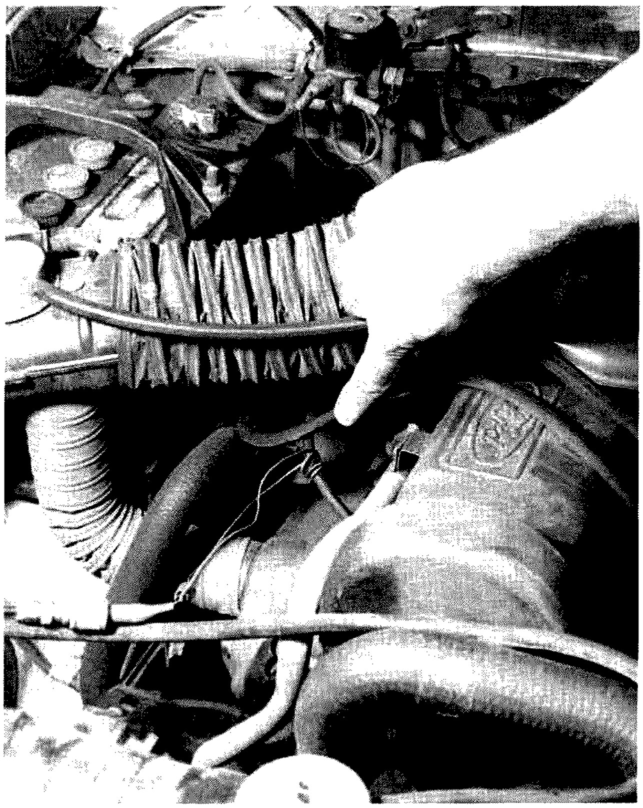

Photo B. This shows the method of obtaining the external trigger pulse from the number one cylinder. Notice that the wire is only loosely coupled around the plug wire and does not make direct connection.

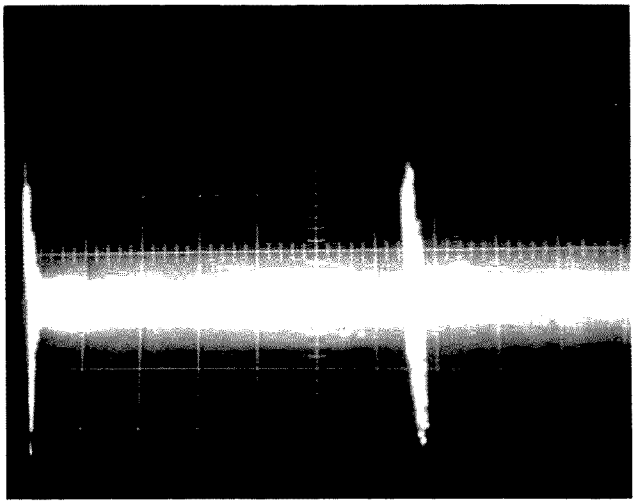

Photo C. With the sweep time of the scope set to 5 ms per centimeter, we see the time duration between two firings to be 33 milliseconds. This represents 909 rpm on a four-cylinder engine.

Engine rpm	Time for all cylinder firings in milliseconds
400	300 ms
450	266 ms
500	240 ms
550	218 ms
600	200 ms
650	185 ms
700	171 ms
750	160 ms
800	150 ms
850	141 ms
900	133 ms
950	126 ms
1000	120 ms
1050	115 ms
1100	109 ms
1150	104 ms
1200	100 ms

Fig. 2.

this kind of math, refer to Fig. 2, where I have figured out all firing times and converted them to rpm for you.

Although the scope could have been set up for a display of all four cylinder firings, I personally feel a little more accuracy is possible by using an expanded sweep and measuring the time for one cylinder firing, rather than by multiplying by the total number of cylinders. There probably isn't much difference, so it will boil down to what each individual feels most comfortable with.

To set the curb idle speed of your car, it is always best to refer to the manufacturer's specs, either in the owner's manual or in a local library, in a good automotive manual. I like *Chilton's Motor Manual* myself, and find it very complete. Generally, it's a matter of adjusting the correct screw on the carburetor. Curb idle speeds will vary, and the specs may call out different rpm for such cases as cars equipped with or without air conditioning, etc. Once the idle speed has been properly set, the timing can be adjusted with the light. This involves loosening the lock nut under the distributor and gently turning the distributor, while watching the timing marks on the front pulley in the strobing flash of the timing light. Timing will also increase or decrease the engine rpm, so you may find yourself going back and tweaking the curb idle adjust again.

A word of caution is called for here. Adjustment of engine timing and curb idle speed will affect the emissions of your car. Go slowly the first time, consult your manuals, and set your car up by the book. Don't forget to reconnect the vacuum line back onto the distributor when you are finished.

It is beyond the scope or intent of this article to go completely into electronic engine analysis and tune-up procedures. Others before me have done this with more success. All I have attempted is to introduce to you the elements of using commonly available test equipment, rather than buying specialized equipment. I have found that, with a basic single-trace, triggered scope, using calibrated sweep and a good VOM, almost any problem in the ham shack or shop can be solved with a little thinking and some understanding.

At today's prices for automotive analysis and tune-up, it won't take long before my simple equipment will pay for itself. Even if it doesn't, the satisfactions of doing it yourself, saving, and learning in the process, are the real long-term payoffs. ■

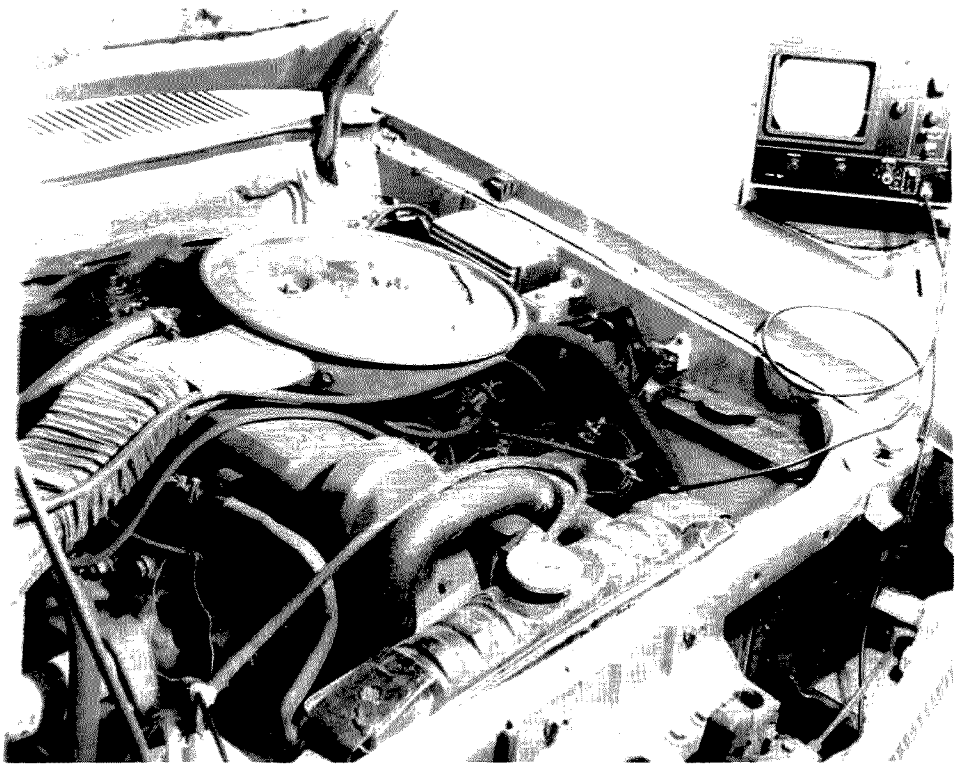

Photo D. Overall test setup used to determine the rpm of the Pinto. The ground connection of the scope is made to the bumper.

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More Repeater Control Devices

-- control unit/audio interface

Over the period of the last two or three years, I have designed, built, and installed a fairly complex control system for a system of five repeaters. Three of those repeaters are local or co-located with the primary control system, while two are remote, located from 20 to 50 miles from the primary site. Since the system is now fairly well finalized, I decided to publish it. None of what is to follow was consciously copied from any other source, but, with a project of this magnitude, there are bound to be some out there who can say, "Hey, that's my circuit." To them I offer my apologies.

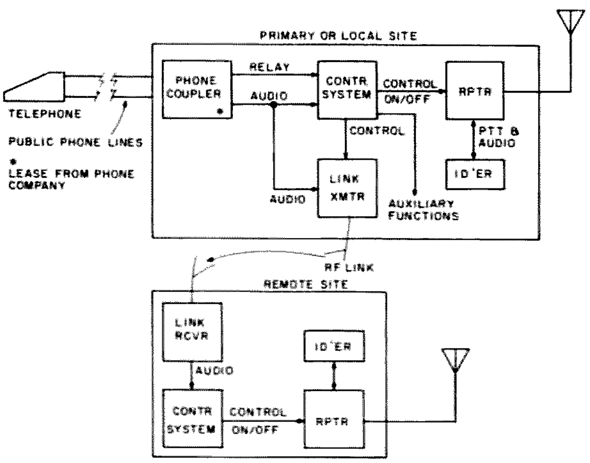


Fig. 1. Control system block diagram. Entry is via public telephone using a Ma Bell coupler. The control system then either controls the local repeater(s) directly or activates a link transmitter to relay control tones to a remote site.

The total repeater control system is shown in block diagram form in Fig. 1. All primary control functions are carried out via tone codes on public telephone lines. There is a control phone termination with a Ma Bell coupler on it. The coupler answers the line and connects the audio into the control system. It also hangs up the phone after a certain period of time. After the control phone number is dialed, a two digit control sequence is sent with touchtones™. The present equipment at the phone site has the capability of about 30 functions, but that can be changed to fit system needs.

In order to control the remote sites through the same system, one of the local control codes will turn on a 450 link transmitter and couple the telephone audio to the transmitter. Activating that code also inhibits all of the other functions at the local site while the remote is being functioned. Each of the remote sites has its own complete decoder system and its own set of control codes. The sites have a 450 receiver coupled into the control system. Under our present system, each of the remote sites has the capability of about 15 different functions, but here again, that is expandable to fit different conditions.

In addition to the control functions at each site, each has an audio interface board for the control decoder and an identifier. The identifier is a CMOS version of my original identifier circuit which appeared in the September, 1976, issue of *73*. As of this writing, the audio interface board design is not completed. I expect to complete the design in the near future. The basic theory and block diagram will be included later in this article.

The entire repeater control system is built around a two digit function code. The use of two digits was the end result of much discussion about various code lengths. It was decided that the added number of functions available or the added security afforded by more than two digits were not really worth the increase in logic complexity or cost.

The system started out entirely in TTL for economic reasons. The control at the local site was the first built and is still TTL, but the remote site equipment is CMOS and any expansion to the system will use CMOS. Only the CMOS circuitry will be discussed in this article.

Basic Control Function

The basic control function is shown in block form in Fig. 2. It consists of a tone decoder/clock generator and a function decoder. The way the system is laid out, each function decoder provides one primary function and up to four auxiliary functions. The way it works is that each

function decoder module accepts a unique primary digit (i.e., a 1) and then a second digit (i.e., 2) to complete a given function. The primary function has separate two digit ON and OFF codes having the same first digit (i.e., 1-2 ON, 1-3 OFF). The auxiliary functions all have separate ON codes, but all share a common OFF code (i.e., 1-4, 1-5, 1-6, etc., ON, 1-0 all OFF). It is possible to wire the function board to provide more than one primary function, but I didn't do it that way because it used up more of the available codes. Also, although it is feasible with this scheme, I steered clear of repeating digit coding such as 1-1.

Notice, also, that I show the digit going to the function decoder module(s). The * is a master reset which shuts off all functions at a site simultaneously. The # is used as a reset function for the initial logic states simply to eliminate possible functioning of an undesired code if doing two in sequence. For example, a sequence of 1-2 - # would turn on a function and then reset the initial stages of the decode logic. An automatic reset function is also provided which performs the same function about 10 seconds after the last tone is sent. The # and automatic reset are ORed on the decoder module, and both appear on the reset line.

Due to the many different control requirements and the low drive capability of CMOS circuits, I also provided an interface module which can provide either relay or transistor outputs or both.

Audio Interface Module

The as yet unfinished audio interface module is shown in block diagram form in Fig. 3. The module will provide the wide range agc action which is so vital to proper 567 tone decoder operation plus high group/low group tone filtering, which, while not strictly a necessity, will provide for more stable, false-free decoding. At the present time, I do have agc amplifiers on all of the decoders, but I am unhappy with the sensitivity of the circuit to the parts used. I (hopefully) will have a new design done in the near future. Also, since I'm not happy with the present circuit, I haven't designed a printed circuit board as yet.

Tone Decoder Module

The tone decoder module consists of a set of 567 tone decoders, a clock generator, and a reset generator. The basic 567 tone decoder circuit is almost right out of the *Signetics Data Book*, with only a couple of component values changed. The block diagram of the module is shown in Fig. 4, and the complete schematic in Fig. 5. NE567 tone decoders have been discussed by me (*73*, April, 1976) and many other authors, so I will forego any detailed circuit description in this article. It should be remembered, however, that the 567 output goes low with the tone present and that the NOR gates on the outputs are actually functioning as AND gates.

A look at Figs. 4 and 5 will show some circuitry not included in most decoder circuitry, but which is most necessary to allow sequential decoding. Those circuits are a clock generator and a reset generator. Gate U11 forms a circuit which will provide an output whenever any column tone is present. The output of this circuit is used to drive the clock and reset pulse generators.

As you look at the clock and reset circuits, you may well ask, "Why the gates instead of monostable multivibrators (74121, 74123, 14528)?" Well, the TTL version I mentioned earlier uses 74121s, and they gave me fits with false and double triggering. The CMOS version wasn't readily available to me.

While experimenting one night, I stumbled on the cir-

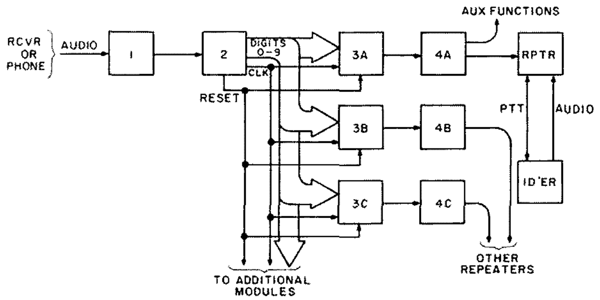


*Fig. 2. Basic control decoder block diagram. The numbers in the blocks are separate modules (1: audio interface; 2: tone decoder; 3: function decoder; 4: interface). The outputs of the tone decoder module are TTL logic levels. There is one output for each digit plus * and #. In addition, there are clock and reset pulse generator outputs. These outputs drive the function decoder module(s). The function decoder outputs, via appropriate interface module(s), control the repeater(s) and auxiliary function(s). The identifier module is a separate, independent module requiring audio and PTT to the repeater.*

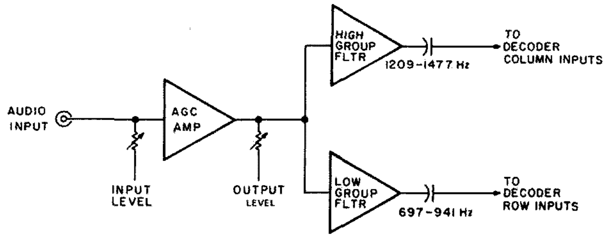


Fig. 3. Audio interface block diagram. Incoming audio passes through an agc amplifier which provides a constant output for inputs varying from about 50 mV to over 1 volt rms. The audio is then filtered into high and low tone group ranges for input to the tone decoder module.

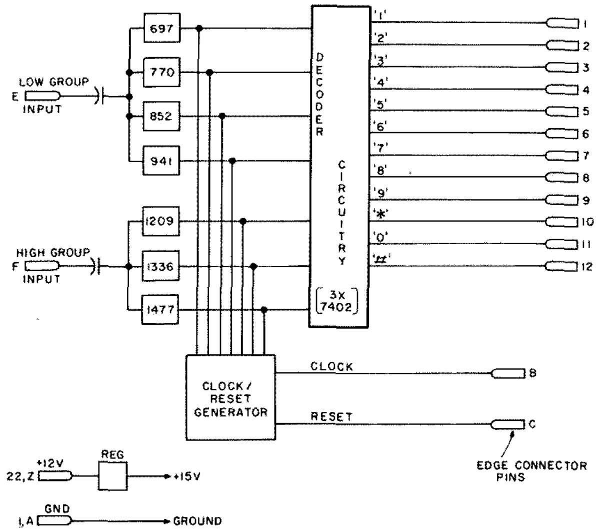


*Fig. 4. Tone decoder module block diagram. The basic decoder consists of seven 567 decoder ICs and three 7402 gate packages providing logic outputs for digits 0-9, *, and #. Additionally, the module contains clock and reset generator circuitry. This circuitry provides a clock pulse output every time a digit is decoded and a reset pulse 7-10 seconds after the last digit is decoded.*

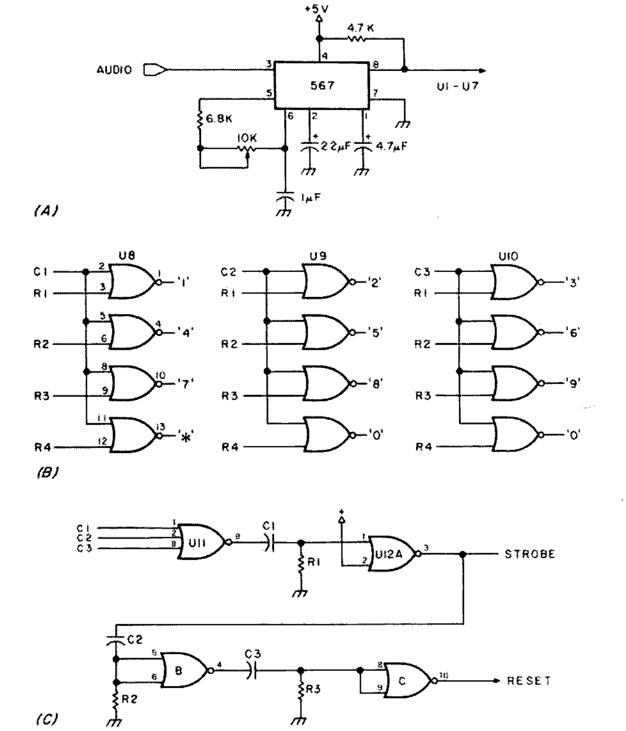


Fig. 5. Tone decoder schematic diagram. a) Individual 567 decoder; the remaining six are identical. b) Digit decoder connections. ICs U8, U9, and U10 are 7402 quad NOR gates. c) Clock and reset generator. U11 and U12 are CMOS gates 4025 and 4001, respectively.

cuit of Fig. 6, and it worked so simply and reliably that I replaced all my monostables in the CMOS designs with the gate circuit. It works in a very simple manner. When the input goes high, it charges the capacitor C to the supply voltage. Then, when the input goes back low, the capacitor has no place to discharge except through the resistor or through the input of the CMOS gate. Therefore, the output of gate U1 is a pulse whose duration is determined by the time constant RC.

As a matter of routine on this and all the other modules, I provided LED indicators on each digit output plus the reset and clock pulses. By this time, LEDs had gotten so reasonable in price that I put one on every control signal, which could be useful in determining proper circuit operation. The LEDs are driven by high gain transistor switches such as MPS6521s.

Function Decoder Module

A schematic of the function decoder module is shown in Fig. 7. Since each user would have different coding and different modules within a given system configuration, I have indicated the digits simply as D1, D2, etc.

The basic function decoder building block is the D-type flip-flop. This type flip-flop changes its Q output to agree with the D input upon application of a clock pulse. If the output was already in the same state as the D input, no change will take place in the output.

The D input of IC U1A is wired directly to the desired master digit (as explained earlier) for that function board. Then, if that digit is high (a logical 1) when a clock pulse comes along, the Q output of IC U1A will go high and remain high.

The high output of U1A then simultaneously enables all of the second digit gates (U8 and U9). The other input of gate U8C is wired to the primary function ON digit.

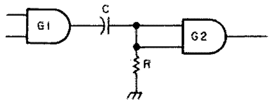


Fig. 6. Basic CMOS pulse generator. This circuit can be implemented with gates or with buffers. The one shown is a 4071 gate.

Now, assuming the master digit was sent and the ON digit is now sent, the output of U8 will go high and place a high on the D input of U1B while awaiting a clock pulse. When the clock pulse arrives, it will set the output of U1B high, thus turning on the desired function via flip-flop U2. The same clock pulse will simultaneously reset the first or master flip-flop since its D input was low during the clock pulse. About seven seconds after the last digit, a reset pulse will come along and reset U1B to a low state. This will not affect the output state.

Flip-flops U2, U3, U4, U5, and U6 are wired as set-reset flip-flops and, wired as such, provide a latching function. This function could also have been provided with cross-connected NOR or NAND gates as desired. When the high from the output of U1B is applied to the SET input of U2B, its output goes high, in turn energizing a function via the interface module. The reset input of U2B is ORed with the master reset (*) and the output of U2A which responds to the unique two digit OFF code. As a result, the function is turned off either by a two digit code or by a master reset.

The remaining auxiliary functions all activate in the same manner as the primary function and with the same first digit. The difference is in the OFF function. All of the auxiliary latch stage's resets are tied together and go to the output of U10A. They are also ORed with the master reset (*) input. With this arrangement there is one two digit code which resets all auxiliary functions at the same time, and they are also

Function	ON	OFF
Primary	6-1	6-2
Auxiliary 1	6-3	6-0
Auxiliary 2	6-4	6-0
Auxiliary 3	6-5	6-0
Auxiliary 4	6-7	6-0

Table 1. Typical function coding.

reset with the master reset. In all of the cases that I have built so far, I have used X-0 (X is the primary digit) as the auxiliary function OFF code. To make the picture a little bit more clear, refer to Table 1, which shows typical codes for a single function decoder module.

The user could alter this scheme to add more separate OFF codes, but it would be at the expense of total number of functions. For example, the F3 ON code could be wired to reset the second function instead of the common reset line.

In most cases where I have to bring a signal such as the clock onto a board and drive several devices, I have used a gate to buffer the signal before using it on the module. Also, to be on the safe side, I added buffers to each function output for more drive to the interface module. I also, as mentioned earlier, put an LED and driver on the output of each function. This proves to be an invaluable aid to both checkout and normal use. As with all the boards in this system, I provided an on-card regulator. Also, although not shown on the schematics, I put .01 uF capacitors directly across the supply pins of each device.

Interface Module

It is necessary to provide an interface between the somewhat fragile CMOS outputs and the real world of repeater controls. The circuit to be controlled might range from a Darlington transistor, requiring only microamps to operate, to a large power relay, requiring tens or hundreds of milliamps and (most probably) capable of producing a large reverse voltage spike on release. Additionally, the output might

require a switch to ground, or it might require dry (floating) relay contacts.

To take care of these diverse requirements, I have used two standard interface circuits, one transistor and one relay. The schematics are shown in Fig. 8. The transistors used are power Darlingtons requiring little drive and capable of sinking six Amps. I provided a reverse diode to clamp out any reverse spikes which might appear on the line from controlling an inductive device. In the case of the transistor outputs, they are switching to ground, and I used common phone jacks for control outputs. I mounted the jacks on a small metal panel on the front of the circuit card.

The relay output uses 12 volt PC card mount relays having contacts rated at least to 2 Amps. The relays are driven by a high gain transistor such as the MPS6521 or equivalent. I used a small barrier strip to bring out the relay contacts to the front edge of the module. If multiple relay contacts are desired from one module, they will have to be brought out to the rear edge connector.

Identifier

The identifier module is an offshoot of my original TTL design which appeared in the September, 1976, issue of *73*. The main drawback of the TTL version was the current consumption — almost one Amp.

The second problem was complexity. Most of the complexity was a result of an attempt to automatically identify about three minutes after the identifier was originally keyed, without restarting the timing circuitry.

I did some research into the memories I was using and found that I could drive the address inputs with the output of a CMOS device without destroying the device. With that in mind, I redesigned the identifier using CMOS devices for the counters and data selectors, but retaining the TTL memory and 555/556-type clock. The revised circuit with all the reidentify circuitry removed is shown in Fig. 9. The programming for the memory is shown in Table 2. The basic IDer function is the same as described in my earlier article, so I won't go into much detail here.

Briefly, operation is as follows. One half of the 556 functions as a clock which is turned on and off by the action of the start-stop flip-flop made up of U4A and U4B. The output of the clock drives counter U2, which sequences data selector U3 through each of the eight memory outputs, advances the word address by one, and then repeats the output scanning operation. This sequence is repeated until 256 bits are decoded. If different length IDs are desired, a gate could be installed to decode the outputs of the counter at the desired stopping point.

Construction

I built all of my present system on 4½ by 6½ general purpose circuit cards with 44-pin edge connectors. The cards then go in a standard rack for logic cards. This type of construction makes for easy changes and lots of versatility.

As I mentioned earlier, 1 put metal brackets on the front edge of the cards, with jacks and controls installed on the brackets.

At the time of this writing, I have started printed circuit layouts on two of the system boards, and I expect to have some of the modules available by the time the article gets into print. For information on availability and pricing write to CONTACT Electronic Research and Development, 35 W. Fairmont Dr., Tempe AZ 85281.

Interconnection and operation of a set of modules as a system is greatly aided by use of a logic card rack of some kind. I tried to make the PC cards' connections such that wiring of the logic

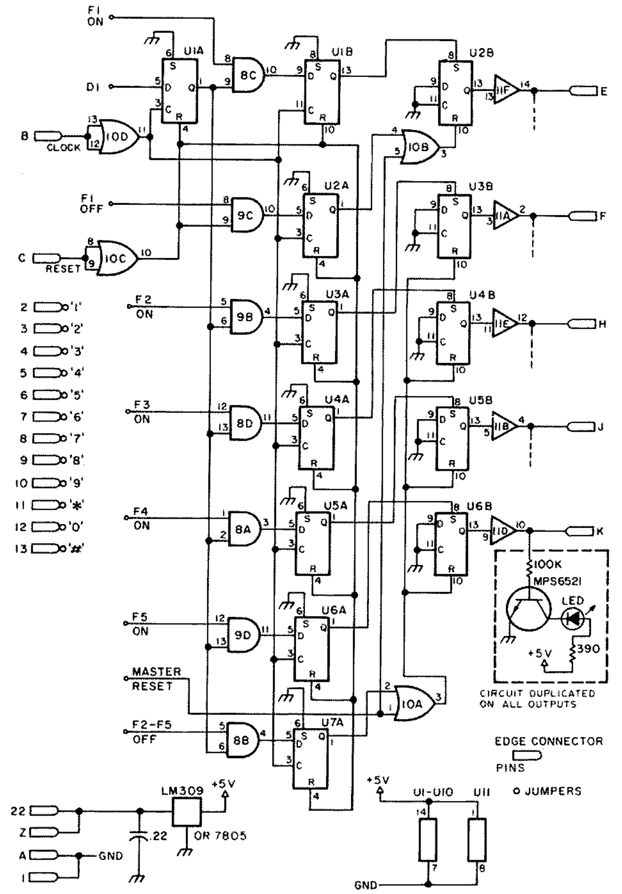


Fig. 7. Function decoder module schematic diagram. U1-U7 are 4013 CMOS dual D type flip-flops, U8 and U9 are 4071 AND gates, U10 is a 4081 OR gate, and U11 is a 4050 hex buffer. The circles on the schematic represent locations for on-board jumpers. The jumpers are for function coding.

	B0	B1	B2	B3	B4	B5	B6	B7	
01									
02	X	X	X		X		X		D
03			X						E
04		X		X	X	X		X	W
05	X	X				X		X	R
06	X	X		X				X	7
07	X	X		X	X	X		X	
08		X		X				X	A
09		X	X	X				X	
10		X		X		X			H
11		X	X	X		X		X	B
12	X								
13									
14									

Table 2. Programming sample for the CMOS identifier. Shown is the program for DE WR7AHB where an X indicates a "1" programmed in a bit position. The blanks in the first address provide start-up time for the identifier and transmitter.

R/C	567	Frequency
R1	U1	697
R2	U2	770
R3	U3	852
R4	U4	941
C1	U5	1209
C2	U6	1336
C3	U7	1477

Table 3. Table of tone decoder settings. Attach your frequency counter to pin 5 of the 567s to read the frequency.

rack wouldn't be too difficult. To make power busing easy, I made the connections on both sides of the board serve the same purpose. Terminals 1 and A are GROUND, while terminals 22 and Z are +12 V. The decoder outputs are on pins 2 through 13, and the clock and reset are on pins B and C respectively. These connections are then paralleled down a series of connectors.

Unless multiple relay contacts are desired, the only other connections on the back of the rack are a small terminal strip for power supply connection and a fuse block. I also added a 2000 uF capacitor across the supply input to the rack since the actual power source was some distance away.

Setup and Alignment

The first stage of system setup consists of deciding on the digit coding desired and then wiring the appropriate gates on each function decoder module. The PROM for the identifier must be programmed for the desired callsign. I have presented programming information in other articles, as have others, so I won't repeat it here.

Alignment is necessary on the audio and tone decoder modules. The agc amplifier input/output levels must be properly adjusted and the tone decoder frequencies must be set.

Agc alignment is easy, but requires a source of audio and an audio frequency voltmeter. First, set the audio input to the agc circuit to the maximum expected input voltage and connect the audio voltmeter to the output. Adjust the output of the agc for a convenient reading and start increasing the input level control. Increase the control until the output no longer increases. Now adjust the agc output level for the desired input to the decoder (about 150 mV rms). Now, you should be able to decrease the input from the audio source by at least one order of magnitude without the output varying.

Adjustment of the tone decoders consists of setting each 567 to its proper frequency. To be done properly, this requires a frequency counter, but it can be done with a tone pad. Power up the tone decoder module, put your counter on pin 5 of U1, and adjust the pot for a frequency of 697 Hz. In a similar manner, adjust the remaining decoders for their proper frequency. I have shown the IC numbers and frequencies in tabular form in Table 3.

Now connect the audio module and the tone decoder module together either in the logic rack or on the workbench. Here an extender board (also available from CONTACT) is a great help. Hook a touchtone generator to the audio input of the audio module and apply power to the system. Start depressing the digits on the pad. As each digit is activated, its proper LED on the tone decoder module should light, the clock LED should flash once, and, about 5-7 seconds later, the reset LED should flash.

If all of the above has progressed to a satisfactory conclusion, you are ready to plug in a function decoder module and continue testing. Once everything is connected together, sending the correct ON digits should cause the LED for that function to light, and the OFF digit should cause it to turn off.

Interface module checkout is simply a matter of seeing if the proper transistor or relay is activated when the correct function code is sent, and the proper LED on the function board is illuminated. Identifier module checkout requires either an audio amplifier or connection to your transmitter and a method of monitoring the transmitter audio. I have provided an identifier test button in the design. Every time this is pressed, the IDer will send the programmed identification and should keep the transmitter keyed through the keying transistor. The only adjustments that have to be made are the ID speed, pitch, and timeout delay.

Conclusion

A typical system configuration would consist of the following modules: audio, tone decoder, function

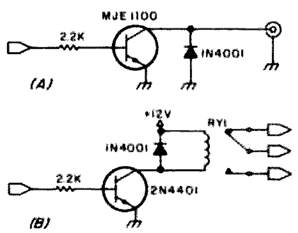


Fig. 8. Interface module schematics. a) Transistor switch. The transistor used should be a high gain one. In my case, I used MJE1100s. b) Relay output circuit. The relay driver must be a fairly high gain transistor. I normally use an MPS6521 for this type of application. The relays are PC mount with at least 2 Amp contacts. The module provides the option of using either 5 or 12 volt relays by either installing or bypassing a five volt regulator.

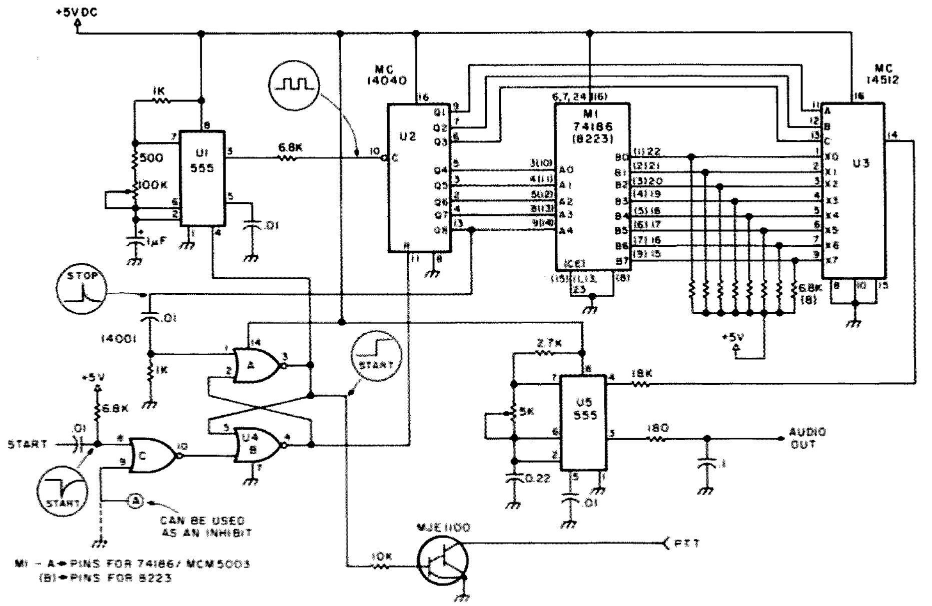


Fig. 9. CMOS identifier module schematic. The circuit is the same as my earlier article, but now in CMOS and without the automatic reidentify feature. M1 is an 8223 programmable read only memory. If more than one message or a longer one is desired, a 74186 memory could be used with appropriate wiring changes.

decoder (2), interface (2), and identifier. Addition of a COR/timer module such as laid out in my article in the January, 1977, issue of *73* would make a complete repeater control system.

I have had very good luck with this system. The only problems I have encountered were mostly my own fault. Don't use ceramic-type capacitors for the tone determining capacitors on the tone decoder module. I found out the hard way that they drift badly with temperature. I had some initial trouble with clock timing when I first went to CMOS on the function decoders, but the delay I mentioned earlier appears to have solved that problem. I got completely wiped out on a remote site once by lightning causing a surge on the power line and wiping out a lot of devices. I have since added various kinds of lightning protection on all of the sites, but I don't really know if it will be effective.

Use of this system requires a method of sending tone signals down the phone line after the line is connected at the receiving end. In some instances we have controlled our repeaters with an acoustically-coupled tone encoder, but it was not completely satisfactory. A touchtone phone is the key, but there is even a problem there. In many exchanges, Ma Bell reverses the phone line polarity when the answering connection is made, and this shuts off the tone pad in your phone so you can't send tones down the line. The answer to this problem is a little gadget the phone company will install on your phone called "polarity guard." There is no charge for the gadget itself as far as I know, but naturally it will cost you a service charge to have the thing installed.

Again, I am trying to make a complete system of module circuit boards available, but it is a slow process. If you are interested, write to CONTACT as mentioned earlier. If you decide to put one of these systems together and have any trouble, please feel free to contact me. The only thing I ask is that you include an SASE. ■

Parts List

Tone Decoder

U1-U7	NE567	7 – 2.2 uF/15 V electrolytic
U8, 9, 10	7402	7 – 4.7 uF/15 V
U11	7410	7 – .1 uF mylar
U12	4001	7 – 4.7k ¼ W
	1 - 7805	7 – 6.8k ¼ W
		7 – 10k pot

Function Decoder

U1-U7	4013	5 – MPS6521 or equiv.
U8, U9	4081	5 – LED
U10	4071	5 – 100k ¼ W
U11	4050	1 – .22 uF

Interface Boards

One of the following per controlled circuit:
MJE1100 or 2N4401
1N4001
2.2k ¼ W
12 volt relay

Identifier

U1	555 timer	1 – MJE1100	1 – 500 ¼ W
U2	4040	2 – 1k ¼ W	1 – 100k pot
U3	4512	10 – 6.8k ¼ W	1 – 5k pot
U4	4001	1 – 2.7k ¼ W	4 – .01 uF
U5	555	1 – 18k ¼ W	1 – .22 uF
M1	8223/82S23	1 – 180 ¼ W	1 – .1 uF

New Products

from page 25

amateur. It was called the FM-21, originally marketed as a six-channel radio that had twelve-channel expandability and the rather novel feature of requiring but one crystal per channel. The FM-21 has since given way to a "kissin'-country-cousin" of the two meter MK-3, the 220 MHz FM-76. Other than coverage and power output, the two radios appear to be twins. I can personally vouch for the FM-76, since one is mounted in my car and is in use daily. For better than six months, it has performed without a flaw, and, due to my life-style, I really give any mobile installation a real workout.

The FM-76 has something else going for it. As most of you are aware, the selection of 220 MHz amateur equipment is still quite limited, and if you are going to build a repeater, you have but two choices. Either you build it from scratch or you start with a good radio and build from there. Nobody has a tally, but there are many successful 220 MHz repeaters out there that got started as an FM-76. I know of at least one remote-base using an FM-76 as a 220 downlink as well. Repeater and remote-base service take a lot from any radio, and in that department, the FM-76 seems to excel.

There is more to this story, though, than radios. Very important is what does an amateur do when his radio decides to do things it's not supposed to do? Fact is, not every amateur is an rf or digital expert. When a radio decides to "go west," where do you turn? If you are lucky enough to own a Clegg radio, you simply mail it back (or drive over if you are not too far away) to Clegg Communications, and, in a few days, it's back in your hands working properly. In fact, when we drove out to Lancaster to do this story, we took with us Lou Belsky K2VMR's FM-27B. Three days later, Lou had his radio back in his car and on the air. This includes the time it spent going UPS back to Queens NY. Clegg believes that product support after sale is important and strives to supply the best in the shortest possible time. No matter where you live, if you have a way of getting your radio to Clegg, Clegg will make it play, doing so at a price that won't bankrupt you.

Clegg sells only "factory direct," and this has been the key to holding the price to where we, the amateur consumer, can afford his goodies. His current facility in Lancaster is well stocked for quick delivery and good, fast after-sale product support and service. Also available are accessories such as power supplies for base station use, antennas, and many other items we amateurs need. Soon, possibly before you read this, Ed hopes to be moving into even larger quarters that will enable him to expand his ability to meet our needs.

By listening to his peers in the amateur community, by looking ahead and being willing to "take a chance," by having something available for every VHF-interested amateur in every price range, Edward T. Clegg has become almost a legend in his own time. He's a ham who cares about amateur radio, an active amateur who keeps in tune with the needs that we have and endeavors to fill them. Moreover, as I can personally attest, he is a human being who cares a lot about his fellow man. Those of you who know him, know of what I speak; those who have never met Ed have missed something special. I sincerely hope that one of these days you have the chance I have had.

Ed Clegg pioneered VHF at a time when such was not really fashionable; he was there when it started and is still here today. There are many of us who hope that the "Man and his Radios" will be here for many years to come. Yes, I'm sold on Clegg equipment. Why not? I've owned a lot of it over the years and never once have I been dissatisfied. And I know many others who feel the same way.

Bill Pasternak WA6ITF
Newhall CA

Ham Help

I need information and a schematic on converting the Motorola T43A series of VHF transceivers. Keep up the good work on a fine magazine.

Billy L. Nielsen WB4APC
Rt. 2, Box 253E
Radcliff KY 40160

Help! To get on CW, I need a schematic and alignment info on a Gonset G-76 AM-CW transceiver.

Don Patterson WA1FXK/2
Box 123, 773 RADS
Montauk AFS NY 11954

Do you know of any persons or clubs that are into classroom instructions in my area? I would like to get some help and get my license.

Medardo Cruz
4911 Ave. I
Brooklyn NY 11234

I wonder if any of your readers can tell me where I might purchase DC4 silicone grease?

Neil Johnson W2OLU
74 Pine Tree Lane
Tappan NY 10983

Alexander MacLean WA2SUT/NNN0ZVB
18 Indian Spring Trail
Denville NJ 07834

How Do You Use ICs?

-- part VIII

Recently I was asked to try to unscramble a little circuit that appeared in another magazine.[1]

I didn't have all the parts needed to make the circuit, but I was able to come up with some suggestions for the correspondent, and immediately sent for the materials to build the circuit — just to make sure.

It struck me that this simple little circuit is a good demonstration of circuit function and analysis.

The circuit is an LED blinky circuit. All it does is turn two LEDs on and off alternately at a slow rate that can be seen by the eye. However, within that simple operation is the ability to show the operation of digital circuitry visually.

As a secondary benefit, you finally get to sit down and build a real live IC project, although perhaps it's not the most spectacular.

Let's take it from the beginning, the circuit analysis leading to the fault in the original circuit.

Fig. 1 is the circuit as it originally appeared.[2] You can read the circuit the way it is drawn — it is simple enough — but it will be easier if the circuit is redrawn so that the IC sections are shown individually.

This is shown in Fig. 2. The circuit uses the SN7400 IC, which has been described in a previous part of this series.

This is a four section IC. The redrawn circuit shows that two sections are not even in the circuit. They are grounded out.

That's one way to simplify a circuit. Now, for the problem. When the circuit was built as it was shown, it did not work. This was because the circuit is not correct. It is a simple defect, but let's go over the circuit closely.

The basic technical description in the original article described the circuit as a multivibrator. This is a switching oscillator. The LEDs show this operation visually. Obviously, if you build the circuit and the lights don't blink, it means the circuit doesn't work. The object in this case is to make the lights blink. That's why you built it in the first place.

However, the lights blinking is the result of circuit operation. We have eliminated two sections of the IC which are not even part of the circuit — let's cut out a bit more.

The blinky part of the IC circuit is the two remaining IC sections and the LEDs. We can see that the LEDs don't blink; what we want to know is why.

The circuit can be further divided into three main functions, any one of which could cause the malfunction.

In order to work properly, the circuit must get the correct voltage, the oscillator circuit must function, and the LED indicating circuit must function.

No work, no blinky. Now comes the easy part. You have to start troubleshooting. How do you go about it?

The voltage to an IC circuit is easy to check. In an unknown circuit, the first thing to check is the pin connections. If the Vcc and the ground pin are correctly drawn and wired, then you measure the source voltage.

If the voltage to the device terminals is within the correct range, you can eliminate it as a possible cause in a simple circuit like this. There are circuits where pulses on the voltage bus can cause mind-boggling troubles, but they won't cut off a simple circuit.

That leaves two elements. The oscillator supplies the signal that lights the LEDs, but the only function the LEDs have is as indicators. They are not part of the oscillator circuit.

In this circuit the voltage is correct, so we are left with two possible troubles. Either the LED indicator circuitry is not correct, or the oscillator is not correct.

There is not much choice, really. The first thing you have to know is if the oscillator is working. Then you can worry about the LEDs.

Now then, if the LEDs aren't going to tell you if the circuit works, what is? Let's look at the circuit again to see exactly what we are playing with.

The oscillator circuit has been redrawn in Fig. 3 without the extra section and the LEDs. We are left with the basic multivibrator.

This we have seen before. In the article dealing with the crystal oscillators, it was pointed out that they were actually not an oscillator at

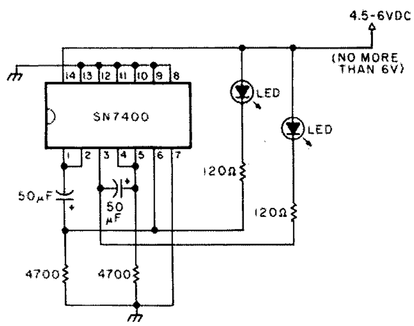


Fig. 1. Original blinky schematic (incorrect).

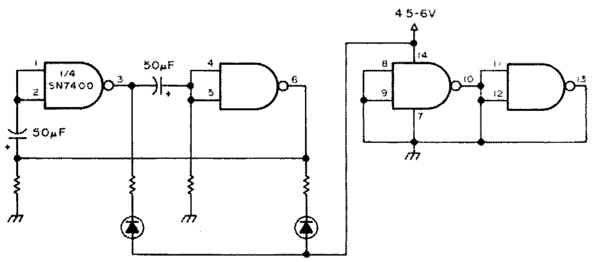


Fig. 2. Fig. 1 redrawn (still incorrect).

all, but a form of IC multivibrator circuit whose frequency of operation was determined by the crystal.

This circuit is an old friend. If you remember the basic configuration of the other circuits, the problem with this one should stand out from the page as you look at it now.

You have three basic fault choices. The IC could be defective, the parts values could be wrong or they could be defective, or the circuit could be wrong.

One of the first things that comes to mind when looking at an IC multivibrator is that normally both sections are symmetrical. Does that look symmetrical to you? That was the trouble. The circuit was incorrect. It didn't work, but how do you test it?

You test it with another indicating device. The thing to keep in mind is what it is indicating. A digital IC is a switch. It's on or it's off. In this case, it is supposed to be on and off consecutively.

As this is an oscillator, it must have a frequency. The frequency determines the test equipment to show its operation.

Here we have an awkward situation. It is supposed to flip-flop slowly enough for your eye to see the blinks. This might be a bit fast for a meter and a bit slow for a scope to really show the waveform.

When I built the test circuit (Fig. 4), I changed the values of the circuit constants. I used 2200 Ohm resistors and 0.1 uF capacitors. This raised the frequency high enough for the scope to really show the waveform.

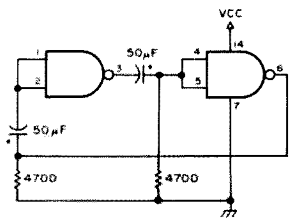


Fig. 3. Simplified circuit (Fig. 1).

Once the circuit was hooked up right, it took off the first time. Then other values were tried while it was on the scope.

It also worked with 0.01 uF caps in the circuit. This raised the frequency even higher. Now, the basic multivibrator is a symmetrical circuit. Electronically, both pulses are identical in shape and duration. It is possible to vary that to an extent.

Just to see what it looked like, one of the capacitors was made 0.1 uF and the other was made 0.01 uF. This resulted in a nonsymmetrical waveshape. One of the pulses was most definitely a different width than the other.

There is a limit to how far you can bend the circuit before it stops working, but if you have a scope, try a few different combinations to see what it looks like once you get the basic circuit working.

These values result in a switching circuit which is great for a scope but far too fast to see visually. To get back to the original idea, much larger values are used to get a lower frequency.

It is the combination of the resistor and the capacitor in each leg of the circuit which determines the frequency. Within reasonable limits, there is a wide range of combinations that can be used.

The original article suggested that no higher than 4700 Ohms be used, because it would affect the bias too much. 2200 Ohms was the highest on hand, and the 50 uF capacitors called for gave a frequency that blinked too fast. The LEDs looked like they were on continuously. The 100 uF caps slowed it down so that the blinking showed fairly clearly.

Now then, without the LEDs, how do you tell if the circuit works? First of all, it showed on the scope, but instead of seeing the familiar square wave, you got the trace being deflected at a slow rate.

What if you don't have a scope? That's simple, too. Stay with the switch action. There is a dc voltage at the output of each IC section of the multivibrator. Here the trick is making the meter show it.

In this case, you don't want a fast frequency, so start with the slow speed constants. If you have to substitute, you may come up with an inconveniently high frequency, but you still want to know if the circuit works.

If you do have a nice low frequency, you can prove circuit operation with the dc scale of your VOM or VTVM. The meter may not read correctly, but you will see the needle fluctuate up and down as the circuit switches on and off.

If you can get that, you know the circuit works. Make this test carefully. The needle may not follow the variations well, and if the frequency is too high, it will just quiver. It still tells you the circuit works, but it's really not too good for the meter – so keep an eye on it and get off fast.

If you can actually see a back and forth meter pulse rather than a fast quiver, it is a good indication that you have a nice blinking rate.

Of course, this would be the ideal situation in which to use a logic probe if you happen to have one. It will tell you immediately if the circuit is switching, and you won't have to fuss about frequency at first.

When the circuit works, you can add the indicator. In the original circuit, the LEDs went between the output and the Vcc pin. That's a bit redundant. You only need one source to light the LED. That way, it was relying on reverse biasing to turn the LED on and off.

When the test circuit was made, the LED was put between the IC stage output and ground. Thus, it was switched on when the IC section was in its high or "on" state.

Schematic symbols are nice, but if you really want to know which way is up on the LED, take one and its resistor and connect it between the Vcc pin and circuit ground. If it lights, you're OK; if not, reverse the diode. If it still doesn't light, it may be defective – try another LED.

Don't forget those resistors. As with the LED readouts, they are current-limiting resistors and just as necessary to prevent damage to the single LED. The value isn't too critical. 150 Ohms would be the smallest you would want to use; I prefer 220 or higher. If you want to be fancy, measure the actual current drawn to get the value you want.

Don't forget what you have here. The IC multivibrator is the operative part of the circuit. The LEDs merely indicate the operation visually.

The circuit constants are chosen to have a speed of operation that the eye can follow. It should be slow enough that you can easily see each LED go on and off alternately. When one looks on, the other should look off. At the least, it should show

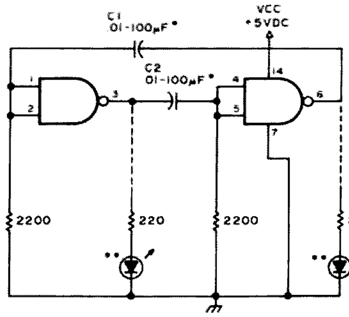


*Fig. 4. Correct multivibrator configuration test circuit. *C1, C2: both of same value. **Optional LED low speed indicators.*

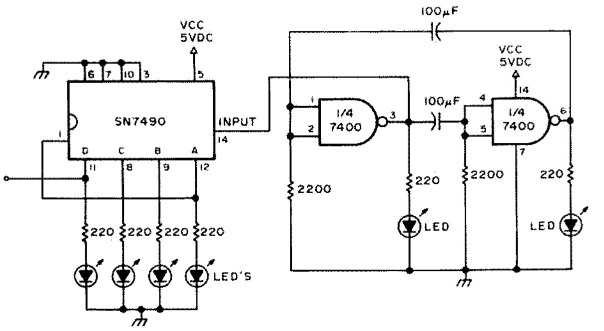


Fig. 5. Basic binary display circuit.

an alternating action, blinking back and forth.

There is another, most interesting, way of looking at what we have here. This little blinky circuit is showing us the high and low state of each section of the working part of the IC.

Since that is all that a digital IC is supposed to do – switch between two states – we can see all that it does right before our eyes.

To carry this a little further, if the speed of the switching operation is set at a speed that the eye is capable of following, much of the electronic operation of any digital circuit can be presented visually.

Even with a more complex circuit, it permits a visual understanding of the actual workings of a digital circuit that would be unobtainable easily by any other means.

This opens up a rather wide range of circuit possibilities that can be used to further your own understanding of circuit operation or as a teaching aid to demonstrate IC basics to others.

For example, the IC multivibrator circuit is quite common in ham projects. It is the basic IC oscillator. The choice of circuitry determines its function, such as crystal or audio or whatever. The basic circuit is much the same, apart from frequency.

Probably the next most important digital functions are frequency dividing/counting and circuit switching (gating).

One of the hottest ham projects going is the frequency counter. These IC functions are the main meat of the IC counter.

Fig. 5 shows a beginning application of the test demonstrator. Starting with our original blinky, which should be slow enough to see, we add an SN7490 decade counter IC. This is the basic counter circuit hooked up to show the counting action by displaying the outputs.

The second IC is hooked up to show its binary outputs. This is the whole key to the IC's ability to provide a coded output that can be translated into numbers.

This should be slow enough that the viewer can actually see the binary numbers in lights, and watch the combinations change visually with each pulse. With the explanation of the binary number system and perhaps a chart, a viewer will soon get a feel for the numbers as they change.

There you have two basic IC functions: the initial switching action and the counting action.

There are a few other points about this circuit. It may still be a bit fast when you are watching the binary numbers blink.

It is not hard to get a feel for them, but if you are using this circuit for demonstration purposes, you might consider putting in another 7490 IC stage between the multivibrator and the LED display. That will slow it down so that it can easily be followed.

You can have both 7490s set up with LEDs to give a fast/slow display. There are a lot of possible options, depending upon what you want to show.

One other thing should be mentioned. These ICs are negative edge triggered. It can be confusing at first to see that when the LED lights up at the input to the 7490, nothing happens. It doesn't pulse until the LED goes out on the negative part of the pulse.

Your eye will get used to it in a while, particularly if you understand or explain the circuit timing and what the pulses are doing.

Fig. 6 is a chart of how the LEDs will display the binary coded numbers. It takes only a short while to master it, and then it should be easy to "read" it.

Remember that it reads from right to left, each position adding to the next. There are four positions used, corresponding to 8, 4, 2, and 1. The lit positions are added together to get the total, which is the number that is counted.

Now you see what a handy little gadget the decoder/driver IC really is. It does all the work of translating the binary data to a form that can be displayed as an immediately recognizable number by the LED readout IC.

So far we can flip-flop and we can count. We can also time. Many operations in IC equipment involve the ability to switch or pulse a circuit at a specific point in the sequence.

It is a timing pulse in the counter that gates the counting circuit. This is what changes it from an event counter to a frequency counter – the ability to tie the count to a known time period.

This is usually no more than an IC gate or two. The hard part is knowing where and when to do it.

We are concerned with two specific problems: the timing of the pulse and the polarity. Both of these can be demonstrated with the addition of a few more 7400 gate sections.

You can use the unused sections of the blinky IC, but

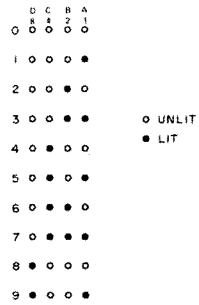


Fig. 6. Binary chart.

I found it easier to use a separate IC on another part of the IC board where it was less crowded.

Fig. 7 shows the basic takeoff circuit from one of the binary outputs. This is also the basic IC inverter circuit, so let's go into a little more detail about what's happening here.

The 7490 is being keyed by a negative pulse. This means that its input LED (at the blinky) is out of phase with the actual pulse action.

If you watch the other LED of the blinky IC circuit, it will be pulsing with the correct phase for the circuit. When it is on, it is high, which means that the other IC half is low and pulsing the 7490.

For this hookup, the takeoff was from the 1 binary output at pin 12. Now watch the relationships between the LEDs as they blink.

The blinky circuit LED to watch is the one that is *not* the input LED to the 7490. This, in effect, is the visual indication of the pulse that keys the 7490.

Notice that the blinky LED pulses twice for every blink of the LED at pin 12 of the counter IC. In effect, that part of the counter is acting as a divide-by-two circuit.

Now notice the pin 12 LED in relation to the indicator LED of the 7400 section fed by pin 12. They are out of phase. When one is on, the other is off.

Fig. 8 shows the addition of another 7400 IC section to reverse the phase of the first section. Now the LED at pin 12 and the indicator LED are in phase and blinking to-

gether.

The easiest way to demonstrate a timing pulse controlling a circuit is to use the 7490 counter's own reset circuit.

Fig. 9 shows a test circuit for this. Notice that the basic change is the connection of the 7400 switch sections to the reset pin of the 7490. Also, the switch is connected to the binary eight output and will reset the circuit to zero when the count reaches eight.

For correct counting action, at least one of the 7490's zero reset pins must be at low logic. To interrupt the counting sequence, it is only necessary to pulse the reset pin(s) to high logic.

As the pulse count changes from seven to the next pulse, it produces a high output at the binary eight pin. This same pulse appears at the reset pin of the counter IC.

When this happens, the counter automatically displays the binary zero output code: all outputs low. This happens so quickly that there is no visual binary eight output. The count goes from binary seven to binary zero, and picks up with binary one on the next count.

Thus, in effect, the eighth count is zero, which is displayed instead of an eight output code.

The counter reset can be hooked up to other binary outputs besides the eight. The four output will give you a visual count of one, two, three, and zero. The same principle holds for the two output.

While this is a simple concept to apply, there are a few pitfalls. In a counter circuit the reset action is usually keyed to the gating pulse. This is to keep them working in harmony.

You want the signal gate open for the correct time period for the count, and you want the reset action to take place when the gate is closed and be completed before the gate is open for the next count.

Otherwise, you might have the situation where the gate is open and a reset pulse appears during the count.

This means that the circuit will reset itself during the actual count, which will give you an inaccurate count. Things like this are why digital designers spend so much time making graphs and charts of circuit timing — to find these glitches on paper before they have to try and find them in their equipment.

It may seem odd to see that the output for the next counter stage is taken from the D output, which is the binary eight output.

This will take a little explaining. The problem is how to get a ten pulse out of an eight output.

The answer is to follow the actual outputs and how they affect the next stage. To do this we will pick up the count at the end of the seventh count.

Up to the end of the seventh count, there has been a low output at the binary eight output and at the input to the next stage which is fed by that output.

As the next negative pulse hits the first counter stage, it causes a high output at the binary eight output and at the input to the next counter stage.

This does nothing to the next stage. The counter is negative edge triggered. A high output means nothing to it yet, except to prepare it for the next negative pulse.

At the end of the eight count, the binary eight output of the first IC remains high. This is important. It stays on the whole cycle.

The ninth count adds a high output at the binary one output, and does nothing to the eight output, which is still on. All this while, there has been no change to the next IC stage.

At the tenth count, all of the binary outputs go to low (which is the binary for zero). At that point, the low logic is also fed to the next stage.

Since this stage is looking

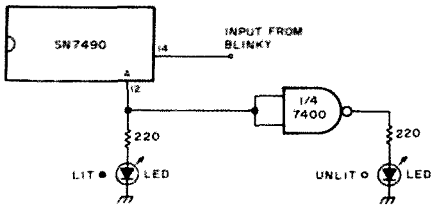


Fig. 7. Inverted output indicator or switch section.

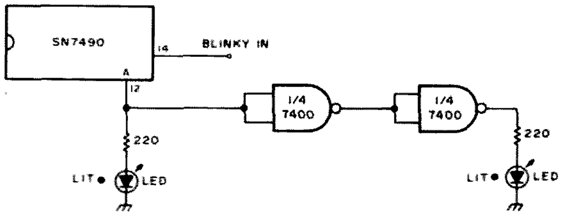


Fig. 8. Non-inverted output indicator or switch.

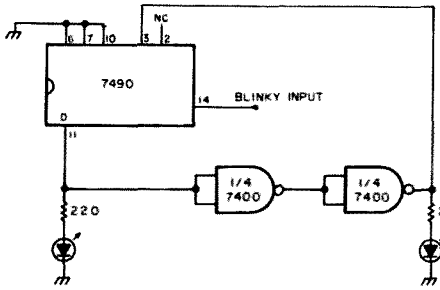


Fig. 9. Non-inverting switch used to reset counter (at 8 count).

for a low logic input, it registers its first count of one. Thus, even though the output of the binary eight output only registers as eight, its logic results in the needed pulse at ten for the next stage to begin counting.

There is one obvious thing about this test circuit. Since the output pulse and the pulse from the IC train which resets the counter are the same phase, the logical question would be, "Why not use the pulse from the IC itself to reset, instead of adding another circuit?"

In this circuit, you can do just that. It works just as well. The circuit counts to seven, and on the eighth pulse resets to zero and begins the counting sequence again.

However, that would not show the IC used as a switch. In many circuits you will not have the option of letting the IC switch itself. You will need separate switching action that can be controlled as you need it.

It is probable that there are many other circuits that can be coupled to LED indicators for a visual demonstration of circuit operation, but you will have to be careful.

Not all IC outputs will drive an LED, and you may cause damage trying. I shot a handful of 7490s trying to couple to the divide-by-two, -five and -ten hookup. They still work as counters, but not as dividers.

You may also have problems because of the phase of the TTL logic (most of which appears to be negative edge triggered). That means that the LEDs may not be on when you want them.

Still, for a few dollars worth of parts, there are a variety of IC operations which can help you become familiar with digital IC operation through hands-on practice. ■

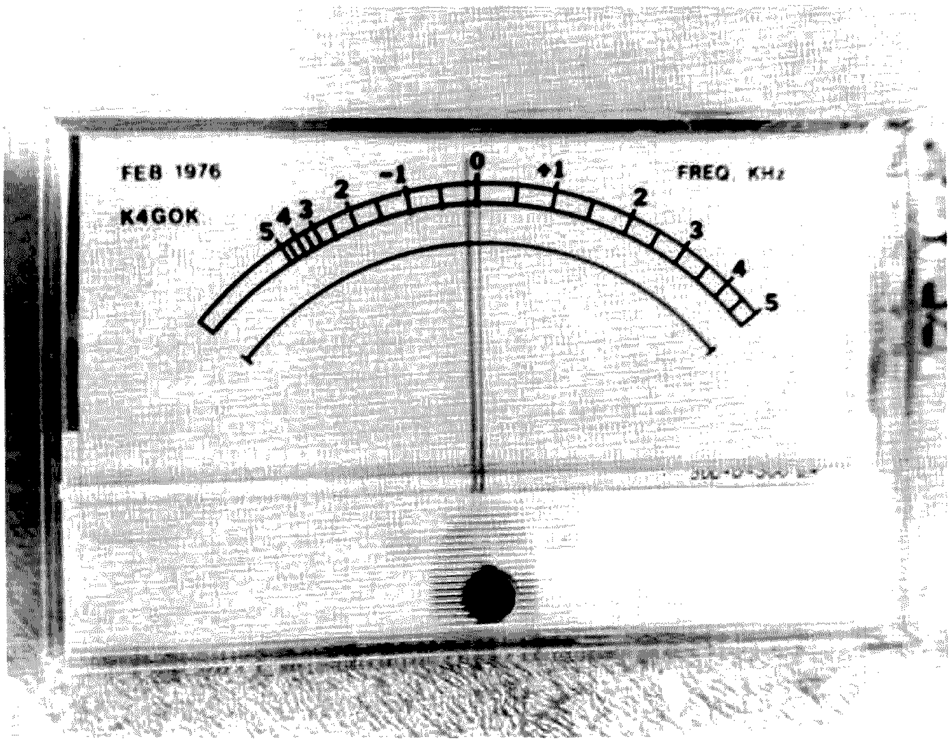
References

1. Thanks to Ralph A. Schlegel ex-9HR, ex-W2ICX, 10 Grandview Ave., Pawling NY 12564.
2. *Electronics Hobbyist*, Fall-Winter, 1976.

Finally! A Practical Discriminator!

-- metering system, that is

Marion D. Kitchens K4GOK
7100 Mercury Ave.
Haymarket VA 22069



The prototype discriminator meter, the particular one used and described in the design process.

The do-it-yourself amateur can easily improve the FM station by the addition of a simple discriminator meter. The meter can be calibrated to read directly the difference between the transmitting frequency being received and the frequency to which the receiver is tuned. Receiver crystals can be trimmed precisely to local repeater frequencies. You can help other amateurs align their transmit crystals to the same frequency, which is a big help in getting everybody on the correct input frequency to your local repeater.

This article describes the design process used and the results obtained in building a discriminator meter for an Ultracom 25 2 meter transceiver. Although the particular design presented here was based on components in my possession, the procedure is described so that custom designs can be made with the particular equipment and components the builder may

already have. Assumptions are made in the analyses to keep the mathematics to the simplicity of Ohm's Law.

Discriminator Characteristics

First, the characteristics of the discriminator must be determined. The discriminator alignment procedure for the builder's receiver will be of assistance in locating the discriminator signal input point and the discriminator output point. An accurate means of determining the discriminator input frequency must be available. A signal generator and digital counter are preferred. Fig. 1 shows the arrangement used to determine the discriminator output voltage as a function of the input frequency. Fig. 2 shows the results obtained for the Ultracom 25. The discriminator provides approximately .2 volts change for each kHz frequency change, at frequencies near its 455 kHz center frequency. This characteristic is reasonably linear up to about 460 kHz, but is highly nonlinear as the frequency decreases below about 450 kHz. (The audio characteristics of the discriminator are quite different than the dc characteristics of interest here – don't worry about nonlinearity in the audio responses.) A reasonable frequency range for most needs is about ±5 kHz. Examination of Fig. 2 shows that a voltmeter covering +1.0 volts to -0.8 volts could be used, if properly calibrated, to read directly frequencies ±5 kHz from the discriminator center frequency.

A surplus 1 mA 4-inch meter was available. Upon careful disassembly, it was found that this meter could be converted to a 500-0-500 uA meter by repositioning the friction-mounted return springs. The meter internal resistance was about 200 Ohms, much too low to be connected directly to the high impedance discriminator output. If a very sensitive meter, say 50-0-50 uA or better, is available, it may be practical to simply add the proper series resistor and connect it directly without unduly loading the discriminator output. It is worth a try.

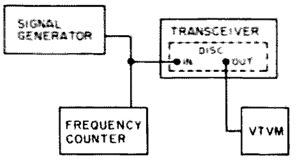


Fig. 1. Test setup for measuring discriminator characteristics.

Circuit Design

The problem for the less sensitive meter was to design a high input impedance dc circuit that would accept inputs both above and below system ground without applying bias voltage to the discriminator. The circuit must operate from a single-ended power supply (12 volts from the transceiver) for convenience and must provide both plus and minus 0.5 mA to the 200 Ohm meter. The high input impedance and zero volts dc bias can be obtained with a self-biased junction FET. The +1 volt to -0.8 volt input signal suggests an FET with a pinch-off voltage of around 2 volts. Driving the meter with plus and minus 0.5 mA suggests a bridge circuit with each bridge leg drawing about 5 mA, i.e., about 10 times the meter full scale current.

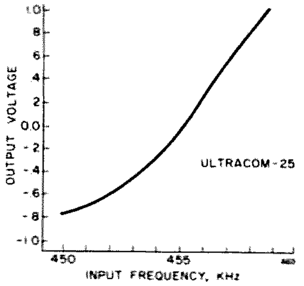


Fig. 2. Ultracom 25 discriminator dc characteristics.

The circuit then begins to take the form shown in Fig. 3. Since the meter current is not significant (< 10% of the current), the value of R4 + R5 is readily computed.

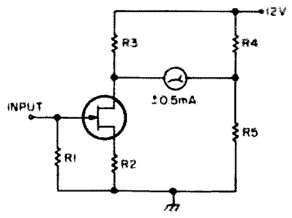
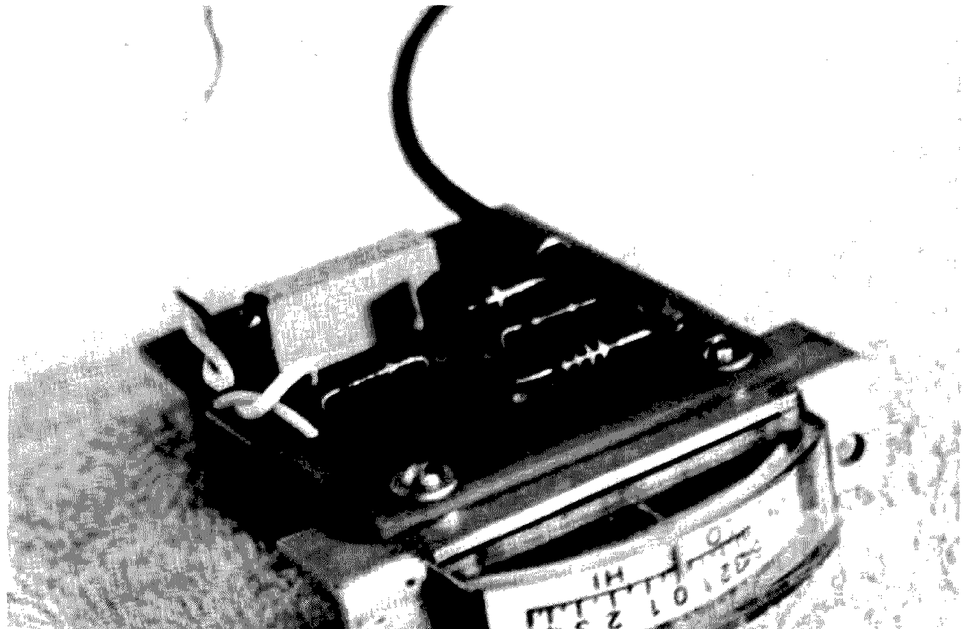


Fig. 3. Basic circuit configuration.

$$R4+R5 = \frac{12\ V}{.005} = 2.4k$$

Using a 2.5k pot for R4 + R5 allows for easy zeroing of the meter and accommodating variations in components of the other leg of the bridge. My circuit employed a surplus 5k ten-turn trimpot allowing easy trimming to zero.

In order to design the active leg of the bridge, it is necessary to know the characteristics of the FET to be used. The test setup shown in Fig. 4 can be used to find the FET characteristics if they are not available.



A second discriminator meter showing circuit board mounted to a small edge reading meter. This one is ready to be installed in the box housing a home brew synthesizer. The FET is a 2N3819 available from Radio Shack as RS 2035. The input pot has been replaced with a fixed resistor.

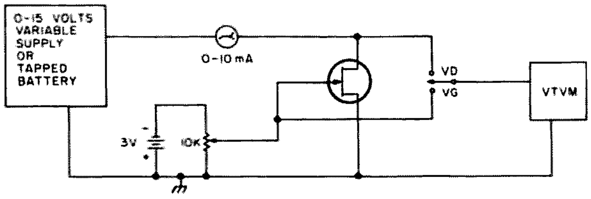


Fig. 4. Test setup for finding FET characteristics.

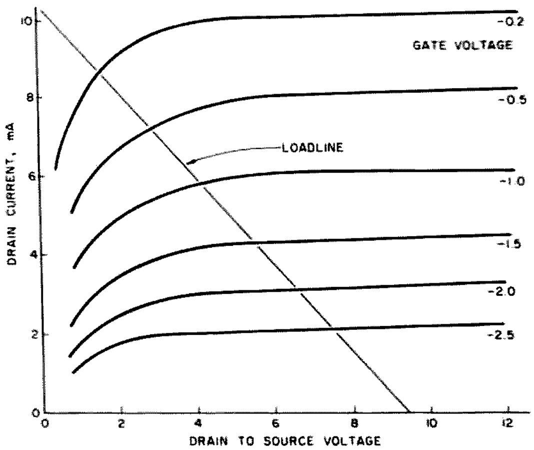


Fig. 5. FET characteristics as measured.

Several FETs from the junk box were examined and a Radio Shack N-channel FET (one of the P-channel, N-channel pair in a package) was found to have the desired characteristics. Fig. 5 shows the characteristics measured.

Once the FET characteristics are known, a bias and operating point must be determined. In general, a drain voltage of near ½ the supply voltage is desired to allow the maximum voltage gain. That is, the drain voltage can theoretically vary +½ to -½ the supply voltage if the FET drain is biased at the supply voltage midpoint. For the case in point, this ideally should occur with an FET current of about 5 mA, simultaneously with a gate self-bias of around -1.0 volt. If a gate bias of -1.5 volts is selected, a ±1.0 input swing can be tolerated without driving the FET into its pinch-off region. Examination of Fig. 5 shows that a drain voltage of 5 volts can be obtained with a -1.5 gate voltage at a current of 4.3 mA. Six and ½ volts (5 + 1.5) at the drain requires a 5.5 volt drop across R3 when the current is 4.3 mA. Note that when the bridge is balanced, no current flows through the meter and therefore all FET current flows through R3.

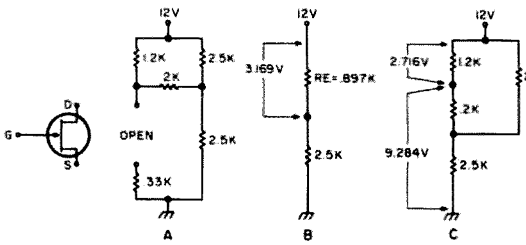


Fig. 6. Equivalent circuits when the FET is "pinched off."

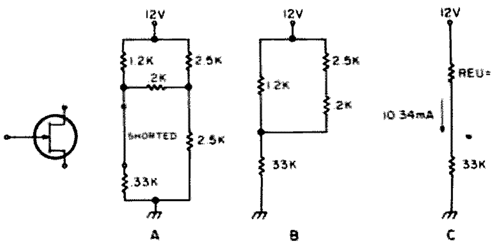


Fig. 7. Equivalent circuits when the FET is fully conducting.

$$R3 = \frac{V_{CC} - V_D}{I_D} = \frac{5.5}{.0043} = 1.28k$$

A value of 1.2k can then be used for R3.

The value of R2 can be computed from the desired gate bias (equal to the negative source voltage) and FET current.

$$R2 = \frac{1.5}{.0043} = 349$$

A 330 Ohm standard value resistor can then be used for R2.

The load line should now be drawn on the FET characteristic curves and the circuit characteristic determined. The load line can be found by considering two conditions of the FET: (1) an open circuit, and (2) a short circuit.

Consider the condition when the FET is completely "pinched off," that is, it presents an open circuit to the bridge as shown in Fig. 6(a). Equivalent circuits are shown in Figs. 6(b) and 6(c), where:

$$Re = \frac{(1.2 + .2)\,(2.5)}{(1.2 + .2) + (2.5)} = .897k$$

The voltage across Re is:

$$V_{Re} = \frac{(12)\,(.897)}{(.897) + (2.5)} = 3.196 \text{ volts}$$

and the voltage across the 1.2k resistor is:

$$V_{1.2} = \frac{(3.169)\,(1.2)}{(1.2) + (.2)} = 2.716 \text{ volts}$$

Since no current is flowing through the 330 Ohm resistor, both ends of it are at ground potential. That means that the FET source is at zero volts and its drain voltage is:

$$V_d = 12.0 - 2.716 = 9.284 \text{ volts}$$

The FET drain to source voltage is 9.284 volts when its current is zero.

When the FET is driven completely on, that is, it acts like a short circuit, the equivalent circuit is as shown in Fig. 7(a). Since the lower 2.5k resistor is large compared to the 330 Ohm resistor and the 200 Ohm meter, its effect on the circuit is small. The equivalent circuits are shown in Figs. 7(b) and 7(c). The effective resistance of the upper portion of the circuit is:

$$Reu = \frac{(1.2)\,(2.5+.2)}{1.2+2.5+0.2} = .831k$$

and the total current is then:

$$I = \frac{12}{.831 + .33} = 10.34 \text{ mA}$$

The load line can be plotted on the FET characteristic curves by locating the two points, zero volts at 10.34 mA, and 9.284 volts at zero mA. A line drawn between these two points represents the load seen by the FET.

$$R_{load} = 9.284/10.34 = .898k$$

The FET operating point, or its bias conditions with no input signal, can be found by an iterative process. First, guess a gate to source voltage, say -1.25 volts, and find from the characteristic curves the FET current and drain to source voltage at the point where the -1.25 volt gate curve intersects the load line. Fig. 5 gives values of 4.7 volts and 5.1 mA. The 5.1 mA of current through the 330 Ohm resistor produces a gate self-bias of -1.68 volts. The computed voltage and the guessed voltage should be averaged and the process repeated, using the average value as the new guess, until the computed and guessed values are equal. The operating point for the characteristic curves and load line of Fig. 5 were found to be:

-1.48 volts gate to source self-bias
5.30 volts drain to source
4.48 mA FET current

The circuit response to input signals can be determined by examining the voltages and currents along the load line. If an input signal drives the gate to source voltage from its -1.48 volt operating point to -1.00 volts, the drain to source voltage is 4.05 and the current is 5.88 mA. The input signal required is equal

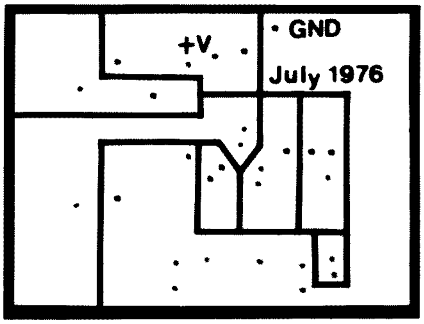


Fig. 8. Printed circuit board layout.

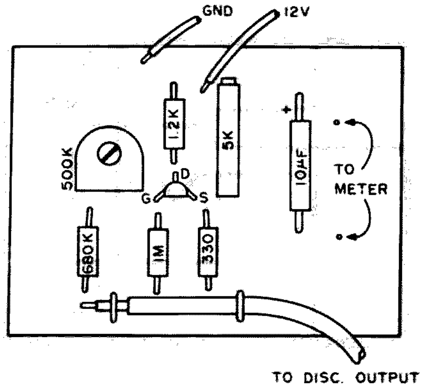


Fig. 9. Component placement.

to the -1.00 gate to source voltage plus the voltage across the 330 Ohm resistor.

$$V_{in} = -1.00 + (5.88)\ (.33) = +0.94 \text{ volts}$$

Given the voltage at the FET drain,

$$V_d = 4.05 + (5.88)\ (.33) = 5.99 \text{ volts}$$

the voltage across the 1.2k resistor and its current can be found.

$$I_{1.2} = \frac{12.0 - 5.99}{1.2} = 5.01 \text{ mA}$$

The load line indicates that 5.88 mA flow through the FET, so the additional current must flow through the meter.

$$I_m = 5.88 - 5.01 = 0.87 \text{ mA or } 870 \text{ uA}$$

The circuit response in terms of meter current for an input voltage can then be found.

$$\text{Resp} = 870/0.94 = 926 \text{ uA/volt}$$

Since the meter to be used is ±500 uA full scale, and the signal from the discriminator is about 1 volt, a voltage divider of about 2 to 1 will be required at the FET input. The circuit input impedance is determined by the 1 meg resistor between the FET gate and ground. A 680k fixed resistor in series with a 500k pot was used with the 1 meg resistor to form a divider that could be easily adjusted.

Notice the expected discriminator output voltages of +1.0 and -0.8 do not drive the circuit into regions where it cannot operate. That is, the circuit is not driven too close to zero mA current, nor is it driven to a positive gate voltage which would lower its input impedance. The circuit is also not driven near its maximum current limit. All three of these conditions should always be checked to assure proper circuit operation.

Construction

A printed circuit board layout is shown in Fig. 8. This layout fits the parts that I had, but will fit most parts by drilling holes in the correct location. The board is easy to copy with an etch resist marking pen. My assembled board was mounted by bolting directly to the meter terminals. Fig. 9 shows the parts placement.

The bridge balancing pot, R4 + R5, must be adjusted before connecting the meter to the circuit. After assembling the circuit board, apply power from the source to ultimately be used. A well-regulated power source must be used. Adjust the balancing pot for exactly zero volts across the terminals that are to be connected to the meter. Now the meter can be connected without fear of damage.

A direct reading frequency scale can be added to the meter to make it easy to use. Most military surplus meters have scales on a thin aluminum plate. This plate can usually be unscrewed and reversed, thus providing an attractive blank scale that just fits the meter. The plastic meters with permanent scales can be modified by the addition of a piece of heavy bond paper. In either case, a temporarily attached blank scale is to be calibrated. The test setup of Fig. 1 is used to accurately provide known frequencies to the discriminator. Apply power to the meter circuit and connect it to the discriminator output. Adjust the signal generator in 1 kHz steps and carefully mark the blank scale accordingly. The accuracy of the meter is determined by the precision of this calibration. Do it carefully! India ink and rub-on lettering can be used to make an attractive scale. Protect it with a light coat of clear plastic spray paint.

Using The Instrument

The meter described measures how far the discriminator input frequency is from its center frequency. The absolute accuracy with which a received signal can be measured is then dependent upon the accuracy of the receiver local oscillator ahead of the discriminator. Keep this in mind when reporting other amateurs' transmit frequencies! The discriminator meter can be used to align two transmitters to the same frequency. If a meter with a large scale is used, frequency differences of less than 100 Hz can easily be read. One hundred Hertz out of 146 MHz ain't half bad! Your receive crystals can be trimmed to frequency by listening to local repeaters and adjusting crystal trimmers until the discriminator reads zero. You will be able to measure receiver crystal warm-up frequency drift. Some of my crystals appear to drift 200 to 400 Hz. After you observe for a few months, you may suspect that some repeater output frequencies vary a few hundred Hertz from time to time. The warm-up drift of a home brew synthesizer was measured by comparing its transmit frequency with a local repeater. The transceiver receiver crystal was trimmed to the repeater frequency. A spot switch was added to the synthesizer to allow it to switch to the repeater transmit frequency while the receiver was still receiving via the crystal. An extension of this technique with several different repeaters can be a big help in getting a synthesizer on frequency without need of a frequency counter. You may find that all repeaters are not quite on their advertised frequency and that a compromise on the synthesizer frequency may have to be made to get as close as possible to all of the repeater frequencies. Readers will undoubtedly find additional uses for the discriminator meter.

Concluding Remarks

The discriminator meter was easy to design and build. It worked as expected on the first try. It was a fun project that can be duplicated in a week by just about anyone. All in all, it is a worthwhile piece of test equipment to add to the FM station. ■

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A Kilowatt Alternative

-- try a gain antenna

Since the beginning of amateur radio, hams have worked on improving the efficiency of their signals. And many, not wanting to spend the time, would buy a linear amplifier, instead of putting up a decent antenna.

Although a kilowatt amplifier may boost a 200 Watt signal 6 dB, the power is often wasted by using a dipole or vertical antenna. After all, you are generally trying to communicate with one person in a distinct portion of the world at a time. Why, then, should you send your signal to all parts of the Earth? A beam or antenna array would solve this problem by directing your signal in a distinct direction. At the same time, a certain amount of gain would be realized, and QRM from many stations would be minimized.

The variety of beam antennas in use today is astounding. Each has a distinct pattern, gain, and front-to-back ratio (the difference, in dB, between a signal transmitted off the front and off the back of the antenna).

Although it is possible to buy a beam antenna, money can be saved by "rolling your own." Books are available on how to build your own beam antenna, so the remainder of this article will deal with the choosing of a beam antenna, not the construction of one.

The Yagi

The yagi is a parasitic beam antenna. This means that the reflector and director elements are not connected to the feedline.

The main element consists of a simple dipole. The reflector is slightly longer than ½ wavelength, and the directors are slightly shorter than ½ wavelength. A two-element beam, consisting of a dipole and a parasitic element, when properly adjusted, will exhibit a reasonable amount of gain. (See Fig. 1.)

All minor back lobes cannot be completely eliminated, but a gain of 5 dB is to be expected when using a two-element yagi. When another parasitic element is added, to make a three-element beam, a practical gain of 7.0 to 8.5 dB is to be expected. In general, doubling the number of parasitic elements will increase the antenna gain by 3 dB. (See Table 1.)

Yagis can be constructed out of tubing and wire. Wire yagis are identical to their pipe counterparts in operation. For best operation, a yagi should be elevated at least 30 feet off the ground.

Vertical Beams

Because a single ¼ wavelength vertical antenna does not exhibit any gain over a dipole, many hams pass by this low-angle radiator without realizing that two or more vertical antennas can be used to form specific patterns. The vertical radiates rf at a low angle, making DX much easier to work. Shown in Fig. 2 is a two-element, phased, vertical system.

Coax is used as a delay line in this system. One vertical receives rf ¼ cycle before the other one does. This way, two verticals can become an end-fire array. Note: The coaxial phasing harness lengths mentioned in Fig. 2 are electrical, not physical, lengths.

Cubical Quads

A cubical quad is an efficient, low-cost DX antenna. It is light and has a small turning radius. A quad is effective even when mounted close to the ground.

The quad consists of a simple loop, with reflector and director loops. Although the quad may be more difficult to build and erect than a yagi, the gain compares very favorably to that of a yagi. More details can be found in William Orr's book, *All About Cubical Quad Antennas*.

Long Wires

Single long wires, vee beams, and rhombics are very effective DX antennas. They have a high amount of gain. I am not going to go into the details of any of these antennas, however, for most hams would not have the amount of land necessary for them. For those who are interested in long wire antennas, the *ARRL Antenna Book* should prove quite useful. ■

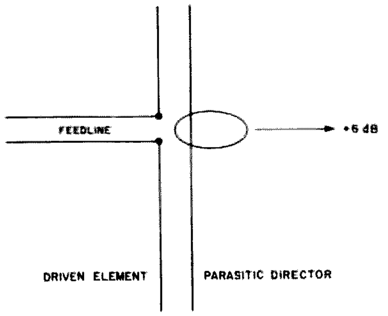

Fig. 1.

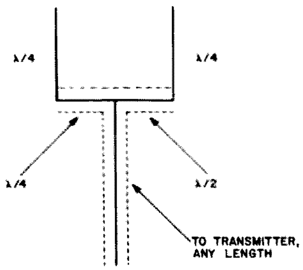

Fig. 2.

4 elements (3 parasitics)	9 dB*
7 elements	12 dB*
19 elements	15 dB*
56 elements	18 dB*
933 elements	27 dB*

*Table 1. *Gain will be slightly less, in actual practice, by about 1 dB.*

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All About Transceivers

-- Novices, take note!

Many radio amateurs are searching for their dream transceiver or their dream station and are finding the search and selection difficult. Selection, unfortunately, is most frequently based upon cost rather than performance characteristics.

Dream stations have been described many times over the years – the best in spark gap and audions, a Collins station, all solid state, all mode (AM, FM, SSB, FSK, ATV, SSTV, EME, etc.) stations, and computer controlled or "the lazy man's station." Every amateur has visions of his dream station, and as the years progress, these visions change.

What you may set as criteria for that dream rig (size, power, all mode, sensitivity, selectivity, stability, frequency coverage, etc.) are not the same as some I must also consider: Does its appearance please the XYL? Does it fit the shack decor? Does it have pretty lights? "You have to sell your other stuff before you can buy anything new!", etc.

Since my XYL (WB5TNI) finally got her license after 27 years, I am at the stage of converting my tube-type, patchwork station into some type of unified, solid state station which we can both use. First we must consider the heart of the station, a separate transmitter and receiver or a transceiver. We chose to go for a transceiver to which we hope to add a remote vfo to give split frequency capability.

Most rigs have much in common as far as basic characteristics are concerned – they cost more than I can afford, they do not cover all the frequencies I wish to operate (how am I going to cover MARS frequencies?), they do not function in all modes I wish to use, they have insufficient power at a critical moment in the QSO, and they are not quite sensitive enough to pull that station out of the DX muck. I am sure that you can think of other basic characteristics.

A dream transceiver, or dream station, must fulfill your needs. How do you like to operate in amateur radio – CW, SSB, RTTY, SSTV, ATV, VHF, EME, satellites, rag chew, Technician, Novice, General, Advanced, or Extra? Many factors must be considered when we get down to actual hardware.

A station for the professional Novice would seem fairly simple to dream up as the maximum parameters have been established by the FCC – 250 Watts, vfo, CW only, and limited frequencies. One still has to choose between solid state versus tubes, kits versus factory-built equipment, and new versus old (used). However, most Novices look forward to advancing to higher class licenses. These Novices must consider most of the same criteria as the General or higher class licensee if they wish to grow into their rig. Many of the characteristics looked for by the Novice would also be good for more advanced licenses.

The vfo must be stable, and there should be provision for offset tuning. As a Novice, one needs only CW, but the transmitter should key cleanly (without chirps) and have a fast break-in mechanism. Almost all current new equipment will meet these criteria. Equipment designed for a specific small number of frequencies can be better designed than that for a larger range. A CW filter with 400 cycles or less passband is a must for CW enthusiasts. Selectivity, the ability to separate one signal from another, should also be good. Sensitivity, to dig signals from the muck, ideally should be 0.5 uV or less on all bands. Although most transceivers have a very narrow output impedance (50-70) Ohms), the ability to tune the output over a wider range would be helpful.

The Technician's requirements on the high frequency bands are the same as the Novice's. However, he has a range of choices in the VHF bands. We will not discuss VHF in this article.

We really come to a wide range of choice with the General, Advanced, or Extra class licensee. A good method of making a choice among the many currently available transceivers is to listen to the discussions of amateurs on the air. Amateurs are fairly free with their comments concerning the good and bad characteristics of the various rigs. Another method is to listen to the quality of the rigs you hear on the air.

In our area, the popular transceivers seem to be the Heath SB series, Kenwood TS-520, Yaesu, and Drake. The Swan transceivers have

never been popular here. We are also noting a decrease in popularity of the Drake TR-4C and the Yaesu FT-101. The Kenwood and Atlas transceivers seem to be increasing in popularity. Five years ago, the Drake, Heath, and Yaesu were the most popular units. I personally have a Swan-350 which is one continuous headache, and a borrowed Drake TR-4. The TR-4, in the experience of hams in this area, is a better rig than the TR-4C. In our area, there are probably more Kenwood TS-520s (with Heath being second) than any other rig. (In our charts, the Tempo "one" is added for consideration as some amateurs still prefer tube-type units. Collins is not considered, due particularly to cost, the fact that other transceivers can outperform the KWM-2, and because the KWM-2 has not been modernized for many years.)

If I were to buy a new rig today, I would have great difficulty deciding just what I would choose. Even after the research I have done for this article, I still find choice confusing. I like some features on one unit, and others I don't like. So it goes with all available units. My dream transceiver has yet to be designed and built. However, each of us has our own requirements, and we must compromise with what is available.

What would I like for my dream transceiver? Cost should be below $500 (but that is impossible in the current market); built-in ac and dc power supply; variable power — 100 to 150 Watts PEP output, with capabilities of going to 300 Watts PEP output when the going gets rough; full coverage of all HF amateur bands, plus enough extra on the ends to cover MARS frequencies; capabilities built-in for CW, SSB, FSK and AFSK, and adaptable to SSTV; digital dial backed by an accurate frequency counter; WWV monitoring capability on 10 and 15 MHz; VOX and push-to-talk; all solid state; separate vfo to use split frequencies for DX; sensitivity on all bands of 0.25 uV, or less, for 10 dB S+N/N; carrier suppression of 60 dB or better, unwanted sideband suppression of 60 dB or better, and spurious and harmonics down by at least 60 dB; and selectivity of 2.1 kHz at -6 dB on SSB, and not much greater than that at -100 dB. On CW I would like a filter or selectivity of about 150 Hz. And, of course, I would like a noise blanker and a sidetone monitor.

Transceiver	TR4-C	FT-101E	FT-301	SB-104	HW-104	HW-101	TS-520	TS-820	3750	2020	'One'	210X	Triton IV
Characteristic:													
Mode: CW	+	+	+	+	+	+	+	+	+	+	+	+	+
AM	+	+	+	-	-	-	-	-	-	+	+	-	-
LSB/USB	+	+	+	+	+	+	+	+	+	+	+	+	+
FSK	-	-	+	-	-	-	-	+	-	-	-	-	-
Frequency:													
160 meters	-	+	+	-	-	-	-	+	+	-	-	-	OPT
28-28.5 MHz	OPT	+	+	+	+	+	+	+	+	+	?	OPT	+
29-29.5 MHz	OPT	+	+	+	OPT	+	+	+	+	+	?	OPT	OPT
29.5-30 MHz	-	+	+	?	?	-	?	+	+	+	?	OPT	+
WWV	-	+	+	+	+	-	+	+	+	+	-	OPT	+
Aux. Bands	-	1	-	OPT	-	-	-	1	-	-	-	OPT	OPT
Crystal Cali.	+	+	+	-	+	+	+	+	-	+	?	+	+
Suppression (-dB)													
Carrier	60	50	40	55	55	45	40	40	50	50	40	50	60
Unwanted SB	60	50	40	55	55	45	40	50	50	50	50	60	60
Spurious	?	40	40	50	50	55	?	60	40	50	30	40	45
Harmonics	?	?	40	45	45	45	40	40	40	40	30	35	45
Sensitivity (uV)	.5	.3	.25	.6	.6	.35	.5	.25	.25	.3	.5	.3	.3
Selectivity SSB													
Selectivity													
SSB	2.1	2.4	2.4	2.1	2.1	2.1	2.4	2.4	2.4	2.4	2.3	2.7	2.3
CW	-	OPT	OPT	OPT	OPT	OPT	OPT	OPT	400	600	400	-	OPT
Noise Blander	OPT	+	+	OPT	OPT	+	+	+	+	+	?	OPT	OPT
Power Supply:													
Internal ac	-	+	-	-	-	-	+	+	+	+	-	-	-
Internal dc	-	+	+	+	+	-	+	-	-	+	-	+	+
Power, final													
Input, W PEP	300	250	200	?	?	180	160	200	200	180	300	200	200
Output, PEP	?	?	?	100	100	?	?	?	?	?	?	100	?
Sidetone Oscillator	+	+	+	+	+	+	+	+	+	+	?	-	+

Fig. 2. Transceiver basic characteristics. + = present in transceiver, - = not present, OPT = optional accessory.

The Tempo 2020 and Hy-Gain 3750 are still rather unknown quantities, although the specs look good. We are beginning to see more and more Japanese-built rigs that seem to be the same basic unit with only the name plate, front panel, and a few options difference.

Although there are many ways to broadly divide transceivers into groups, the following are usually the first considered:

Cost: Below $500, $500-1000, $1000-2000, and over $2000. New versus used equipment.

Construction: Kits versus factory-assembled. Solid state, tubes, hybrid.

Modes: CW only; CW/SSB; CW/AM/SSB; CW/SSB/AM/FSK.

Frequency: Single band versus allband, or multiband; vfo, crystal, synthesizer.

New equipment and new models of present equipment are coming out at all times, so what is said in this article may be superseded shortly. Heathkit is featuring the SB-104 which has superseded other units in the SB series. Although the Heathkit HW-101 is still advertised, it appears the HW-104 is destined to replace the HW-101. Kenwood brought out the TS-520, and shortly thereafter the TS-820 appeared on the market. Yaesu is also bringing out new models — first the FT-101, then the FT-101B, the FT-101E and EE, and now the FT-301D. With every new model the price seems to go up. There are now very few, if any, transceivers selling new for under $500 if one considers the total cost of putting the transceiver on the air.

The question of new versus used is faced by both the newcomer and the established amateur. New units have a much better warranty than used units, but if repairs are needed, how long would it take to get the unit repaired under warranty? Where does one have to send the transceiver for warranty repairs? There are different types of warranties — factory and dealer. A few dealers also offer warranties in addition to the factory warranty.

TRANS-CEIVER	Drake TR-4C	Yaesu FT-101E	Yaesu FT-301	Heath SB-104	Heath HW-104	Heath HW-101	Kenwood TS-520	Kenwood TS-820	Hy-Gain 3750	Tempo 2020	Tempo 'One'	Atlas 210X	Triton IV
Basic New	599.95	749.00	769.00	N/A	N/A	N/A	629.00	830.00	1895.00	759.00	399.00	679.00	699.00
Basic Used	469.00	425.00	?	595.00	449.00	249.00	529.00	?	?	?	319.00	519.00	?
Kit	N/A	N/A	N/A	669.95	489.95	339.95	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ac power	120.00	X	125.00	89.95	89.95	57.95	X	X	X	X	99.00	195.00	129.00
Crystal Calibrator	X	X	?	-	X	X	X	X	-	X	?	X	X
Spaaker	24.95	X	19.00	29.95	19.95	19.95	X	X	59.95	X	19.00	**	X
Microphone	39.95	X	X	39.95	39.95	39.95	39.95	39.95	39.95	X	39.95	39.95	29.50
SUB-TOTAL	784.85	749.00	913.00	829.80	638.80	457.80	668.95	869.95	1994.90	759.00	556.95	913.95	827.50
dc Power	135.00	X	X	X	X	84.95	X	N/A	N/A	X	120.00	X	X
Noise Blanker	100.00	X	X	26.95	26.95	?	X	X	X	X	?	40.00	29.00
CW Filter	?	45.00	45.00	39.95	39.95	29.95	45.00	45.00	X	X	X	N/A	25.00
29-29.5 MHz	7.95	X	X	X	16.95	X	X	X	X	X	?	*	5.00
28-28.5 MHz	7.95	X	X	X	X	X	X	X	X	X	?	*	X
160 meters	N/A	X	X	N/A	N/A	N/A	N/A	X	X	N/A	N/A	N/A	97.00
Dig. Dial	N/A	N/A	X	X	N/A	N/A	N/A	170.00	X	Hybrid	***	*299	N/A
TOTAL	1035.75	794.00	958.00	896.70	723.65	572.70	713.95	1084.95	1994.90	759.00	676.95	1252.95	983.50

*Fig. 1. Cost comparison. X = Built into the transceiver, N/A = Not available, ? = not known. Available options are listed with cost. *Auxiliary vfo Model 206 (digital dial) provides complete coverage of 3-5, 6-8, 8-10, 14-16, 20-22, and 28-30 MHz. (206 also functions independently as a 100 Hz-40 MHz frequency counter. Price $299.) **Built into ac power supply console. ***Available as an option at one time, no longer listed.*

Questions to ask are where the repair work will be done — factory or local dealer — and how long it will take for repairs.

When buying used equipment, you may be buying someone else's troubles. If you buy either new or used equipment, you should buy from a reputable firm or person. In the charts we list new and used prices as published in amateur journals by reputable firms. Used prices from individuals can vary greatly, as can equipment condition. Locally, the maximum used price is at least 15-20% less than east coast or west coast prices. Used prices from individuals are usually less than used prices from retail stores.

If you do not know which are reliable companies, then ask your friends who may have had dealings with the firms or listen to the comments made on the air by other amateurs.

Buying used equipment from individuals can be very hazardous, particularly if you do not know how to judge used equipment. It is best to take a friend with you who can judge used equipment. If possible, take a friend who owns a unit like the unit you are considering or has had some experience operating such a unit.

Several points should be kept in mind when buying used equipment. First comes visual inspection, externally and internally. Is the unit clean or beat-up? Have modifications been made on the unit? Is there evidence of rewiring or soldering not of factory manufacture or not equal to factory quality soldering? Are there any additional holes in the cabinet or chassis that were not there when the unit came from the factory? Also determine if repair parts are still available. Some of the older units are sold as is because repair parts are difficult to obtain. Other units are difficult to repair because the manufacturer has gone out of business, or has gone out of the amateur radio business.

Second, you should check the receive characteristics. Attach the transceiver to an antenna and check the receive characteristics on all bands. Is it noisy? Does it separate the signals well? Does the S-meter work? Compare sensitivity, or ability to pick up weak signals, with a unit you know works properly. Is there distortion or a broken cone in the speaker? Do you get ringing on SSB or when the CW filter is used? Does it cover the frequencies you wish to work? Does the crystal calibrator work?

If the receive section seems to work well, then check the transmit section. If possible, make on-the-air contacts, and get reports. Terminate the output of the transmitter through a wattmeter into a dummy load to measure output power. Can you load it to full rated power on each band? Are the final tubes soft? Does the transmitter cover the frequencies which you would like to work? Do you get maximum output at the point where you get the maximum dip on the plate-current meter? If not, you may find the transmitter is improperly neutralized.

Fig. 1 is a cost comparison chart. The most important figure is the *total*, which is what it would cost to put a new unit on the air (exclusive of the antenna system) at the level to include options that may be standard on other units. For example, some units have noise blankers as standard equipment, whereas this may be optional with others. The cost of such options is included in the total. We also include both ac and dc power supply cost in the total. Under microphone, we list the cost of factory recommendations, but it is realized that cheaper microphones are available. Some units have built-in speakers, but an external speaker is usually to be preferred. Three of the listed transceivers have digital readouts based upon frequency counters, and one has a hybrid readout combining a digital readout for megahertz and kilohertz and a dial for hundreds of cycles. Most of the units have frequency readouts resettable within ±1-2 kHz and a drift of less than 100 Hz after warm-up.

The FCC requires that the amateur licensee have some method of measuring transmitter frequency independent of the frequency-determining device of the transmitter itself. Most amateurs meet this requirement by using a calibrated receiver with a 100 kHz and/or 25 kHz crystal calibrator which has been zero beat with one of the primary frequencies of WWV. Some transceivers have WWV receive capability, others do not. A few can receive WWV on both 10 MHz and 15 MHz. The capability to receive WWV is a desirable feature on a transceiver. In the chart, *crystal calibrator* refers to one with 100 kHz calibration points. A few units also have 25 kHz calibration points,

and WWV also means that the transceiver has receive capability for WWV.

All transceivers considered in the comparison did cover the full 80-40-20 and 15 meter bands and 28.5 to 29.0 MHz of the 10 meter band. In the chart, we list additional coverage by the transceivers that is in excess of these basic bands. A few units also have provision for auxiliary bands which may be determined by the user.

During years of low sunspot activity, there is considerable activity on the 160 meter band, even though there are frequency and power restrictions in certain geographic areas for use of this band. I personally would not pay extra for the 160 meter band. However, it is important to me that a transceiver be able to cover at least to 29.5 MHz for OSCAR activity and that it cover sufficiently beyond the band edges for MARS frequencies. It is important to consider the total coverage of the transceiver — if you don't want the extra coverage now, you may want it in the future.

Some transceivers have selectable sideband on all frequencies, others have only lower sideband on 80 and 40 meters and only upper sideband on 20-15-10 meters. In our chart, an X in the LSB/USB column means the unit has selectable sideband. The lack of selectable sideband is not a serious detraction, as most amateurs use only the lower sideband on 80 and 40 and only upper sideband on 20, 15, and 10 meters.

Final amplifier input power is limited to a maximum of 250 Watts for Novices and Technicians, and other classes of licensees have a maximum input of 1,000 Watts for CW and AM, and 2,000 Watts PEP for sideband. FCC regulations state that an amateur should use the minimum amount of power necessary to maintain communications. For each 3 dB increase, one must double the power. Assuming 100 Watts output as the baseline, one must go to 200 Watts to bring about a noticeable difference in reception over 100 Watts, to 400 Watts for 3 dB increase over 200 Watts, and 800 Watts output from 400 for another 3 dB increase. Generally, one can figure about 100 Watts output from 160-180 Watts input to the final. Most of the transceivers reviewed had an input of about 200 Watts and generally can produce satisfactory communications.

Many amateur radio magazines — *Ham Radio, QST, 73* — carry articles evaluating in depth new equipment as it is marketed. These are usually good sources of unbiased technical evaluations, and usually indicate how the particular unit under test compared with the manufacturer's published specifications. We are using the manufacturer's published specifications in our comparison charts.

Sensitivity is the ability of a receiver to pull in weak signals and is rated in microvolts (uV) for 10 dB S+N/N. The 1977 *Handbook* defines sensitivity as "the signal at the input of the receiver required to give a signal plus noise output some stated ratio (generally 10 dB) above the noise output of the receiver." Sensitivity can be increased through the use of a solid state, low-noise preamplifier, as much noise is generated by thermionic emission from tubes. The amount of thermionic noise in tubes can be decreased by running them at a lower voltage — e.g., 100 V instead of 180 V — in the early stages of the receiver where the most noise is generated before the signal is adequately amplified. An all solid state receiver has a lower noise level, and usually better sensitivity than does a tube type receiver. The newer transceivers are all of the solid state variety in the receiver section. Exceptions to this statement in the comparison chart are the TR-4C and HW-101, which are predominantly tube types.

Selectivity is a measure of the ability of a receiver to separate adjacent signals. Selectivity is a measure of the width of the bandpass at a point 6 dB down (-6 dB) from the peak of the bandpass curve. For a receiver with 2.4 kHz selectivity, the bandpass is 2.4 kHz wide at -6 dB. For SSB, a selectivity of 2.1 to 2.4 kHz is good, as an SSB signal is usually no broader than 2.4 kHz. On CW, since theoretically it is a single frequency signal, the bandpass can be much narrower. Most receivers with CW filters have a 400 cycle bandpass, but some have only 150 cycle bandpass. In newer types of receivers, a crystal filter is used to provide bandpass attenuation.

The selectivity bandpass at 6 dB down must be sufficient to pass the necessary signal information (single sideband, double sidebands, or carrier plus sidebands) without undesired attenuation. An AM signal requires about twice the bandpass of an SSB signal. A CW signal, as stated previously, requires even less bandpass frequency.

If your transmitter has a sidetone oscillator, you can hear yourself as you send CW. The ability to hear yourself with a sidetone oscillator in the transmitter, or on the keyer, helps in sending better formed CW. Without being able to hear yourself send, you can have difficulty with proper spacing and formation of characters.

Other characteristics of transceivers are also important and are used as selling points in advertising. We have listed in the charts only what we consider to be the basic characteristics of importance in a good transceiver. ■

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German Amateur Procedures

-- and repeater information

This article has two purposes. The first is to inform anyone who talks to a German ham on the HF bands, because he may be interested in knowing more about the other man's hobby environment. The second is to help anyone anticipating a trip or work assignment in Germany, who may well wish to do some hamming while in the country. For these reasons, this article will explain the ham license structure and hobby activities available in Germany.

Like most hams all over the world, the German ham you talk to has had to pass a series of exams. They are given by the Deutsche Bundespost. The minimum age at which one can become a ham is 16 years. There are two main divisions of licenses, the class A/B and the class C. Holders of a class A or B can operate all permissible amateur bands on all modes, with the only difference between them being the transmitter power authorized. If you've worked a German ham on the HF bands, he had either a class A or B license, because the class C license is the equivalent of the American Technician class and allows only operation above 144 MHz.

If you will refer to Table 1 for a summary of the bands and modes for each license, you will note that, unlike the American Technician class, the German class C ham may not operate CW on any band. He has not been required to pass a CW exam to get his license. This is the only difference between the class C and class A/B ham, because all hams take the same written exam on technical, regulatory, and operational subjects. The code test is at 60 characters per minute and requires a solid minute's copy each of, first, five-letter groups, then German language text, and then English language text. A maximum of three errors is permissible. If a ham has a class C license, he need only pass the code test to upgrade to a class A license.

If the exam is failed, the applicant may take it again. If the second attempt is failed, a mandatory waiting period of one year must be observed before trying again. If the third attempt is failed, a period of three years must be waited out before trying again.

License fees are paid by the month at 3 Deutsche Marks (DM) ($1.25), plus 3 DM for the issuance of a new or duplicate license. The exam costs 15 DM ($6.25) the first time and 5 DM for a repeat.

A ham must operate as a class A operator for a year's probationary period before he may upgrade his license to class B status, if his record is good. A class A station is allowed a maximum of 50 Watts final power amplifier dissipation, a class B station 150 Watts, and a class C station 50 Watts. While this system is different from the American use of power input, you can readily compare them if you refer to the normal efficiencies of SSB and FM amplifiers.

Just as in the U.S.A., you can tell something about a German ham from his callsign. Old-timers with class B licenses are assigned a DL, DK, or DJ prefix, and newer operators have a DF prefix. Class C stations are DC or DD prefixed. If the ham is not a citizen of Germany, but of another country, he receives a a DJØ class A/B prefix or a DCØFA to JƵ class C call. American military stationed in Germany receive a DA1 or DA2 prefix for a class B or a DA4 prefix for a class C license, depending on the class of their U.S. license.

To operate in Germany as an American, there are two basic systems in use. If you are a tourist, you can obtain a temporary reciprocal license commensurate with your U.S.A. license class, and you will use your U.S.A. call with a /DL. The ARRL has an information package available for your use in applying in advance for the license. Or, if you're in a hurry or already in Germany, write the German equivalent to the ARRL, the Deutscher Amateur Radio Club (DARC), at Postfach 1153, 3507 Baunatal 1, West Germany. Ask in your letter for a tourist license valid for three months, and include the following information in the format shown:

1. Family name, Christian name, nationality
2. Birthday
3. Place of birth
4. U.S.A. address
5. U.S.A. callsign
6. ARRL membership status
7. Copy of U.S.A. license
8. Dates of 3-month period desired
9. Mail address in Germany

10. Actual address in Germany
11. 15 DM international check or money order, or wire to the DARC bank account, Postscheckamt Essen 5613-430, with a note (showing your U.S.A. callsign) that it is for a tourist license.

You should expect up to six weeks processing time for your license to go through the DARC to the German authorities and back to you. If you are to be stationed in Germany with the U.S. military under the Status of Forces Act, you must go through the U.S. Army liaison office to apply for a license. Write for application forms to the Commander, 5th Signal Command, Attn: CCE-OP-T-ML, APO NY 09056. This license will be issued for a year at a time, at an annual cost of 39 DM ($16.50), by the FTZ division of the Deutsche Bundespost (DBP). It will be a class B license for all classes except Technician and Novice. Technicians receive a class C license, and Novices are not eligible for a DA call license. However, a Novice can obtain a three-month tourist license to hold him over until he can upgrade at the FCC examinations given twice a year at Ramstein Air Base, Germany.

Now that we've discussed the license and privilege structure, it's time to talk about what can be done on the air with the license. The HF bands, you will note, are smaller than in the U.S.A., but are not legally divided into modes of emission or subbands. However, "gentlemen's agreements" exist, much the same as in the U.S.A. German hams like working DX and rag chewing as much as any ham, and the usual blend of home brew and commercial equipment can be found, made by German, Japanese, and American manufacturers. Customs and taxes really elevate the prices on gear, however. Can you imagine paying $1000 for a new Drake R4B receiver or $800 for a Yaesu FT-221? "Discount" is a word not readily found in a German ham dealer's vocabulary. However, in the usual ham spirit of "keeping the rig new while forgetting to buy shoes for the family," hams manage to stay on the air. Hams here also find themselves interested in CW, SSB, SSTV, and RTTY, with, of course, the usual local and international blend of contests available to jam the weekend bands into an aspirin bottle.

Of the over 25,000 German hams, many, either because of their class C license or a genuine interest and desire for the open spaces of radio, find their interests directed towards VHF/UHF operation. It is in this area that the German hams really excel. Technical proficiency is, on the average, very high, and these bands lend themselves to home brew and antenna projects readily. As can be seen from Table 1, there are no 50 MHz or 220 MHz bands in Germany. As a result, most activity is on the 144 and 430 MHz bands, and even these bands are smaller than in the U.S.A.

There is a high degree of activity on FM using both simplex and repeaters. The main two meter and 70 cm frequencies are given in Tables 2 and 3, from which you can see that the Germans use the standard two meter 600 kHz offset, and a 7.6 MHz offset on 70 cm. There

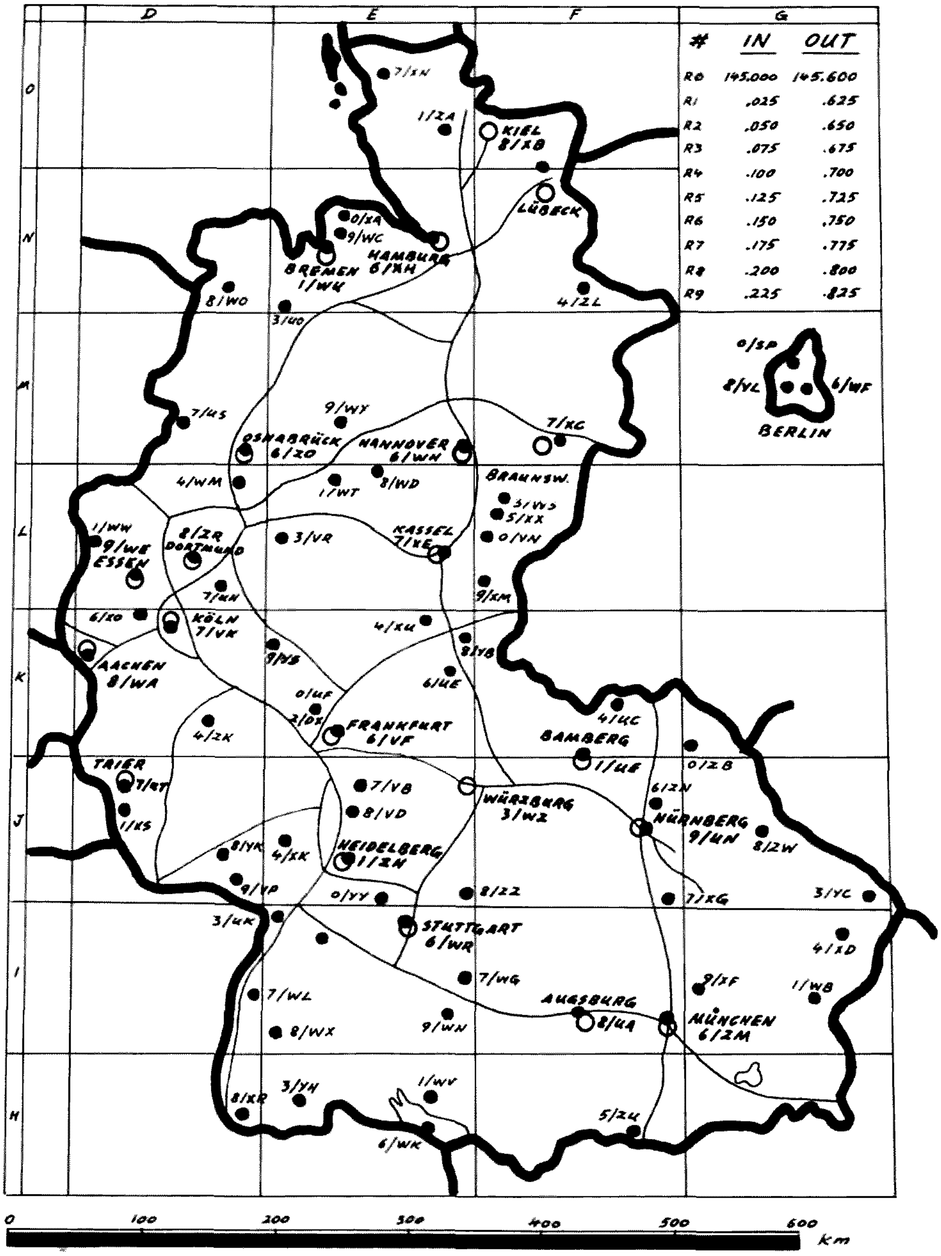

Fig. 1. Two meter repeaters in Germany.

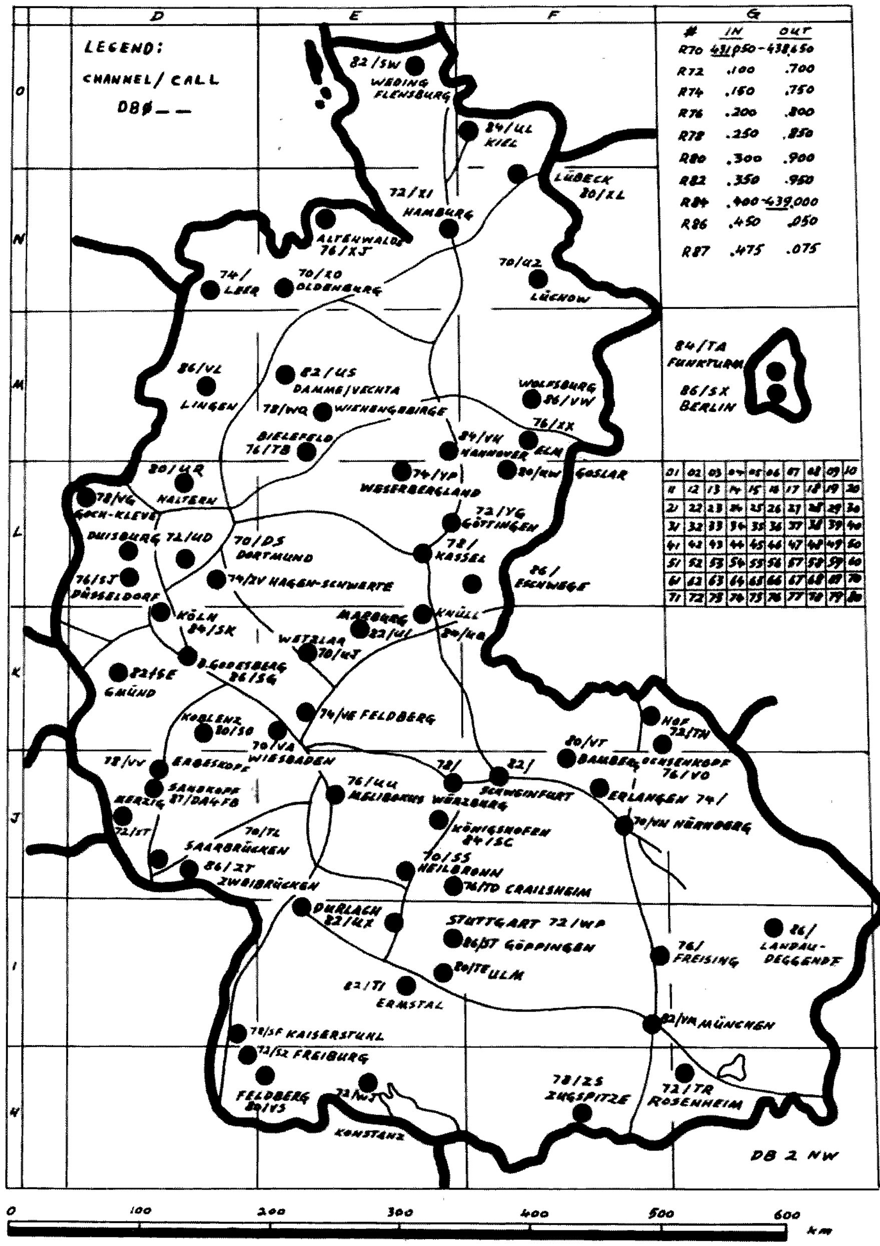

Fig. 2. 70 cm repeaters in Germany.

are ten two meter repeater channels allocated to about 77 active machines on a 25 kHz spacing, and with no oddball or reverse splits. Fig. 1 is a map of two meter FM repeaters in Germany. The 70 cm repeaters number 45 at present, and, although provision is made for the eventual use of 25 kHz spacing, present spacing is mainly 50 kHz. Fig. 2 shows the German 70 cm repeaters. All German repeaters operate on a dual entry of carrier squelch plus a 1750 Hz tone burst. No other entry tone burst frequency is allowed, and many commercial transceivers sold in the U.S. have a special German "G" version, which includes a tone burst circuit for this purpose. The DARC coordinates all repeater locations and frequencies, and the DBP will not process a license application for a repeater that has not been approved by the DARC. Some DARC standards for repeaters include a 4-5 second delay on transmitter turnoff, a 1-2 minute time-out on individual transmissions, and a 1-1.5 second delay between squelch off and time-out timer (TOT) reset, at which time a short audio beep called a "roger beep" is sounded to tell the repeater users that the TOT has reset. This last feature works wonders in discouraging tailgaters from excluding breakers and emergency traffic. In addition to FM repeaters, there are a few repeaters available for ATV and RTTY, plus some linear transponders. All German two meter repeaters are extremely busy. Unless he has an adequate command of the German language, the American ham in Germany will usually avoid the repeaters and operate on the simplex channels, with 145.550 MHz being the standard frequency adapted by the DA stations.

So far it would seem that the VHF/UHF scene is exclusively FM, but this is far from true. There is heavy use of two meter SSB, and it is not unusual to work Austria, Switzerland, Belgium, France, Luxembourg, Holland, or England on good days. Nor is it unusual to talk to a two meter station using a 15 Watt transceiver and a 40 to 88 element yagi array! Also, the Germans are heavily active on OSCAR and, in fact, operate a branch of AMSAT, AMSAT-DL, which furnished the mode "B" 70 cm to two meter transponder now in operation in OSCAR 7. In fact, there are more active mode B users in Europe than in the whole U.S.A.

There are some FM repeaters appearing on the 23 cm band now, and several groups are working with such high frequencies as 10.5 GHz microwave. But this is relatively specialized and beyond the scope of this article.

Those hams who aren't on the air talking may well be at their benches building a home brew project. Home brewing is very popular, especially at VHF and above, and there is a whole subgroup of hams devoted to this aspect. There is even a magazine, called *VHF Communications*, which is published in both German and English language versions four times a year and is devoted to home brew projects. The nice thing about this particular publication is that it offers as a service the complete availability of critical parts and printed circuit boards to duplicate any project that has

been published. German home brew equipment generally reflects a high standard of technical sophistication and construction technique excellence.

If you have a radio frequency interference problem, don't despair. The Bundespost has a large fleet of specially equipped radio test vans and friendly, helpful, proficient technicians who can come to you and evaluate your station and transmitted signal. If you are "clean," German law requires the owner of the TV, stereo, antenna preamplifier, etc., to fix his equipment by shielding, grounding, and filtering. Of course, if you are at fault, you can be required to install your own station low pass filters, grounding, etc., as may be required, plus obey license restrictions until you are clean, just as in the U.S.A.

If you like to meet your ham friends, look at the latest commercial equipment, or buy some parts or kits, have a dinner with music and a live dance band, you can do it all at a German hamfest. Just as in the U.S.A., these popular occasions come in all sizes, from large to small, ranging from national to local in scope. Not only are the German fests categorized by size, but they are also sometimes devoted to a particular interest group. Can you imagine a Dayton Hamfest devoted to exclusively VHF/UHF interests? In Germany, one such event that draws national attendance of VHF/UHF enthusiasts is held every autumn at Weinheim, and is quite a feast for those who like VHF/UHF FM, SSB, commercial and home brew equipment and antennas.

The national radio club, the DARC, boasts a membership of over 90% of Germany's 25,000 hams and offers a wide variety of services. The club's national magazine, *CQ-DL*, is published monthly with 80 pages and 30,000 copies. The club is organized into 19 districts, each of which can have up to 50 local clubs. The club magazine offers operating and legal news on the international, national, and local fronts, technical articles, etc., just like any ham magazine. If you think the new equipment reviews written by the American hams in American magazines are worthwhile, you should see the articles written by the DARC engineering staff after a checkout in the club's lab. One commercial Japanese all-mode two meter transceiver that got a one page review by an American magazine received an eleven page thoroughly technical review by the DARC!

Another service of the DARC is an international and national QSL bureau, which handles cards sent and received. Cards are processed from the club and its allied national QSL bureaus to the individual district clubs. One more service is a third party insurance policy for hams to cover damages; for example, it might cover damages caused by an antenna blowing down or falling onto a neighbor or his roof.

As mentioned earlier in the article, the DARC works extremely closely with the German government. What does all this cost? At first, the annual dues of 65 DM ($27) seem like a lot, but when you consider all the services available, as only partly mentioned above, it becomes much more reasonable.

Incidentally, U.S. hams stationed in Germany with the military are generously afforded reciprocity by the DARC as a courtesy, which means that the ham can defer receiving the German language *CQ-DL Magazine* and the insurance policy, and still use the full QSL bureau services through a local DARC club for only 11 DM ($4.60) a year. All it takes is 40 or more QSL cards sent out by U.S. postage rates to make the fixed charge look good, and it looks even better when you discover that, while in the U.S. a first class letter costs 13¢, in Germany a first class letter within the country costs 21¢, and international European mail from Germany costs 50¢ or more. Nonetheless, many American hams do pay the full dues and enjoy the full privileges of the DARC. You'd be surprised how well you can understand the German language ham magazine, even if you don't "spricht Deutsch," by looking at the pictures and catching key words in the text; after all, a dB or kHz in English is the same in German!

Speaking of clubs, the largest and most organized American club in Germany is the Wiesbaden Amateur Radio Club. This club is headquartered in Wiesbaden, Germany, has an international cast of members, but is heavily composed of Americans working in Germany. This ARRL affiliated club is associated with its DARC counterpart local club, and enjoys outstanding cooperation and rapport with the local German club and the DARC. Members come from over an hour's drive away to attend the monthly club meetings, and the club's activities include the only "Americanized" hamfest, held once each May in Germany, as a regular event. The hamfest is an excellent meeting place for hundreds of German and American hams, as well as those of several other nationalities. It's a real sight to see the German hams eating the club's food concession's barbecued hamburgers, while the American hams eat wurst and brotchen. The hamfest has a technical booth, where FM transceivers are checked for frequency, power, and deviation. Other fest features enjoyed by all

Frequency	Class A/B modes	Class C modes
3.5-3.8	A1, A2, A3, A3J, F1, F3	none
7.0-7.1	A1, A2, A3, A3J, F1, F3	none
14.0-14.35	A1, A2, A3, A3J, F1, F3	none
21.0-21.45	A1, A2, A3, A3J, F1, F3	none
28.0-29.7	A1, A2, A3, A3J, F1, F3	none
144-146	A1, A2, A3, A3J, F1, F3	A3, A3J, F3
430-440	A1, A2, A3, A3J, F1, F3	A3, A3J, F3

Table 1. Higher frequency bands are deleted.

Simplex: calling/working frequencies
145.500 / 145.525 / 145.550 / 145.575

Repeaters:

Channel	Input	Output
0	145.000	145.600
1	145.025	145.625
2	145.050	145.650
3	145.075	145.675
4.	145.100	145.700
5	145.125	145.725
6	145.150	145.750
7	145.175	145.775
8	145.200	145.800
9	145.225	145.825

Table 2. Two meter FM band plan.

Simplex: 435.0

Repeaters:

Channel	Input	Output
70	431.050	438.650
72	431.100	438.700
74	431.150	438.750
76	431.200	438.800
78	431.250	438.850
80	431.300	438.900
82	431.350	438.950
84	431.400	439.000
86	431.450	439.050
87	431.475	439.075

Table 3. 70 cm FM band plan.

are the flea market, door prize raffle, and end-of-the-day flea market auction, with the latter being especially novel and enjoyed by the German hams.

Also, of course, the club offers code and theory classes during the year. Since elimination of the mail exams, it has become harder to get new hams or upgrade licenses, but the FCC has been very helpful by working with the authorities to allow an examiner to come to Germany twice a year to give commercial and amateur exams. If you want to talk to a club member, you'll find him on 145.550 MHz FM or on the club's repeater, DA4FB. This open repeater is the only one in Germany that has a license granted to an American-backed club, and operates on channel 87, as per Table 3. So, by all means, bring along your two meter and 70 cm FM rigs when you come to Germany.

As you can see, hamming in Germany has a lot to offer. Perhaps this article will allow you to have a more meaningful and interesting rag chew with the next "D" prefix station you talk to, or, if you are coming to Germany to visit or work, you will be better prepared to enjoy your hobby more fully. The hams in Germany and Europe are very friendly and helpful, and you are sure to enjoy your next QSO or visit.

I've had the pleasure of living and hamming in Germany for three years, and would like to take this opportunity to express my deep appreciation to all the hams in Germany, the DARC, and the Wiesbaden ARC, for making it so much fun and for helping me to see another aspect of my hobby. A special thanks to Jean Binet DCØHO/FØAOB and to Herb Brasington DA1KD/WB4EWX for their help and encouragement in the writing of this article. Auf Wiedersehen! ■

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The DA4FB Story

-- American repeater in Germany

How do you draw together amateurs who are spread over a large geographical area (4700 square miles) and provide for reliable communications among them? One obvious solution to this problem is the installation of an FM repeater. But, when you consider that the geographical area of concern is in the Federal Republic of Germany, and that the majority of the amateurs are Americans, the solution to the problem is a little more complex.

Members of the US Wiesbaden Amateur Radio Club (USWARC), a large group of amateurs composed heavily of Americans living and working in West Germany, began discussing this problem in May, 1976. A repeater committee was formed, and various members of the club and committee were tasked to begin to look for a suitable site, secure equipment, and apply for the station license.

The area of desired coverage was so large that a central location for the repeater was necessary. The terrain consists mainly of rolling hills, and is divided almost in half by a range of mountains that runs northeast/southwest through the area. Jerry Stewart K5CFQ/DA1HZ was able to secure permission to install the proposed repeater at a military communications site near the center of the area. The site is on a 2300-foot mountain, has a 300-foot microwave tower, is manned 24 hours a day, and has emergency backup generators. What more could be asked for?

Preliminary negotiations were initiated with Deutschland Amateur Radio Club (DARC) officials for the authority to install and operate a repeater. The FTZ division of the Deutsche Bundespost (DBP, the German equivalent of the FCC) will issue a license for a repeater only if the license application has been coordinated with

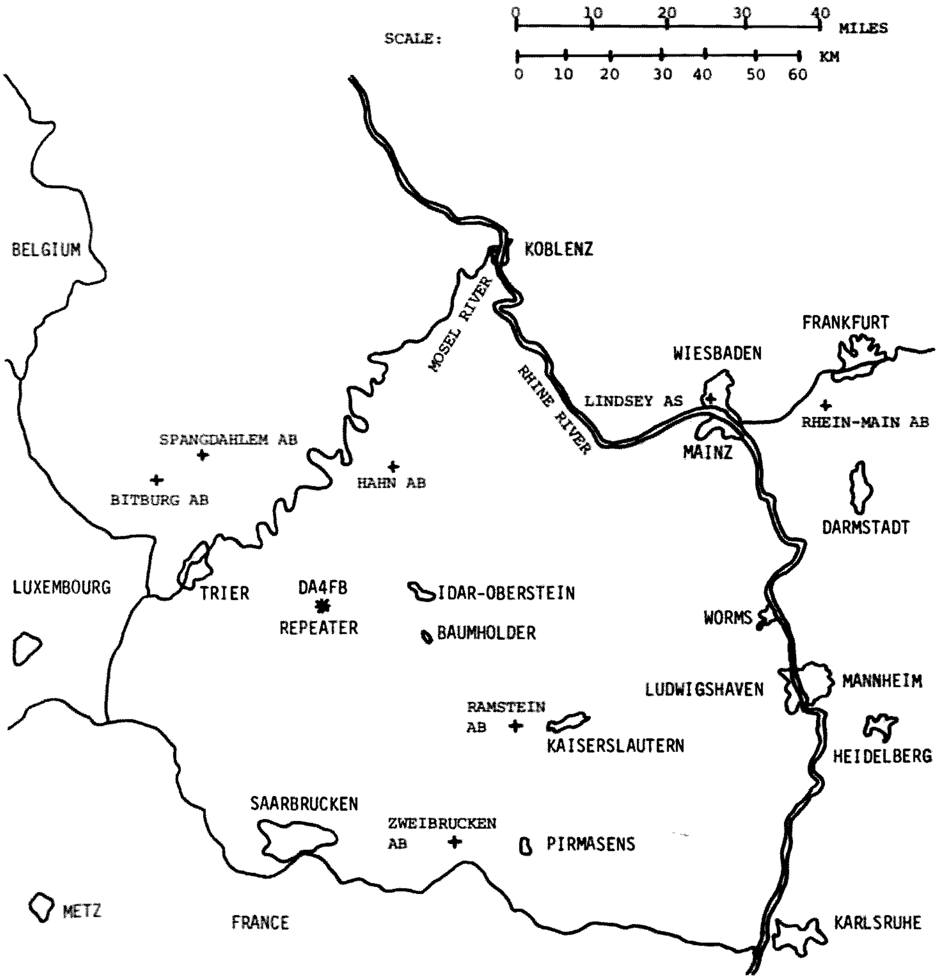
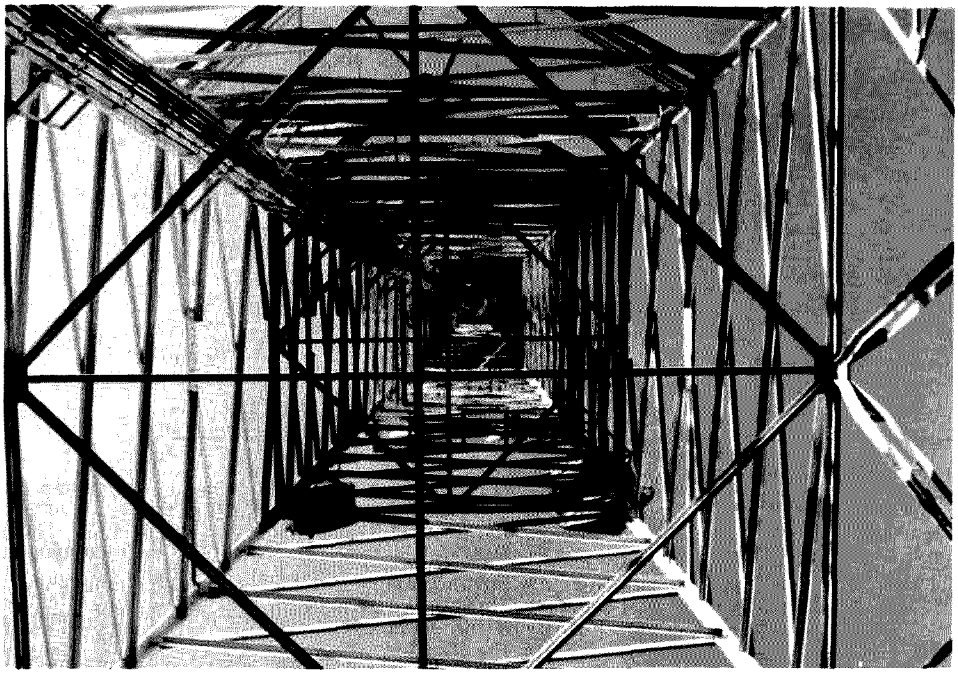


Fig. 1. Area of coverage of DA4FB 70 cm repeater, with major cities and USAF military installations indicated. The antenna is at a height of 800 meters (2624 feet), and has a cardioid pattern oriented toward Frankfurt.

the DARC. The DARC analyzes the application and insures sufficient separation between repeaters (both in frequency and distance) before giving the OK to the FTZ to issue the license. The DARC makes the frequency assignments and tells the FTZ what frequency pair is to be on the license. As you can see, the DARC is a very powerful organization. But their power is well directed, and repeater wars are almost nonexistent in Germany.



DARC officials indicated that the 2 meter band was extremely crowded and that they could only agree to a repeater in operation on the 70 centimeter band (430-440 MHz). The USWARC discussed this proposal and agreed that a 70 cm repeater was acceptable.

The search for equipment then began in earnest. About the only rig available at first was the VHF Engineering 70 cm repeater. The projected cost of the repeater, coax, antenna, control logic, duplexer and miscellaneous parts soon grew to over $1000, and the repeater committee started looking for fundraising projects.

Some of the USWARC members are associated with Motorola GmbH, and high level corporate management was informed of the club's repeater project. Soon, a rebuilt 70 cm MOTRAC repeater, complete with control logic, duplexer, and 350 feet of 7/8" foam coax, was donated to the club by the corporation!

By this time, eight months had passed since first discussion of the project, and the committee was ready to install the repeater antenna. A CushCraft 4-pole phased array was purchased, and it was decided that the cardioid pattern should be directed toward Frankfurt (as that city was the farthest distance from the site in the area of desired coverage). Installation was planned for the first weekend in December. (Why do all complex antenna projects have to be accomplished in the winter?) The weather cooperated, and the weekend turned out to be clear and cold. Normally, German winter weather would prevent anyone from seeing the top of the tower from ground level. The job was time-consuming, with the installation of the heavy coax being the major back-breaker. The antenna was placed about 5 feet below the top of the tower, a definitely impressive location with a commanding view of the countryside.

The repeater was installed in a new upright cabinet, and work began on the control logic to conform with DARC standards. At about the same time, the repeater frequency pair was changed by the DARC due to complaints to the DBP by a repeater group who had previously operated a machine on the frequency pair assigned to the USWARC in the same general location as the club's repeater site. A new pair on standard channel R87 was assigned to the club, with input on 431.475 MHz and output on 439.075 MHz. This provided 25 kHz separation from the next adjacent channel (R86) and is the first such channel assignment in Germany. New frequency elements were purchased for the machine, and work continued.

Finally, all the modifications were complete and the repeater was tuned and adjusted for proper operation. The only remaining items were the repeater license and correct programming of the ID unit, which is a little tough without the correct callsign. The wait for the license seemed eternal, and was due to slight confusion over what the correct licensing office was, since the club, trustee, and repeater were in different DBP administrative areas. This was cleared up, and in the third week of March, 1977, the license was issued with the callsign DA4FB. This is another "first," as all other repeater callsigns in Germany have DBØ prefixes. The DA prefix simply reflects the American club's operation under the German-American reciprocal licensing agreement.

The ID unit was programmed, and the machine went into test operation for a week before being transported to the site. On April 9, 1977, the repeater was installed on-site, and DA4FB became the first American-sponsored repeater to be licensed and in operation in the Federal Republic of Germany.

The repeater system was designed to give base station to base station coverage over most of the area depicted in Fig. 1. It was soon found that coverage was better than that planned for. Solid mobile operations are possible within about 30-40 miles of the repeater site. A five Watt base station with an eleven element beam is able to fully quiet the repeater receiver from Rhein-Main Air Base near Frankfurt, a distance of 72 miles from the site. A mobile station using a ten Watt transceiver and a 5 dB gain mobile antenna has copied the repeater signal with full quieting in the city of Heidelberg, a distance of 75 miles. Occasionally, a QSO will be conducted with a station outside of the depicted area. One station, DC5NB, located in Aschaffenburg, is a regular on the repeater. He is 97 miles from the site, and uses two 91-element yagis: one for transmit and one for receive. (The Europeans are big on VHF, UHF, and microwave work.)

Many American hams reside in the coverage area, but not too many are active on the 70 cm band. Many US Army installations and all major USAF installations in Germany are within range of the repeater. Kaiserslautern boasts the largest American community outside the US, with over 50,000 Americans. *All* hams are invited to use the open repeater and also join in the activities of the USWARC. If any further information is needed about the club or the repeater, contact the club vice president at the following address: Jean Binet DCØHO/FØOAB, In den Haferwiesen #30, 6506 Nackenheim, West Germany.

Many of the club members participated in this project and, without everyone working together, the job would have taken much longer and probably would not have enjoyed such success. The following is a list of the hams who devoted their time and energy to the USWARC repeater project: Mike Baker W8CM/DA1BM, Carl Beckenbach WA1LHW/DA1TT, Tex Bell WD8BGA/DA1BO, Jean Binet FØOAB/DCØHO, Herb Brasington WB4EWX/DA1KD, Jerry Cole WA7YMR/DA1JC, Chuck Elquist W6JIF/DA1BZ, Ed Goldsby W3JKL/DA1UC, Terry Huston WA8RYC/DA1TH, Gerhardt Pless DC8CX, Joe Roman WB7CCK/DJØNA, Jerry Stewart K5CFQ/DA1HZ, John Stohel WB7CVU/DA1AY.

Special thanks are due to Mike Baker, who was the design engineer, mastermind, and driving force for the whole project. Without the multi-linguistic talents of Jean Binet and Carl Beckenbach, the liaison work with the DARC and the DBP would have been difficult indeed. The USWARC would also like to express its unfailing gratitude to Motorola GmbH for its complete support of the repeater project. ■

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Decode Morse

-- with an 8080

Why should you want to read another article on Morse decoding? I could tell you that this was the ultimate program (which it isn't), or that I have invented a new technique (I haven't). In fact, there is nothing tremendously novel about the material presented in this article. However, you will read about a completely general decoder algorithm which can be implemented on any microcomputer system. For those of you with an 8080-based system, a full program listing of the algorithm is included as an example.

My fascination with automatic decoding was fostered by the introduction of the first microprocessors. Up until then, I had considered the project too inflexible, from a hardware point of view. The microcomputer concept was appealing because of the easy way in which changes in the system could be implemented. I must admit that, from the very beginning, the problem of computer-generated Morse code was not as interesting a project, since it is relatively straightforward. Hence, this article will not be concerned with that aspect of a system.

The concepts used in this decoder are from many sources, including my own work. The magazine articles which I have studied are listed at the end of this article. Most authors start their presentation with a list of features and a description of the method for distinguishing dots from dashes. This is a good approach, so I will do likewise.

Variable	Description
TIME	Elapsed time counter (14 bits). If overflow occurs(>14 bits), time is set to large value.
DD	Dot-dash time(≈15 bits). Value is calculated in Dot and Dash routine.
LS	Letter-space time(≈15 bits).
STAT	Main status register: Bit 7 Key status = 1 if key down 6 DD Flag = 1 if TIME DD 5 LS Flag = 1 if TIME LS 4 Sidetone 3 --- 2, 1, 0 Debounce counter
STAT2	Secondary status register Bits 5-0 are the CRLF counter
CODE	Code register, used for storage of incoming dots and dashes. For dots CODE = CODE * 2, for dashes CODE = (CODE * 2) + 1. Bits 5-0 are used.
CPTR	Column pointer, used for automatic CRLF function. Six bits or more may be required for storage.

Table 1. Description of variable storage requirements.

Decoder Features

My idea of desirable features are those that minimize the external hardware requirements for normal operation. There will always be special cases, which need advanced hardware for error-free operation.

Here is the list of features incorporated in my algorithm:

1. All program timing is done with software delays.
2. A sidetone is generated for monitoring the operation of the decoder.
3. An automatic carriage return/line feed (CRLF) sequence is generated.
4. The code input is debounced for reliable performance from a variety of sources.
5. The speed range is from at least 5 wpm to about 50 wpm.
6. The I/O routines that must be supplied by the user easily patch into the program.

The method used for interpreting dots, dashes, letters, and spaces is adapted from Petit's original article. Briefly, the rules are as follows:

1. If the key-down interval is ⩾ DD (the last dot-dash time, explained later), then the present element is a dash; otherwise, it is a dot.
2. If the key-up interval is ⩾ LS (the last letter-space time), then a character has been completely received and should be processed.
3. If the key-up interval is ⩾ 2LS, then a word has been completed.

Assuming a dot has been received, by rule 1, then DD is set to twice the duration of this dot. For dashes, a more complicated set of calculations is performed. In hand-sent code, which is most difficult for the computer, a tendency for variations in dash duration is common. This usually occurs at the end of words and often precedes a long pause during which the operator collects his thoughts. Therefore, I decided to average the received dash interval with the last received element. The averaging is accomplished by dividing the duration of the present dash by two and, then, adding the last value of DD. This is the LS value referred to in the above rules. By dividing by two once more, the new DD value is calculated. Two features result from this set of manipulations: (1) The letter-space decisions are heavily weighted by the duration of dashes, and (2) the effect of excessively long dash intervals is reduced. These seem like desirable traits, and yet do not add much complexity to the algorithm.

Software

The algorithm which has been partially discussed is presented in flowchart form in Figs. 1 and 2. A generalized symbolic approach, similar to BASIC statement

structure, is used, except for the status subroutine. This routine will be discussed in detail, since it is the cornerstone of the decoder.

The main routine is presented in Fig. 1. All the operations necessary for translating the received code into text form can be easily identified. Starting from the top and working down, the first step is program initialization, followed by a routine for printing a space.

After the space is printed, a key-down input causes the program to go to the Down routine. When the key returns to the up state, a branch to the Dot or Dash routine occurs. Within each routine, calculations for updating DD and LS, along with storage of the received elements, are made.

While the input continues in the key-up condition, the elapsed time is measured in the Wait routine. If an end of character is detected before the next down state, a transition to the Decode and Print routine is made. After printing the character, another wait loop is entered. If it times out, then a word has been received. Before printing a space, a check as to whether or not the algorithm should stop is performed. Usually the program will continue by printing a space.

Looking at the program subroutines presented in Fig. 2 will illustrate further details of the software. Four internal subroutines are called by the main program routines. These are (1) Status, (2) Print, (3) Decode, and (4) Delay. The Delay subroutine times out after 1 ms has elapsed. Obviously, this function will require different initialization, depending on the microcomputer used. The Decode subroutine performs the actual conversion from the dots and dashes, stored as a unique digital pattern, to the ASCII character representation.

In this algorithm, an automatic carriage return and line feed sequence is initiated by the first space character occurring after the 55th column. This is handled in the first section of the Print subroutine. Normally, the character is printed by calling a user-defined subroutine. However, if the CRLF sequence must be printed, the CR is immediately output, and a counter is set up for delaying the printout of a line feed.

The Status subroutine is the most complicated portion of software in the decoder. Note that all the timing in the main routine is determined by this subroutine. A call to the Delay routine, which returns after 1 ms, is the first action taken. Then the possibility that a line feed must be printed is tested and appropriate actions taken. Next, the key input (or receiver) is sampled for an up or down state. If a new state is detected, the debounce counter is decremented. A zero debounce count signifies that, in fact, the key has changed state and causes the key status to be updated. Otherwise, the debounce count is stored and the routine continues. Now the user-written routine for outputting the sidetone value is called, and, then, the elapsed time counter is incremented (checking for overflow). Lastly, the LS and DD flags, which indicate whether the time is ≥ LS or DD, are stored. These flags are easily checked in the main routine's decision-making process.

Details, Details . . .

Many flags, counters, pointers, and registers have been mentioned in the algorithm description. These are summarized in Table 1. In the 8080 listing presented, they occupy ten bytes of memory. Further explanation of the characteristics of these variables will complete the description of the algorithm.

The TIME counter is incremented as each pass through the Status subroutine is completed. An overflow condition is checked, and the variable is set to a large value, if

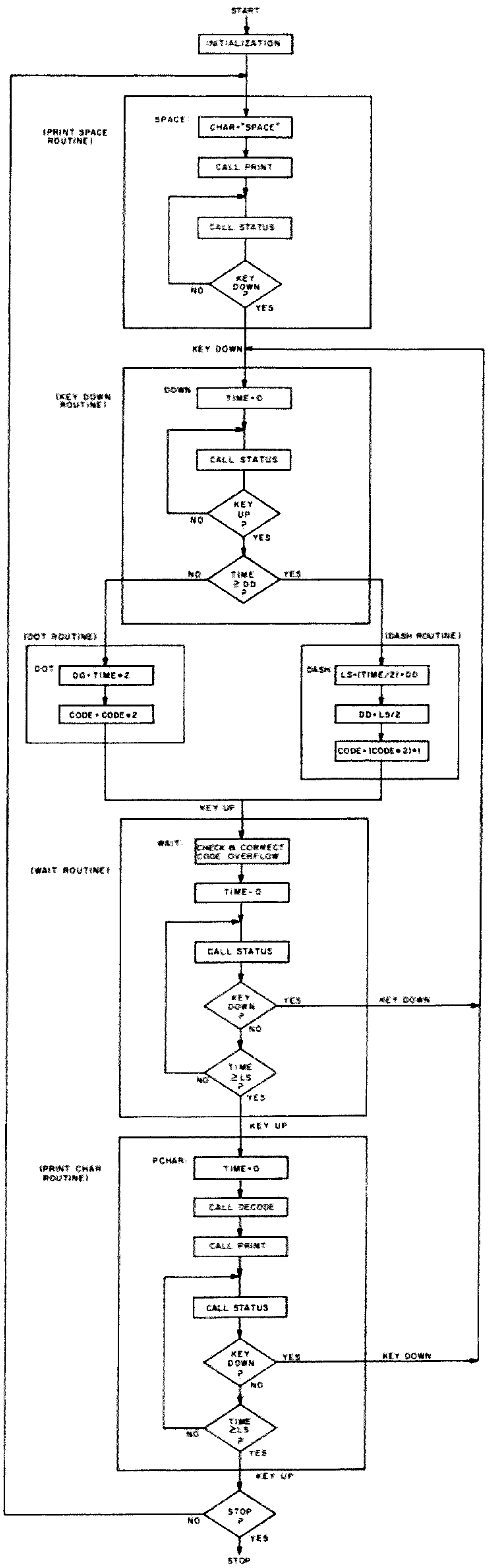

Fig. 1. Main decoder algorithm.

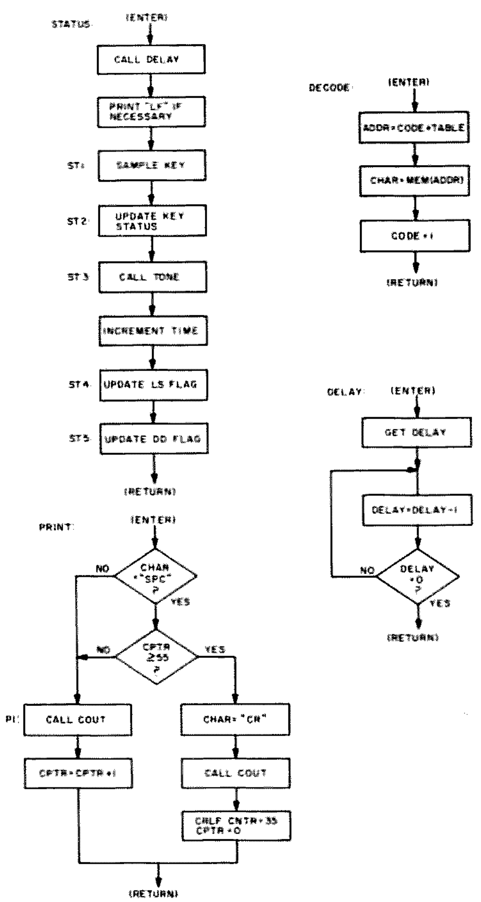

Fig. 2. Main subroutines of program.

00		20	5, and error
01		21	4
02	E	22	# ($\overline{SK}$)
03	T	23	3
04	I	24	
05	A	25	
06	N	26	?
07	M	27	2
08	S	28	= ($\overline{AS}$)
09	U	29	
0A	R	2A	.
0B	W	2B	
0C	D	2C	
0D	K	2D	
0E	G	2E	
0F	O	2F	1
10	H	30	6
11	V	31	& ($\overline{BT}$)
12	F	32	/
13		33	
14	L	34	
15		35	:
16	P	36	+ ($\overline{KN}$)
17	J	37	
18	B	38	7
19	X	39	,
1A	C	3A	
1B	Y	3B	
1C	Z	3C	8
1D	Q	3D	
1E		3E	9
1F		3F	0

Table 2. ASCII look-up table for character decoding. The hex number corresponds to the value of the code counter.

necessary. Both the DD and LS counters have been previously described, and they should be about one bit larger than the TIME counter. The main status register, STAT, holds the flags and single bit variables. There is nothing unique about its organization, except where it might simplify programming. A secondary status register, STAT2, is used for counting the delay necessary after a carriage return and before the line feed is issued. This feature may only be necessary for mechanical printers.

The CODE register is used for storage of the incoming dots and dashes. It is initialized to a value of 1 before each character is received. For a dot, the value is doubled; for a dash, it is doubled and then incremented by one. This is the simplest technique for storage of the elements, which results in a 64-location ASCII look-up table. To make sure that the contents of the counter are less than 64, an overflow condition must be checked after each entry. If an overflow occurs, the value is divided by two, and the algorithm continues. In using such a simple method, a sacrifice is made in not uniquely decoding a few special characters. For example, an error is decoded as the number five. The corresponding ASCII look-up table is presented in Table 2.

For the automatic CRLF feature, a pointer for the column position must be kept. This is the function of CPTR. In my version of the algorithm, I check for a value greater than 55, at which time the CRLF sequence is initiated.

Subroutines

There are two kinds of subroutines necessary for proper operation of the algorithm. The first kind, the main program subroutines, are well-defined for any microprocessor chosen for implementation of the decoder. The second type, user-supplied subroutines, will vary from one particular equipment setup to another. A few more comments concerning the first type will be made before attention is focused on the user-supplied subroutines.

There are several subtle aspects concerning the Status subroutine. In Fig. 1, the subroutine is called repeatedly while in the down state. The rate at which this loop is executed defines the frequency of the sidetone output. If all the possible paths through the Status subroutine are not matched for execution time, an instability in the sidetone output will result. A difference of only a few machine instructions can be detected by the ear. This problem can be handled by whatever method is easiest for the microcomputer used. In the 8080 example program, 13 bytes of extra jump instructions are used for the timing equalization.

The second point worth mentioning is the comparison of the TIME counter with LS and DD. Since these are 16-bit unsigned values, you will have to be careful if it is necessary to break it up into 8-bit comparisons. Beware of your microcomputer's 2's complement arithmetic!

The user-supplied I/O subroutine requirements are summarized in Table 3. There are four routines, which are concerned with printing a character, sampling the key input, generating the sidetone, and stopping execution of the program. All these functions require interfacing with your particular computer configuration.

As examples, the subroutines that I used in my 8080 program will be described. First, notice that they are linked to the main routines through an I/O patch table, which follows the Delay subroutine. This makes it possible to call the user subroutines from one section of code. There is no need to hunt through the listing for the subroutine calls when supplying your customized I/O. The Cout subroutine sends the ASCII character to the UART or display device, after checking if the device is ready. For sampling the key

COUT	Called by the Print subroutine. A character is passed, the UART status is checked, and the character is sent to the display device.
SKEY	An input line is tested for the key up or down state. The appropriate result is returned to the status subroutine.
CONT	The main program can be stopped by an appropriate hardware input which is checked by this routine.
TONE	Called by the status subroutine. If the key is down, toggle the sidetone output line and save value in STAT register. If key is up do nothing.

Table 3. User I/O subroutine specifications.

input, the Skey subroutine reads an input line and then returns with an appropriate flag. The Cont subroutine reads a status line and then either returns to the main program or stops execution. (Instead of stopping execution, a branch to another program would be possible.) A sidetone is generated by the Tone subroutine. The key state is checked, and, if the key is up, a return to Status occurs. Otherwise, the last sidetone value is toggled, output, and saved for the next iteration. This generates a square wave with a period equal to two passes through the Status subroutine.

User Modifications

Perhaps one of the most interesting aspects of playing with computer programs is making changes which reflect how you feel the program should have been written. Since I suspect many of you are already considering changes to this program, let me suggest a few first.

One possible modification would be to calculate a smaller value for LS (but not for DD). When copying the 18 wpm code bulletins from W1AW, I set LS = DD = [(TIME/2) + DD]/2, which is a simple change. Since the original LS value calculated in the algorithm is approximately equal to the average dash, this would suggest that Petit's rule, of using 3/4 of the dash, might be a good compromise.

Other possible changes include timing modifications and altering the line length for your particular terminal. Timing changes would be possible in the CRLF sequence (i.e., change CRDLY) or in the 1 ms Delay subroutine. By changing the duration of the delay, the sampling rate and sidetone frequency would be affected. If your display device doesn't accommodate at least 55 characters per line, this value could be changed (in the Print subroutine).

The four user-supplied subroutines are obvious places where you may require different code than in my examples. This could be as simple as changing port assignments.

Hardware

Simple hardware interfaces were built for the initial testing of the decoder. These are illustrated in Fig. 3 and consist of output and input circuitry.

The sidetone output is a square wave, which can easily drive a speaker using an emitter follower. The NPN transistor can be any power transistor out of your junk box. The interface for driving your display device is probably available from other projects, so I won't make any comments concerning this subject.

For receiving code, two simple circuits will get you going. Initially, I would suggest hooking up your favorite key or keyer to the code input line; a 1k pull-up resistor may be necessary. After the operation of the algorithm has been checked, it is time to connect a receiver to the computer.

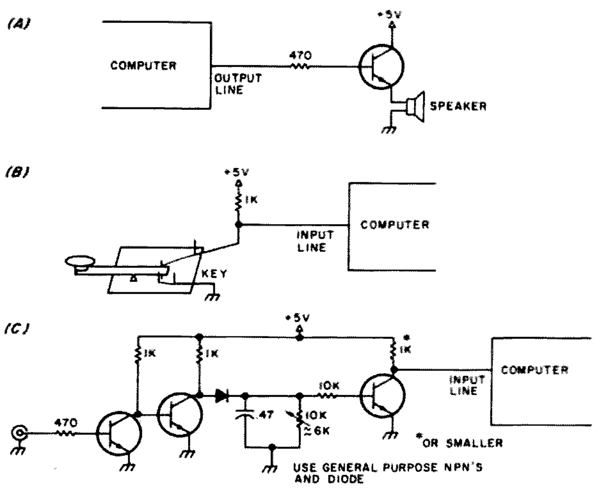

Fig. 3. Simple hardware interfaces. (a) Speaker connections; (b) key input; (c) receiver audio adapter.

I know of no easily constructed optimum interface between a receiver and a computer. Many ideas have been proposed, including narrow pass band filters and phase locked loops. These approaches are not appropriate for the goal of minimizing external hardware under normal conditions. Instead, I will assume you have a good receiver with an adequate CW filter. Connecting the circuit of Fig. 3(c) will provide satisfactory operation in most cases. The audio input is amplified (only about 2 V p-p input is required) and then applied to a peak detector, which follows the envelope of the received signal. The variable resistor can be used for adjusting the decay time constant, or a fixed value can be substituted. The output stage operates as a switch for driving the computer. By monitoring the sidetone output, the input level can be easily adjusted for any signal.

The Next Step Is Yours

With the information presented in this article, you should be able to program a computer for Morse code reception. If nothing else, this is an impressive demonstration for your friends. I hope you will not restrict your efforts solely to the ideas presented here, but will continue with further experimentation on your own.

Possible areas of experimentation include a different LS calculation, a BASIC program implementation, or matched filtering for the receiver interface. With a fast BASIC interpreter, most of the algorithm could be written directly from the flowcharts. However, the Status subroutine would be best left as a machine language program. Using some of the newly-available tapped analog delay lines (such as the Reticon TAD-32), an adaptive matched filter for optimum detection may be possible.

As a final challenge, consider how it might be possible to implement the decoder using one of the new single-chip microprocessors. The 8080 listing which follows is less than 512 bytes!

Thanks

I would like to thank the authors for writing the articles which are listed under references. A special thanks goes to Steve Belter WB9SGP, for his suggestions and support.

I will be happy to correspond directly with anyone on this subject; please include an SASE. ■

References

1. Petit, "The Morse-A-Verter," *QST*, January, 1971.

2. Riley, "A Morse Code to Alphanumeric Converter and Display," *QST*, October, 1975.
3. Levy, "A Morse to RTTY Converter," *73*, June, 1976.
4. Thomas and Belter, "Meet the Microprocessor," *QST*, August, 1976.
5. Hickey, "The Computer ... Versus ... Hand-Sent Morse Code," *Byte*, October, 1976.
6. Grappel and Hemenway, "Add This 6800 Morser to Your Amateur Radio Station," *Byte*, October, 1976.
7. Filgate, "A Morse Code Station Data Handler," *Byte*, October, 1976.
8. Wells, "CW for the 6800," *73*, April, 1977.


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8080 MDS MACRO ASSEMBLER, V2.2
WB9KPT MORSE CODE DECODER  6/77

                 ;
                         TITLE   'WB9KPT MORSE CODE DECODER  6/77'
                 ;
                 ;*******************************************************
                 ;
                 ;       8080 MORSE CODE DECODER
                 ;               W. THOMAS  WB9KPT  6/77
                 ;
                 ;       FEATURES:
                 ;               1)SOFTWARE TIMER
                 ;               2)SIDETONE
                 ;               3)AUTOMATIC CRLF
                 ;               4)DEBOUNCED INPUT
                 ;               5)5-50 WPM
                 ;               6)EASY I/O PATCHING
                 ;
                 ;*******************************************************
                 ;
                 ;       USER ASSIGNED CONSTANTS:
                 ;
03FF                     MEMTOP  EQU     1023    ; TOP OF MEMORY
0084                     DLY     EQU     132     ; 1 MSEC DELAY
0023                     CRDLY   EQU     35      ; CRLF DELAY COUNT
0004                     DBNCE   EQU     4       ; DEBOUNCE VALUE
0000                     STOP    EQU     0       ; STOP ADDRESS
000A                     LF      EQU     0AH     ; LINE FEED
000D                     CR      EQU     0DH     ; CARRIAGE RETURN
0020                     SPC     EQU     20H     ; SPACE
                 ;
                 ;       VARIABLES ARE STORED HERE:
                 ;
0010                     ORG     10H
0010                     TIME:   DS      2       ;ELAPSED TIME
0012                     DD:     DS      2       ;DOT-DASH TIME
0014                     LS:     DS      2       ;LETTER-SPACE TIME
0016                     STAT:   DS      1       ;MAIN STATUS REGISTER
0017                     STAT2:  DS      1       ;2ND STATUS REGISTER
0018                     CODE:   DS      1       ;CODE COUNTER
0019                     CPTR:   DS      1       ;COLUMN POINTER
                 ;
                 ;*******************************************************
                 ;
                 ;       MAIN PROGRAM    (START EXECUTION AT 60H)
                 ;
                 ;*******************************************************
                 ;
0020                     ORG     20H     ;PROGRAM STARTS HERE
0020 20204554    TABLE:  DB      '  ETIANMSURWDKGO'  ;ASCII TABLE
0024 49414E4D
0028 53555257
002C 444B474F
0030 48564620            DB      'HVF L PJBXCYZQ  '
0034 4C20504A
0038 42584359
003C 5A512020
0040 35342333            DB      '54#3  ?2= .    1'
0044 20203F32
0048 3D202E20
004C 20202031
0050 36262F20            DB      '6&/  !+ 7,  8 90'
0054 20212B20
0058 372C2020
005C 38203930
0060 31FF03      START:  LXI     SP,MEMTOP ;SET STACK POINTER
0063 3E00                MVI     A,0     ;INITIALIZE VARIABLES
0065 321900              STA     CPTR
0068 321600              STA     STAT
006B 321700              STA     STAT2
006E 3C                  INR     A
006F 321800              STA     CODE
0072 210000              LXI     H,0
0075 221000              SHLD    TIME
0078 21A000              LXI     H,160   ;10 WPM
007B 221200              SHLD    DD
007E 21F000              LXI     H,240
0081 221400              SHLD    LS
                 ;
                 ;       PRINT SPACE ROUTINE
                 ;
0084 3E20        SPACE:  MVI     A,SPC   ;CHAR="SPACE"
0086 CDA501              CALL    PRINT
0089 CD2701        S1:   CALL    STATUS
008C 3A1600              LDA     STAT    ;KEY DOWN?
008F E680                ANI     80H
0091 CA8900              JZ      S1      ;LOOP IF KEY UP
                 ;
                 ;       DOWN ROUTINE
                 ;
0094 210000      DOWN:   LXI     H,0
0097 221000              SHLD    TIME    ;TIME=0
009A CD2701       DW1:   CALL    STATUS
009D 3A1600              LDA     STAT    ;KEY UP?
00A0 E680                ANI     80H
00A2 C29A00              JNZ     DW1     ;IF NOT, LOOP
00A5 3A1600              LDA     STAT    ;TIME >OR= DD?
00A8 E640                ANI     40H
00AA C2BB00              JNZ     DASH    ;IF YES, GO TO DASH
                 ;
                 ;       DOT ROUTINE
                 ;
00AD 2A1000              LHLD    TIME    ;GET TIME
00B0 29                  DAD     H
00B1 221200              SHLD    DD      ;DD=TIME*2
00B4 3A1800              LDA     CODE    ;GET CODE COUNTER
00B7 87                  ADD     A       ;CODE=CODE*2
00B8 C3DF00              JMP     WAIT    ;GO TO WAIT
                 ;
                 ;       DASH ROUTINE
                 ;
00BB 2A1000      DASH:   LHLD    TIME    ;GET TIME
00BE CDD700              CALL    HL2     ;TIME/2  (PART OF DASH)
00C1 EB                  XCHG            ;MOVE TO DE REGISTERS
00C2 2A1200              LHLD    DD      ;GET DD TIME
00C5 19                  DAD     D       ;(TIME/2)+DD
00C6 221400              SHLD    LS      ;LS=(TIME/2)+DD
00C9 CDD700              CALL    HL2     ;LS/2
00CC 221200              SHLD    DD      ;DD=LS/2
00CF 3A1800              LDA     CODE    ;GET CODE COUNTER
00D2 87                  ADD     A
00D3 3C                  INR     A       ;CODE=(CODE*2)+1
00D4 C3DF00              JMP     WAIT    ;GO TO WAIT
00D7 7C          HL2:    MOV     A,H     ;DIVIDE HL BY 2
00D8 B7                  ORA     A       ;SET CARRY=0
00D9 1F                  RAR
00DA 67                  MOV     H,A     ;H=H/2
00DB 7D                  MOV     A,L
00DC 1F                  RAR
00DD 6F                  MOV     L,A     ;L=L/2
00DE C9                  RET
                 ;
                 ;       WAIT ROUTINE
                 ;
00DF FE40        WAIT:   CPI     64      ;CODE OVERFLOW?
00E1 FAE600              JM      W1      ;IF NOT, GO TO STORE CODE
00E4 B7                  ORA     A       ;SET CARRY=0
00E5 1F                  RAR
00E6 321800       W1:    STA     CODE    ;STORE NEW CODE
00E9 210000              LXI     H,0
00EC 221000              SHLD    TIME    ;TIME=0
00EF CD2701       W2:    CALL    STATUS
00F2 3A1600              LDA     STAT    ;KEY DOWN?
00F5 E680                ANI     80H
00F7 C29400              JNZ     DOWN    ;IF YES,GO TO DOWN
00FA 3A1600              LDA     STAT    ;TIME >OR= LS?
00FD E620                ANI     20H
00FF CAEF00              JZ      W2      ;IF NOT, WAIT
                 ;
                 ;       PRINT CHARACTER ROUTINE
                 ;
0102 210000      PCHAR:  LXI     H,0
0105 221000              SHLD    TIME    ;TIME=0
0108 CDD501              CALL    DECODE  ;DECODE CHARACTER
010B CDA501              CALL    PRINT   ;PRINT CHARACTER
010E CD2701       PC1:   CALL    STATUS
0111 3A1600              LDA     STAT    ;KEY DOWN?
0114 E680                ANI     80H
0116 C29400              JNZ     DOWN    ;IF YES, GO TO DOWN
0119 3A1600              LDA     STAT
011C E620                ANI     20H     ;TIME >OR= LS?
011E CA0E01              JZ      PC1     ;IF NOT, LOOP
                 ;
                 ;       CONTINUE ROUTINE
                 ;
0121 CDE901              CALL    @CONT   ;STOP?
0124 C38400              JMP     SPACE   ;IF NOT, PRINT SPACE
                 ;
                 ;*******************************************************
                 ;
                 ;       MAIN PROGRAM SUBROUTINES
                 ;
                 ;*******************************************************
                 ;
                 ;       STATUS SUBROUTINE
                 ;         TEMPORARY STORAGE:
                 ;               B REG= STAT
                 ;               C REG= KEY SAMPLE
                 ;               DE REG= TIME
                 ;
0127 2684        STATUS: MVI     H,DLY   ;LOAD DELAY VALUE
0129 CDE301              CALL    DELAY
012C 3A1700              LDA     STAT2   ;GET CRLF COUNTER
012F E63F                ANI     3FH     ;MASK CRLF COUNT
0131 CA4001              JZ      ST1     ;IF =0,GO TO SAMPLE KEY
0134 3D                  DCR     A       ;DECREMENT CRLF COUNT
0135 321700              STA     STAT2   ;STORE STAT2
0138 C24001              JNZ     ST1     ;IF NOT =0,GO TO SAMPLE KEY
013B 3E0A                MVI     A,LF    ;CHAR="LF"
013D CDA501              CALL    PRINT   ;PRINT LINE FEED
0140 CDED01       ST1:   CALL    @SKEY   ;SAMPLE KEY INPUT
0143 3A1600              LDA     STAT    ;GET STAT
0146 E69F                ANI     9FH     ;RESET TIME FLAGS: LS=DD=0
0148 47                  MOV     B,A     ;SAVE STAT
0149 E680                ANI     80H     ;MASK KEY STATUS
014B B9                  CMP     C       ;KEY=SAMPLE?
014C CA5001              JZ      ST2     ;IF YES,GO TO UPDATE KEY STATUS
014F 04                  INR     B       ;DEBOUNCE=DEBOUNCE+1
0150 78           ST2:   MOV     A,B     ;UPDATE KEY STATUS
0151 E607                ANI     07H     ;MASK DEBOUNCE
0153 FE04                CPI     DBNCE   ;NEW KEY STATE?
0155 C25D01              JNZ     ST3     ;IF NOT,GO TO CALL TONE
0158 78                  MOV     A,B     ;GET STAT
0159 E670                ANI     70H     ;RESET STAT: KEY=DEBOUNCE=0
015B 81                  ADD     C       ;NEW KEY STATUS
015C 47                  MOV     B,A     ;SAVE STAT
015D CDF101       ST3:   CALL    @TONE   ;SERVICE SIDETONE
0160 2A1000              LHLD    TIME    ;GET TIME
0163 23                  INX     H       ;TIME=TIME+1
0164 7C                  MOV     A,H     ;CHECK FOR OVERFLOW
0165 E6C0                ANI     0C0H
0167 CA6F01              JZ      ST4A    ;IF NOT,STORE TIME+1
016A 263F                MVI     H,3FH   ;IF YES,STORE LARGE TIME
016C 221000       ST4:   SHLD    TIME    ;STORE TIME
016F EB                  XCHG            ;MOVE TIME TO DE REGISTERS
0170 2A1400              LHLD    LS      ;GET LS TIME
0173 CD9C01              CALL    CMPS    ;TIME >OR= LS?
0176 D29201              JNC     ST5A    ;IF NOT,GO TO DD TEST
0179 78                  MOV     A,B     ;GET STAT
017A F620                ORI     20H     ;SET LS FLAG=1
017C 47                  MOV     B,A     ;SAVE STAT
017D 2A1200       ST5:   LHLD    DD      ;GET DD TIME
0180 CD9C01              CALL    CMPS    ;TIME >OR= DD?
0183 D29701              JNC     ST6A    ;IF NOT,GO TO STORE STAT
0186 78                  MOV     A,B     ;GET STAT
0187 F640                ORI     40H     ;SET DD FLAG=1
0189 47                  MOV     D,A     ;SAVE STAT
018A 78           ST6:   MOV     A,B     ;GET STAT
018B 321600              STA     STAT    ;STORE STAT
018E C9                  RET
```

```
                 ; TIMING EQUALIZATION FOR SIDETONE PURITY
018F C36C01       ST4A:  JMP     ST4      ;GO TO STORE TIME
0192 F600         ST5A:  ORI     0        ;DO NOTHING
0194 C37D01              JMP     ST5      ;GO TO DD TEST
0197 F600         ST6A:  ORI     0        ;DO NOTHING
0199 C38A01              JMP     ST6      ;GO TO STORE STAT
                 ; COMPARE SUBROUTINE (IF DE >OR= HL THEN CARRY=1)
019C 7C           CMPS:  MOV     A,H      ;HL=2'S COMPLEMENT OF HL
019D 2F                  CMA
019E 67                  MOV     H,A
019F 7D                  MOV     A,L
01A0 2F                  CMA
01A1 6F                  MOV     L,A
01A2 23                  INX     H
01A3 19                  DAD     D        ;IF DE >OR= HL THEN CARRY=1
01A4 C9                  RET
                 ;
                 ;       PRINT SUBROUTINE
                 ;               CHARACTER IS IN "A" REGISTER
                 ;
01A5 C5          PRINT:  PUSH    B        ;SAVE BC REGISTERS
01A6 FE20                CPI     SPC      ;IS CHAR="SPACE"?
01A8 C2C901              JNZ     P1       ;IF NOT, PRINT CHAR
01AB 3A1900              LDA     CPTR     ;GET COLUMN POINTER
01AE FE37                CPI     55       ;CP >OR= 55?
01B0 3E20                MVI     A,SPC    ;RESTORE CHAR="SPACE"
01B2 FAC901              JM      P1       ;IF NOT, PRINT CHAR
01B5 3E0D                MVI     A,CR     ;CHAR="CR"
01B7 CDF501              CALL    @COUT    ;PRINT CARRIAGE RETURN
01BA 97                  SUB     A        ;SET A=0
01BB 321900              STA     CPTR     ;CP=0
01BE 3A1700              LDA     STAT2    ;GET STAT2
01C1 F623                ORI     CRDLY    ;SET CRLF COUNT
01C3 321700              STA     STAT2    ;STORE STAT2
01C6 C3D301              JMP     P2       ;GO TO RESTORE BC
01C9 CDF501       P1:    CALL    @COUT    ;PRINT CHAR
01CC 3A1900              LDA     CPTR     ;GET COLUMN POINTER
01CF 3C                  INR     A        ;CP+1
01D0 321900              STA     CPTR     ;CP=CP+1
01D3 C1           P2:    POP     B        ;RESTORE BC REGISTERS
01D4 C9                  RET
                 ;
                 ;       DECODE SUBROUTINE
                 ;
01D5 3A1800      DECODE: LDA     CODE     ;GET CODE COUNTER
01D8 C620                ADI     TABLE    ;CALCULATE ADDRESS
01DA 6F                  MOV     L,A      ;SET L=ADDRESS
01DB 97                  SUB     A        ;SET A=0
01DC 67                  MOV     H,A      ;SET H=0
01DD 3C                  INR     A
01DE 321800              STA     CODE     ;STORE CODE=1
01E1 7E                  MOV     A,M      ;CHAR=TABLE(ADDRESS)
01E2 C9                  RET
                 ;
                 ;       DELAY SUBROUTINE
                 ;         ASSUMES 2MHZ CLOCK,NO WAIT STATES
                 ;           DELAY=(DLY*7.5)+7.5 USEC
                 ;
01E3 7C          DELAY:  MOV     A,M      ;GET DLY VALUE
01E4 3D           DLY1:  DCR     A
01E5 C2E401              JNZ     DLY1
01E8 C9                  RET
                 ;
                 ;       I/O PATCH TABLE
                 ;         ALLOWS EASY I/O DRIVER ASSIGNMENTS
                 ;         FOR USER SUPPLIED SUBROUTINES
                 ;
01E9 CD1102      @CONT:  CALL    CONT     ;CALL CONT SUBROUTINE
01EC C9                  RET
01ED CD0402      @SKEY:  CALL    SKEY     ;CALL SKEY SUBROUTINE
01F0 C9                  RET
01F1 CD1902      @TONE:  CALL    TONE     ;CALL TONE SUBROUTINE
01F4 C9                  RET
01F5 CDF901      @COUT:  CALL    COUT     ;CALL COUT SUBROUTINE
01F8 C9                  RET
                 ;
                 ;*****************************************************
                 ;
                 ;       USER DEFINED SUBROUTINES   (EXAMPLES FOLLOW)
                 ;
                 ;*****************************************************
                 ;
                 ;       COUT SUBROUTINE
                 ;         SENDS CHAR IN "A" REG TO UART
                 ;
01F9 47          COUT:   MOV     B,A      ;SAVE CHAR
01FA DBF7         CH1:   IN      0F7H     ;XMIT READY?  (BIT 0)
01FC 1F                  RAR
01FD D2FA01              JNC     CH1      ;IF NOT, LOOP
0200 78                  MOV     A,B      ;PRINT CHARACTER
0201 D3F6                OUT     0F6H     ;UART XMIT PORT
0203 C9                  RET
                 ;
                 ;       SKEY SUBROUTINE
                 ;               RESULT RETURNED IN "C" REG
                 ;                 IF DOWN THEN C=80H
                 ;
0204 DB10        SKEY:   IN      10H      ;READ KEY INPUT PORT
0206 E601                ANI     1        ;KEY DOWN?  (BIT 0)
0208 C20E02              JNZ     SK1      ;JUMP IF DOWN
020B 0E00                MVI     C,0      ;KEY UP
020D C9                  RET
020E 0E80         SK1:   MVI     C,80H    ;KEY DOWN
0210 C9                  RET
                 ;
                 ;       CONT SUBROUTINE
                 ;         CHECK FOR RCVR READY
                 ;           RETURN IF CONTINUE
                 ;
0211 DBF7        CONT:   IN      0F7H     ;GET RCVR READY  (BIT 1)
0213 E602                ANI     02H
0215 C8                  RZ               ;IF ZERO, CONTINUE
0216 C30000              JMP     STOP     ;OTHERWISE... STOP!
                 ;
                 ;       TONE SUBROUTINE
                 ;         IF KEY DOWN THEN CHANGE SIDETONE
                 ;           STATUS IN "B" REG
                 ;
0219 78          TONE:   MOV     A,B      ;GET STAT
021A 17                  RAL              ;KEY UP?
021B D0                  RNC              ;IF KEY UP RETURN
021C 1F                  RAR              ;RESTORE STAT
021D EE10                XRI     10H      ;TOGGLE SIDETONE
021F 47                  MOV     B,A      ;SAVE STAT
0220 1F                  RAR              ;OUTPUT SIDETONE
0221 1F                  RAR
0222 1F                  RAR
0223 1F                  RAR
0224 D310                OUT     10H
0226 C9                  RET
                 ;
0000                     END
```

```
@CONT  01E9     @COUT  01F5     @SKEY  01ED     @TONE  01F1
CH1    01FA     CMPS   019C     CODE   0018     CONT   0211
COUT   01F9     CPTR   0019     CR     000D     CRDLY  0023
DASH   00BB     DANCE  0004     DD     0012     DECOD  01D5
DELAY  01E3     DLY    0084     DLY1   01E4     DOWN   0094
DW1    009A     HL2    00D7     LF     000A     LS     0014
MEMTO  03FF     P1     01C9     P2     01D3     PC1    010E
PCHAR  0102     PRINT  01A5     S1     0099     SK1    020E
SKEY   0204     SPACE  0084     SPC    0020     ST1    0140
ST2    0150     ST3    015D     ST4    016C     ST4A   018F
ST5    017D     ST5A   0192     ST6    018A     ST6A   0197
START  0060     STAT   0016     STAT2  0017     STATU  0127
STOP   0000     TABLE  0020     TIME   0010     TONE   0219
W1     00E6     W2     00FF     WAIT   00DF
```

HEX PROGRAM DUMP:
(INCLUDING EXAMPLE USER DEFINED SUBROUTINES)

```
D20,226
0020 20 20 45 54 49 41 4E 4D 53 55 52 57 44 4B 47 4F
0030 48 56 46 20 4C 20 50 4A 42 58 43 59 5A 51 20 20
0040 35 34 23 33 20 20 3F 32 3D 20 2E 20 20 20 20 31
0050 36 26 2F 20 20 3B 2B 20 37 2C 20 20 38 20 39 30
0060 31 FF 03 3E 00 32 19 00 32 16 00 32 17 00 3C 32
0070 18 00 21 00 00 22 10 00 21 90 00 22 12 00 21 FA
0080 00 22 14 00 3E 20 CD A5 01 CD 27 01 3A 16 00 E6
0090 80 CA 89 00 21 00 00 22 10 00 CD 27 01 3A 16 00
00A0 E6 80 C2 9A 00 3A 16 00 E6 40 C2 BB 00 2A 10 00
00B0 29 22 12 00 3A 18 00 87 C3 DF 00 2A 10 00 CD D7
00C0 00 EB 2A 12 00 19 22 14 00 CD D7 00 22 12 00 3A
00D0 18 00 87 3C C3 DF 00 7C B7 1F 67 7D 1F 6F C9 FE
00E0 40 FA E6 00 B7 1F 32 18 00 21 00 00 22 10 00 CD
00F0 27 01 3A 16 00 E6 80 C2 94 00 3A 16 00 E6 20 CA
0100 EF 00 21 00 00 22 10 00 CD D5 01 CD A5 01 CD 27
0110 01 3A 16 00 E6 80 C2 94 00 3A 16 00 E6 20 CA 0E
0120 01 CD E9 01 C3 84 00 26 84 CD E3 01 3A 17 00 E6
0130 3F CA 40 01 3D 32 17 00 C2 40 01 3E 0A CD A5 01
0140 CD ED 01 3A 16 00 E6 9F 47 E6 80 B9 CA 50 01 04
0150 78 E6 07 FE 04 C2 5D 01 78 E6 70 81 47 CD F1 01
0160 2A 10 00 23 7C E6 C0 CA 8F 01 26 3F 22 10 00 EB
0170 2A 14 00 CD 9C 01 D2 92 01 78 F6 20 47 2A 12 00
0180 CD 9C 01 D2 97 01 78 F6 40 47 78 32 16 00 C9 C3
0190 6C 01 F6 00 C3 7D 01 F6 00 C3 8A 01 7C 2F 67 7D
01A0 2F 6F 23 19 C9 C5 FE 20 C2 C9 01 3A 19 00 FE 37
01B0 3E 20 FA C9 01 3E 0D CD F5 01 97 32 19 00 3A 17
01C0 00 F6 23 32 17 00 C3 D3 01 CD F5 01 3A 19 00 3C
01D0 32 19 00 C1 C9 3A 18 00 C6 20 6F 97 67 3C 32 18
01E0 00 7E C9 7C 3D C2 E4 01 C9 CD 11 02 C9 CD 04 02
01F0 C9 CD 19 02 C9 CD F9 01 C9 47 DB F7 1F D2 FA 01
0200 78 D3 F6 C9 DB 10 E6 01 C2 0E 02 0E 00 C9 0E 80
0210 C9 DB F7 E6 02 C8 C3 00 00 78 17 D0 1F EE 10 47
0220 1F 1F 1F 1F D3 10 C9
```

Frank J. Derfler K9KIC
99-1440 Aiea Hts. Dr. #51
Aiea HI 96701

Futureshot

-- just around the corner

Fred Thompson hurried through the shopping mall. His watch showed him that it was 8:57, and he knew that Harry closed the doors promptly at 9 pm. Harry's Computer Store was the largest in the city, and Fred was sure Harry would have the integrated circuit he needed.

"Whoa," Fred said, "got time for a paying customer, don't you?"

"Sure," Harry backed away from the door he was about to close and chuckled, "glad to take your money. What do you need?"

"Program chip." Fred answered. "Got a French language course?"

"Check the wall unit over there. We don't get too much call for those, so it's probably down in the bottom cabinets someplace."

Fred keyed "French language" into the wall mini-terminal. The liquid crystal display listed two brand names.

"Hey, you've got two kinds in stock."

"Better check," Harry advised, "one might use two chips."

Fred asked the computer for a compare and contrast. Sure enough, one program, which gave complete branching and learning reinforcement, used two chips. One chip was the program and a file. The other was just a vocabulary file of four megabits. The price differential was only about 30%. Fred touched the listing for the two-chip version to indicate his choice. A green LED came on over the handle of the bottom drawer. He opened the drawer and took out one of the bags from the cubbyhole indicated by a photoluminescent panel.

"What, no servomechanism to drop it in front of the point of sale terminal?" Fred chided.

"I told you we don't get much call for that program," Harry responded. "Gotta save the gadgets for the big sellers — private secretary and the like."

"Been selling a lot of the private secretary?"

"Oh yeah, been selling a lot of the vocal interfaces, too, both male and female voices."

"I didn't buy the talk feature. I think it's great telling the machine what to do without any backtalk."

"Yeah, they say the darnedest things. Don't know what some of those programmers are thinking of sometimes. Well, anything else? We called up a back file of 'Star Trek' on the TV tonight, and I want to get home to make sure it gets recorded okay."

"Captain Kirk still chasing Klingons, eh? How much do I owe you?"

"With state and federal sales tax, twenty dollars and forty cents. Want to use my terminal or have you got your remote toy with you? Last ham radio operator I had in here insisted on using his homemade handi-term. Took him three tries, and he wound up crediting me with a hundred dollars too much."

"Never fear, mine works!" Fred said. He pulled back his shirt sleeve to reveal what appeared to be an odd-shaped calculator, with a rubber stick attached. "I don't mind an exterior antenna. Gives me great coverage through the local repeater," he said. As he talked, he composed a digital message that consisted of his amateur radio callsign, Harry's account number, his account number, the date (November 2, 1985), and the amount. He pressed the transmit button, and Harry's counter terminal registered the correct transfer on its readout. "Hah, see!" he said proudly.

"How long do you figure till everybody has one of those?" Harry asked.

"Probably never, except for a few kinds of salesmen. It's just a toy, like you said. Well, thanks a lot."

"Thank you. We've got Spanish, Russian, any kind of language course you want."

"This is for my daughter's French class. A few of the kids don't have access to a microcomputer at home yet, so I thought I'd let her take a CPU to school in her book bag and use the school's peripherals."

"If I can help, let me know. Night, Fred."

"End," Fred responded in BASIC.

Fred got back to his car and saw that the parking meter had almost run out. "Boy, a dollar sure doesn't buy much time anymore," he thought.

On the way home, the message indicator on his amateur radio rig was blank, so he put out an "available" or CQ message. Almost immediately the display showed a response and the callsign K9KIC. Fred knew that this was the call of a young man named John, who lived nearby. They had never met, but they had shared many interesting conversations over the radio. At the next stop sign, Fred saw that John wanted to switch over to voice transmission. He picked up a pencil-thin microphone which was connected to the radio by a piece of slender plastic line. "Hey, John, what brings you on this band now? Did the amateur radio satellite fall out of synchronous orbit?"

"No," came the voice through the solid state speaker, "Murphy has struck, and I need some technical help."

"Well, tell me what you've got, and I'll make one of my educated guesses," Fred responded.

"You were with me when I bought that old Z-80 CPU at the swap meet. I've got it up and running on an antenna-aiming program for the Russian amateur radio satellites. Everything goes fine

until I actually hook up the azimuth and elevation rotators. The first time it changes the azimuth, everything stops. Whaddya think?"

"Well, my young lad, my educated guess is spikes."

"Spikes! But there are lots of capacitors everywhere, and the power supply just has tons of farads hanging on it."

"The power supply, yes, but you are about to learn one of the main reasons why computer designers, radio designers, and almost everyone who pushes an electron has gone to fiber optics for signal circuits. These program chips that I just bought are a good example – two power connectors and ten optical signal ports each. Sure makes it nice."

"Okay, Fred, I can see I'm going to have to listen to one of your lectures, if I want to get my antenna pointed. Go ahead."

"You are aware that wires used to be used for carrying things other than power?"

"They still carry rf, Fred."

"Hrumph. That's power, too. Anyway, all the signal leads in computers, radios, phonographs, and everything else once were metallic. The time and money we used to spend eliminating hum, rf interference, and all the other kinds of unwanted signals were amazing. Bypass capacitors by the bushel, special circuit board and cabinet designs, tons of sheet metal. Then, about '79, the use of fiber optics for carrying signals really came of age. Practical microcomputers were only a few years older, so the marriage was a natural. Their use in radios and TVs was spurred along by federal legislation aimed at reducing TV interference, so you just don't find many of the metallic signal bus systems anymore."

"Well, I did."

"Right, and now we have to reinvent a few old tricks. I think that every time the relay in that old antenna rotator control unit of yours clicks, a big spike is sent back to the computer over the control wires. That spike drives the microprocessor crazy. Do you have any old discrete optoisolators in your junk box?"

"I'm not really sure what they are."

"Nowadays they are just a part of many chips, but basically, they relay a control signal, via light, to get rid of any spikes that might be introduced. You come on over tomorrow, and I'll see if I can find a reference that tells us how to use them. Here, I've keyed up my address. Come over about 10 am."

"Okay! Thanks a bunch, Fred. See you then."

As he signed off from his contact, Fred pulled into his carport. He put the tires of his car into the wide grooves in the composite floor and stopped when a light glowed on the dashboard. Beneath the car, twin spring contacts were already recharging the car's battery. He opened the front door of the house by punching a four digit sequence on the lock.

"Hi, anybody home?" he asked.

"We're downstairs," a female voice answered.

He went down into the main portion of the house, which was below the level of the surrounding ground. This arrangement gave both superb insulation and a nice landscape. The family room was dark, with the skylight in the clear mode to give an undistorted view of the night sky.

"Did you just get off work, dear?" he asked. His eyes were still adjusting to the darkened room.

"Yes, we had another one of those late conferences – more decisions and options," his wife replied.

"I'm glad you're home, Daddy," his daughter Jeanne interjected. "This is one of the first tries for our class project. Mother may understand stocks and bonds, but laser communications are too much for her."

"Oh great," Fred said, "I had forgotten it was tonight. We must not have entered it into the secretary. Where is the target?"

"The computer says that Orbiting Base I is due to pass over in about 15 minutes. We are going to try hitting it with a laser from the roof of the school. We want to use the communications mirror on the Orbiting Base to bounce a signal. I've got this laser detector set up here, and Sue and Billy each have one, too. It's not very precise, but we can show the principles involved."

"That would be a pretty fair accomplishment," Fred replied. "The military and some hams have been using the satellite mirror incremented light element system for some time, but if you kids can bounce off the Orbiting Base, you can get some good communications and good tracking data at the same time." Fred walked over to the small computer terminal hanging on the wall of the family room. He touched a sensitive square on the top of the visual display and said, "Print time; Print Orbiting Base time; Print difference; Run."

Immediately the solid state display showed:

2137:20
2143:33
6:13

"You going to work through the skylight?" he asked his daughter.

"Yes, I don't think we'll lose very much, since it's in the clear mode."

"If you two will excuse me," his wife said, "I'm going to take a bath. Secretary," she said, touching the computer terminal. The screen printed "READY" above the time numerals still on its face. This indicated that the secretary program was ready for use. "Bath; Hot; Full; Run," she said. "Isn't science wonderful!?" she chided, after taking her hand off the computer's touch spot. "Let me know when you talk to the woman in the moon."

"Ouch," Fred said, "give 'em females on the Orbiting Base, and they want the whole moon."

"Just our fair share, Daddy," Jeanne laughed.

The minutes and seconds displayed on the computer terminal went by swiftly. The Orbiting Base passed overhead. The laser detector was operating at its highest gain, but nothing was heard. Ten minutes after the direct overhead pass, the phone buzzed and Jeanne hurried to answer it.

"No, Billy, we didn't hear anything. What? You did. I know I had everything set up right. OK, we'll have to check it out tomorrow."

"They heard the bounced signal?"

"Yes, but without all three results, we can't get any accurate position data to write up. It isn't just enough to receive a signal; we have to be able to show good tracking data, too, if we are going to get a good grade on the project."

"Boy, high school science projects sure have changed," Fred mused. "Let's see if there is anything wrong with your receiver that an old technician can recognize."

Fred placed the equipment in self-test and made all of the checks with no discrepancies apparent. Opening the small cabinet revealed only two lumps coated with protective material. One was the entire detector and amplifier, and the other was the power supply. "Not an adjustment anyplace; besides, everything checks out okay."

"Thanks anyway, Daddy. At least I know I had it turned on and pointed the right way. The Orbiting Base will be over again tomorrow night. Maybe we can get a new receiver by then."

Later, as the house quieted down for the night, Fred addressed the computer again. "House; Status; Run." A floor plan of the house appeared. All doors and windows were shown in green, indicating they were

locked. Below the diagram, a row of numbers began to appear on the screen. They showed the temperature of the water in the solar heaters, the output of the wind generator, and the amount of power that had been drawn from the commercial mains to supplement the wind generator over the past 24 hours. The temperature in the various rooms and other factors, such as circulating air flow, were also shown. Security systems, fire detection, and environmental control were all under the control of the home computer system while the family slept.

The next morning found Fred hard at "work." Actually, he went into the office less and less each year. The marriage of cheap data processing with high quality communications interconnections allowed many people to do a great deal of their work at home. As a lead design engineer, Fred had ties, via telephone lines, to the five design engineers in his group. They were able to exchange ideas, diagrams, and comments through their computer terminals at home. They could confer individually, or as a group.

The "smart" terminals they were using contained powerful microprocessors and were actually stand-alone computers. They could work individually, in concert with other smart terminals, or as an extension of the central "big memory" operated by Fred's company. The savings in real estate and overhead more than paid for the cost of the additional communications circuits. Many businesses still required the personal touch. But those that could were encouraging their people to work at home. Fred's wife was at "work" in another part of the house. Their breaks were frequent, and their family life was quite strong.

At a little before 10 am, the secretarial program in Fred's computer printed out "K9KIC COMING TO VISIT AT 10 AM."

A few minutes later, the doorbell rang. The young man he admitted was quite different from the bookish boy Fred had expected to see. John was tall and athletic. He held out his hand and said, "Hi, I'm K9KIC."

"Come in," Fred said. "I've got an optoisolator on my desk."

They discussed optoelectronics, the good old days of ham radio, and several other topics. Fred was just about to relate how he had changed over his old receiver to fiber optic elements, when his daughter walked in.

"Hi, Dad, can you help me for a minute?" She was weighted down with various pieces of her laser project. "Oh, I'm sorry. I didn't know you had company."

"Jeanne, this is John, one of my ham radio buddies. John, my daughter Jeanne."

"Say, isn't that a laser detector?" John asked.

"Yes, I just brought it back from a complete checkout. Everything seems to be fine, but it wouldn't work on a beam we bounced off the Orbiting Base last night."

"Maybe your bandpass was too narrow," John said, helping her with her load.

"I checked . . ." Fred tried to say.

"Or maybe you were getting a frequency shift."

"That could . . ." Fred tried again.

"Oh, do you think so?" Jeanne asked wide-eyed. "I just don't know much about these things," the winner of the local science fair for the last three years said innocently.

"Maybe we can try it on the ridge outside of town tonight . . ." were the last words Fred heard as they disappeared out the door.

He chuckled. "Bubble memories, laser mirrors, and electric cars, but some things never change!" ■

Try A Micro Contest Logger

-- the 6800 does it all

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Any contester will tell you that the removal of duplicate contacts from a contest log is absolutely necessary but can be an arduous and time-consuming chore, particularly when a large number of contacts are involved. For example, say 2000 QSOs are made on one band. Each callsign must be compared against all other callsigns on that log, in order to determine if a duplicate exists. When done manually, with pencil and paper, this operation can take nearly as long as the actual on-the-air operation, and, needless to say, it's nowhere near the fun.

Naturally, since I do operate in all the major contests, the first function I wanted to perform with my new micro, once it was up and running, was the removal of duplicate contacts from a contest log. The program presented here does just that. It reduces the operation to merely entering each callsign from the log into the processor via the control keyboard. Duplicate contacts are identified with both an audible and a visual indication.

The ultimate contest program, of course, would be used during the actual operation of the contest and would identify duplicates before they were logged. It would maintain the log for you, printing it out on hard copy for submission to the sponsor. Such a program would be beyond the memory capacity of my system, and I have no hard copy device. I, therefore, designed this program to be used after the contest. Callsigns are taken from the completed logsheets, and the duplicate contacts identified must be marked on the logsheets as such.

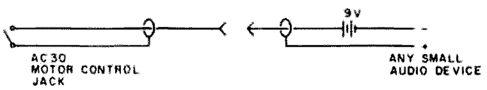

Fig. 1.

This program is written for the SWTPC 6800, with the CT-1024 control terminal and AC-30 cassette interface. The AC-30 is necessary only in the generation of the audible alarm described below. As suggested by SWTPC, memory locations 0000 through 0020 are unused. The program requires $478_{(10)}$ bytes of memory, leaving all remaining memory for the workspace. Each callsign is assigned six bytes, plus one for the end-of-callsign control character (a period).

It is possible to process 1100 callsigns in 8K of memory, while 500 may be handled by 4K. As you will notice in the assembly listing, maximum use is made of the INEEE and OUTEEE routines contained in the Motorola Mikbug firmware, and direct addressing is used extensively.

Upon execution of the program from its starting point, location 002F, the home-up and erase to end of file functions are performed to produce a clean screen, and then the "Enter Callsigns" screen message appears on the control monitor. Callsigns of variable length are entered from the keyboard, each followed by a period. They appear on the monitor in column format at the left margin. In the event of a typing error, a slant bar is entered (anytime before the period) and the erroneous callsign may be entered correctly. A line feed, carriage return, and erase to end of file string follow each callsign entered, to produce the column format and to cause a clean screen on page changes. The compare routine is bypassed for the first callsign entered. After that, as each callsign is entered, it is compared to all others already in the workspace. Upon detection of a duplicate entry, the screen message "Duplicate – Type A Space" appears following the callsign, and the audible alarm alerts the operator. The alarm is extinguished when the space (actually any character will do) is typed.

This audible alarm feature was included only as a convenience, so if your system does not include the AC-30, don't worry; the program will still function as written. You will, however, have to glance

up at the screen after each entry to check for the visual indication of a duplicate on the monitor screen. Any audio device may be used for the audible alarm. Simply place the auto/manual switch of the AC-30 in the auto position, engage input A as a reader, and use the motor control jack A as a switch to turn on the audio device. (See Fig. 1.) The "Duplicate" and "Memory Full" screen message strings contain reader-on commands, and a reader-off is generated after keyboard input. I merely plug in a cassette recorder locked in the play mode and containing a program tape. Crude as it may be, the Kansas City Standard tones never fail to get my attention when the recorder is activated by the remote switch.

After the last callsign to be processed, key in a dollar sign, which terminates the entry and compare function and begins a "Print" function. Should the end of your memory be reached before you have come to the last callsign, the "Memory Full" screen message is displayed along with the audible alarm. The dollar sign must then be entered to begin the "Print" function.

The "Print" function actually serves no purpose, except to allow a simple recheck to insure all duplicates have been properly marked on the log. The callsigns are displayed at the left margin in column format. Printing continues rapidly until an identified duplicate contact is reached. The callsign is followed by a "Duplicate" screen message, and you are instructed to type a space to continue. After the last callsign is displayed, a screen message instructs that you type a "P" to print again or a "C" to clear. If the "P" is selected, the print operation cycles through again, while a "C" clears the memory workspace and prepares for the entry of a new series of callsigns, perhaps the processing of another band.

Included in the program are two constants, which are dependent on the memory capacity of your system. Location 0023 contains the highest memory address, while 007F contains the address of the highest callsign starting point in memory. I have used 1FFF and 1FF9, respectively, for an 8K memory. If you are using 4K, simply change to OFFF and OFF3.

This program should prove to be a most valuable addition to your program library. You can process your log in a minimum of time and still have complete confidence that you are submitting a clean log. ■

Fig. 2.

```
                        NAM    SUPERDUPER
      E1D1    OUTEEE    EQU    $E1D1     MIKBUG FIRMWARE
      E07E    PDATA1    EQU    $E07E     MIKBUG FIRMWARE
      E1AC    INEEE     EQU    $E1AC     MIKBUG FIRMWARE
              *
0021  01DE              FDB    $01DE     Constant start of workspace
0023  1FFF              FDB    $1FFF     Constant high memory address
0025  0000              RMB    $0000     Initialize with zeros
0027  0002              RMB    2         Reserve for temp storage
0029  0002              RMB    2         Reserve for temp storage
002B  0002              RMB    2         Reserve for temp storage
002D  0002              RMB    2         Reserve for temp storage
                        ORG    $002F
              *         STARTING LOCATION
002F  DE 21   START     LDX    $0021     Start of workspace
0031  86 20             LDA A  #$20      Put a space in A
0033  A7 00   NEXT      STA A  0,X       Load the space in memory
0035  9C 23             CPX    $0023     Reach end of memory yet?
0037  27 03             BEQ    ENTER     Yes, to enter
0039  08                INX              No, go to next mem loc
003A  20 F7             BRA    NEXT      To NEXT
              *         BEGIN ENTERING CALLSIGNS
003C  BD 014B ENTER     JSR    STG4      Display MSG4
003F  DE 21   ENTER2    LDX    $0021     Start of workspace
0041  C6 20   LOADB     LDA B  #$20      Put a space in B
0043  A6 00             LDA A  0,X       Load A from memory
0045  11                CBA              Is it a space?
0046  26 2C             BNE    LDCTR     No, to LDCTR
0048  DF 27             STX    $0027     Yes, store X temp
004A  BD E1AC ENCHAR    JSR    INEEE     MIKBUG
004D  A7 00             STA A  0,X       Store char in memory
004F  C6 24             LDA B  #$24      Put $ in B
0051  11                CBA              Is it a $?
0052  26 03             BNE    SLNT?     No, to SLNT?
0054  7E 00EA           JMP    END       Yes, to END
              *         ERROR?
0057  C6 2F   SLNT?     LDA B  #$2F      Put a / in B
0059  11                CBA              Is it a /?
005A  26 04             BNE    PD?       No, to PD?
005C  DE 27             LDX    $0027     Yes, restore X
005E  20 EA             BRA    ENCHAR    To ENCHAR
              *         PERIOD?
0060  C6 2E   PD?       LDA B  #$2E      Put a . in B
0062  11                CBA              Is it a .?
0063  27 03             BEQ    FIRST     Yes, to FIRST
0065  08                INX              No, get another char
0066  20 E2             BRA    ENCHAR    To ENCHAR
              *         FIRST CALLSIGN?
0068  CE 0000 FIRST?    LDX    $0000     If this is the first
006B  9C 25             CPX    $0025        entry, don't search
006D  26 27             BNE    SEARCH    To SEARCH
006F  BD 0146           JSR    STG3      Display MSG3
0072  20 CB             BRA    ENTER2    To ENTER2
              *         CHECK THE COUNTER
0074  C6 07   LDCTR     LDA B  #$07      Load the counter with 07
0076  08      LOOP      INX              Increment X
0077  5A                DEC B            Decrement the counter
0078  2F 02             BLE    FULL?     If zero, to FULL?
007A  20 FA             BRA    LOOP      Else to LOOP
              *         IS THE MEMORY FULL?
007C  DF 25   FULL?     STX    $0025     Store X temp
007E  8C 1FF9           CPX    #$1FF9    See if reached end
0081  27 02             BEQ    MEMFUL    Yes, to MEMFUL
0083  20 BC             BRA    LOADB     No, to LOADB
              *         MEMORY IS FULL
0085  BD 013C MEMFUL    JSR    STG1      Display MSG1
0088  BD E1AC           JSR    INEEE     MIKBUG
008B  C6 24             LDA B  #$24      Put a $ in B
008D  11                CBA              Is it a $?
008E  26 F5             BNE    MEMFUL    No, to MEMFUL
0090  DE 25             LDX    $0025     Yes, store X temp
0092  A7 00             STA A  0,X       Load the $ in memory
0094  20 54             BRA    END       To END
              *         SEARCH ROUTINE
0096  DE 21   SEARCH    LDX    $0021     Load X from temp
0098  DF 2B   AGN       STX    $002B     Store X in temp
009A  DF 2D             STX    $002D     Store X in temp
009C  DE 27             LDX    $0027     Load X from temp
009E  DF 29             STX    $0029     Store X in temp
00A0  C6 07             LDA B  #$07      Load the counter with 07
00A2  8D 14             BSR    CPRMEM    To CPRMEM
00A4  27 23             BEQ    DUPE      It is a dupe, to DUPE
00A6  DE 2D             LDX    $002D     No, then load the location
00A8  08                INX                 of this callsign in X
00A9  08                INX                 and increment 7 times
00AA  08                INX                 to begin looking at
00AB  08                INX                 the next callsign
00AC  08                INX
00AD  08                INX
00AE  08                INX
00AF  9C 27             CPX    $0027     Is it this callsign?
00B1  26 E5             BNE    AGN       No, to AGN
00B3  20 2F             BRA    ISLAND    Yes, to ISLAND
              *         COMPARE SUBROUTINE
00B5  08      CPRCON    INX              Increment X
00B6  DF 2B             STX    $002B     Store X temp
00B8  DE 29             LDX    $0029     Load X from temp
00BA  A6 00             LDA A  0,X       Load A from memory
00BC  08                INX              Increment X
00BD  DF 29             STX    $0029     Store X temp
00BF  DE 2B             LDX    $002B     Load X from temp
00C1  A1 00             CMP A  0,X       Compare A and X
00C3  26 03             BNE    CPRET     Not equal, to CPRET
00C5  5A                DEC B            Decrement counter
00C6  26 ED             BNE    CPRCON    Counter not zero, to CPRCON
00C8  39                RTS              Counter zero,return w/flag cond
              *         DUPLICATE CALLSIGN FOUND
00C9  86 11   DUPE      LDA A  #$11      Put $11 in A
00CB  BD E1D1           JSR    OUTEEE    MIKBUG (turns on alarm)
00CE  BD 0141           JSR    STG2      Display MSG2
00D1  DE 27             LDX    $0027     Load X from temp
00D3  C6 2E             LDA B  #$2E      Put a . in B
00D5  A6 00   LOADA     LDA A  0,X       Put memory char in A
00D7  11                CBA              Is it a . ?
00D8  27 03             BEQ    PDFND     Yes, to PDFND
00DA  08                INX              no, look next char
00DB  20 F8             BRA    LOADA     To LOADA
              *         REPLACE PERIOD WITH ASTERISK
00DD  C6 2A   PDFND     LDA B  #$2A      Put an * in B
00DF  E7 00             STA B  0,X       Put the * in memory
00E1  BD E1AC           JSR    INEEE     MIKBUG
00E4  BD 0146 ISLAND    JSR    STG3      Display MSG3
00E7  7E 003F           JMP    ENTER2    To ENTER2
              *         END OF MEMORY
00EA  BD 0150 END       JSR    STG5      Display MSG5
00ED  DE 21             LDX    $0021     Start of workspace
00EF  A6 00   END2      LDA A  0,X       Put char fm memory in A
00F1  C6 24             LDA B  #$24      Put $ in B
00F3  11                CBA              Is it a $?
00F4  27 07             BEQ    DECIDE    Yes, to DECIDE
00F6  C6 2A             LDA B  #$2A      No, put an * in B
00F8  11                CBA              Is it an *?
00F9  26 1B             BNE    PRCHAR    No, to PRCHAR
00FB  20 30             BRA    DUPRNT    Yes, to DUPRNT
              *         DECIDE
00FD  BD 0155 DECIDE    JSR    STG6      Display MSG6
0100  BD E1AC           JSR    INEEE     MIKBUG
0103  C6 50             LDA B  #$50      Put ASCII P in B
0105  11                CBA              Is it a P?
0106  27 E2             BEQ    END       Yes, to END
0108  C6 43             LDA B  #$43      No, put ASCII C in B
010A  11                CBA              Is it a C?
010B  26 F0             BNE    DECIDE    No, invalid reply,ask again
010D  7F 0025           CLR    $0025     Reset storage loc to zero
0110  7F 0026           CLR    $0026     Reset storage loc to zero
0113  7E 002F           JMP    START     To START
              *         PRINT THE CHARACTER
0116  C6 20   PRCHAR    LDA B  #$20      Put a space in B
0118  11                CBA              Is it a space?
0119  27 08             BEQ    INCX      Yes, to INCX
```

```
011B  C6 2E           LDA B #$2E    No, put an * in B
011D  11              CBA           Is it an *?
011E  27 06           BEQ   PRCRLF  Yes, to PRCRLF
0120  BD E1D1         JSR   OUTEEE  No, MIKBUT
0123  08       INCX   INX           To get next char
0124  20 C9           BRA   END2    To END2
               *      PRINT CR AND LF
0126  DF 25    PRCRLF STX   $0025   Store X temp
0128  BD 0146         JSR   STG3    Display MSG3
012B  20 0B           BRA   LDX     To LDX
               *      PRINT DUPLICATE
012D  DF 25    DUPRNT STX   $0025   Store X temp
012F  BD 0141         JSR   STG2    Display MSG2
0132  BD E1AC         JSR   INEEE   MIKBUG
0135  BD 0146         JSR   STG3    Display MSG3
0138  DE 25    LDX    LDX   $0025   Load X from temp
013A  20 E7           BRA   INCX    To INCX
               *      DISPLAY MESSAGE SUBROUTINES
013C  CE 015C STG1    LDX   MSG1    Load X start of MSG1
013F  20 17           BRA   PRINTO  To PRINTO
0141  CE 017B STG2    LDX   MSG2    Load X start of MSG2
0144  20 12           BRA   PRINTO  To PRINTO
0146  CE 019A STG3    LDX   MSG3    Load X start of MSG3
0149  20 0D           BRA   PRINTO  To PRINTO
014B  CE 019F STG4    LDX   MSG4    Load X start of MSG4
014E  20 08           BRA   PRINTO  To PRINTO
0150  CE 01BD STG5    LDX   MSG5    Load X start of MSG5
0153  20 03           BRA   PRINTO  To PRINTO
0155  CE 01C1 STG6    LDX   MSG6    Load X start of MSG6
0158  BD E07E PRINTO  JSR   PDATA1  MIKBUG
015B  39              RTS           Return from subroutine
               *      ASCII MESSAGE DISPLAY STRINGS
015C      114D MSG1   FCC   /Reader On followed by screen
          454D               message (MEMORY FULL...TYPE $
          4F52               TO PRINT)
          5920
          4655
          4C4C
          2E2E
          2E54
          5950
          4520
          2420
          544F
          2050
          5249
          4E54
017A      04          FCB   End of Message
017B      0D0D MSG2   FCC   /Reader on, carriage return, six
          1717               spaces followed by screen message
          1717               (...DUPE...TYPE A SPACE)
          1717
          2E2E
          2E44
          5550
          452E
          2E2E
          5459
          5045
          2053
          5041
          4345
0199      04          FCB   End of Message
019A      130A MSG3   FCC   /Reader off, line feed, carriage
          0D16               return, erase to end of file
019E      04          FCB   End of Message
019F      1016 MSG4   FCC   /Home up, erase to end of file,
          2020               four spaces, followed by screen
          2020               message (...ENTER CALLSIGNS...)
          2E2E               followed by line feed, carriage
          2E45               return
          4E54
          4552
          2043
          414C
          4C53
          4947
          4E53
          2E2E
          2E0A
          0D
01BC      04          FCB   End of Message
01BD      1310 MSG5   FCC   /Reader off, home up, erase to
          16                 end of file
01C0      04          FCB   End of Message
01C1      1016 MSG6   FCC   /Home up, erase to end of file,
          2020               three spaces followed by screen
          2050               message (P TO PRINT   C TO CLEAR)
          2054
          4F20
          5052
          494E
          5420
          2020
          4320
          544F
          2043
          4C45
          4152
01DD      04          FCB   End of Message
               *      Beginning with 01DE, all remaining memory
               *      comprises the workspace
                      END

START  002F NEXT   0033 ENTER  003C ENTER2 003F LOADB  0041
ENCHAR 004A SLNT?  0057 PD?    0060 FIRST? 0068 LDCTR  0074
LOOP   0076 FULL?  007C MEMFUL 0085 SEARCH 0096 AGN    0098
CPRCON 00B5 CPRMEM 00B8 CPRET  00C8 DUPE   00C9 LOADA  00D5
PDFND  00DD ISLAND 00E4 END    00EA END2   00EF DECIDE 00FD
PRCHAR 0116 INCX   0123 PRCRLF 0126 DUPRNT 012D LDX    0138
STG1   013C STG2   0141 STG3   0146 STG4   014B STG5   0150
STG6   0155 PRINTO 0158 MSG1   015C MSG2   017B MSG3   019A
MSG4   019F MSG5   01BD MSG6   01C1
```

Computerized Global Calculations

-- finding the best way to Pago Pago

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```
10 PRINT "THIS IS GLOBAL"
20 PRINT " "
30 REM      INPUT DATA FOR MY LOCATION
40 PRINT "MY LOCATION IS"
50 PRINT "LATITUDE(DEG,MIN, 1 FOR NORTH- 0 FOR SOUTH)"
60 INPUT L2,M2,Y
70 PRINT "LONGITUDE(DEG,MIN, 1 FOR EAST- 0 FOR WEST)"
80 INPUT L1,M1,Z
90 PRINT " "
100 REM     CALCULATE CONSTANTS FOR MY LOCATION
110 L1=(L1+(M1/60))*3.14159/180
120 L2=(L2+(M2/60))*3.14159/180
130 K1=SIN(L2)
140 K2=COS(L2)
150 IF Z=0 THEN 170
160 L1=-L1
170 IF Y=1 THEN 190
180 K1=-K1
190 PRINT " "
200 REM INPUT DATA FOR HIS LOCATION
210 PRINT "HIS LOCATION IS"
220 PRINT "LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)"
230 INPUT L4,M4,B
240 PRINT "LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)"
250 INPUT L3,M3,A
260 PRINT " "
270 REM CALCULATE CONSTANTS FOR HIS LOCATION
280 L3=(L3+(M3/60))*3.14159/180
290 L4=(L4+(M4/60))*3.14159/180
300 IF A=1 THEN 330
310 C1=ABS(L1-L3)
320 GOTO 340
330 C1=ABS(L1+13)
340 IF C1<3.14159 THEN 360
350 C1=(2*3.14159)-C1
360 IF B=1 THEN 390
370 K1=-K1
380 REM  CALCULATE DISTANCE
390 A1=(K1*(SIN(L4)))+(K2*(COS(L4))*(COS(C1)))
400 D=(3.14159/2)-(ATN(A1/(SQR(1-A1↑2))))
410 D=69.15*180*D/3.14159
420 PRINT " "
430 REM    OUTPUT
440 PRINT "DISTANCE IN MILES",D
450 D1=1.6093*D
460 PRINT "DISTANCE IN KILOMETRES",D1
470 STOP
480 END
```

Fig. 1. Program listing for GLOBAL.

How many of you DXers now keep a hand calculator next to your rig? After Frank Kelly described "Global Calculations for the DXer" in the August, 1976, issue of *73 Magazine*, no doubt some of you have tried it. The article showed how to calculate the distance between two places anywhere in the world.

When you're working that rare DX in Timbuktu, it's always nice to drop a tidbit of information like, "I calculate that our QSO spans a distance of 8346 kilometers, QSL?" Pretty impressive-sounding information, no doubt, and it's a novel topic for conversation.

After a while, though, you can become tired of doing all of that number-crunching every time. No doubt some of you have let the bit bug bite. Either you have picked up some type of microcomputer or are at least interested in them. If so, let the number-crunching bother you no more. Let the computer do it!

This article describes a computer program that calculates the shortest distance between any two points on the globe. All you need to do is type in the latitude and longitude of any two locations on Earth, and it prints out the distance in miles and kilometers.

I call the program GLOBAL, for obvious reasons, and it is written in the programming language BASIC. GLOBAL is listed in Fig. 1. It is very straightforward and takes very little time to run. In Fig. 1, statement numbers 40 through 90 have the computer ask you to input information about your location or the location of the first station. (If you are holding a three-way QSO, you could tell the other fellows how far apart they are.) Statements 100 through 180 calculate the parameters for the first station. Unlike Kelly's method, your station can be located anywhere in the world. So, if you're not in North America, you can still use the program. Statements 200 through 250 ask you questions about the second station's location, and statements 280 through 370 calculate the parameters for his location. The actual calculation of distance is carried out from statement 390 through 410, and then the distance is output in both miles and kilometers.

The language BASIC that I used may be slightly different from the one that you're using, but I've attempted to make it so that the program will work on most machines. Notice that when inputting latitude, you must type 1 for north or 0 — zero for south latitudes. If your machine will accept what they call string variables (mine won't), then you could change the program to accept the letters "N" or "S", or the words "North" or "South." The same applies for longitude. You will need to alter the IF statements: 150, 170, 300, and 360. For instance, 150 would become: 150 IF Z$="W" then 170. Also, all of the variables, A, B, Y, and Z, would need to be changed to A$, B$, Y$, and Z$, since these usually denote string variables.

One other important point

```
RUN
THIS IS GLOBAL

MY LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?40,52,1
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?73,19,0


HIS LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?48.52,0,1
LONGITUDE(DEG,MIN,1 FOR EAST-0 FOR WEST)
?2.2,0,1

DISTANCE IN MILES                3596.772218
DISTANCE IN KILOMETRES           5788.28553
```

```
RUN
THIS IS GLOBAL

MY LOCATION IS
LATITUDE(DEG,MIN, 1 FOR NORTH-0 FOR SOUTH)
?40,52,1
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?73,19,0


HIS LOCATION IS
LATITUDE(DEG,MIN 1 FOR NORTH-0 FOR SOUTH)
?22.54,0,0
LONGITUDE(DEG,MIN, 1 FOR EAST-0 FOR WEST)
?43.15,0,0

DISTANCE IN MILES                4793.847786
DISTANCE IN KILOMETRES           7714.739241
```

Fig. 2. Two runs for GLOBAL. The first calculates the distance between Huntington, Long Island, NY and Paris, France. The second calculates the distance between Huntington and Rio de Janeiro, Brazil.

is that GLOBAL converts degrees to radians before calculating. Make sure that your version of BASIC uses radians for angle calculations. If your BASIC needs degrees, then you'll have to eliminate the conversion factors (3.14159/180) from statements 110, 120, 280, 290, and 410, and you'll have to change pi (3.14159) to the value 180 in statements 340, 350, and 400. One last thing you should know is that part of statement number 400 reads like this: SQR(1-A1↑2). The A1↑2 means A1 to the exponent 2, or A1 squared. Some machines may need that written A1**2, or, if all else fails, just multiply A1 by itself (A1*A1). So with these hints in mind, you should be able to get GLOBAL to perform for you, no matter what kind of BASIC your machine eats.

Fig. 2 shows the output for two different runs of the program. These two runs are identical with the examples that Frank Kelly gave in his article. The first run calculates the distance between Huntington, Long Island, NY (40°52'N., 73°19'W.) and Paris, France (48.52°N. 2.2°E.) as a total of 3596 miles, which is the same as Kelly's figure. The second run calculates the distance between Huntington and Rio de Janeiro, Brazil (22.54°S., 43.15°W.) as 4794 miles, again the same as in Kelly's calculations.

If you get tired of typing in your own location, you can always calculate L1, L2, K1, and K2 from your location and assign these in the first statements of your program. You could then eliminate statements 40 through 180. By the way, GLOBAL takes up very little space in memory, less than 1K, and the above measure would reduce it even more. ■

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Micro Meets JANET

-- meteor scatter, anyone?

The idea of utilizing meteor scatter propagation for data transfer first occurred to W5HK and WB9WXM during one of their long, frequent bull sessions on FM this past April. Bob had just received his first computer, an 8080, and Steve was nearly through reading *Hobby Computers Are Here.* Both were looking for a way to genuinely show the computer's value in VHF communications. It was not long before the pulse data characteristics of data transfer encouraged them to look at an old mode that has been almost forgotten — meteor scatter. This mode has never been highly popular, either commercially or with the amateur, because it requires either high speed CW or a very quick mouth on SSB to communicate. Information transfer is tedious and requires more patience than most of us have. But wouldn't this mode be ideal for the microprocessor and the transfer of data in quick bursts?

A look through a nearby technical library showed an interesting fact: Most information on meteor scatter was written in the 1950s, and there appeared to be considerable interest in it until satellites attracted the interest and backing of government and industry. Almost an entire issue of the *Proceedings of the IRE* was devoted to the mode in late 1957. In it were described the successful commercial experiments conducted between 1953 and 1956 using meteor scatter. The JANET principle refers to the technique first suggested in 1950 by McKinley and proven commercially in a long term RTTY link over a 950 km path in Canada between 1954 and 1956. JANET utilizes a duplex system of two stations and a continuously transmitting carrier. When A is transmitting, B is listening for the signal to appear from a trail. These ionization trails appear in the upper atmosphere and vary in length from 15 to 40 km. They have a thickness on the order of 1 meter.[1] When the detector registers a predetermined signal level, it will begin storing data. JANET, as the IRE article states, was named after Janus, the Roman god of the doorway who looked both ways at once.[2]

Meteor scatter itself is a result of the continuous, although sporadic, bombardment of the Earth by meteorites. Approximately 10^{10} particles, representing a mass of approximately 1 ton, hit the Earth each day.[3] The important point is that a fiery spectacle is not required to produce a usable trail; grains of sand that are invisible when entering will suffice. The meteoric particles enter the ionosphere at a height of 80-120 km. "Although a single observer may see only two or three visible meteors per hour, hundreds of trails can be detected in the same period by sensitive radio equipment."[4]

The average number of trails varies from season to season, for reasons best left to further reading, and meteor showers can greatly enhance the duty cycle of communications. For purposes of reliable year-round communications, we are interested in the fact that trails are always present and that their occurrence is always frequent enough to ensure a reasonable information rate (60 wpm at a continuous RTTY speed of 1300 wpm, for example, in tests conducted in the 1950s).

The characteristics of the trails are such that fading is a problem because high altitude winds can shift the ionized gas trail slightly; trails that are either underdense or overdense can introduce distortion of the signal. A small number of trails appearing at the optimum angle between two points become the vehicle for the communications link. An effective system would endeavor to use a single trail at a time in order to minimize fading and multipath distortion. Thus, the practical duty cycle would be decreased, to less than .05.[5] Because of the critical angle of entry for meteors to form usable trails between points A and B, the optimum path is not a great circle route, but, rather, a few degrees to either side. An effective antenna for 50 MHz would be a non-highly directional yagi. Great success was achieved with JANET, using two five-element yagis aimed 8° either side of the great circle path and 8° above the horizon. Because of the Earth's rotation, more trails will appear on one side of the direct path in the morning and the other in the evening. This antenna permits both propagation paths to be utilized.

At the time the JANET principle was published and advocated as a commercial viability, the error rate had been reduced to less than 0.1 percent, and average information rates from 30 to 60 wpm were achieved. The major

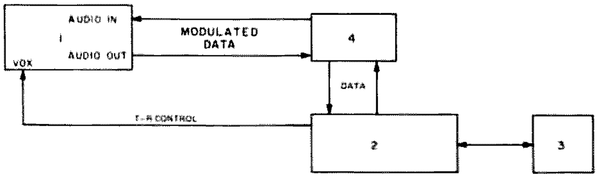

Fig. 1.

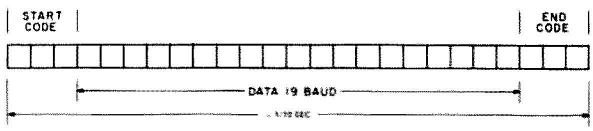

Fig. 2.

problem, as was to be expected, was to develop effective gating equipment to determine when the signal from the distant station was at a usable threshold.

Since most of the work on the meteor scatter mode has been done in the 30-50 MHz range, it is difficult to predict exactly what the relative values for error rate and duty cycle would be on 144 MHz. From discussions with other amateurs, we learned that meteor scatter commonly provides 3-6 second trails on six meters, 1-2 second trails on two meters, and possible occasional trails on 432 MHz. From our attempts to find articles and to locate other individuals who were familiar with the mode, we learned several things that were disappointing. Very little was done with the mode commercially after the satellite became a reality, very few VHF amateurs had ever worked the mode or knew anything of it, and a great deal remained to be done at 144 MHz and above to determine its characteristics.

From our investigation of the mode, we became convinced that meteor trail scatter, although practically forgotten, had very considerable potential for data transfer and that experimentation on two meters would be essential to find the answers. In summing up the mode's disadvantages (from a data viewpoint), there are few. The path appears to be limited to 2000 km, is not as fast as satellite or other continuous modes, and would require well-aimed antennas and precision tuning between amateur stations to effectively utilize the short burst time with a minimum of "search and setup" time. These disadvantages are *vastly* overshadowed by the advantages:

1. Reliable communications, regardless of sunspot or solar conditions;
2. 24 hour a day usability, unlike the amateur satellites;
3. A reasonably low error rate, due to the inherently stable condition of the path for the short time it is there;
4. A degree of security and privacy not achievable on HF or satellite repeaters — the critical angle of usable trails between points A and B precludes usable signals being detected beyond several hundred kilometers around each station;
5. Spectrum efficiency and reuse as a result of 4 above — indeed, the authors of the 1957 article on JANET believe stations could operate on the same frequency if they are operating from moderately right angles to one another's paths;
6. Above all, this mode is uniquely suited to the sporadic, parcel nature of data communications; the birth of hobby computers makes meteor trails viable as they never have been before, making possible an inexpensive and reliable way for nationwide contacts using the home computer.

At this point, we decided to develop a working system built around the 8080 uP. First, we had to decide what basic system configuration could best utilize the meteor burst mode in a relatively economical fashion.

Meteor Burst Modes

Several possibilities exist for the automatic transfer of data via meteor burst. In decreasing order of complexity:

1. Full duplex — A duplication of the JANET system provides a station with the ability to utilize the greatest number of trails, thus increasing usable transmission rates. For the exchange of large amounts of data, it is probably the only viable technique. For the amateur, it has several pitfalls. The narrow spacing that would have to be used on two meters (if the repeater segment were to be avoided) would require an expensive duplexer and cavities. Critical retuning would have to be performed every time the frequency was changed. A much simpler duplex system, available to any amateur, would involve crossband operation between 2 and 1¼ meters or 2 and 6 meters. This alternative should be considered in the future.
2. Modified full duplex — In theory, a commercial base station, amateur repeater, or television station could be monitored by a distant meteor burst station. The reception of the monitored signal from point A at point B could be used to gate the amateur transmitter to release data. If both points A and B utilized this gating method, higher transmission rates could be achieved.
3. Simplex — This requires selection of defined transmission periods that are long enough to have a high probability of hitting one usable trail. Much less information could be exchanged than with 1 or 2, but for the VHF amateur using a 300 baud per second rate with a microprocessor, 30 baud, or approximately six words, could be transferred in a 1/10 second burst. This is more than adequate for DXing or short messages. It is the suggested technique because of its relative cost. One minute transmissions would result in a high probability of completed QSOs in less than ten minutes, with none of the tedium associated with conventional meteor burst operation. Experimentation would determine the best transmission length and data parcel size. After this technique was developed, transmission bursts might effectively be decreased to rapidly transfer data. Of course, an individual interested in high volume traffic would then find considerable merit for constructing a station based on duplex or crossband operation. For most amateur operation, simplex operation would be fully adequate. It is this system we are developing and to which we are encouraging interest be directed.

Simplex Version

Having determined that we would utilize a simplex system, we decided that we would need the following basic components:

1. 2 meter FM transceiver with 100 Watts and 4-7 element yagi;
2. Microcomputer;
3. TTY or video terminal;
4. Modulator and demodulator.

A block diagram using the simplex version is shown in Fig. 1. The data format is shown in Fig. 2.

Station A Send	/ / /WB9WXM (S) BOB (S) IL (R) +++
Station B Receive	WB9WXM BOB IL
Station B Send	/ / /WB9WXM (S) W5HK (S) STEVE (R) +++
Station A Receive	WB9WXM W5HK STEVE
Station A Send	/ / /TS700 (S) 100W (S) 4L (S) YG (R) +++
Station B Receive	TS700 100W 4L YG
Station B Send	/ / /TX (S) YS221 (S) 50W (S) 5L (S) YG (R) +++
Station A Receive	TX YS221 50W 5L YG
Station A Send	/ / /PLS (S) QSL (S) TNX (S) 4 (S) QSO (R) +++
Station B Receive	PLS QSL TNX 4 QSO
Station B Send	/ / /73 (S) BOB (S) OK (S) QSL (R) +++
Station A Receive	73 BOB OK QSL
Station A Send	/ / /73 (S) WB9WXM (S) QRX (R) +++
Station B Receive	73 WB9WXM QRX
Station B Send	/ / /W5HK (S) QRX (R) +++

This is how a typical QSO might appear. Total QSO time — 8 minutes. A new state was worked on two meters, direct and with meteor burst data transmission. (S) = space, (R) = return, / / / = start code, and +++ = end code.

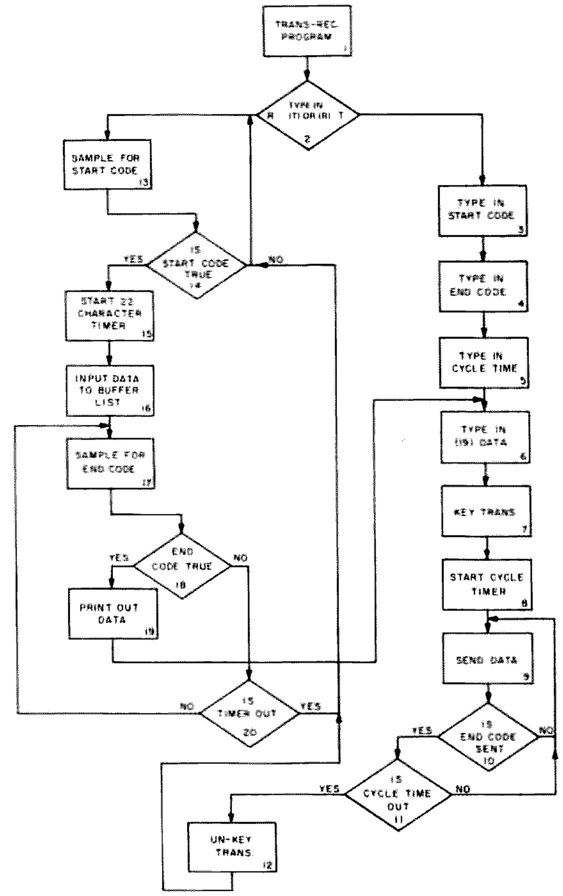

Fig. 3. Flowchart of the program that will be used in the first system.

1. Initial program waits for a command.
2. Decision block: If a (T) is typed in or an (R), will either jump to block #3 or #12.
3. Start Code block: Type in the Start Code to be sent and to be sampled when in the receive program.
4. End Code block: Type in the End Code to be sent and to be sampled when in the receive program.
5. Type in the cycle time desired; ½, 1, 2 min. etc. This is the total time the data message will be cycled.
6. Type in the message to be sent, up to 19 characters. The last character of the message has to be a carriage return.
7. Because of carriage return being typed, the system keys the transmitter.
8. The cycle timer is activated (this is a software timer).
9. The total data is sent – Start Code, message data, End Code.
10. Decision block detects if the End Code is sent, if (no) is generated the program loops back to #9 until a yes is generated in #10. Once this happens the program jumps to #11.
11. Decision block to determine if the cycle time is reset: If (no) the system continues to send the data until the cycle timer is reset. Once this is true, the program jumps to the receive block #12.
12. Un-keys transmitter for receive portion of program.
13. Sample for Start Code.
14. Decision: If Start Code is false, then continues sampling. If true, jumps to #15.
15. Start a timer whose length is equal to the maximum number of remaining characters, which is 22.
16. Load data to buffer register.
17. Sample data for End Code.
18. Decision block for End Code: If true, go to #19, if false, go to #20.
19. If End Code was detected, then the data between Start Code and End Code is printed out.
20. If End Code was not detected, this decision block is used to determine if the 22 character timer #15 has timed out. If no, jump back to #17. If yes, return to #13. Begin Start Code sampling.

Fig. 4.

Mode of transmission will be narrow band FM with deviation between 2.5 and 5 kHz. Experimentation will begin at 5 kHz. The modulator and demodulator are based on the Audio Cassette Standard described in the article entitled "A Nifty Cassette-Computer System" in *Hobby Computers Are Here.* Since this standard has been adopted by the industry for the audio transfer of digital information, it provides the most economical and effective means of transferring data, at the reasonably fast rate of 300 baud per second.* Secondly, although the original JANET system utilized double sideband AM with audio frequency shift keying, narrow band FM provides advantages in terms of signal to noise ratio and noncriticalness of tuning. Those who have operated FSK on HF will appreciate the criticalness of exact tuning. FSK is not tolerable with a short burst meteor mode. With FM, a signal tuned in reasonably close will provide a usable signal, and, unlike FSK, the frequency of the audio tone is automatically in tune. As a further bonus, this provides the multitude of VHF FMers with the ability to use existing FM gear, if they couple it with an inexpensive microprocessor-based data system. Of course, further experiments can use SSB, FSK, or other more exotic modes, such as decimal frequency shift keying. The goal here is to provide the largest number of amateurs with an inexpensive yet effective way of using this mode.

Now let's return to the data format and give it a closer look. Total transmission was chosen to be 25 baud in 1/10th of a second or less, repeated for 1 minute. The repetition is to insure that a complete data transmission will be received. The first 3 baud are the recognition code, thus allowing the receiving station to know if a transmission is starting. The next 19 baud are information such as call, QTH, handle, etc. Last, the remaining 3 baud are the ending code to tell the receiving microprocessor that the message is completed. Total transmission time is ≤ 1/10th second; repeating for 1 minute will cycle this 600 times. Only experimentation will determine if this time is sufficient. When the receiving station has decoded an ending code, it will print out the message, and the receiving station can then send a reply by the same format. When sending data, the microprocessor will key the transmitter by using the VOX circuit; this will enable the transceiver to be either receiving or transmitting as determined by the microprocessor program.

That's the total system in operation, but one of the most important things is the microprocessor program. Since both W5HK/9 and WB9WXM are not the most proficient programmers of microprocessors (we are both learning), we brought in a third party to write the program. (See Figs. 3 and 4.) Gary Chaffin is a non-amateur who has a great love for the microprocessor and programming; he is also one of the sharpest people we know in that field. The microcomputer we are using is the IASIS Computer in a Book. Besides being a learning tool, it is also a powerful microcomputer using the 8080A.

Conclusion

At this point in time, we are actively constructing a system based on the principles described in this

*In this article, the tones of 2400 cycles for mark and 1200 cycles for space are suggested. These tones are relatively inexpensive to generate; a stable 4800 Hz can be divided by 2 for mark, and divided by 4 for space.

article. The reason for writing this article now, rather than after a system is fully operational, is quite simple; we need the assistance of other interested VHFers outside of this area to prove the system. Whereas an EME enthusiast can test his system by listening for his echo, the narrow propagation angles and short time for reflection from a meteor trail only 100 km in altitude make it impossible to use the same technique.

We believe this technique has considerable potential and feel it is an effective marriage of the microcomputer and the meteor burst mode. It has the potential for contacts that are not limited in duration as are present OSCAR QSOs, or distance as is the case with conventional VHF propagation. From the Chicago area we should be able to work most of the country on meteor burst. We welcome those with computers and interest to join us on 145.180 this winter. We could all be pleasantly surprised with what can be done when JANET is refurbished and utilized in an environment where she best functions — the short data bursts of the modern microprocessor. ■

References

1. "Radio propagation by reflection from meteor trails," Sugar, G. R., *Proceedings of the IEEE* (1964), 52, 116, p. 121.
2. "The Principles of JANET — A Meteor-Burst Communication System," Forsyth, Vogan, Hansen, and Hines, *Proceedings of the IRE,* December, 1957, p. 1643.
3. *Ibid.*, p. 1644.
4. *Ibid.*, p. 1644.
5. *Ibid.*, p. 1653.

Suggested Bibliography

Proceedings of the IRE, December, 1957 (numerous articles).

Meteor Astronomy, A.C.B. Lovell, Clarendon Press, Oxford, England, 1954.

"Meteor scatter: a newly discovered means for extended range communication in the 15 and 20 meter bands," *QST*, Vol. 37, pp. 11-15, 15b April, 1953.

"Radio propagation by reflection from meteor trails," Sugar, G.R., *Proc. IEEE* (1964), pp. 52, 116.

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Run, Sheila, Run!

-- real-life radio control

The fifteen-year-old girl was placed in the starting blocks. A silence fell over the stadium. Everyone was tense, straining. The starter raised his pistol and called, "Runners on your mark, ready!"

"BANG!" The report of the starter's pistol pierced the silence and tenseness of the stadium. Sheila leaped from the blocks like a coiled spring, and, for the next 14.2 seconds, the only sound to be heard was the pounding of her feet on the cinder track, along with the almost-monotone of my voice speaking into a microphone telling the blind Sheila, "Left – left – right – looking real good – half way – now, you're there – real good – that's all, you're done now."

Coach Jim Blasingame aims Sheila Holzworth in the starting blocks.

I laid the microphone down and turned the transmitter off, as there was no longer any need for it. Her teammates had met her and were now walking her back to the stands. Sheila was very dejected with her time. The 14.2 was not very good for the one-hundred-yard dash. She had been very nervous on this run, as she had gotten into the fence on an earlier practice run that day. She had had only about a dozen practice sessions with the radio equipment she was using.

14.2 seconds for the one-hundred-yard dash may not be a good time for your average runner, but Sheila changed that the following week with a 13.2 time. The second time she was not as nervous and had had a few more practice sessions. Sheila is now within three-tenths of a second of the rest of her team, which is not bad for a girl who, only five years ago, lost both of her eyes. It was a freak accident in which the orthodontic headgear she was wearing broke and flew into her eyes. Her father, being a doctor, had given her immediate first aid, and she started to recover. But a secondary infection set in, and it became necessary to remove both of her eyes.

Now, five years later, she wants to do, and does do, everything that other fifteen-year-old girls do – skateboarding, roller skating, riding horses, bicycling (tandem) – and she planned to participate in the bicycle ride across Iowa this year. She also begs to be allowed to drive a car. Prior to the accident, she was very active in track and athletics, but the accident slowed her down a bit. She used to run with her coach in front of her, but in the high school meets this can't be done.

A friend of mine, who also knows Sheila's family, asked me one day, "Ed, you're a ham and know about radio; is there any way that we can

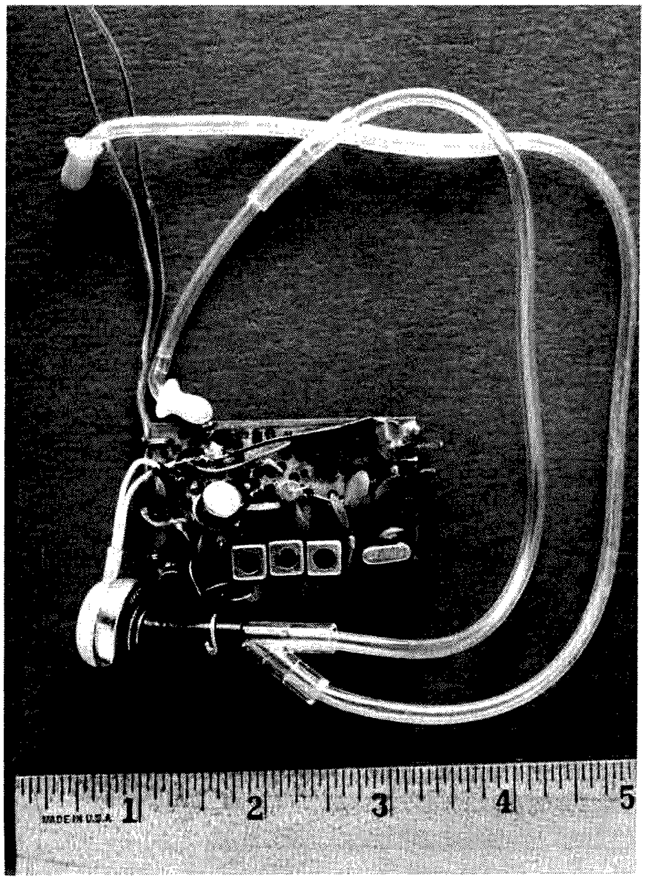
wire Sheila for sound, so she could run in track?"

My response was, "Let me see what I can scrounge up and what is available." I was thinking of two meters and a pocket scanner, on a little used frequency, with earphones. It sounded like a good idea, if a bit bulky. But, at least, it could be made to work, and this kid really wanted to compete with the other kids on their level.

A quick call to another ham, Ron Kinton WBØMBZ (who knows a lot more about radio than I and has a bigger junk box), revealed that it might take time to get crystals for an odd frequency and that the plain bulk of the pocket scanner might not be good. He said he would get back to me the next day. Sure enough, he did, with a model airplane receiver donated by another ham, Tom Taylor KØHHE. It was already on six meters, so Ron proceeded to modify it by removing all the heavy digital circuits and adding one stage of audio amplification. This proved to be sufficient to drive a high impedance earphone. To get the receiver down to the lower part of six meters, a surplus crystal from an old Collins aircraft transmitter was found. These components combined to give us the magic number of 50.4 MHz for a receiver frequency.

Ron gave me the receiver and told me to tune it up and make it work. He even donated his ancient Gonset Communicator III for the cause. But he didn't have a 50.4 rock. His vfo for the Gonset didn't work either. I had a Heath sixer and a 50.4 rock, which I soon found out was no good either. But the Heath HW-16 I used for a CW station had a vfo that worked on six meters. It was pressed into service to provide the proper signal to tune the receiver with. The HW-16 and vfo combined with a counter enabled me to tune the receiver down to the proper frequency, and, in the meantime, I was able to locate another 50.4 crystal. After a few hours of tweaking i-fs and coils, it became apparent that I needed to get further away from the transmitter. I then called yet another ham, Ken Freberg WBØIFE. Good old Ken, he never questions the crazy stuff I do, just helps out any way he can. We took the Novice course together and got consecutive calls, and I have had him over for several projects. Ken took over the duties of operator, and I became a "Sheila" and proceeded to walk up and down the street at night, in a light rain, muttering to myself, while trying to fine tune that tiny receiver, which we now had down to just about one ounce of weight, including the earphone.

After satisfying myself that this just might work, I contacted Sheila's family, and we made arrangements for a few tests. This proved to be very encouraging. I presented to Sheila the tiny receiver and the large, seven ounce carbon battery that we had for practice. Now was the time for the first of many trips for Sheila, with my voice in her ear. She held the receiver and battery in her hand, while holding the earphone in her ear – it wouldn't stay in her ear, so she had to hold it. A walk down her long, broad driveway was an outstanding success for both of us. I was even able to guide her up to and around several parked



Receiver module showing the high impedance earphone with medical IV tubing and Y junction. The splice between the IV tubing and the Plantronics earphones is medical catheter tubing.

Sheila with her headband. The object on this side is a nicad battery. One antenna is worn in front, the other in back, both under her shirt.

cars. It is difficult to say who was more excited over the promises this held for Sheila, but it was decided right away that she should try to run with the radio. A belt was brought out to tape the heavy battery to. Some surgical tape was used to hold the earphone in place and also to wrap the receiver with, so it could be pinned to her shirt. Her coach, who lived nearby, showed up, and we proceeded to let Sheila run. In her very own tunnel, in the absolutely black abyss world of the blind, with only the voice of the person who held the microphone to guide her, she ran.

Her best friend, Kim Novak, was asked to try as a controller for her. Because of their long friendship, we thought she would be good, but Kim got too excited and was unable to tell Sheila what she had to know. Her coach then took over the microphone for the rest of the test that day. It soon became apparent that we had a real winner on our hands. This girl and her abilities are fantastic.

I returned to my home and proceeded to rework all the external hookups, so the receiver could be placed in a sweatband. My wife made a pocket in the headband for the receiver. Another pocket was added later for a nicad battery, which was added for the competition runs. The placement of 2 antennas was necessary, as her body would null the signal when she was between the transmitter and receiving antennas. With the system pretty well completed and refined, I met with Sheila nearly every day for practice. Because of our practice schedule, I have become Sheila's controller. True, it takes time, but what better way to develop a hobby into something positive?

This girl was so eager and trying so hard that she developed shin splints, which were extremely painful, but she kept on trying. We finally had to quit for a few days, so Sheila could recover. I found that if I asked her if she hurt, the answer was always "no," but if I watched her very closely, I could tell when she hurt. I had to watch her constantly, until she finally realized that she couldn't perform when her legs were sore.

It is still a real problem to keep her in the narrow space that is allowed on a track, but I am sure that the day will come when Sheila will keep in her lane, and she will come out in one of the first three places. The amazing thing is the faith and trust this girl has to run down a track with no more than someone telling her which way to go! We have all tried it at one time or another, and the results of seeing another ham walking down the track blindfolded, with the radio for a guide, can sometimes be quite funny. When Sheila does it, running faster than any of us old men can, it is nothing short of amazing. She makes mistakes, but don't we all? They don't make her feel very good, but, with practice, I am sure that she can do the things that she wants. I don't think I can ever take this girl and her efforts as commonplace or for granted. I constantly marvel at her abilities, and I will be forever grateful for the opportunity I have had to work so closely with her. The fact that amateur radio has had a hand in this project just makes my hobby that much better. ■

Rear view of the headband showing the pocket holding the receiver and battery and the placement of the audio tubes. The two wires coming down are the antennas.

Ron Kinton WB0MBZ making some adjustments on the Gonset Communicator III during a practice session, with Sheila standing next to him. The antenna is a 5/8 wave on 2m extended to ¼ plane on 6m using aluminum foil for a ground plane. Works FB, 1:1 swr.

CB to 10

-- part VI: antenna suggestions

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One of the better things to happen to amateur radio lately is the availability of lots and lots of low cost communications equipment – new and used Citizen's Band transceivers. These range from old tube types to modern solid state units.

Want to be cheap? Just do as I did – find an old tube radio, get it into operating shape, and convert it to 10 meters. I was given a Johnson Messenger 1 tube radio by a "good buddy" who was all hung up on his latest 40-channel play-pretty. Well, sort of "given" . . . it cost me three beers and a quick radio repair job. A couple of tubes later (which I scrounged), I had it going great on CB channel 11. The radio was putting out 10 Watts AM into a wattmeter and dummy load.

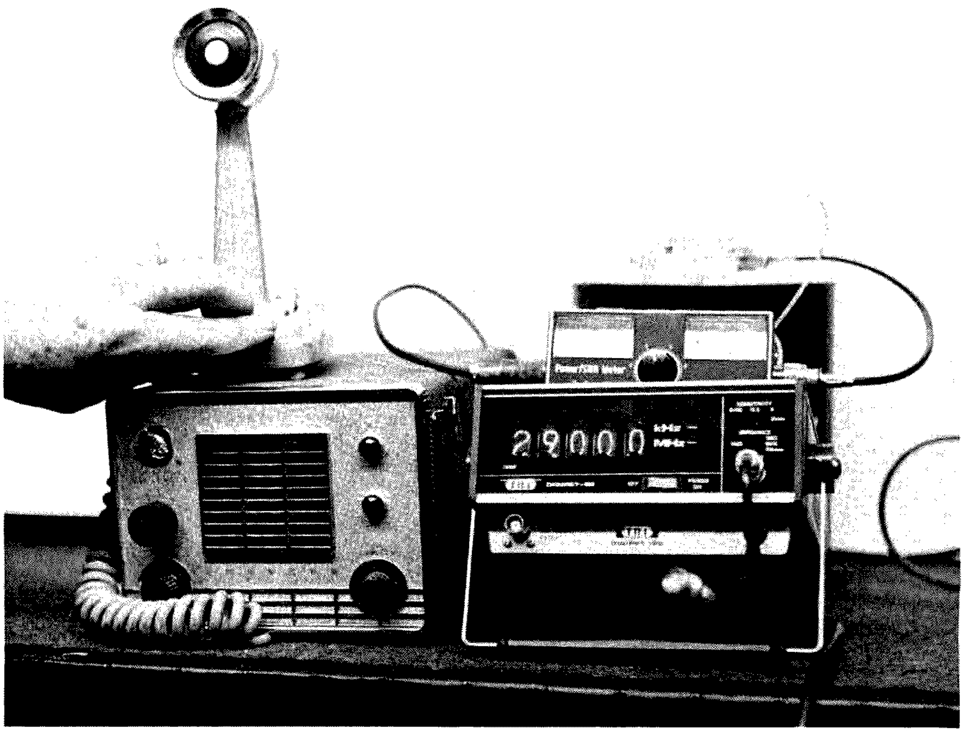
Photos by James Clegg

That's one of the reasons most of the tube types were (and still are) so popular. They could be "tweaked" for more output very easily. In this area, 29.000 MHz is coming into use for channel 1, since there is really no established band plan for this equipment. Let the CW boys use 28 to 28.5, of course; SSB has 28.5 to 29; and let the AM activity start at 29.000 through 29.290. That gives everyone a lot of room.

The 2 meter band is getting more and more crowded. Onward and upward is the cry, but the cry I hear right now is my pocketbook. So, let's fall back and regroup and have a whole bunch of fun in the process. The Johnson has a 5-channel capacity, a built-in ac power supply, and puts out 10 Watts with no problems. The conversion was about as simple as sticking a couple of crystals in. You just have to tweak on the rf stages, both receive and transmit, for optimum performance at 29 instead of 27 MHz.

Checking with a number of good buddies in the area reveals a huge quantity of tube type radios. These are just ideal for conversion to 10 meters. I have a solid state rig converted to 10 in my truck, and it works like a champ. Having solid state for mobile and a cheap tube set for base use is the way to go. The people I want to talk to can now get me on 10 meters instead of 2. Because it's sparsely populated, there's no problem like on 2. It was hard to work SSB on HF without the 2 meter radio sounding off. So, this way, if DX is around, I can get a call or give one to alert the "good guys."

What about antennas? Well, there is a lot of "scrap"



10 Watts at 29.000 MHz.

lying around. This scrap is good stuff, and it can usually be obtained for the asking. I've seen many antennas whose only problems were that the fellows using them couldn't make them work, shorted PL-259, cut coax too short, etc. The latter may be just fine for this use because that's what you have to do to go up in frequency, of course – generally cut off about 2 inches for 29 MHz.

The antennas for mobile use are of many types, ranging from cheapos to the expensive, high quality items. With base-loaded coils, I just snip a couple of inches off the whip, rather than worrying about getting into the coil. Then there are the center-loaded types; again, take a couple inches off. On my truck I use a 4-foot, fiberglass, top-loaded antenna (Radio Shack, new $9.95 with $4.95 mirror mount), which I got for no cost when one of the fellows was getting the swr down and trimmed it off too short. It started going up on him, and that was it; he had to scrap it and get a new antenna. That was fine with me; it's going in my direction anyhow. There's a rubber tip over the end; remove it, and you will see the end of a wire. Carefully take your pocketknife, fish the wire out, and trim. Of course, all the trimming is done while using the 10 meter radio in conjunction with an swr meter.

Then there's the full length "whip," 102 inches long, plus a 4-inch spring and ball mount. If you like it "whipping" around, trim a couple and get talking. As you go down the street, you will come to know the height of tree branches above the street.

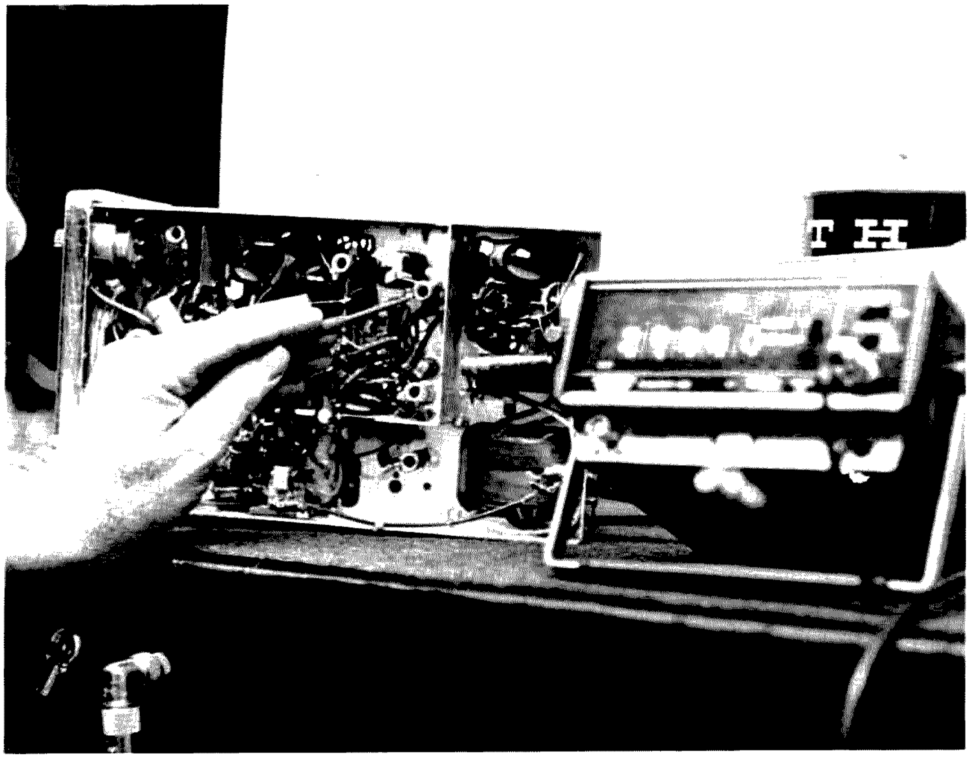
Seriously, there's a world of CB antennas out there just for the seeking, so put the old ham spirit to work and scrounge! Base station antennas are equally as easy to convert. Just a little trimming is all it takes. They range from the cheapies that have no gain (actually a loss compared to dipole reference), to quarter wave, to the big, long ones, more than 19 feet, that have several dB of gain. Again, I have a preference as to type. I just don't like the big, long ones; they're hard to handle and sure do catch the wind. However, if it's cheap, the price is sure hard to beat, so that could be the way to go. I use a compact antenna called the "Starduster." I believe it sells new for about $45.00. I spent a couple of hours helping with an antenna erection and inquired, "What are you going to do with that old antenna?" I got it free or, at least, as a reward for my help.

The advantage of a compact antenna is that it can be easily mounted on top of the HF or whatever beam without a lot of trouble, whereas the long ones would be just about impossible. Of course, the trimming takes place closer to the ground. I just put the antenna on a 20-foot mast to make adjustments, and it changes very little when I finally put it way up there.

Beam antennas? Well, there are uses, of course. Say there's one specific direction you want; you could convert and side mount the beam. The average CB beams are just too big and unwieldy to be practical for our use, unless they're on top of a tower, and the chances are you already have a good HF beam. I have a TH-6DXX, and 4 working elements on 10 meters, which are enough for me. If it is difficult to make contact on the vertical polarized ground plane, then we just switch to horizontal on the existing HF beam. Also, the ground plane works very well in the omnidirectional pattern, to catch calls from mobiles that may be in any direction, and, of course, band openings. With the ground plane, I can hear stations that I would otherwise miss if I was using the beam and did not have it turned in their direction. The ground plane is up 85 feet, and the distances worked are amazing – base to base, and base to mobile. If I want to talk to my good buddy 60 miles away, I just ring his number (channel 1, 29.000 MHz), and away we go.

There are all sorts of goodies to be found. I honestly believe that those fellows must buy PL-259s by the bushel. Just scrounge, and you can come up with all sorts of radios, antennas, swr meters, coax, plugs, connectors, microphones, power supplies, external speakers, coax switches, and a whole raft of stuff.

I'm looking forward to conversions of HTs to 10 meters. They sure can do everything a 2 meter unit can (using direct frequencies), and they're a whole bunch cheaper. It should be lots of fun for hidden transmitter hunts, and, when the band opens, I think it would be a real kick to talk from here to California on an HT! SSB CB radios have come down a lot in price for the 23-channel models, but are still fairly high. I believe they'll come down some more. How about a conversion to 29 MHz for 23 channels of AM, with switching to drop it to the 28.5 MHz region for SSB? It's sure going to be fun. So, start scrounging! ■



Heavy-duty rf section.

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CB to 10

-- part VII: convert a TRC-11

A lot of hams have been talking about converting CB rigs for 10 meter use. I've even seen band plans for use with converted synthesized rigs which retain the same spacing as the CB channels. If you would like to avoid the work needed to convert a synthesized rig, but still want to join the group on 10 AM, try Radio Shack's Realistic TRC-11. It is a six-channel rig, which requires very little effort to be put on 10.

Like most of us who have to watch our pennies, I like to be able to justify buying a new rig. The justification I needed grew out of the results of our first Red Cross simulated emergency test of 1977. Our drill went well, but, during the debriefing, it became apparent that, in a real emergency, our dependence on 2 meter FM simplex channels might lead to problems. We sent three field teams out. Each team used a separate simplex frequency, either 46, 52, or 94, for their own communications. The field control stations also used our 146.37/97 repeater for relay to Red Cross headquarters.

Our later discussions pointed out that we should avoid 94, because it is a repeater frequency and mutual interference could arise. 52 is a nationally recognized frequency and could be crowded. 46 is set aside by the Ohio Area Repeater Council for statewide emergency use. All the frequencies we used had a potential for severe interference in the case of a real emergency, so we talked about possible alternate frequencies. 10 meter AM with a converted CB rig seemed like a natural.

Crystals

The TRC-11 is a crystal-controlled rig and uses separate crystals for transmit and receive. The transmitter uses fundamental frequency crystals. To transmit on 29.3 MHz, get one cut for 29.3.

The receiver is single conversion with a 455 kHz intermediate frequency. The receive crystal frequency is 455 kHz less than the frequency to be received. To receive on 29.3 MHz, get a crystal cut for 28.845 MHz.

I ordered my set of crystals from International Crystal Mfg. Co., 10 N. Lee, Oklahoma City, Oklahoma 73102. They cost $7.90 each. It may be possible to get them for less elsewhere, but, in two separately mailed orders, the crystals have been received within two weeks, so the service was worth any extra cost. Their catalog number for transmit crystals for the TRC-11 is 820308. For receive it is 8203097. Specify catalog number and crystal frequency when ordering. I suggest sending a check when you order — it will save time on processing your order, and International pays the shipping if you do.

Adjusting the Crystal Oscillators

Don't! That's right, you don't need to do a thing to the oscillator circuits. They are broadband enough that they take off with no problems at 10 meters. Before I received my crystals, I wanted to see if I would need to work on the oscillators. The only crystal I had was a spare for my Heathkit SB-301 heterodyning chain, and it was at 29.895, which is above the 10 meter band. I did want to check it out, so I jumpered the crystal into the circuit and tried it into a dummy antenna. It worked with no trouble, so I was sure it would work in the band as well.

Tuning for Output Power

Tuning up for maximum output power on 10 meters is very simple. Before I retuned for 10, I wanted to check how much I was getting on CB channel 9, which comes with the rig. Before retuning, channel 9 had 3 Watts, and 29.3 MHz had about a quarter of a Watt. After retuning for 29.3 MHz, I had 3 Watts there and 1.5 on channel 9.

To peak the TRC-11 for 10 meters, simply adjust the settings of coils L5 and L6 for maximum output, as measured on a wattmeter. All coils are plainly marked on the printed circuit board. L5 and L6 are very near the coaxial connector, towards the left rear side of the unit.

That's all the work you need to do to get the TRC-11 going on 10 meters. Simple, isn't it? Although I have not tried it, I believe the Realistic TRC-9A should convert just as easily as the TRC-11. The TRC-9A is listed as the three-channel, economy version of the TRC-11. It uses the same crystals, and the schematics are nearly identical.

Antennas

As I mentioned earlier, my major use for this rig is as an alternate frequency for emergency use. I did not want to

put a permanent antenna on my car, so I tried Radio Shack's magnetic mount CB antenna, model 21-940, and found that it, too, is very simple to convert for 10 meter use.

The swr is adjusted by decreasing the length of the whip, using the cut-and-try method. I physically shortened the length of the whip to about 73 cm. On my unit, minimum swr was obtained with 66.3 cm of the whip extending above the top of the collar where the setscrew is located. I was able to get the swr down to 1.2/1.

Results

During our second Red Cross drill, Ted White WA8WQC and I tried identical mobile setups using the TRC-11 and model 21-940 antenna. Our results indicated nearly 100 percent usability over a 5-mile path with several hills and numerous buildings. Line-of-sight paths yielded good results at nearly double this distance.

The only problem we encountered was caused by the fact that I have a rather soft microphone voice. Using my usual voice gave poor results, because I was not driving the modulator circuit hard enough. With a little self-control, I find it is easy enough to speak a little louder and closer to the mike to overcome this problem.

If you are looking for a CB rig that is easy to convert for use on 10 meters, and don't want or need to convert a 23-channel synthesized rig, I suggest trying the Realistic TRC-11.

No matter what type of rig you convert to 10, the model 21-940 magnetic antenna from Radio Shack is easily converted to fill your need for an antenna.

With such an easy way of getting on 10 meters AM with a converted CB rig available to you, you no longer have an excuse to miss the action. See you on 10! ■

Battery Backup for Digital Clocks

-- don't miss a second

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With the addition of a crystal timebase to my digital clock, it began to keep time very accurately — to about a second a month. Unfortunately, my house seems to have more than its share of short power interruptions and blown fuses. An accurate clock is of no great use if it must be reset every few days. Power line independence is a necessity for electronic digital clocks.

None of the ideas on battery power for clocks could be adapted to mine without cutting the foil on the printed circuit board in at least a couple of spots. Since I seem always to manage to slit my thumb along with the circuit board, I like to avoid this approach if at all possible.

The circuit in Fig. 1 should work for just about all clocks, without *any* modification to their circuitry. It amounts to connecting a battery in series with a resistor across the output of the clock supply.

R1 serves two purposes. First, it limits the charging current supplied to the battery while the clock is plugged in. Second, when power fails, it limits the discharge current to about 5 mA. This causes the clock LEDs to extinguish, and the clock runs with no readout, consuming very little power.

Depending on the clock, a different value for R1 may be needed. A little experimentation will determine an appropriate value. Closing S1 will allow the readouts to function on battery power, but the battery won't last long this way, so I used a momentary contact push-button.

Battery life seems to be very long in this circuit. After several months of "field testing," the battery tests as good as new. The trickle charge current it draws seems to do no harm.

Upon power failure, my timebase slows down from 3579545 Hz to 3579515 Hz. This is a change of about 10 parts per million and is equivalent to about 5 minutes per year, or less than one second per day. Most failures last a few minutes or a few hours at most, so this drift is not really any problem. Regulating the voltage at the timebase could eliminate even this drift.

This kind of project is my favorite — it uses only three parts, total cost could not exceed two dollars, it requires no "mods" to existing equipment, it gives real improvement, and it can't fail to work! There is something awfully nice about pulling the plug on your digital clock, plugging it in again and seeing it still displaying the correct time. ■

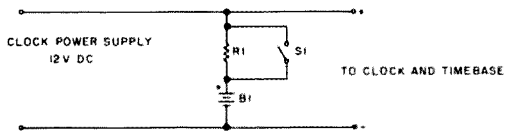

Fig. 1. R1 — 2k Ohm, see text; B1 — small 9 V battery; S1 — momentary contact switch.

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Carlton Colville
Lowestoft, Suffolk
England

Roll Your Own QSL Cards

-- originality for rare ones!

The QSL card is as old as amateur radio itself, and cards are as varied as the operators and the gear they use. This article describes a method of photographically home brewing cards that stand out from the pack and are very suitable for that special contact. They also might winkle out that card from the rare DX station.

The technique is simple. Ordinary darkroom equipment is all that you need. The process is based on "lith" and

Photo 1.

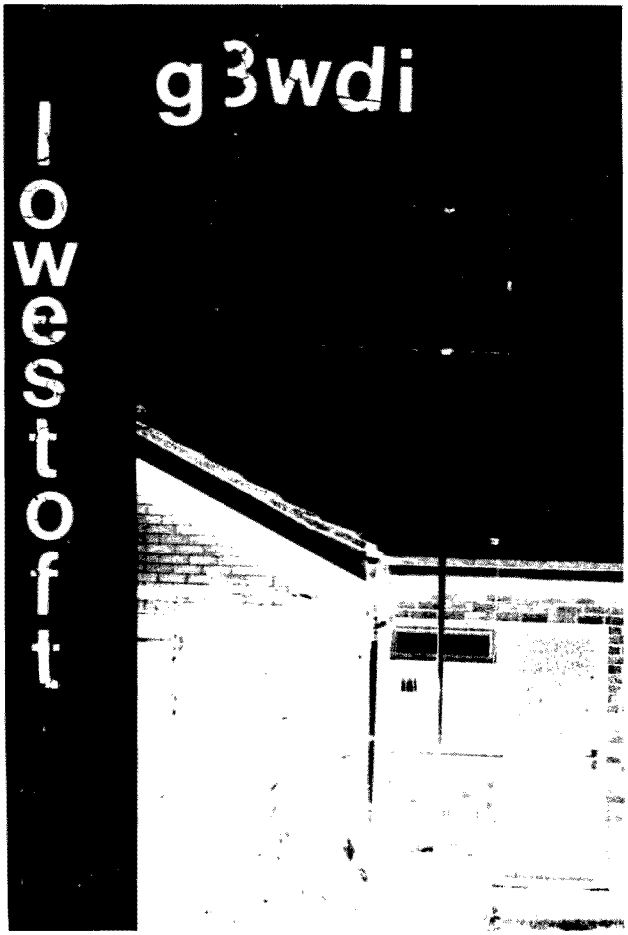

Photo 2.

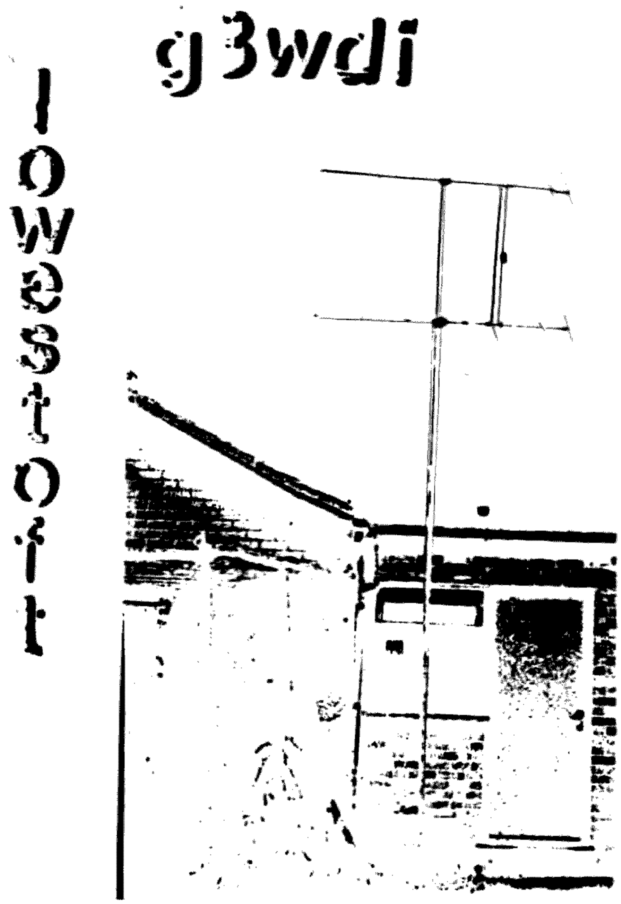

Photo 3.

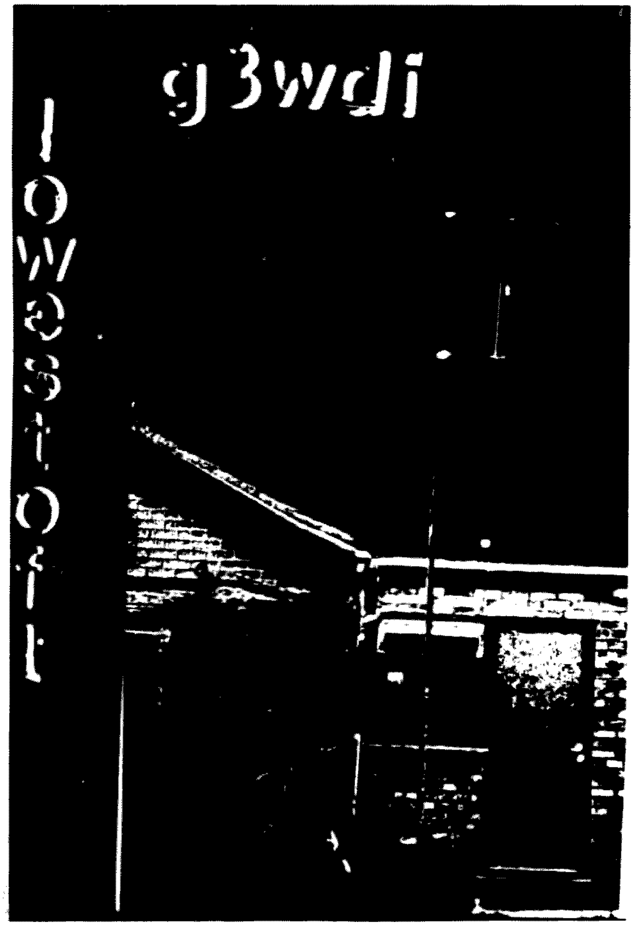

Photo 4.

"line" film, together with lith developer. Advertisements in the photographic press should provide the names of suitable suppliers of these materials.

Lith film is very contrasty and produces pictures in two tones – black and white. Greys on the original picture are thus rendered black or white, according to their density.

A suitable photograph for a QSL card is taken or selected from the negative file. In my case, a photo showing my shack and "antenna farm" was selected. As a normal print this had been less than successful, and it was in the reject file. However, it was most suitable to experiment with. A print of suitable size for a QSL card was made from this negative on a sheet of lith film. The result, after processing and drying (careful use of a hair dryer speeds up the drying), was a large black and white transparency (Photo 1). Using self-adhesive letters, the callsign and other details were added to the picture. In my case, a strip had been masked on the left-hand side for this purpose. A contact negative was then produced on a sheet of line film, and the result is shown in Photo 2.

The negative and positive transparencies are now taped together, slightly out of register, and printed onto a sheet of lith film. The result is shown in Photo 3.

A negative is then produced from this print. Using either the positive or negative, prints are now made onto normal photographic paper for use as QSL cards (Photo 4). In my case, the prints were stuck onto a card, and QSL information was written on the back, since writing directly on the back of photographs is difficult.

Some control over the finished picture can be exercised during the processing – unwanted detail can be blacked out or scratched in. The six over six in my picture was scratched in with a pin, when it disappeared into the sky during processing.

This process of tone separation can be used with filters and colored paper to produce exotic, if expensive, QSLs. At G3WDI these cards will be reserved for special contacts. My first 2m contact with the USA will certainly receive one, while G8HRF in the next block may not! I will watch my incoming QSLs with interest. ■

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Glide On Six

-- radio control primer

Radio-controlled model sailplanes and the six meter band were made for each other. We all know how quiet the activity has been on six since the dip in the sunspot cycle has chased all the good DX away. Well, when your twelve-foot-span sailplane is just a dot on the distant horizon, and the rf link that will guide it back home is only 750 milliwatts into a crude rod type antenna, you can appreciate all that peace and quiet. While other types of flying models use radio control guidance, none test the range of the equipment and the vision of the pilot like sailplanes. These planes depend on the rising air currents which drift downwind to sustain them, and they must follow these currents to gain altitude. This results in flights that roam all over the sky in search of lift and gently circling climbs to heights of several thousand feet before a landing in the grass at the pilot's feet.

A modified Windrifter sailplane with transparent yellow plastic covering to show off internal craftsmanship. Span is 99 inches.

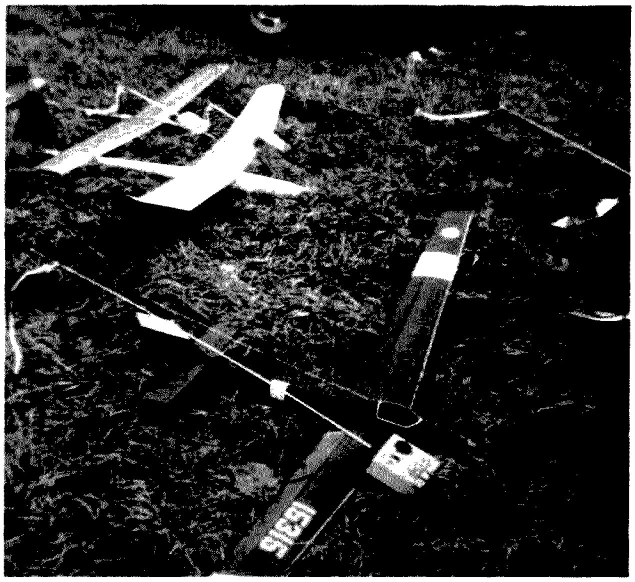
In addition to pleasant Sunday afternoons at the local meadow flying for fun and practice, the coming of summer brings the contest season, with trips to places like Harris Hill near Elmira, New York, and the rolling fields of York, Pa. There, contestants numbering over 100 pilots and their planes gather to see who can stay aloft ten minutes precisely, and then land in a fifty-foot diameter circle for additional points. The majority of these planes are guided by four meter R/C rigs on 72 MHz, requiring a Class C CB license. But since there are only 7 channels authorized for R/C use, much time is wasted waiting for your particular channel to be clear. With 6 to 10 pilots on your channel, the wait can be a long one.

The equipment functions by digital pulse coding of the transmit carrier consisting of a clock pulse and additional data pulses, each of which controls a specific aircraft guidance function. The superhet receiver detects the pulse train and passes it to the decoder, which divides up the various data pulses and distributes them to the servomotors. A pulse width comparison circuit in each servo determines where the servo output arm is in relation to where the incoming pulse says the the pilot wants it to be. The error voltage is fed to a small dc motor which moves the output arm and a small potentiometer until the error disappears. There is one servo each to control the rudder, elevator, spoilers, and captive towhook on the aircraft. Power for operation is supplied by AA size nicads in both transmitter and airborne system, with a usable duration of three hours or so.

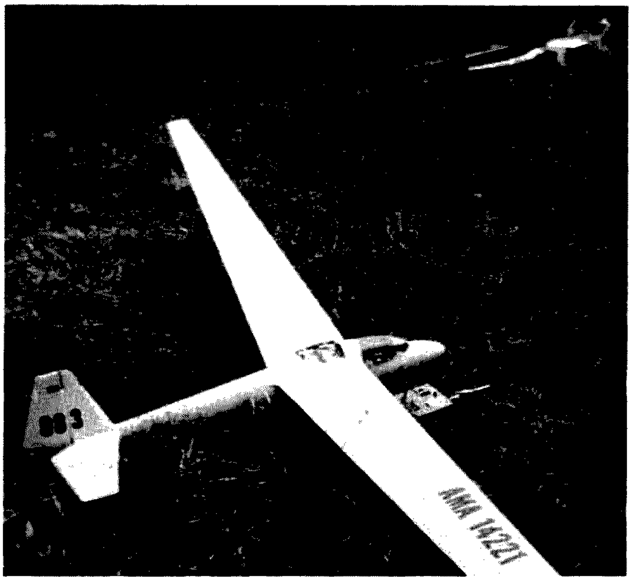
An interfering frequency has the effect of lengthening the data pulses fed to the servos, causing them to run to one end of the output arm and spiral the aircraft into the ground. Loss of radio contact generally has the same effect, in that the receiver agc cranks the i-f strip gains wide open and random noise triggers the servos, all of which used to occur with great regularity when the rigs were on 11 meter CB. Although the 5 frequencies there were not shared with "phone ops," the close proximity and large difference in power levels made those channels unusable.

The resulting crowding in the four meter band has resulted in pressure on the FCC to create a special code-free R/C controller's license class which would allow the pilots of planes, cars, and boats to pursue the hobby with reliable guidance systems. When one considers the damage or injury which could result from the crash of an aircraft weighing four to twelve pounds diving to earth at a hundred miles per hour, it's easy to see why modelers and R/C equipment manufacturers are pushing for space on six meters.

The majority of modelers are like most CBers, in that their interest is in using the rigs, not working on them. There are many, however, who would make fine



A "Hi-Pro" sailplane with molded fuselage and rudder. Wings have large movable flaps to change the airfoil and aircraft speed.

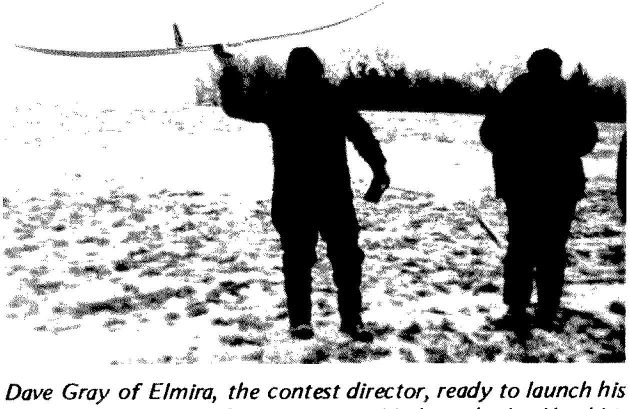


An all molded plastic and fiberglass model of a KA-6 sailplane. Span is 10½ feet, weight is nearly 12 pounds — ready to fly.

amateurs, given some encouragement from local hams. These Class C CBers already have a good record of compliance with FCC rules; indeed, pilots must show their licenses in order to fly in contests. These pilots would find that, in addition to reliable model control, there are some other, rather interesting things which the ticket offers. All they need is a little push in the right direction. And in case you think that big numbers are important, there are over 61,000 members of the Academy of Model Aeronautics, and 3 out of 4 of them fly Radio Control. It would make a significant increase to the amateur ranks if this resource could be tapped.

Which brings us back to that open field in the sunshine and the sailplane flirting with the puffy white clouds. The confidence that a ham rig gives to the sport of glider flying contributes in large part to the pleasure these birds have to give. To see your own creation so at home in the sky while it obeys the smallest movement of your hands makes all the code practice and radio theory sessions worthwhile. And at day's end, when it's time to key up the local repeater for some friendly rag chew, there is no end of ways to work models and flying and infinite descriptions of launches and landings into the conversation.

The next time you're driving down the road and see someone out in a field flying his plane, stop and say hello. He may be a four meter pilot who might like to be a ham or a ham who might give you some stick time on his latest creation. Either way, you can't lose! ■



Dave Gray of Elmira, the contest director, ready to launch his Hobie Hawk glider. This plane is sold through the Heathkit catalog.

Dave Lear WA2ERM throws his Pierce Paragon sailplane off the slope at Harris Hill. The horizon is over 8 miles away and the temperature that day was plus 16 degrees.

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More IC-22S

-- add a programming switch

I have found the following modification of the Icom 22S to perform in an entirely satisfactory manner, and to add considerably to the practical capabilities of this machine. As you who already own one know, all of the possible frequencies may be obtained by utilizing various combinations of diodes soldered into the programming board. It follows naturally that, if one could switch in various combinations at will, then all of the capabilities would be possible.

The first problem was where to put such a switch, so that it could be always available and wouldn't be dangling on a cable somewhere. You will see in Photo A where I chose to place this switch. I chose a small, 8-position SPST rocker switch made by AMP Special Industries. This switch plugs into a regular 16-pin IC socket. I bought two of the switches because, should a switch fail with use, I might not be able to find an exact duplicate later.

Photos by Dale Andrews

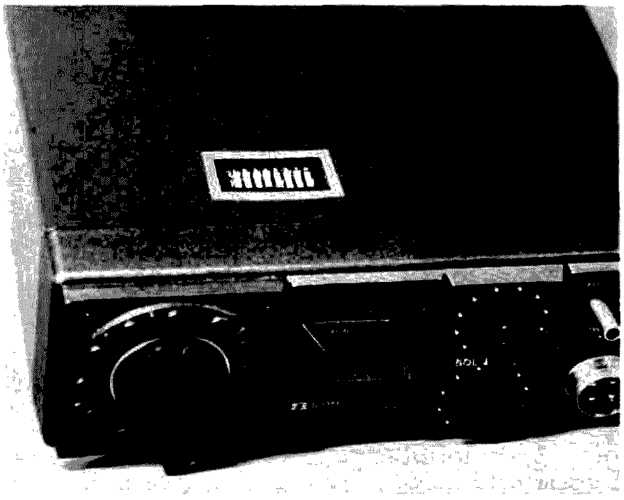

Photo A.

Photo B shows a detail of the switch in place, plugged into a 16-pin IC socket which is mounted on a small piece of 10 x 10 perfboard. The perfboard is supported on two arms, which extend from the small aluminum bracket plate. My aluminum bracket was cut from a junk box – extruded aluminum T-section. A bracket made from any piece of metal would serve just as well.

A look at Photo C shows the bottom of the transceiver with the 8 hookup wires soldered into position 13, in my case. However, you can use any channel or switch position you choose.

There is a ninth wire required, which is attached to the common channel position you may choose, and which goes down to the new switch common bus.

In Photo D, the hookup cables have been pushed aside to expose the underside of the bracket, perfboard, socket, and switch combination. Here you will note that

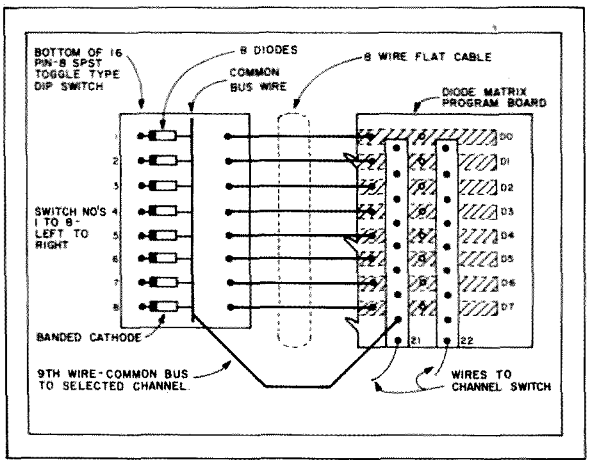

Fig. 1. A portion of the diode matrix program board. The 8-wire cable is attached to channel 21, with the ninth wire connecting the new switch assembly common bus to the program board channel 21 common bus. Note that your dip switches will probably be numbered from 1 to 8. Thus, no. 1 switch will attach to no. D0 program board hole, no. 2 switch to no. D1 program board hole, etc. Thus, when setting up frequency, you must remember to call no. 1 switch D0, no. 2 switch D1, etc. As you can see, this arrangement allows you to switch in any combination of diodes on your selected channel.

a common bare wire was bent and installed between the two rows of socket pins. The bent-down ends of this wire were epoxied to the perfboard. Eight diodes were installed, with the cathode (banded) ends going to each of the eight socket positions on the right, the anode ends going to the common bus wire, and, you can also see, the ninth wire, mentioned above, attached to the common bus. The eight wires going to the program board are attached, one to each socket pin in the left-hand run. Be sure to identify the wire for installation in the proper holes of the programming board.

Construction Hints

The bracket, IC socket, switch, bus bar, diodes, and wiring were all constructed outside the cabinet. The switches, diodes, and wires were all tested for continuity before installation.

The entire bracket assembly was then installed and epoxied to the circuit board and transformer can, as shown in Photo B. Note that this assembly was positioned far enough to the left of the machine, or towards the top of Photo B, to allow access to the meter pilot light. The perfboard is also epoxied to the bracket arms. The socket itself is held by the solder on its pins below.

The bracket must be so sized as to position the top of the body of the switch level with the underside of the transceiver cover plate, allowing the rockers to extend into the opening. After the switch was in place, with careful measuring, a rectangularly-shaped hole was cut in the cover plate. This hole was filed to size, and, as you see in Photo A, I touched up the raw metal edges with paint and used bright red tape to set it off.

I hope, with the above description and accompanying photos, that you will be able to install a similar improvement on your Icom 22S and will enjoy using it as much as I have. Of course, I recommend installing diodes permanently for those channels you use frequently, but this little gadget will get you into all the others when you want to. ■

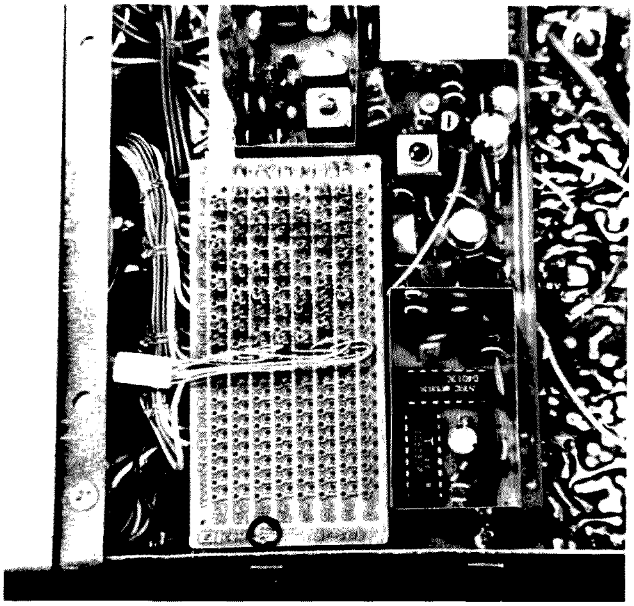

Photo C.

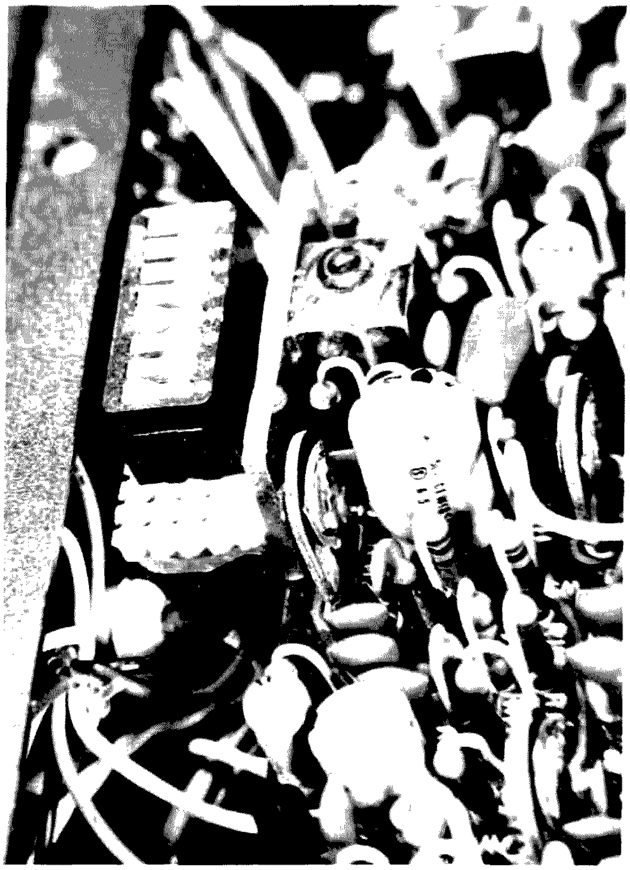

Photo B.

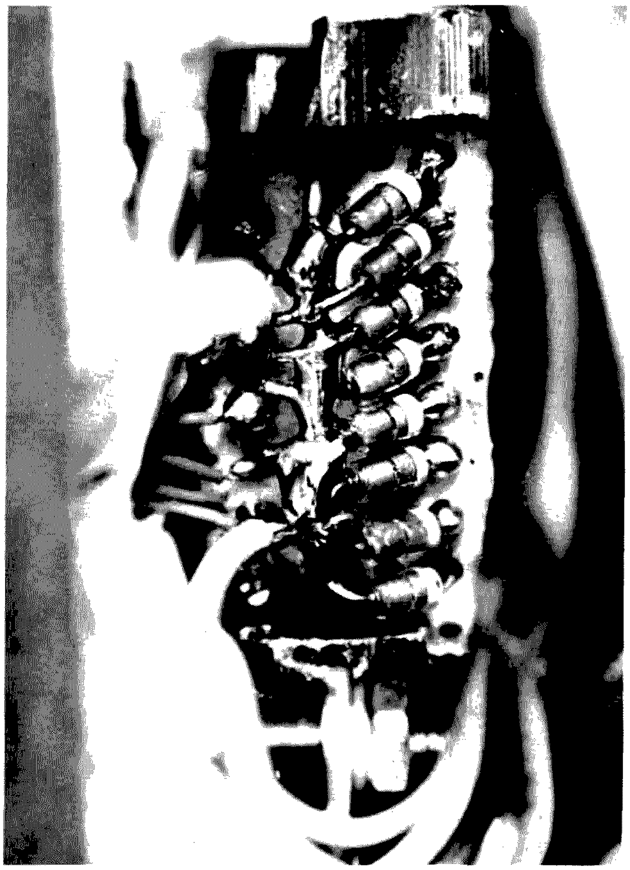

Photo D.

73 Magazine *Staff*

Amplitude vs. Frequency

-- poor man's spectrum analyzer

Anyone who has used a spectrum analyzer for checking the frequency response of audio or rf filters quickly appreciates its great convenience. Filter values can be changed, and you note instantly the effect upon the selectivity, the change in cutoff frequencies, etc. But, even when using a $12,000 professional instrument, you often find it desirable to switch it into a manual scan mode. In this mode, you turn a single knob, which varies the frequency being fed into a filter under test and simultaneously moves the spectrum analyzer display along its horizontal (frequency) axis. So, as you manually turn the knob, you can note, at any given frequency, the displayed amplitude, or, conversely, you can look for changes in amplitude and note at what frequency they occur.

The manual scan feature on professional instruments was the idea responsible for the simple adapter described in this article. This adapter uses a signal generator and oscilloscope combination. It will not turn them into anything near the equal of a $12,000 instrument, but it does provide an extremely useful method to develop a simplified amplitude versus frequency display on an oscilloscope.

The idea is to turn off the horizontal sweep on the oscilloscope and use an external voltage to move the trace horizontally, at the *same* time that the frequency being fed into the circuit under test is varied. Fig. 1 presents the main idea. If you can simultaneously use one hand to rotate the frequency control knob on the signal generator, and the other hand to rotate the potentiometer connected to the battery, an amplitude versus frequency display is created. Stopping at any given point, you can temporarily use paper tape on the oscilloscope face to mark down the frequency, and thus calibrate the horizontal frequency line on the oscilloscope.

In practice, you need to add a feature to the signal generator so it provides the horizontal control voltage – in order to make the scheme a practical reality, as only one knob is rotated. The practical details for accomplishing this depend upon the equipment being used.

For instance, one setup on which this scheme was tried utilized a 3" scope and a Southwest Technical Products function generator. The horizontal sweep was switched to "external," and the horizontal position control used to move the dot on the oscilloscope screen to the extreme left. Then, by applying a variable dc voltage to the external horizontal input terminals, it was determined that the voltage had to vary from 1 to 9 volts to move the dot completely across the screen. The function generator uses a single

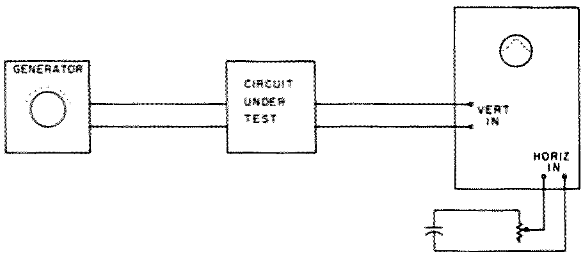

Fig. 1. Basic idea for setting up a manual scan system with a signal generator and an oscilloscope.

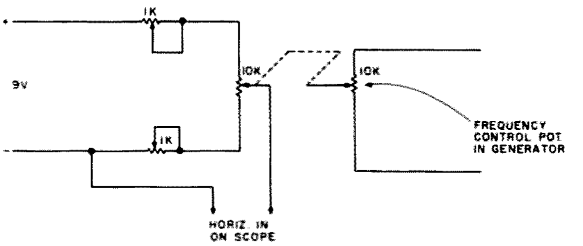

Fig. 2. This simple adapter circuit can be added to an audio-type generator which uses a potentiometer for its frequency control element.

10k potentiometer as a frequency control. This potentiometer was replaced by a dual 10k unit, as shown in Fig. 2. The two 1k PC potentiometers simply allow trimming up of the voltage range covered by the 10k potentiometer, so the dot on the oscilloscope screen moves exactly from extreme left to extreme right, as the generator is turned through one frequency range.

A similar scheme can be applied to other generators, even those using a variable capacitor as a frequency control element. The only problem which must be solved in each individual case is the mechanical coupling of a potentiometer to the shaft of the frequency control element in the generator.

You could add further refinements to the basic idea, depending upon need and the specific equipment involved. For instance, it might be desired to scan across the oscilloscope screen, as the signal generator is only tuned across a narrow part of its frequency coverage on a given band. A higher dc voltage to the control potentiometer will allow the potentiometer to sweep across the required voltage range over less of its rotational range. A better solution is to make the control potentiometer part of a resistive Wheatstone bridge. The bridge can be balanced at any given point, as the control potentiometer is rotated, and the scan across the oscilloscope screen is started at that point. A typical circuit is shown in Fig. 3. Furthermore, by making the dc voltage to the bridge variable, you could expand or constrict the width of the scan. An ultimate embellishment might be to add a variable gain, dc voltage amplifier to the output of the bridge circuit. The display, which you see on the screen as a circuit is tested, will be a vertical line, changing in amplitude both above and below the center line on the oscilloscope as it moves across the oscilloscope screen. You can adjust the vertical position control on the oscilloscope, so only the top "half" of the display shows. This does get a bit closer to a real spectrum analyzer display. But, depending upon the circuit under test, it may hide negative peak clipping taking place in a circuit.

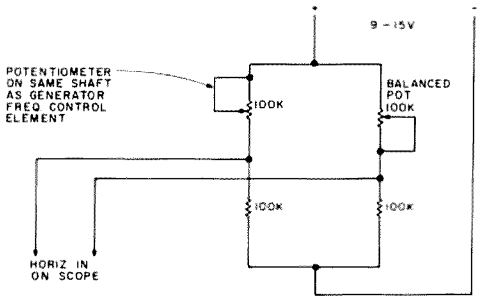

Fig. 3. Bridge circuit to allow better control over setting point on signal generator scale where scanning starts across oscilloscope.

You should neither overestimate nor underestimate the usefulness of this adapter. It displays only a simple plot of amplitude versus frequency for a circuit under test. Many other things, such as phase shifts, might be taking place in the circuit which you would not be aware of. Nevertheless, for someone who likes to experiment or needs to adjust simple tuned circuits or filters, this simple adapter will give you a little and very useful hint of what life would be like with a $12,000 Hewlett-Packard spectrum analyzer on your bench. ■

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How About An Auto CQ?

-- generate some 10m activity!

How many times have you tuned across 10 meters and wondered if it was really dead? I used to sit down and call CQ for a while, until I got tired of it or else got hoarse. Wouldn't it be nice if I could call CQ automatically? Then I could spend the time more constructively, and I just might beat a hole in the band!

I could use a tape and operate VOX[1], but this would be plagued by nuisance tripping as I shuffled papers or stumbled around the shack. No — I must have a more sophisticated solution! And so was born the tone-actuated, tape-driven auto CQer described below.

Certain requirements for this magic machine were immediately set forth:

1. The device must be immune to ambient noise.
2. Any tone used must not be transmitted.
3. The circuitry must include capability to make the control tape.
4. The automatic operation must be easy to cancel.

To make all this happen, the block diagram shown in Fig. 1 shows briefly how the auto CQer works. A tone on the tape is detected and clocks a flip-flop. The flip-flop, in turn, drives a relay to activate the PTT line in the transmitter. A 4 kHz tone was chosen because it falls about an octave above the bandpass of SSB transceivers available today and, thus, is not transmitted. The tone from the tape on playback is first applied to an active filter, A1, whose narrow bandpass is centered on 4 kHz. The output of this filter is rectified by CR1 and averaged by C2. The resulting dc voltage is fed to comparator A2, whose output clocks the 948 flip-flop for on-off control of the PTT line.

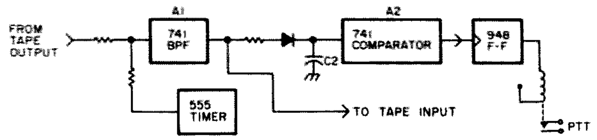

Fig. 1.

The result of this is that the state of the 948 is changed only when a tone is detected. The transmitter is thus protected from nuisance tripping.

Basics

The circuit shown in Fig. 2 has two modes of operation. The first develops the tone and mixes it with the microphone audio to be recorded. The second mode, playback, detects the tone from the playback audio, as outlined above, and activates a flip-flop to control the transmitter.

In the record mode, the 555 tone generator develops a 4 kHz square wave. This is keyed by unshorting the timing capacitor, C1, with S1. The square wave is fed to an active filter A1. This 4 kHz active bandpass filter provides a clean sinusoid to mix with the voice audio for the recording.

In the playback mode, the audio from the recorder is fed into the active filter, and the tone is separated and detected. The rectifier/filter on the output of A1 also integrates or sums the tone. This means that the tone must be detected and remain so for a certain minimum time. After about a second or so (depending upon the playback amplitude of the tone), the reference threshold of the second 741 (A2) is reached, and, acting as a comparator, it flips from a high (+) to a low (≈ 0) output voltage. This voltage clocks the flip-flop to its opposite state. The output of the 948 drives the transistor, which in turn activates a small relay to key the transmitter PTT line.

To prevent audio feedthrough to the transceiver speaker, the audio to the mike jack is shorted to ground by C3 when Q2 conducts during receive. This short is released in transmit to pass audio on to the mike jack on the transmitter. The normally open side of SI serves to reset the 948 flip-flop, just in case the PTT line gets stuck in transmit. S2 shifts audio control from the auto CQer to the station microphone. Just remember to operate S2 when you answer someone!

Building It

I built the circuit on

vectorboard, and the layout is not critical at all. However, I have found that if the part locations follow the way the schematic is drawn, it is a lot easier to troubleshoot later on. In addition, inputs and outputs fall to the edges of the board more readily.

A word about parts: The 741 operational amplifier was chosen for its ease of use and procurement. The 948 flip-flop, though an old DTL device, is hard to beat at 20¢ from James Electronics.

Care and Feeding

My audio input is from a compressor which puts out .25 volts p-p. The mixing resistors are set to divide this audio down to the proper level for the recorder input. The same goes for the tone level. It may be necessary to adjust R2 so as not to overdrive the tape recorder. The speaker output of the tape recorder feeds the audio to A1. The audio level at the output of A1 determines if, or at what time delay, the comparator, A2, switches. A little experimentation may be necessary here to determine the required audio output level for a one or two second delay. This delay provides further noise immunity. If a scope is available, 2.5 V p-p at A1 is sufficient. Any more output volume than that may well overload and distort the voice audio into the transmitter.

Set the tone frequency by measuring the dc voltage on C2. Use a VTVM or other high impedance voltmeter, and adjust the value of R1 for maximum deflection. The response is slow, so wait for the voltage to stabilize. The voltage should be greater than about 0.4 volts dc for the comparator to operate.

The comparator has positive feedback around it to provide a noise margin of 90 mV, which results from the hysteresis. This means that with a threshold of, say, 0.4 volts, the input voltage must get to 0.445 V (0.4 + .09/2)

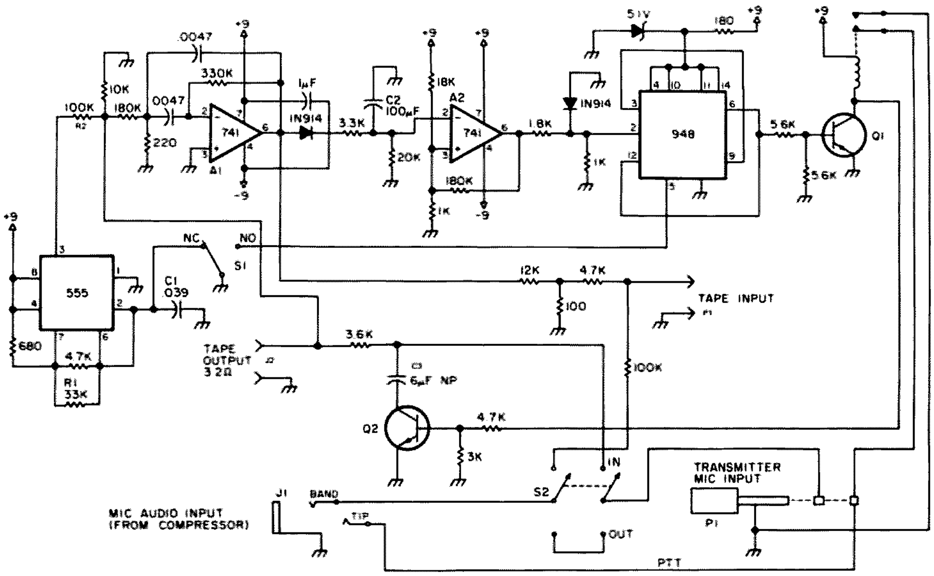

Fig. 2.

before the output changes state. The reverse is also true. If the input starts above 0.445 volts, it must fall below 0.355 volts (0.4 − .09/2) for the output to change.

A word of caution in substituting parts: The 948 flip-flop clocks at a threshold voltage and is, therefore, not dependent on the rise and fall times of its clock signal. A JK TTL flip-flop like the 7473 should be clocked with a fall time of, at most, 30 ns. The output slue rate of the 741 is much too slow at 30 μs. The transistors, on the other hand, can be any common NPN. The 2N2222 is a good choice because of its price and availability.

My intent is not to limit substitutions, but rather to provide a starting place for the experimenter. A little thought given to certain substitutions will save a corresponding amount of grief later on.

The simple power supply is shown in Fig. 3.

How To Use It

The first step to using the auto CQer on the air is to make the tape. Plug the tape input, P1, into the mike input of the tape recorder and a microphone into the audio input on the CQer. Now you're set to record the tape.

You will need about 3 seconds of tone (just to be safe) to activate the flip-flop, so plan accordingly. I made my tape on a 30-second CQ, 30-second listen program, but this is offered only as a starting point. Just remember to give the tone at the beginning *and* at the end of the CQ.

To use the CQer is even easier. Plug the transmitter mike input, P1, into the transmitter and the station mike into J1. The tape recorder speaker output plugs into the tape output jack, J2. Set the playback volume to trip the PTT in about 1 to 2 seconds, but not so high as to overmodulate. If the recorded audio of tone and CQ are of the same relative level, it will be possible to achieve the right balance of playback volume and mike gain on the transmitter.

On the air, set S2, punch up playback and sit back and relax. Even though the band may be dead, at least all you're doing is wearing out the tape and not your vocal cords!

To answer a call, just switch S2, shut off the recorder (you might do this with another position on S2, if your recorder is equipped with a remote jack), and operate your rig normally.

The reliability of this machine has been excellent. After about 18 months of use on the air, the only problem has been when the recorder batteries run low, and the tone frequency shifts and goes undetected. It is for this reason that the reset switch, S1, was included, just in case the transmitter gets stuck.

Since I've built this device, I can't imagine not having it. It actually is my way of having a beacon on 10 meters, to which I am so devoted. You can hear what is being transmitted, and so can catch it if anything goes haywire. I hope that the utility of this machine will provide you with more time to really enjoy this great hobby of ours. ■

Reference

[1] Fischer, "Bring a Dead Band to Life," *73 Magazine*, December, 1976, p. 125.

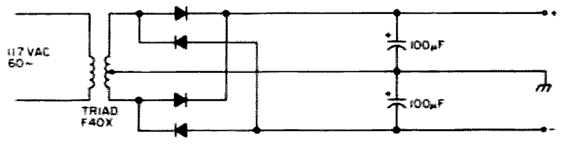

Fig. 3.

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SSB For the "Frog"

-- tame the croak

The Yaesu FRG-7 is a remarkably good receiver for "all-wave" reception of AM or radio telegraphy. It falls short, however, of being good for SSB reception, unless you have one of the new models featuring a fine tuning control. This article is addressed to the owners of FRG-7s having serial numbers between 502001 to 505999 or between 060001 to 072000. If you have one, read on.

For $7.25 you can buy a modification kit from Yaesu. I did. You shouldn't. Why? Except for matching knobs, you can buy the needed parts (if you can't find them in your junk box) for a small fraction of the cost of the modification kit.

You need just two items. One is a small variable capacitor, small in physical size as well as in capacitance. The latter should be somewhere around 5 pF – not much more, not much less. It should have a shaft about one inch long (2.5 mm) and must be of the single-hole mount type. The other item is a knob to fit the shaft of the variable capacitor. If you have a choice, get one with a dot or other type of position indicator. If you're a purist, buy a replacement for the volume control of your FRG-7. It's a bit large, but it'll match.

Now you're ready to dissect your FRG-7. You'll need a Phillips, or Reed Prince, type screwdriver and a ¼-inch nutdriver. With the latter, take out the two screws along the bottom rear lip of the cabinet. With the former, remove the six small screws around the front edge of the cabinet and the one small screw at the top of the rear edge. Now, slip the chassis forward out of the cabinet.

Use a small, blade-type screwdriver to loosen the setscrews, and then remove all the control knobs. Then use the Phillips screwdriver to remove the three screws retaining the escutcheon plate.

With the slimmest soldering iron you can find, unsolder the two wires leading to the "Lock" lamp. Then remove the nut from the "Mode" switch. Next, take out the four screws that hold the external front panel to the inner one. Slip off the panel, and prepare to do some precise measuring.

If you have a metric rule, as everyone should, use the following figures. Otherwise convert them to inches.

From the right-hand edge of the front panel, measure in 14.4 cm. Then, from the bottom edge, measure up 6.2 cm. Mark the intersection, and drill a very small hole, barely through the panel. Pause there, turn the panel over, and carefully cut out the padding around the hole you just drilled, removing enough to leave a clear spot about 18 mm in diameter, centered on the hole in the panel.

Put the outer panel back on the receiver, and run the drill through the hole just far enough to clearly mark the spot to drill through the inner panel. Remove the outer panel, and drill the inner one. Make a hole just large enough to mount the variable capacitor. The one I got from Yaesu required a 7.5 mm (about 5/16 inch) hole. Note that you'll need a semicircular bushing between the capacitor and the panel; the speaker mount intrudes into the space needed for the capacitor. This is easily made.

While you're drilling, enlarge the hole through the front panel to 14 mm (about 9/16 inch).

After you've mounted the variable capacitor and screwed tight its retaining nut, replace the front panel and also the escutcheon plate. Don't forget to reattach the two wires to the "Lock" lamp or to replace the nut on the "Mode" switch! Very carefully set the plates of the variable capacitor to half mesh. Then attach the control knob, having the dot or pointer straight up. Replace all control knobs.

If you bought the Yaesu modification kit, *do not* install the 33 pF capacitor in place of the 51 pF capacitor C-458.

Note the printed circuit board just behind and a bit to the right of the variable capacitor you just installed. All the parts you'll be concerned with are located close together on the corner of the board that's next to the variable capacitor. The parts identification numbers are marked on the board, but you must look closely to see them. Locate T-403, a transformer in a tiny square can. Then spot TC-403, an adjustable capacitor just to the left of T-403 and a bit behind it. Look a bit behind TC-403, and spot the two terminals to which are attached wires running down under the chassis to the main variable tuning capacitor. The rearmost of these two terminals is the "ground" one. The foremost one is "hot."

Now run wires from the

variable capacitor you installed over to these two terminal posts, being careful, of course, to hook the rotor to the rearmost and the stator to the foremost!

If you bought Yaesu's kit, now you're ready to file the provided instruction sheet very carefully in the wastebasket, and get out the instruction manual that came with your FRG-7. Turn to page 12 of your manual. Look under the heading "Main Tuning Dial, T-403, TC-4D3." I quote:

"The following alignment should be done after warm-up of the receiver.

"Set the dial hairline to the center of the dial window. When the main tuning dial is rotated until it stops over the 1000° scale mark, the delta mark should be within 5 mm of the hairline.

"Set the Mode switch to lsb and the MHz dial to 0°. Set the main tuning dial to 1000°; a beat tone *may* be heard. Adjust T-403 until the beat is heard and is brought to zero beat. Set the main tuning dial to 0°, and adjust TC-403 for zero beat. Repeat these two procedures until zero beat is obtained at both 0° and 1000°."

The procedure in the manual works quite well. The one contained in the instruction sheet is utterly worthless!

The addition of the fine-tuning control makes the FRG-7 quite easy to use for SSB reception. More selectivity might be desired. Should you feel you need that extra selectivity, read the article by Ron Risher VK3OM in the March, 1977, issue of *Amateur Radio*. He describes a nonbutchering operation, one using a spare deck on an existing switch to select an alternate filter, consisting of four cascaded SFD-455-B solid state filters linked by small coupling capacitors. I haven't tried it, but it sounds intriguing! ■

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Beat the Books

-- study hall special

There comes a time in every kid's life when he wants more out of study hall than just studying. My time came about two weeks ago, and being a ham, I naturally wanted to do something with radio. I knew from the start that it would be hard, for Ma (as we had nicknamed our teacher) had an eagle's eye that could weed out a well-hidden game of solitaire in a class of 55. Anyway, I began to think of ways to outwit Ma and still have fun. A code practice oscillator was out, as I had already bored myself to tears tapping out English assignments on the desk with my pencil. Of course, the ultimate goal would be a QSO with a portable transceiver, but it seemed a little far-fetched at the time. But the more I thought of it, the more feasible it sounded. The walls of the study hall were made of wood and plaster, easily penetrated by radio waves.

I began my search for a suitable battery-powered QRP transmitter. This proved easy, for the second magazine I looked at was the January, 1977, issue of *73*, which contained a dandy little portable transistor QRP transmitter, easy to construct, and, from the description by the author, pretty potent at getting those waves into the sky.

Having decided on a transmitter, I was then faced by the dilemma of what to house the thing in. It must be inconspicuous, but large enough to handle the transceiver and batteries, which amounted to quite a load. I decided on a card filing box, for these were a fairly common sight at school.

For a receiver, I decided on a converter for a broadcast band radio with an earphone attachment. I wasn't taking any chances with Ma, who had the ears (and the temperment) of a wildcat. The pocket radio conveniently fit inside the lid of the card file box with a bit of double-sided foam tape.

I then constructed an aluminum chassis to fit the box, and on this I mounted the transmitter, which consisted of a transistor oscillator and a tuned circuit tuned to 40 meters, the chosen band. The BC converter was a bit tougher, as a bfo had to be constructed to take in the signals without the tones sounding like pure ac.

But eventually everything was straightened out and ready for initial testing. I plugged in a 40 meter crystal, plugged in a dipole, and flipped her on. A little tuning later, and the receiver began hauling in all sorts of signals, and with my station receiver, I roughly calibrated the dial. The transmitter really blared away on my station transceiver. Finally, after a grueling two hour slop-together job, all was ready. The next day, after breakfast, I tucked away a tiny earphone, grabbed my 98¢ "Junior" code key (I wonder how many old-timers still use those things), snatched a long wire antenna with a phone plug at one end and an alligator clip at the other, and smuggled the whole mess out the door past my mother.

When I got into study hall that day, I sat in the back row where there was a radiator for a grounding, and connected the transceiver. I didn't have the slightest idea about where to connect the antenna, and glanced around for a support. I ended up connecting it to a vacant desk three seats to the right. I ran the earphone up my shirt. Even Ma doesn't have x-ray vision. I turned everything on, and immediately zeroed in on WB9––– calling CQ, S9. I answered him, hoping the key clicks (audio, not rf) wouldn't be noticed. To my great joy, he came back TNX, OM. UR RST IS 369. NAME IS. . . Immediately my mind soared. Mini rotary beams! DX! SSB! Maybe later, that W8 is really giving me QRM. I might lose my first study hall QSO! ■

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Clocking Those Clock Kits

-- check out the MK-03!

The current plethora of digital readout clock kits makes it very difficult for the potential buyer to decide which is the one best suited for his needs. One of the many that are presently available, and which has not been advertised to any great extent by its suppliers, is the MK-03 Aircraft Clock-Timer kit. Bullet Electronics, the kit maker, may be underestimating the potential popularity of this kit. Its many unique features place it apart from others that are available.

Although this clock may have its primary application in cars, boats, and planes (FAA certification may be required), its compactness and features have a number of good applications in the ham or CB shack. OSCAR buffs will find it ideal for alerting them to the next pass, as the quick-setting alarm feature enhances this type of use. Power supply voltage requirement is 9 to 18 volts dc; thus a simple base station power supply is all that is required for fixed use. A power supply for this purpose is available from the kit supplier.

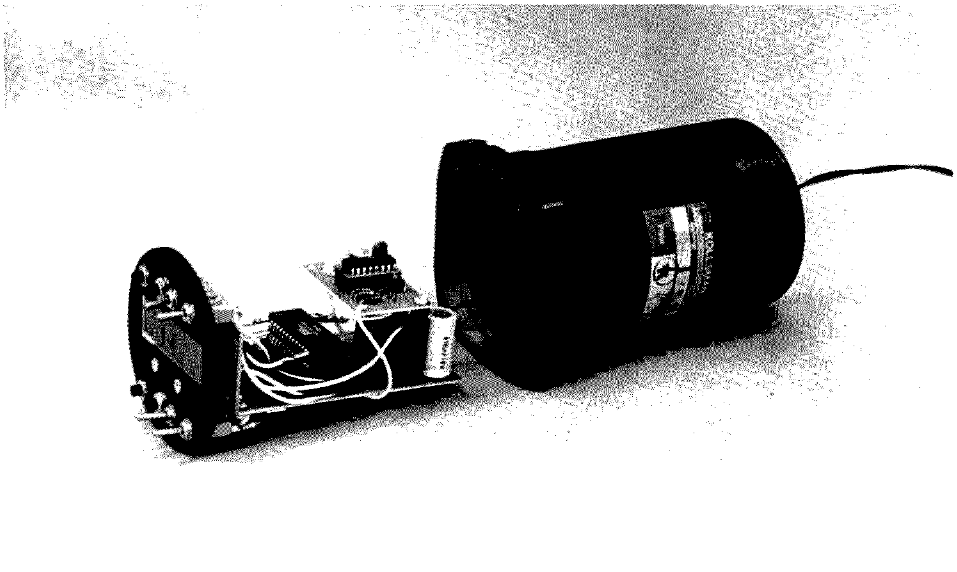
The kit, as received from Bullet, contains all parts, except switches and a case, to make a working clock-timer. The lack of case and switches allows you to design the enclosure and panel to suit your exact needs. In my case, the objective was to place the entire assembled unit inside a standard aircraft instrument case for use in a sailplane (glider). This was an old altimeter case, as shown in the photo. Doing this required a fair amount of ingenuity, but the result was very satisfactory. Others may wish to use a larger, less difficult package, and, if panel space is available, as at a fixed station installation, larger switches and layout would be more convenient.

The printed circuit boards for this kit include a six-digit readout board (allowing the FND-70 0.5-inch readouts to be directly soldered to the board), a main clock-timer board, and a timebase board. The latter uses a ceramic resonator as its standard, and a CD4060 CMOS as a 14-stage binary counter/oscillator. The oscillator frequency is divided by 2^{13} to produce the output frequency (50 Hz in this instance). My scope showed the output of this oscillator to be an excellent 4.9 volts square wave. Bullet advertises this oscillator kit as being available as a separate item, incidentally.

The main clock-timer board is standard, as far as digit drivers are concerned. However, the board uses two 50252 28-pin ICs, stacked in parallel, to accomplish the separate clock and timer functions.

The clock chip (bottom) operates as a normal 24-hour six-digit display clock. The timer chip (upper) operates as a 24-hour six-digit display elapsed time indicator. As received, the two chips are piggy-backed together, with the pins, which are paralleled in operation, already soldered together by the kit supplier. No soldering to the pins is required, as the dual IC is eventually installed in a DIP socket, which the user has previously soldered to the board. Connections to the top chip which are required are made with slip-on connectors (not supplied).

Components in the kit appear to be of good quality, and, for the most part, are



Bullet MK-03 Clock-Timer completed and ready for installation in aircraft instrument case. Digital readout board is attached to plastic escutcheon.

"house-numbered" items, indicating that they were probably not to the manufacturer's standard, but are quite satisfactory for general use. Two of the FND-70s, as received with the kit, had one open segment. Otherwise, all parts were excellent. All resistors for board mounting were precut and bent to radius, and all diodes and transistors were cut to length for mounting and soldering. Material was provided to assemble a toroid choke, in the event that the unit is to be powered by an ignition-type engine power source. In addition, an input protection diode is provided to prevent an incorrect polarity connection from damaging the unit.

Circuit board solder plating tended to have a dull appearance, and occasionally some difficulty was encountered in preparing satisfactorily soldered connections. This was particularly noticeable when working on the readout board, which has rather closely spaced traces that compounded the problem. Manufacturers would be wise to increase the cost of a board by a few pennies to provide good traces and well-plated boards, in order to insure customer satisfaction and trouble-free operation.

The many switches required for full operation of the clock-timer increase the complexity of the wiring external to the board, but they do not create any problems, if care is taken in routing the leads.

Instructions and diagrams supplied with this kit are quite complete, with ten pages of information. Nevertheless, they must be read thoroughly prior to constructing the kit, in order not to overlook some item of importance, not necessarily mentioned where you think it might be in the text. There was a schematic error in my instructions, which may be corrected now, as this has been brought to the attention of Bullet.

Upon completion of the entire assembly, I used a 9 volt transistor radio battery to test the clock-timer (this is not recommended for other than testing because of a .085 A current drain). The unit operated immediately, with no difficulties whatsoever, and it was fun to be able to run through the interesting list of functions that this clock is capable of performing.

The fact that the timing and clock functions perform independently of each other permits using the features of one without interfering with the ongoing action of the other. For instance, the elapsed time function, which displays hours, minutes, and seconds, may be started, held, restarted, or reset to zero while the "real-time" clock continues its normal operation, undisplayed.

The switches may be connected to perform the following listed functions. The display switch may be switched either to the off position (in which case all functions continue, but are not visible), or to display either the timer action or real-time clocking.

Real-time clock – Hours set, 10-minute set, minutes set, alarm enable, and clock display mode (shows either real time or what the alarm set time is).

Timer – Start, hold, and reset.

An additional feature may be used, but was not necessary for my application. This is a photo intensity input to the clock chip, which will reduce or increase the display intensity, dependent upon the ambient lighting.

As a full-function device in the shack, or mobile anywhere, this clock-timer appears to have all the requirements, for a modest $26.95. Bullet Electronics, P.O. Box 19442, Dallas, Texas 75219, is the supplier. ■

Arvid G. Evans K7HKL
5128 S 3600 W
Kearns UT 84118

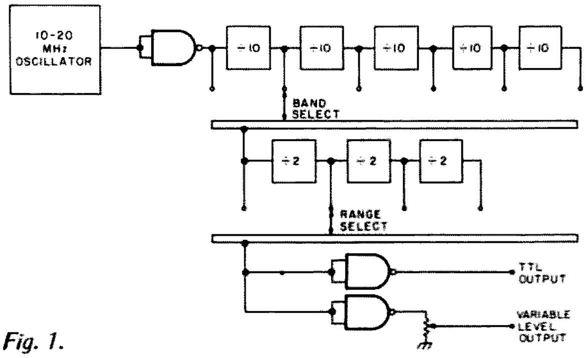


Fig. 1.

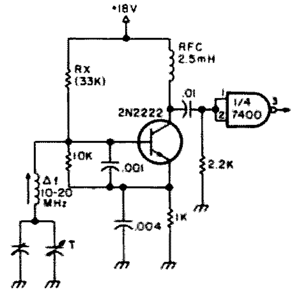


Fig. 2.

Digital Signal Source

-- TTL signals for counters, micros

In playing with logic circuits over the past few years, I repeatedly encountered the lack of a suitable signal source. Several things were tried, including squaring circuits on the wide-range rf generator and several pulse/function generation units, with only marginal success. Recently, while working on a frequency synthesizer, an idea occurred that after breadboard construction seems to be the answer. Development of this idea as outlined below will result in a square wave signal source covering from 20 MHz down to subaudio in fully tunable decade steps. For my purpose, it has proven to be an ideal unit for experimenting with amateur radio applications of TTL and CMOS logic.

Theory

The basic idea as presented in Fig. 1 is for a tunable oscillator in the 10 to 20 MHz range with switchable decade dividers for the range selection and switchable binary dividers for band selection. The resulting frequencies and time constants are listed in Fig. 5.

Construction

Fig. 2 is the oscillator which I used – others would do as well. Try your favorite . . . just be sure the output is adequate to drive the digital buffer. Drive requirements to the first TTL stage can be cut down by biasing that stage into its linear (?) range with a 2.2k resistor to ground as indicated in Fig. 2.

Fig. 3 represents the power supply circuitry and is self-explanatory. Fig. 4 includes the dividers and output circuit. Construction is straightforward with few precautions. It would be wise to keep all divider-to-switch wires separated from each other slightly (just don't bundle them all together in a cable harness). Run a separate power and ground lead for each IC. That way you need only one bypass capacitor on the common +5 volt and ground point.

My final version has a calibrated dial and tunes with a 20:1 VFO drive. However, I find it more convenient to cable the output to my digital counter for direct frequency readout.

I wired the VFO portion using point-to-point technique on insulated standoffs. The divider is on perfboard and wired with wire-wrap pencil.

Summary

While my unit is just the basic generator, hindsight has indicated many additions which might enhance its operation. Some of the possible

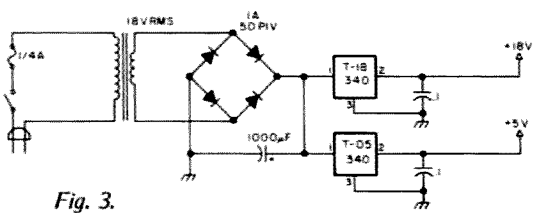


Fig. 3.

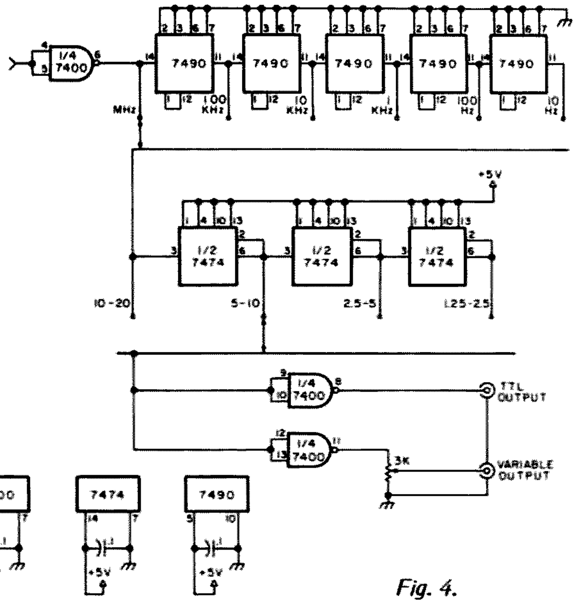
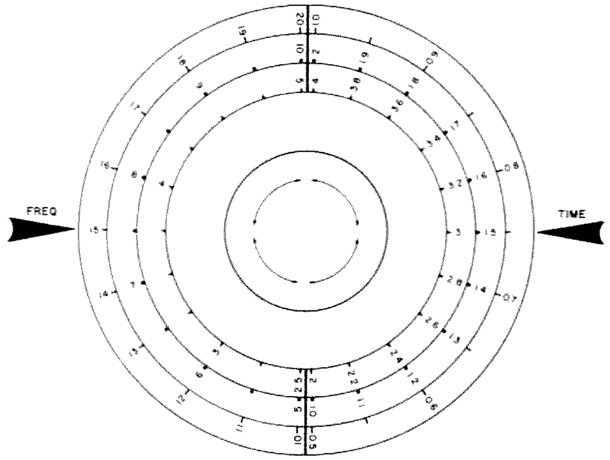


Fig. 4.

additions and their applications are listed below:

1. FM the VFO with an audio oscillator and voltage variable capacitor for working with FM receivers, phase detectors, or PLL circuits.
2. Switch the divider chain from the internal VFO to an external input jack. This would allow signals from external sources to be divided.
3. Switch the divider chain input between the internal VFO and a crystal oscillator to generate harmonically-related standard frequencies.
4. Add a second buffer and output circuit for opposing polarity outputs.
5. Run the output through a one-shot multivibrator for thin-line pulse generation.

In case you use this as an rf generator for general purpose work, you might be interested to know that the square wave output generates strong harmonics beyond 2 meters! ■



Frequency	Time	Frequency	Time
10-20 MHz	0.1-0.05 uS	10-20 kHz	100-50 uS
5-10 MHz	0.2-0.1 uS	5-10 kHz	200-100 uS
2.5-5 MHz	0.4-0.2 uS	2.5-5 kHz	400-200 uS
1.25-2.5 MHz	0.8-0.4 uS	1.25-2.5 kHz	800-400 uS
1-2 MHz	1-0.5 uS	1-2 kHz	.001-.0005 Sec
0.5-1 MHz	2-1 uS	0.5-1.0 kHz	.002-.001 Sec
0.25-0.5 MHz	4-2 uS	0.25-0.5 kHz	.004-.002 Sec
0.125-0.25 MHz	8-4 uS	0.125-0.25 kHz	.008-.004 Sec
100-200 kHz	10-5 uS	100-200 Hz	.01-.005 Sec
50-100 kHz	20-10 uS	50-100 Hz	.02-.01 Sec
25-50 kHz	40-20 uS	25-50 Hz	.04-.02 Sec
12.5-25 kHz	80-40 uS	12.5-25 Hz	.08-.04 Sec

Fig. 5. Suggested dial layout.

73 Magazine *Staff*

Regenerated CW

- - CW: as you like it

One of the useful accessories to a receiver for CW operation is a device that will key an audio oscillator in accordance with an incoming CW signal. Then one doesn't have to listen to the original CW signal with its background noise and QRM, but can listen to a clean, locally generated audio signal. This sort of device also provides a bonus feature useful with transceivers having no tunable bfo and where one must listen to a CW note determined by i-f filter characteristics and the crystal-controlled frequency of a product detector. Usually, these transceivers are set up to produce CW notes of from 600 to 900 Hz. But not everyone enjoys listening to a constant pitch CW note for extended periods. However, if the incoming CW keys a local audio oscillator, one can vary the pitch of the tone actually being listened to without affecting the correct tuning of the transceiver.

Such local oscillator keying devices for CW reception are not new. Many designs were built in tube-type days and worked quite well. The problem was that such a device got to be rather elaborate and costly with tubes. Such devices usually consisted of a sharply tuned audio filter followed by some audio amplification. Then the audio signal was rectified and used to operate a sensitive relay. The relay simply keyed a local, variable frequency sine wave oscillator which one then listened to as it was keyed instead of the original signal.

Using solid state devices one can, of course, duplicate the original circuit idea. Sharp, single frequency audio filters can be built using the commonly available 88 mH toroid coils. The filtered signal can be amplified by an audio IC stage, rectified, and the dc signal used to control a reed relay. Any desired local oscillator can then be keyed by the relay.

This article presents a similar but slightly different approach by taking advantage of some of the new phase locked loop ICs on the market. Basically, a phase locked loop is used to serve as a tunable audio filter and LED switch driver. The LED switch in turn activates a variable frequency tone oscillator. The circuit is compact and inexpensive. Its only disadvantage is that it must be more carefully tuned than a circuit configuration using a passive input filter. But this is mostly a matter of becoming used to the adjustments involved, and it is not a tedious affair. Only parts of the basic circuit can be used if one further wants to simplify the device. For instance, the PLL tunable audio filter can be replaced by a passive LC filter. This eliminates any tuning but takes away from the versatility of the unit since the receiver tuning controls then have to be adjusted so the CW beat note falls in the filter passband. Still another alternative, if one has a receiver with already good i-f or audio signal selectivity but gets tired of listening to the hollow ringing sound of such a receiver, is to use only the LED and audio oscillator portions of the circuit. The LED is driven by rectified af and activates the audio oscillator. Each of these application variations is discussed in the following paragraphs.

Fig. 1 shows the diagram of the 567 PLL tunable audio filter. The 10k potentiometer by pin 5 serves as the frequency tuning control, and the 10k potentiometer in the

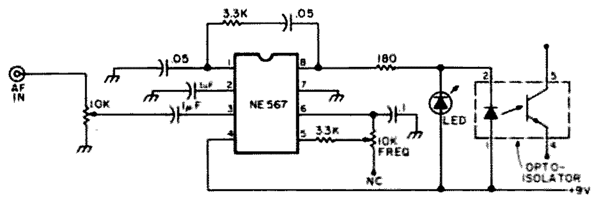


Fig. 1. Tunable audio filter uses a 567 PLL IC. The optoisolator can be a Sprague ED702 (many other surplus units at lower cost will also suffice). A multi-turn potentiometer for the 10k frequency adjustment control will facilitate adjustment, but a regular potentiometer with a large knob will also work.

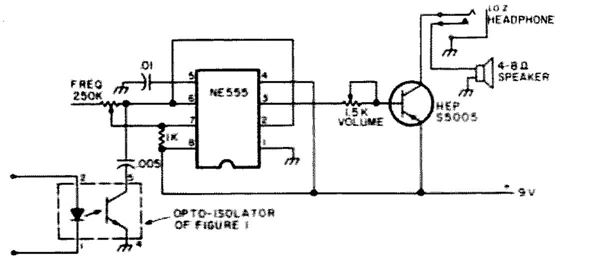


Fig. 2. NE555 audio oscillator/amplifier which can be driven by the PLL tone filter of Fig. 1. Note the simple but effective S5005 amplifier stage for the square wave output of the 555.

input lead is used to adjust the input level. This extra control is provided since one will usually initially monitor the receiver's audio output aurally until the filter locks into place on the incoming signal. The af input level (from a headphone jack, for instance) that provides good aural level may overload the PLL. Hence, the 10k input potentiometer is necessary. The bandpass of the filter varies with the input voltage level, and careful adjustment of the frequency and input level controls is needed. It is best to practice first with steady tone input signals rather than a keyed signal. The output of the PLL drives a regular LED and an LED optoisolator. The regular LED simply serves as a visual tuning aid to indicate the PLL is locked on to the incoming signal. Of course, it will lock on to any input frequency to which it is tuned (or even harmonics of the input signal if it is overdriven). However, by providing a switch to go back and forth between the audio input and the output of the keyed audio oscillator stage, confusion will be eliminated. The optoisolator LED is used as a switch to key an audio oscillator stage. It can be used to key any desired oscillator. Some operators prefer a sine wave signal, while others find a harmonic-rich square wave more interesting to copy.

Fig. 2 shows an NE555 oscillator/amplifier which can be keyed by the circuit of Fig. 1. The circuit is straightforward and provides both variable frequency and volume control. It will drive directly a small loudspeaker or low impedance headphones.

Fig. 3 shows some additional circuits which can be used with the circuit of Fig. 2. Fig. 3(a) shows a passive 900 Hz audio filter and rectifier which can be used to drive the LED optoisolator to key the NE555 oscillator. The PLL stage of Fig. 1 is not used and the 900 Hz filter is driven directly from the speaker output of the receiver being used. Fig. 3(b) shows just a rectifier circuit driving the LED optoisolator. This ultrasimple circuit can be used when the receiver has adequate selectivity and it is only desired to key the NE555 oscillator. The optoisolator approach in the foregoing circuits may seem a bit elaborate for a simple switching function. However, they allow versatility in keying various oscillator circuits and if purchased in untested lots can be very economical. The pin arrangement of most types is as shown in Fig. 1. One can locate the basic elements with a VOM and use a 1.5 V battery with a series 47Ω resistor to see that switching action takes place when the LED is activated. ■

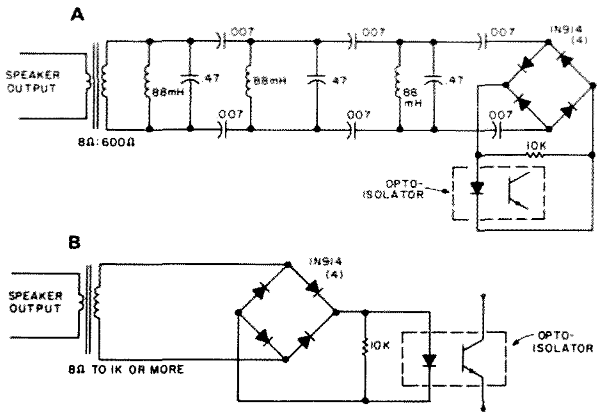


Fig. 3. Two other circuits that can be used to key the NE555 oscillator without using the PLL circuit of Fig. 1. Mylar capacitors should be used in (a). The .007 capacitors are paralleled .005 and .002 mF units.

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High-Band Your KDK

-- monitor the other half!

It sounds almost blasphemous to talk about modifying a beautiful, synthesized rig, doesn't it? Well, it can be done, and it can be done by anyone who knows how to solder two pieces of wire. That's the whole modification. I can add two pieces of wire to the KDK and double its versatility.

Why To

The KDK, as it was designed, covers 144 to 148.995 MHz, and the receiver sensitivity leaves nothing to be desired, with the front end being tuned along with the synthesizer. The frequency coverage is so close to the public service band that it would be nice to have such a sensitive receiver, with a nice sharp i-f and precise frequency readout, to see how the other half lives. No sooner said than attempted.

How To

1. Take the cover off the rig (the two nuts on the back).
2. Lay it upside down with the front panel facing you.
3. Move the red wire on the on-off switch over to the terminal that already has the two white wires with violet tracers.
4. Solder a 1/2-inch piece of bare wire to the rear terminal of the other side of this same switch (the three terminals closest to you).
5. Find the top terminals of the aircraft-type frequency selector switch that have a jumper going from the front wafer to the rear wafer.
6. Solder a 6-inch piece of wire to this point (the rear wafer makes a neater job).
7. Solder the other end of this wire to the center terminal of the top bank of the on-off switch (see Fig. 1).
8. Find the frequency selector terminals on the shielded enclosure directly behind the front panel controls. The terminal you want is the one to the far right as you look at the rig. It has 2 white-with-red tracer wires connected to it.
9. Solder the wire from step 4 to this terminal (the one in step 8). Be very careful that some strands of the wires do not short to ground. I have done this many times, and this is not conducive to receiving.

How To Use It

With the on-off switch turned on, the rig works the same as it always did (if not, see step 9). With the switch off, the rig will stay on. It's very easy to add an external power switch, and I didn't want to drill any holes in the rig. However, you will see some very strange-looking megacycles on the readout. This is because you are feeding values in excess of 9 to the seven-segment decoder. It doesn't hurt anything, just makes it hard to read. If you add 8 to the frequency shown on the MHz switch, you will have the frequency that the rig is really receiving. The KDK now tunes 152 to 155 MHz. With the switch on 148 MHz, the modification doesn't do anything, and the rig still receives (and transmits) 148 MHz. It is possible, with additional switching, to extend the range from 140 to 155 MHz, inclusive, but what do you want for 2¢ and five minutes?

Possible Problem (Only One)

You may find that, when the rig is switched to 152 to 155 MHz, the unlock indicator does not go out (some do, some don't). This is due to the fact that the vco is just out of range. Adjust the vco tuning capacitor *very slightly* and *very slowly*, and you will find a point very near where it was that causes the unlock light to go out. If you are receiving a signal, again tune the vco capacitor for maximum S-meter reading on the signal.

The receiver, when properly tuned up, shows .2 uV sensitivity for 20 dB quieting on 2 meters and about .3 uV on high band. Not bad!

Theory

The terminals on the front of the shielded enclosure determine the division ratio of three 74192s. If the first one (the one on the right, looking at the rig from the bottom) divides by 4, we are on 144 MHz. If it divides by 8, we are on 148 MHz. (Aha! It determines the third digit in the megahertz number.) We simply placed +5 volts on the 8 terminal, so we added 8 to that number. On 148 MHz, there is already +5 volts on that terminal, so . . .

Enough theory, already. Try it; you'll have fun! ■

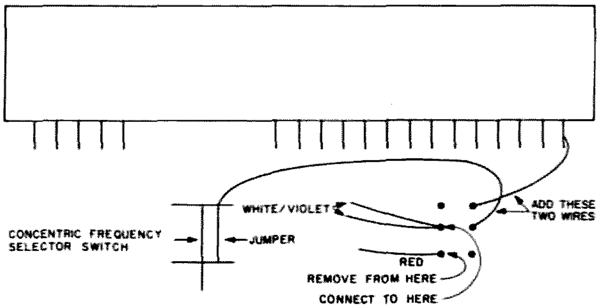

Fig. 1. How simple it is.

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The Rescue

-- real-life drama

The temperature was about 82°, a perfect-day for exploring the back country of Fish Creek. Now, if you're not familiar with the whereabouts of Fish Creek, it's about 50 miles east of Jackson Hole, Wyoming, about one mile from the Continental Divide.

On this beautiful August 21, 1976, two young girls and a male friend decided to take the horses out for a ride in the back country. Nancy, 17, Patty, 19, and John, 17, saddled up the horses that they had been assigned to and started out on what was supposed to be a beautiful afternoon ride.

When you run a ranch, there is always much to do, so I set out with my two cowboys to do some of the chores that had been waiting to be done for some time. Now I think I should mention that the ranch is one and a half hours by four-wheel drive from the nearest telephone. A person could set out from the ranch in any direction and never see another living person for 30 miles. The only electricity is a small, four-cylinder engine generator. Many have said it is one of few ranches left that reflect the way the old west was in the early 1900s.

About 4:30 pm, while I was working in the pasture, I looked down the path to the east and saw a rider heading for the ranch at a full run. One of the rules of the ranch is to never run your horse, so I immediately knew that there was trouble.

In a few minutes, Patty rode up to where I was working. In a state of shock, she started screaming that Nancy was seriously hurt. After quieting Patty down, I got a description of where Nancy was and jumped into the four-wheel drive truck with Mike, another guest at the ranch. We headed for the canyon where Nancy and John were. The road was no more than a cow path, so the traveling was slow and bumpy. Once at the canyon, called Deer Creek, Mike and I started a one-mile hike looking for the injured girl and John. After about twenty minutes of rough hiking, we came upon them in a little clearing.

Nancy was lying on the grass in a state of shock, with blood flowing from her mouth. There was a lump on her head where she had hit the ground, and her left elbow was completely distorted. It was decided that Nancy could not be moved.

Grabbing one of the horses, I headed down the canyon as fast as the horse could go to where the truck was parked. I headed back to the ranch, where I hoped and prayed that the old generator would start. Once at the ranch, I was able to get the generator going, and I headed for my new Atlas 210, which I had just purchased a month earlier. The antenna was a 20 meter dipole on the roof oriented in a northwest and southeast direction. I wasted no time in finding a clear frequency and started calling "Mayday, mayday, mayday; WA6LJL/7 near Jackson, Wyoming, calling mayday. Someone come in, please."

I called several times and got no response. I didn't know what to do, as a girl was lying seriously injured, and this was the only means of help or communication with the outside world. I kept calling, and, then, like music to the ears, I heard "WA6LJL/7 this is K5TZK Bob in Houston, Texas. Do you copy?" Thank God someone heard me! It didn't take long for me to tell Bob the problem. Shortly after I made contact, Ernie W7JRW in Las Vegas and Jim WB5NRX were involved keeping the surrounding frequencies clear, so I could communicate with Bob K5TZK.

Bob immediately got the long-distance operator and explained the situation to her. She then connected the sheriff's department in Jackson, Wyoming, and the U.S. Forest Service Department with Bob in Houston. After about 15 minutes of my giving directions to Bob, the sheriff's department dispatched a helicopter and a registered nurse to our location. We were instructed to start some smoke fires so we could be spotted. For 30 minutes more I gave directions to Bob to relay to the sheriff's department, which in turn relayed them to the chopper.

As the drama continued, there was not a bit of QRM on the frequency, thanks to Jim, Ernie, and, I am sure, others, who helped keep the frequency clear.

It seemed like hours before I heard the low hum of the helicopter as it started to come into view over the

mountains. Seeing our signal fires, it wasted no time getting to us and making a landing. I told the hams on the frequency that it was here, and, all of a sudden, there was a chorus of "Hoorays," making the prettiest QRM that I had ever heard. I signed quickly and headed for the chopper. I boarded, and we took off to the location of the injured girl.

About five minutes later, we spotted the trio and made an unbelievable landing within 30' of where Nancy lay. By this time, she was unconscious. The nurse said she looked bad, so we wasted no time getting her on a stretcher and airborne. We all gave a sigh of relief as the helicopter headed for the hospital.

The next day I drove into town to the hospital to find out how Nancy was. I found her doctor and asked him how she was doing. "Doing well," he replied, "but if she had gotten here 2 hours later, we would have had to amputate her left arm, as the circulation had been cut off and the tissue was dying." Had we tried to take Nancy out by truck, it would have taken us 4 hours to get her to the hospital.

Today, many months later, Nancy is a beautiful young girl living in Palos Verdes, owing her life and healthiness to the many hams who helped. Without this help, she might not be alive today.

So let everyone know that there is no greater service fraternity anywhere in the world today than the hams, who would rather be of service to their fellow man than anything else.

Oh yes, I'll be back there again, and, again, I'll have my trusty little Atlas 210 with me! So, if you hear "WA6 Lovely Japanese Ladies portable 7," give a call and be sure to say hello, as you're the only commmunication we have with society. ■

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Welding Rod Special Antenna

-- for seamless contacts

Most two meter mobile antennas manufactured today are easily mistaken for Citizens Band antennas, especially by CBers and, more importantly, a faction which, of late, has greatly proliferated — the CB rip-off artists.

Many articles have appeared concerning the use of burglar alarms and other devices to protect your rig, but few solutions have been offered concerning the most vulnerable part of your mobile system — the antenna.

The solutions seem to boil down to two things:

1. Take your antenna off when not using it, which is a hassle, even if you use a magnetic mount.
2. Let them take the antenna.

The second solution can be a viable one, providing the antenna is cheap, easily replaced, and doesn't look so great, so not many people bother to steal it anyway.

The antenna described here will adapt readily to the popular Antenna Specialists 5/8 wave roof or trunk mounts, as well as many CB mounts. If you don't have one of these, the roof or trunk mount, less antenna, can be purchased at your local Radio Shack (roof mount — part no. 21-914; trunk mount — part no. 21-913).

The antenna itself is easy to construct. The only materials required are a PL-259 coax connector and a 20-inch piece of welding rod, coat hanger, large copper weld wire, or what have you, and some silicone rubber sealant. Use a hacksaw or a large pair of diagonal pliers to cut about half of the pin off of the PL-259. Take the 20-inch piece of rod, clean the end, and solder it to the center conductor of the PL-259, trying to get a smooth, round bead of solder on the tip of the PL-259 to make good connection with the mount. Fill in the back of the plug with the silicone sealer, in order to keep moisture out.

The PL-259 sleeve is brought down over the rod and screwed over the connector in the usual fashion. The entire assembly may now be screwed down securely on the antenna mount. A 20" piece of rod is used, to allow for about 19" measured from the back end of the connector to the end of the rod, which is a good ball park figure for two meters. An swr bridge may be used to prune the antenna, by careful snipping with wire cutters, but I've never even measured my swr and haven't had any problems.

The antenna has been used on my car for about 8 months and works quite well. No one has yet bothered to steal it, but, if they do, I haven't lost much. I still keep my 5/8 wave in the trunk in case I go out of town and want that "extra 3dB." ■

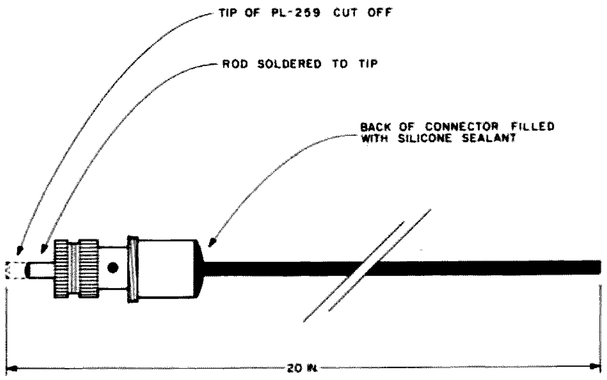

Fig. 1.

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Tanks A Lot!

-- inductor calculation program

If you don't own a programmable pocket calculator, chances are you will before too long. A 100-step programmable calculator is already on the market for less than a scientific-type pocket calculator cost two years ago. They're just too nice a toy to be overlooked by hams for long.

Now suppose you pull a variable capacitor out of the junk box and you want it to resonate with an inductor at a specified frequency. What's the value of L?

$$L_{uH} = \frac{10^{12}}{4\pi^2 (C_{pF})(f^2{}_{kHz})}$$

Not too bad. But now how do you wind the inductor to get this value of inductance? Well,

$$\text{turns} = \sqrt{\frac{L(9a + 10b)}{a^2}}$$

where a is the inductor radius and b is the inductor length. Now this gets a little messy. Squaring, dividing, and taking square roots is not a whole lot of fun. But there is another problem. Assuming we settle upon a value for the inductor radius, we still have to contend with the proper value for the length. How do we find b? Well, we know that turns per inch (tpi) times length equals turns. So if we vary the length b, carry out the above calculation to get turns, then multiply that same length by tpi and compare the result with turns, we can see how close we are. We want the difference between the two to be zero. So we change b just a bit and do the whole thing again and again until the difference is zero or very near zero. But that's a lot of work! You bet, but it's not for a computer.

The program shown here carries out the above procedure starting b at .05 and incrementing it by .05 units after each calculation and comparison until the difference between tpi times length and turns changes sign, that is, crosses zero. Then it decrements b by .001 units and continues in the same fashion until the sign changes again, whereupon it stops and displays the number of turns. The result is, for all practical purposes, excellent. One must initiate the program by putting the various parameters in the memory registers, all ten of which are used with my SR-56.

As an added feature, I thought it would be interesting to know how many times the subroutine

Location	Key
0	0
1	STO
2	0
3	STO
4	6
5	RCL
6	1
7	x^2
8	x
9	RCL
10	9
11	x
12	RCL
13	2
14	=
15	1/X
16	x
17	1
18	EE
19	1
20	2
21	=
22	STO
23	5
24	R/S
25	CLR
26	.
27	0
28	5
29	SUM
30	6
31	Subr
32	8
33	8
34	Subr
35	6
36	1
37	x≥t
38	2
39	5
40	CLR
41	.
42	NOP
43	0
44	0
45	1
46	Inv
47	SUM
48	6
49	Subr
50	8
51	8
52	Subr
53	6
54	1
55	Inv
56	x≥t
57	4
58	0
59	R/S
60	RST
61	(
62	1
63	SUM
64	0
65	RCL
66	4
67	x
68	9
69	+
70	1
71	0
72	x
73	RCL
74	6
75	=
76	÷
77	RCL
78	7
79	x
80	RCL
81	5
82	=
83	$\sqrt{x}$
84	STO
85	8
86	)
87	Rtn
88	(
89	RCL
90	3
91	x
92	RCL
93	6
94	=
95	x≷t
96	)
97	Rtn

Fig. 1.

was called upon to carry out the searching calculation. In one problem that I devised, over 700 passes were undertaken. This bit of information is stored in register zero.

So how do you run it? Select your variable capacitor and, for example, its center position capacitance. Store this value in pF in file 2. Store the frequency in kilohertz in file 1, the number of turns/inch or less, from the closewound value in the wire tables, in file 3, and the radius you've selected in file 4. You can't have more turns/inch than the closewound value. Square the radius and store in file 7. Finally square pi and multiply by 4 and store in file 9. Now you're ready. Punch R/S. The calculator will display the inductance in microhenrys needed to resonate with pF at the specified frequency in an instant. Punch R/S again, and the calculator will continue computing until it stops and displays the number of turns you need to wind at your selected tpi and radius. Any of the memory registers can now be recalled. The computed length can be recalled from file 6. This length times tpi should be very close to the computed turns. Punch reset, and the program is ready to begin again.

Ah, you say, I can get the same stuff from the ARRL Lightning Calculator. True, but you can't get any information on an inductor 3 feet or 0.1 inch in diameter, and it doesn't have all those flashing lights. ■

Memory Registers

0	Subr Calls
1	kHz
2	pF
3	tpi
4	radius
5	uH
6	length
7	$(radius)^2$
8	turns
9	$4 Pi^2$

Fig. 2.

Build the El Sapo Tester

-- for hams with spare time

73 Magazine *Staff*

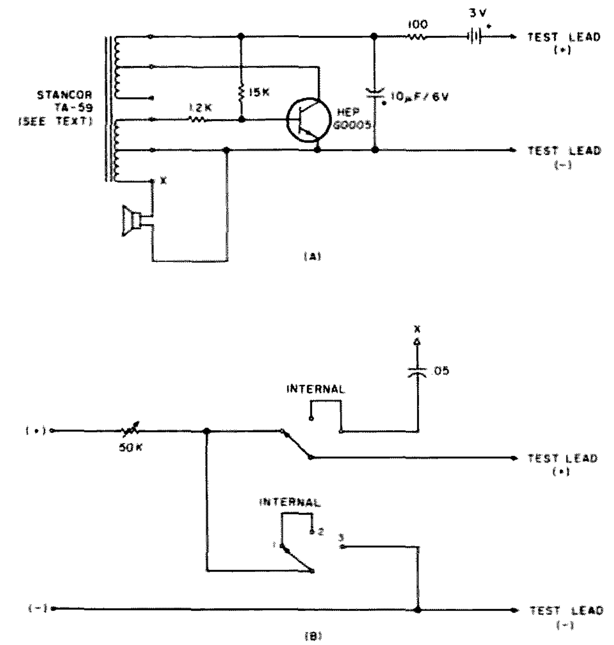

Fig. 1. Basic circuit of tester (a) and switching add-on for more versatility (b). See text for description of components not marked.

The little test instrument described in this article is something for the amateur who has nothing and something for the amateur who has everything. In the former case, it provides, very inexpensively, an instrument that can function as a continuity tester, transistor tester, diode tester, signal injection source, code practice oscillator, CW monitor, substitution microphone, and substitution loudspeaker. In the latter case, it provides a very handy addition to a tool box, for quick continuity and relative resistance checks, without having to look at a meter.

The instrument is nothing more than an audio oscillator using a one transistor circuit. But the components are carefully chosen. A switching scheme is utilized so that a low current is passed through the circuit under test. The volume and/or pitch varies with the resistance placed across its test terminals, and maximum utilization is made of the circuit and its components for several modes of operation. Such basic testers, but without all the versatility of the one described, have been available commercially for years. They are popular with many service technicians, since one can visually concentrate on the circuit being tested or traced out without having to glance away to read a meter. This feature is particularly helpful when doing work on a detailed PC board, since one can lose one's place on the board in the time it takes to glance at a meter.

The circuit of the unit is shown in Fig. 1(a). The oscillator circuit utilizes a transistor transformer, which has one or two center-tapped windings to form the equivalent of a transformer with three windings. One winding is used in the base circuit of the transistor, another as a feedback winding in the collector circuit, and another as an output-coupling winding. Many of the usual miniature transistor transformers will work, aside from the TA-59 unit mentioned, such as the usual 10k Ohm to 2k Ohm CT or 1k Ohm CT to 8 Ohm units. One must be prepared to do a bit of experimenting to get the windings phased correctly and to get the output pitch desired. To achieve the latter with some transformers, it may be necessary to experiment with a small capacitor (.001 to .1 mF) across the base winding. The output "loudspeaker" should ideally be a unit such as a 600 Ohm telephone receiver. But anything, from high impedance, miniature loudspeakers to cheap, dynamic-type

microphones, can be used. Power is supplied by two 1½ volt batteries in series. No on/off switch is required, since no current can flow unless some resistance is placed across the test terminals.

The unit, as shown in Fig. 1(a), can be used by itself, if desired. If the test leads are marked for polarity, one can test diodes and transistors and determine the direction of the junction involved. Resistance values, from a short to about 100k Ohms, can be detected with the upper limit, depending on the specific oscillator components used. As the resistance value increases, the volume will decrease, but the pitch will tend to rise. This is a very handy feature, since, after a period of usage, one is not so aware of the volume changes as one is aware of associating higher pitch with higher resistance. With usage, one can become familiar with the sound of at least the major steps in the output pitch, such as for resistance values of 1k and 50k.

By adding a few more components to the basic circuit, as shown in Fig. 1(b), more versatility can be gained from the unit. The addition of a series 50k potentiometer allows one to control the volume and also to limit the short circuit output current to less than 60 uA. The latter is useful as a safety feature, when testing some semiconductor devices, when one is unsure of the terminal markings. In the center position of the switch shown, the battery line is left floating, and the positive test lead is connected to the speaker over a .05 mF capacitor. The speaker can then function as a replacement test speaker or as a dynamic microphone replacement. The reproduction quality is good enough to at least determine whether or not the speaker or microphone substituted for is basically defective. In the right-hand position of the switch, the battery circuit is completed to ground, and the internal speaker output remains connected to the positive test lead. In this mode, the circuit functions as an injection oscillator, the level of which can be controlled by the 50k potentiometer and monitored on the internal speaker. The output is quite harmonically rich, and it can be used to check amplifiers all the way from the audio range to the HF range.

The switch used in the unit I constructed was a special miniature DPDT toggle switch with a center position. But, in the center position, instead of the usual "off" position, the poles still remain connected to opposite side terminals of the switch. The switch is available for $1 from Tri-Tek, 6522 North 43rd Ave., Glendale AZ 85301. The switch can, of course, be replaced by a regular 2P3T rotary switch, but, then, this requires a larger enclosure. Using the miniature toggle, and with the basic circuit wired on perfboard, the unit was assembled in a 3-1/4 x 2-1/8 x 1-5/8 Bakelite box, complete with batteries.

Probably some more uses can be found for the circuit, with a bit of imagination and a modified switching scheme. For instance, it would seem possible to rearrange things so that the circuit could also function as either a preamplifier or a low level audio amplifier complete with speaker. All in all, it is hard to find a more handy unit for general circuit or equipment checking, before one resorts to proper instruments for specific checks.

The name of the instrument comes from the sound the unit makes. When you test for continuity and encounter a very low resistance, the unit sounds off with a hoarse tone, sounding somewhat like that produced by El Sapo – the frog. ■

Finally!

A Simple PROM Burner!

-- for the 8223 and 82S23

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As a result of my various articles using TTL programmable read only memories, I have received many letters and phone calls for help from people who cannot get devices they have purchased to accept a program. In almost all cases I discovered that they had been sent 82S23s, assuming that 82S23s were the same as 8223s. While the devices do the same job with the same pin connections, they are quite different when it comes to programming. The 82S23 will not program with the same inputs as an 8223.

After doing some research into the device data books and getting some help from a friend, the following circuit was developed which will program either the 8223 or the 82S23.

Circuit

The circuit is shown in Fig. 1. To those of you who have either read my earlier articles or used the Signetics data book, the circuit should appear quite familiar except for the additional power supply input and the FET-zener circuitry.

It turns out that the 82S23 requires 19 volts current regulated to about 65 milliamps in order to program right. The circuit shown in Fig. 2 will perform that quite nicely. The only limitation is in the selection of JFETs. The JFET must have an IDSS of greater than 65 mA. Of course the 19 volt zener must be able to handle the full 65 mA, which means that it should be rated at least 5 Watts.

The remainder of the circuit in Fig. 1 is fairly straightforward. For S1 and S2, I used thumbwheel switches which select the word address in octal. These could be replaced with cheap toggle switches, but the saving in time and effort is well worth the slight extra cost of the BCD coded thumbwheel switches. S3 selects the output bit to be programmed or verified. S4 is a push-button switch used to do the programming once a word and bit are selected, and S5 is used to verify that the bit was actually programmed. S6 was added to switch the programmer from the 8223 devices to the 82S23 devices. S7 simply puts a 12 volt zener across the 19 volt zener for current calibration purposes. The 21 to 19 volt supply is the same as shown in detail in Fig. 2 except for the addition of a meter for current calibration. For the best stability, the zener and FET should be mounted on heat sinks. One last circuit

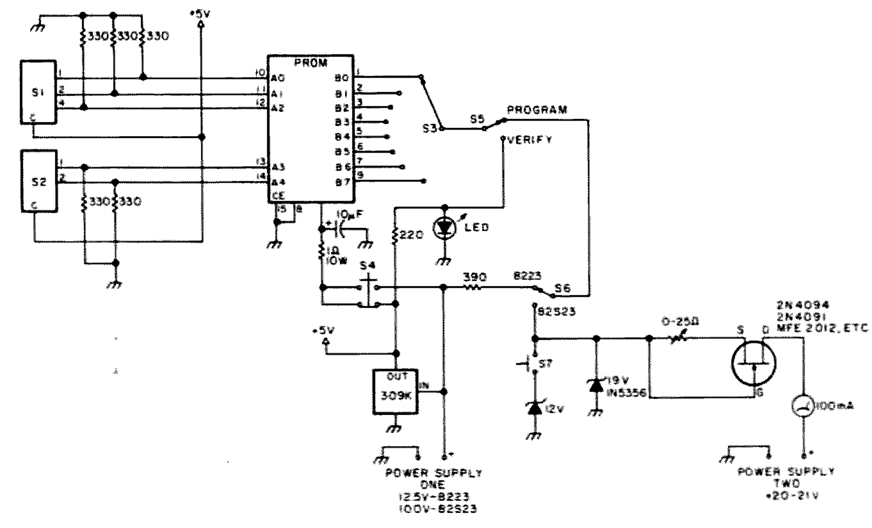

Fig. 1. PROM programmer schematic diagram. Power supplies one and two can be bench supplies or built up specially for this use. Regulation is not critical.

comment: If additional contacts were available on push-button switch S4, I would break the line from S6 to S5 and put it through the extra contacts.

Programming

If programming an 8223, set S6 to 8223 position and adjust power supply one for 12.5 volts. Power supply two need not be on.

If programming an 82S23, set S6 to 82S23. Adjust power supply one to 10.0 volts and power supply two to 21 volts. Now momentarily depress S7 and adjust Ra for a current of 65 ±3 mA. Turn power supply one off, insert device to be programmed, and set S1, S2 to desired octal address. At each address select, one by one, the bits to be programmed with S3. Then momentarily push S4. Now, pushing S5 to the verify position should cause the LED to light if the programming was successful. When all desired bits of one word have been programmed, switch S1, S2 to the next address and repeat the operation.

Conclusion

I have two words of warning for programming either type of device. Monitor the device case temperature with your finger. Any time you can't keep your finger on the device it is time to stop for a few moments to let the device cool down. The other warning is that, once programmed, a TTL PROM is forever programmed whether right or wrong, so it takes time and care to do the job right without destroying a device. I hope this article will help those of you who have had problems or been frustrated by these devices. ■

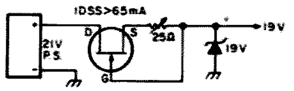

Fig. 2. Constant current supply and current regulator schematic.

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Try A Topical CQ

-- for special interest groups

When I became interested in personal computers, I developed an intense desire to talk to someone — anyone — who shared my enthusiasm for this new and fascinating hobby.

Don't let the term "computer" turn you off. This article is about amateur radio, not about computers. Bear with me for a few moments, and you'll see. I mentioned my interest in discussing computers as a prelude to disclosing a practical solution to the problem of locating someone who shares your interests, whatever they may be.

Since my home town is comfortably small, I wasn't too surprised to discover that I was the only one here who was active in tinkering with a personal computer system. Therefore, when I had questions about computer hardware or computer programming (and believe me, I had many), I became frustrated. I had no one to whom I could turn for enlightenment.

One day, as I was sitting at my bench busily creating an ulcer because I couldn't understand the instructions that some engineer had prepared to help me, I chanced to glance over at my rig. It had been neglected, shamefully, since I had become interested in computers.

Suddenly the thought struck me — surely, someone out there in the ham radio community knows how to interpret this jargon that I've been trying, unsuccessfully, to understand. As I turned on the rig and began tuning it up on 20 meters, I gave no conscious thought to the means I'd use to reach someone who might answer my questions.

"CQ computers, CQ computers," I called into the mike. "Calling anyone who can help me interpret some microcomputer buzzwords." The plea came out as naturally as if I had used the special topic CQ all of my (considerable) amateur radio life.

I wish I could report that an electronics and computer programming expert who had built and operated the exact make and model of my computer had responded. No such luck. But I did get calls from several fellows who were able to clarify the instructions that I had been misinterpreting.

In fact, three QSOs, which lasted several hours, resulted from that topical CQ. I had an opportunity to discuss and learn a great deal about hobby computers that day. It's a gross understatement to report that I enjoyed that experience immensely.

The frustration that drove me to call "CQ computers" may have had a significance for the enjoyment of amateur radio that I never before considered.

What's wrong with calling a topical CQ? Why not call "CQ color photography," "CQ Windom antennas," "CQ linears," "CQ bass fishing," or "CQ recreational vehicles"?

I realize that such CQs sound strange. But perhaps that's just because we haven't heard topical CQs before.

We are all familiar with "CQ DX," "CQ New York for a phone patch," "CQ contest," "CQ for a test," and "CQ for a short QSO." Those calls certainly don't sound strange anymore.

The beauty of the topical CQ lies in its promise of bringing together two (or more) hams for the sole purpose of discussing an announced topic in which both (all) are interested.

The rag chews that used to take place on 75 phone just after World War II were fascinating, in part, because they involved discussions of transmitter, receiver, test equipment, and antenna projects that were in various stages of construction. Most ham gear was of the home brew variety, and almost everyone was engaged in a building project he wanted to discuss. That commonality of interest was what contributed most to the satisfaction one gained from a QSO. If you doubt it, ask a ham who owns a two-letter callsign how often he stayed up until three or four in the morning chewing over construction projects he enjoyed discussing with others.

It's the search for that elusive common interest topic that occupies most of our time at church socials, PTA meetings, cocktail parties, bus stops, or most other gatherings. What we refer to as "small talk" is really this exploratory probing for a subject that interests us. Often, we start with the weather. Then we switch to the old home town, mutual friends, television, children,

traffic problems, disasters, politics, etc., to keep the conversation going while we continue our search for a common interest.

Then, without warning, we pick up a chance remark that leads to the exciting moment when we discover that someone else shares our interest in something. From that moment on, our conversation comes alive, as we share our views and experiences with someone who seems to hang on our every word. A topic of mutual interest has been discovered. The evening is a success; a new friend has been found.

A similar phenomenon occurs repeatedly on the amateur radio bands. In fact, many hams resign themselves to the expectation of a casual conversation. You hear them call "CQ for a short QSO," meaning: "Let's get together to exchange handles, signal reports, QTHs, weather reports, and descriptions of our rigs."

Fortunately, on occasion the "short QSO" can stretch into hours, if some remark made discloses that both hams have a common interest in some topic.

Back to the topical CQ.

As I see it, calling a CQ that announces your interest in discussing a specific topic comes close to insuring that you and one or more other hams are likely to have an enjoyable QSO, QRM permitting. There's no guarantee of a stimulating exchange, of course, because the expertise of all participants as well as the level of interest in the topic by participants play a significant part. But the topical call certainly holds far more promise of satisfaction than does the general CQ with which we are all familiar.

As an added incentive to use the topical CQ, think of the prospect of some ham having a rare DX call responding to your call because he is tired of hit-and-run QSOs and is anxious to discuss your favorite subject with you. It could happen.

There is no good reason why the topical CQ couldn't be extended to seeking help with some project in which you've become involved. My initial call was a plea for help in understanding computer terms, despite the fact that I was thinking of the call at the time as merely an attempt to discuss computers. There is no doubt in my mind now that I was looking for someone who might add to my limited fund of knowledge, i.e., someone to help me.

Over the years, I have listened in on QSOs during which hams have instructed one another on how to tune an antenna, adjust a discriminator circuit, rebuild a VW carburetor, remove the flywheel from a lawn mower engine, prime a water pump, repair a sailboat centerboard, and locate a locksmith on a Sunday afternoon. I have even heard a physician offering medical advice to one of his longtime net buddies, but that's carrying too far the help requests I'm advocating here.

Hams, generally speaking, are people who are unusually alert and have wide diversities of interests and talents. Few will deny that hams are responsive to one another's calls for assistance. Each of us has knowledge and experience that we are willing to share, if only we are made aware of the need.

A topical CQ can announce that need for assistance or can merely signal a desire to contact someone for the purpose of exchanging views about a subject that is of special interest to the person initiating the call.

So, how about it? If you want to talk about my current special interest, personal computers, I'll be listening on 20 meters for your topical "CQ computers" call. ■

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Call Letter Gouger

-- adds class to any shack

High school wood shop instructors are always looking for simple, educational, inexpensive projects for those students who need to be kept busy until such time that they come up with their own projects.

Keep in mind that this project must have educational value for the instructor to justify putting a student on it, and the process of education is a slow one. You will actually be doing the instructor a favor with your request, since he is always looking for just this kind of project. Shown is a piece of cedar, stained first, then routed in about 20 minutes by one of my students while he was waiting for his own project to dry before applying the next coat of sanding sealer. I'm sure WB6TJV will be pleased with the results. ■

RECIPE

Take accompanying photo to local high school wood shop instructor.
Supply him with your call letters.
Furnish $1.00 to $1.50 in U.S. funds.
Wait suitable time for educational process.
Completed callsign will be returned so you can hang it out front of the shack.

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 41

for the most part gotten into HFing.

The move by the ARRL to force dealers to sell ham gear only to hams by refusing to let them advertise in *QST* if they don't promise to be good is about what I would expect from the ARRL. There is something about the bureaucratic temperament which seems to always think in terms of punishment as a way to force people to do their bidding rather than using rewards for behavior mod. Their forcing the FCC into "incentive licensing" was typical . . . forcing hams to get a higher license by taking away bands unless they did. The bureaucratic system of making ever more laws to force people to do what the bureaucrats think is right has not been noticeably successful.

A handful of ham dealers have been making a killing for several years by selling ham rigs to CB dealers for resale to HFers. All they have to do is change a wire or two, add a couple of crystals, tune it up, and move it along for a very nice profit. The dealers, such as Tufts Electronics, which refuse to sell ham rigs to CB dealers or directly to CBers, are at a disadvantage. This loss of sales volume can mean higher prices for some equipment and slower delivery.

Traffic in ham rigs to HFers will slow down when it becomes unprofitable for the ham dealer to indulge in it. There are ham dealers out there who will sell to anyone waving money and even sue the manufacturers if they refuse to ship to them for this trade. While the entire industry looks with disgust on these "sewers," they still have to do business with them or else spend a lot of money on lawyers, with the courts eventually backing up the sewers.

Other than making ham gear in short supply for hams, what problems are HFers causing us? Oddly enough, not all that many. The added volume of sales they represent helps keep ham rig prices down and encourages the development of new equipment. The amplifiers the HFers buy are generally the higher-powered ham amplifiers and thus are relatively free from spurious emissions. Even the FCC admits that the HFers aren't seriously bothering any other service. Perhaps this explains why, though the FCC people at HQ in Washington are bent out of shape over HF operation, little is being done in the field to discourage it . . . even when ham groups get together and supply detailed information about HFer names, locations, equipment, etc.

Will an edict from the ARRL/*QST* change the ways of business when the FCC doesn't seem to really care and when the people involved are not causing any serious damage? It seems unlikely to me that this is anything more than a grandstand play. We'll see.

Ham dealers who sell gear to CBers are quite aware of what they are doing. Chuck Martin WA1KPS of Tufts Electronics comments on the ARRL demand that customers show a ham license to buy a rig, "Are you kidding? We can tell a CBer the minute he walks into the store. We don't waste time asking for ham licenses . . . it's too easy for anyone to borrow one for a purchase. One or two questions and we know who is a ham and who isn't. We sell ham rigs *only* to hams."

The FCC is terribly upset over the TVI and other interference complaints caused by the many illegal power amplifiers being sold to add on to the 4 Watt AM rigs. Since the FCC put the ethical manufacturers out of the business, they've opened the floodgates for the unethical manufacturers . . . who have no reason at all to worry about spurious responses. The result has been hundreds of thousands of incredibly dirty power amplifiers being sold and a resulting tremendous increase in interference.

The manufacturers of legal ham amplifiers have been trying to point out to the FCC that a further restriction on making clean amplifiers will obviously result in the production and sale of dirty amplifiers. Laws further prohibiting amplifiers will result in exactly the opposite desired end. There has been no sign of anyone listening at the FCC. I do think that further prohibitions of linear amplifiers would be about the worst thing the FCC could do. They'll probably do it.

COMPUTERIZED QSLS?

The RTTY chaps have been sending their QSLs by radio for many years; however, I doubt if these confirmations are considered adequate by the organizations issuing certificates.

With more and more microcomputers in the hands of hobbyists, it is probably just a matter of days before a system will be devised to allow the access of one computer by another via the telephone system for either leaving a message or picking one up. Indeed, I'd like to publish the details on the interface boards for accomplishing this, complete with details of the standards and protocols developed to accomplish a confirmed automatic message transfer.

With the phone rates going as low as 19¢ per minute at some hours, this offers a reasonable and fast system as an alternate to the U.S. mails. Even the daytime 40¢ per minute charges aren't bad for a priority message, delivered within a minute or so instead of having to wait until night.

In the past, some organizations have been very sticky about accepting QSL cards which have neither a canceled postage stamp on them nor the stamp of a QSL bureau. I can understand the situation, for one of the early aspirants for one of the *73 Magazine* operating awards sent in some QSL cards which looked perfectly okay, but were fakes. They lacked the QSL bureau stamp or postage to indicate mailing. Fortunately, the fakes included cards from some rare DX stations which I had worked, and I quickly recognized the bogus cards submitted. Tsk.

As more operators use microcomputers, we may be able to have cassette tapes of the logs submitted by DX stations and do away with QSL cards. In the meanwhile, put on your thinking cap and see if you can come up with an interim solution.

The high (and going higher) postage plus slow (and getting slower) deliveries of our postal system are going to help encourage the use of computer-to-computer messages. The Postal Service has its own problems, and it is going to be a long time before they will be permitted to tackle most of the more serious ones . . . so there is no immediate hope of lower postage or much better service.

One of the big miseries of the Postal Service is the political constraints. There are over 12,000 post offices in small towns which could be closed, saving over $100 million annually. These are kept open as a matter of town prestige, not of function. Another big lump could be saved if more rural mail could be delivered to clumps of post boxes instead of free delivery to each customer at his home. When I was young, our post box was almost a half mile away, and I didn't think anything of walking down to it . . . at least not on warm days. Of course, our farm was out a ways . . . we didn't even have electricity (it still doesn't) . . . or running water (still doesn't).

When the Postal Service is permitted to be run more like a business and less like an arm of the government, I think we'll get better and cheaper service. In the meanwhile, the pressure for faster and cheaper service may quickly force the development of computer communications. As pioneers in communications, perhaps hams will be in there with the first systems and help develop the standards which will stick with us.

CATCH 22 FOR HAMS

Early experimenters with RTTY found that they were severely limited in their possibilities by the FCC. Even though the amateur service is chartered by the FCC rules to provide inventions and pioneering, the FCC has constantly gone counter to their regulations by prohibiting any experimentation which would produce signals which the FCC monitors could not copy. So how are hams going to invent something new if anything new is prohibited? Catch 22.

One of the questions I've asked at FCC formal and informal hearings is why . . . why . . . the FCC monitors have to be able to copy ham transmissions using new techniques? If what is being transmitted is so difficult to copy that even the FCC monitoring stations can't hack it, what do they care about what is being transmitted?

Perhaps there was, long ago, the fear that hams would go berserk and send naughty words over the air if they thought the FCC monitors couldn't copy them. Well, I've a secret . . . this is probably one of the first things hams will do. So what? That gets boring very quickly and the pioneers will be on to more interesting matters. There hasn't been any proof that words will do much long-range damage, so let the child in the ham come out and get over the excitement of being able to secretly pass naughty words. Big deal. The important thing is for ham experimenters to have the freedom to try new ideas, new types of communications, new techniques. And they should be able to give these things a try without a seven-year wait from the FCC for permission.

The current FCC ban on amateurs using ASCII is, unfortunately, well precedented by earlier refusals to allow amateurs to do other just as innocuous things. Here we are being held back for years, while the FCC blunders through its molasses-slow procedures to permit what should have been automatically permitted at first request.

FCC HEADACHES

The FCC Amateur Division made the papers recently over the call letter business where one of the FCC employees was accepting cash in return for choice calls. I wish I'd heard before it got stopped.

For years I've been interested in getting W1NSD, but the FCC has put me off, saying they couldn't do it. The call has been open for about 25 years. At one time, I even put in a petition to make it possible to get counterpart calls such as this. The League liked the idea, too, and they also put in a petition asking for the same thing. These petitions, after yellowing for about eight years in the FCC files, were recently thrown out, with no reasonable explanation.

It was my own fault. I could have gotten the call if I had not goofed off. When I moved down south, I was able to get W4NSD. Later, when I moved to Ohio, I got W8NSD. That was back in the '40s and '50s. As a matter of fact, in the Sweepstakes contest of 1951, if you have an old issue of *QST* around, you'll find that I operated the first weekend of the contest as W2NSD/8 (and did quite well). The second weekend of the contest I ran as W8NSD/2 (my new call had arrived just as I was going to New York for a few days).

By 1962, when I moved to New Hampshire, the FCC had stopped giving counterpart calls. There was no rule change; they just decided not to do it any more . . . too much trouble. Having lived in New Hampshire off

Continued on page 199

73 Magazine *Staff*

Adjustable Bench Supply

-- would you believe 1.2-37 volts?

How about constructing an adjustable voltage power supply that can have up to 1.5 Amperes output with good load voltage regulation and full overload protection at minimal cost? Admittedly, a $5.00 estimate depends a lot on what parts are available from one's junk box, but for just a few dollars spent on a new IC, one can have the "heart" of a very versatile power supply.

The new IC is the LM317 by National Semiconductor. This IC promises to be as famous as the LM309, which is so universally used in power supplies for digital circuitry.

The new LM317 is an adjustable, three-terminal positive voltage regulator. Its simple external connections rather belie the complexity and performance features of the unit. As shown in Fig. 1, it has only simple in/out connections and a minimum of three simple external components are required. The output voltage is set by the ratio of two resistors, R1 and R2. By making R2 variable, one can adjust the output voltage to be any value from a few volts less than the dc input voltage to the regulator down to a minimum of about 1.2 volts output. Thus, if the input dc voltage were 40 volts, the output voltage can be continuously varied from about 37 volts down to 1.2 volts.

Although the output voltage is determined only by a resistor setting, the output voltage is regulated at *any* given setting. The regulation will be about 0.1% going from no load to full load (1.5 Amperes, assuming the transformer/rectifier used for the dc input voltage handles this current). The LM317 is also overload and thermally protected. If the current limit is exceeded, such as by a short circuit, the LM317 will simply "shut down." If the regulator gets too hot, either because of excessive load current and/or inadequate heat dissipation, it will also protect itself. Although one can destroy the LM317 like any other IC, it is pretty hard to do with any sort of reasonable care.

The manufacturer suggests two additional capacitors (C2 and C3) be used, which may prove useful in some applications. C2 is used to bypass the adjustment terminal to ground to improve ripple rejection. This bypass prevents ripple from being amplified as the output voltage is increased. About 60 dB ripple rejection is achieved without this capacitor, but it can be improved to about 80 dB by adding it. A 10 mF or greater unit can be used, but values over 10 mF do not offer any significant advantage in further ripple improvement. The manufacturer particularly recommends the use of a solid tantalum capacitor type since they have low impedance even at high frequencies. An alternative is the use of the more readily available and inexpensive aluminum electrolytic, but it takes about 25 mF of the latter type to equal 1 mF of the tantalum type for good high frequency bypassing! C3 is added to prevent instability when the output load presents a load capacitance of between 500 and 5000 pF. By using a 1 mF bypass at the output (solid tantalum again or aluminum electrolytic equivalent), any load capacitance in the 500 to 5000 pF range is swamped and stability is ensured. Both C2 and C3 will not be required for many applications where the LM317 is being used with a specific load circuit. But if the LM317 is used as the heart of a general purpose bench type power supply, they should be included.

Fig. 2 shows a PC board layout and component placement diagram. This layout has been suggested by the manufacturer, but there is no need to follow it exactly as

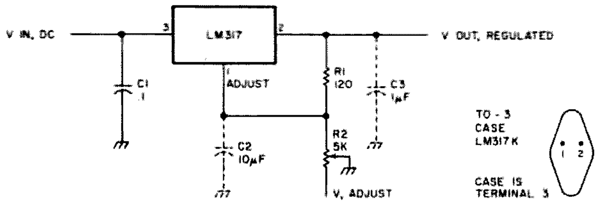


Fig. 1. Basic adjustable voltage regulator circuit using an LM317. Normally only three external components are needed, but C2 and C3 may be useful in certain situations as explained in the text.

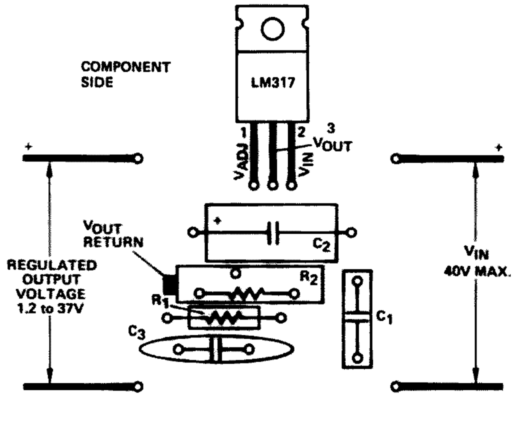


Fig. 2. This is a PC board layout for the regulator suggested by the manufacturer. R2 is shown as a multi-turn pot for ease of adjustment. The figure also shows the pin connections for an LM317 if it is obtained in the TO-220 plastic case.

long as all of the external components are grouped around the regulator with solid short leads. The diagram shows the LM317 in a TO-220 plastic case which is designated the LM317T. Most amateurs will probably prefer to buy the LM317 in the familiar TO-3 metal case and, in this case, it is the LM317K. But, when using the unit, note an important difference as compared to the old LM309K. The case on the LM309K was ground so one could simply bolt the thing down on a chassis for heat sinking. The case on the LM317K is the output terminal, so it must be properly insulated from a chassis.

Various power supply ideas and considerations can suggest themselves for the LM317. For instance, R2, instead of being a variable resistor, can be replaced by switchable fixed resistors to obtain some of the commonly used supply voltages such as 6, 9, 12, 15 volts, etc. This idea, plus a continuously variable output voltage position, is featured in the practical realization of a power supply using the LM317 as shown in Fig. 3. This supply will deliver fixed output voltages of 6, 9, 12, and 15 volts (depending upon how the trim potentiometers are set), plus a continuously variable output of 1.2 to about 24 volts. All outputs can deliver at least 1.5 Amperes with the components specified. The supply is simple to build in any size metal enclosure suitable for the components used. The only precautions to observe are to firmly heat sink the LM317 to one side of the metal enclosure and to keep the 0.1 mF capacitor going from pin 3 to ground, the 10 mF capacitor going from pin 1 to ground, and the 120 Ohm resistor going between pins 2 and 1, *all* connected directly at the LM317 terminals. The other components may be mounted wherever it it convenient to do so.

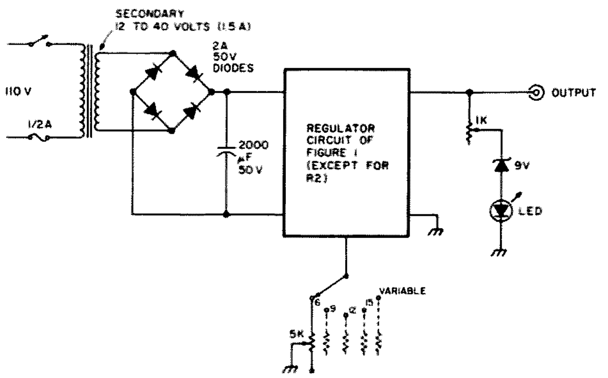


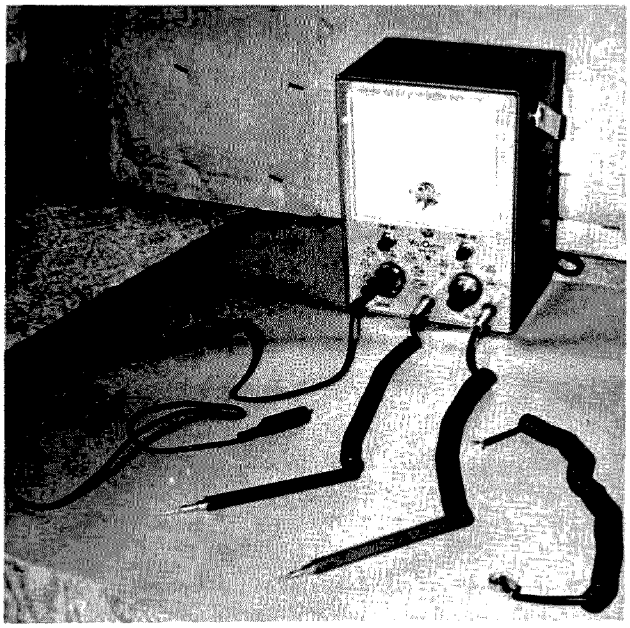
Fig. 3. A complete power supply using the LM317. The switch simply selects different 5k Ohm pots which are set for 6, 9, 12, 15, and a variable voltage output. The latter 5k pot is front panel mounted. The function of the LED is described in the text.

The zener diode/resistor/LED combination at the output of the supply serves as a crude but useful voltage output indicator without having to build a regular voltmeter in the supply. The LED just starts to glow when the output voltage is about 9-10 volts (depending on the tolerances of the components used). The 1k resistor is adjusted so the LED just glows fully when the *maximum* output voltage is reached. So by using the fixed output voltage positions (which are adjusted using a good VOM) and watching the LED, one can obtain a fairly good estimate of what the variable output voltage is set for. ■

Test Instrument Saver

-- an old phone is required

Harry J. Miller
991 42nd St.
Sarasota FL 33580



Delicate, costly test instruments may suffer severe damage when their conventional, too long leads snag on tools or on components spread out on the workbench and are inadvertently yanked off it to the floor.

A partial cure for this hazard is to replace the long leads with the much shorter coiled leads commonly used on cameras and flash units.

The coiled leads can be stretched out to where needed. When let go they retract out of harm's way. Should they lose their recoil power, rewinding the coils in the opposite direction helps restore their springiness.

Since each lead has two wires, their extra continuity gives them longer life. ■

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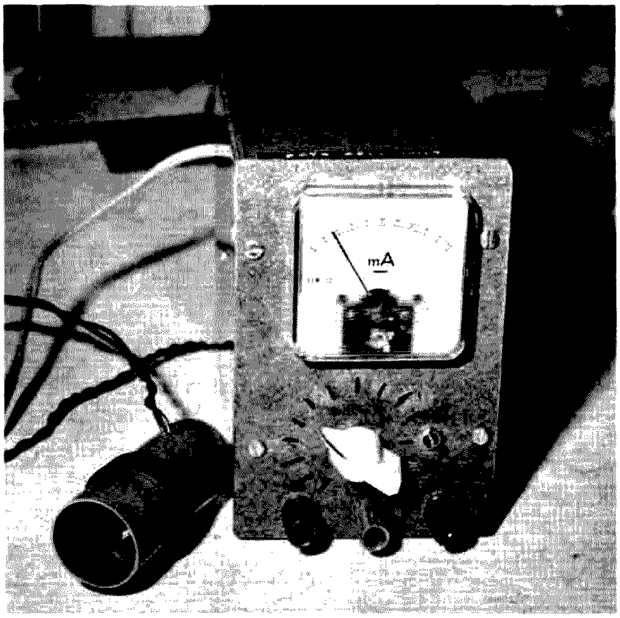
Photoelectric Bench Accessory

-- when you need an extra "eye"

Combine the leftover power supply from an experiment that failed with some twelve for a dollar CdS photocells purchased from S.D. Sales. Mix well with a lull in regular ham activities and the result is an interesting unit with many uses.

The diagram in Fig. 1 shows the basic unit. The photocell is in series with a pot. There is a voltage applied across this series combination to ground. The op amp is used as nothing more than a high impedance driver for the one mil meter used as an indicator of *relative* light flux impinging on the cell. The word "relative" is important to note, as the meter is not calibrated in any special units. Its reading is comparative only and its function is to tell you that light has either increased or decreased at any specific moment. The pot is used to control sensitivity. The higher the resistance, the greater the sensitivity of the unit. The photocell is mounted on two back to back lids from 35 mm film containers of the plastic variety. One film can makes up the body of the probe. This has a hole cut in the side to allow the cell leads to exit. Exiting the leads from the side rather than through the bottom allows the probe to be firmly positioned relative to a light source. A second container has its bottom cut off and is used for a stray light shield around the cell. These details are apparent in the photograph.



Notice that there are two outputs: One is dc coupled through an isolating resistor and the other is ac coupled through a 3.3 uF capacitor.

With the values indicated, here is an idea of sensitivity for general use. An LED energized from an audio oscillator and held next to the cell will give about ½ volt of audio at the exciting frequency when the unit is at maximum sensitivity. This makes a handy bench coupler into your counter. A sixty Watt bulb in a white glass shade will pin the meter from a distance of about nine feet as will an ordinary two cell flashlight.

If you play around with QRP rf levels and are addicted to using pilot lamps as power indicators for tune-up, this unit will allow you to convert the light into a meter reading that seems much more sensitive to slight changes than the eye. When you are fighting for each milliwatt, this is very helpful.

The unit puts out a nice dc pulse with a flash of light hitting the cell. Thus the dc output can be used for triggering an SCR or used to bias the base of a transistor used as a switch or some form

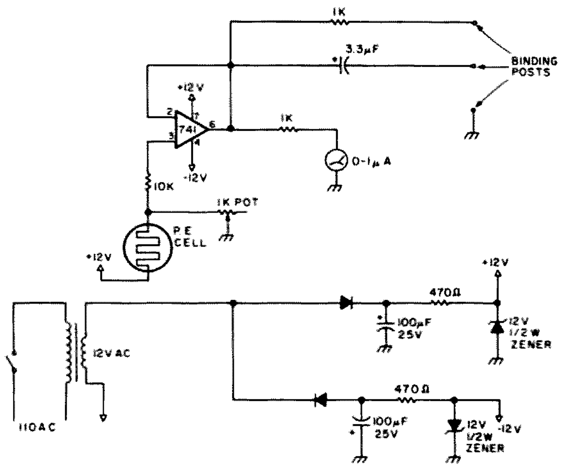


Fig. 1. All resistors ½ W.

of dc amplifier for control purposes.

If you wish to raise the overall sensitivity of the unit, merely increase the value of the pot to 5k or 10k. This will greatly raise the sensitivity but may create stray light problems. For general use, the indicated values work very well.

There is nothing magic about the voltages shown for the op amp; I used an existing supply, but six volts or so would work as well.

Note that there is no need to use shielded cable for the cell leads.

As with most projects, just about the time you get the last screw in place, there is that little voice whispering in your ear, saying, "I wonder what would happen if . . . ?" Well, this project was no exception. Fig. 2 shows what happens when you listen to little voices.

The ac power supply has disappeared, replaced by two C cells in series. The op amp has vanished because a more sensitive (50 microamp) meter has been used. The diode in series with the meter is used to provide a holdoff threshold effect so a small steady meter reading is cancelled. Either unit does about the same job of providing your bench with a photocell dimension that will find many uses. ■

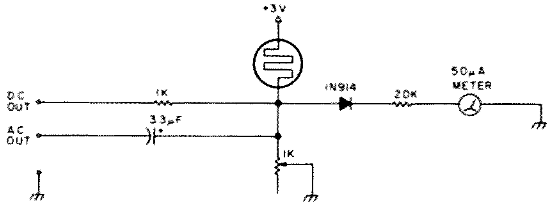


Fig. 2.

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Inside the SR-52

-- calculator doubles as micro

If you are anything like me, this business of math formulas as used in electronics today is enough to scare you half to death.

Being a basically lazy but inquisitive sort, the need for mathematical answers when designing some pet project kept rearing its ugly head. About a year and a half ago I broke down and bought my first scientific calculator, a Texas Instruments SR-50. I loved this instrument, and its ease of use made those formulas I had hated in the past child's play. But the SR-50 had a nagging problem which took some of the edge off the fun. Its problem, simply stated, was only one memory. This fact made me resort to the pencil more times than I cared. Something had to be done.

Then one day, something was done. The first programmable calculator with multiple memory came upon the market. I fell in love instantly and dreamed of the day when I, too, could carry the wisdom of Solomon in my back pocket. But the early introduction price of almost $400.00 made me hesitate. Wisdom was fine, but for $400.00 I found that I could push an awful lot of pencils.

Gradually, as time wore on, I watched the prices drop until one day it broke the magic $200.00 figure, and I rushed with sweatstained, crumpled bills to my local calculator emporium to buy my first programmable calculator ... no, not calculator but, rather, mini pocket computer ... the magnificent SR-52.

Oh joy of joys, oh thrill of thrills, for the next two days I sat mesmerized by the winking, blinking, flashing numbers. At last the drudgery of math was truly defeated.

The programmable pocket computer is a very powerful tool, and, whether you write your own programs or use those of someone else, it is a constant joy. For those of you who have recently bought your first instrument but have not mastered the knack of programming, here is a simple program to calculate Xc, capacitive reactance.

Simply stated, the formula for capacitive reactance says: Xc in Ohms is equal to the reciprocal of frequency in Hertz times capacitance in farads times the quantity 2 pi. What a drag to wade through that humbug. But with the accompanying formual keyed into your favorite SR-52 or SR-56, it suddenly all becomes child's play.

Turn on your machine, press LRN and up pops 000 00. The first three zeros indicate the step number, and the last two zeros indicate the key to be pressed in teaching the calculator its smarts. An extremely well written set of books comes with each and every machine, and in the back of the small book with the SR-52 is a chart detailing each key as to its identification number.

Now, let's key into the machine the program in Table 1.

The formula turns out to be somewhat an unwieldy one to use, as who of us uses capacitance values in farads. In step 008 the machine is told to convert farads to microfarads by going automatically into scientific notation when "EE" is pressed, and then in step 009 and 010 we enter into the program, the minus 6th power of ten. This allows us, when entering the problem's values, to enter capacitance values in microfarads and let the machine convert it to farads. Further into the program we round off our answer to two places beyond the decimal point. This is done in step 033 where we fix the number of places after the decimal point to two in step 034. If we feel that we really don't need any portion of an Ohm in the final answer, step 034 could be keyed Ø instead and the machine will then round off the answer to no places to the right of the decimal. Later, in steps 040 and 041, we tell the machine to go back to its original 10 digit display and clear all memories for a complete new set of values. Isn't that beautiful?

Let's do a sample problem and watch this wondrous little gem go through its tricks. Let's suppose that we have discovered that upon

000	46	*LBL
001	11	A
002	42	STO
003	00	Ø
004	01	1
005	81	hlt
006	46	*LBL
007	12	B
008	52	EE
009	94	+/-
010	06	6
011	42	STO
012	00	Ø
013	02	2
014	81	HLT
015	46	*LBL
016	13	C
017	53	(
018	59	π
019	65	x
020	02	2
021	65	x
022	43	RCL
023	00	Ø
024	01	1
025	65	x
026	43	RCL
027	00	Ø
028	02	2
029	54	)
030	20	$\frac{1}{x}$
031	22	inv
032	52	EE
033	57	fix
034	02	2
035	81	HLT
036	46	LBL
037	15	E
038	25	CLR
039	47	*cms
040	22	inv
041	57	*fix
042	81	HLT

end of program

Table 1.

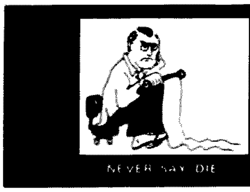
attempting to pipe a touch-tone™ pad into our phase modulator and bypass all the mic stages, we still can't key up that autopatch down the road.

Hmmmm ... the lowest frequency used in the touch-tone pad is 697 Hz, but the guys on the frequency all seem to agree that the high frequency tone is there, but the low frequency tone is very low in amplitude. Upon examination of the schematic we find that the coupling capacitor out of the inter-stage transformer in the mic circuit feeding the phase modulator is only an .02 uF.

Well, let's see ... picking up our trusty SR-52 and loading up the program, we enter the audio frequency value 697 into "A" and the coupling capacitor value .02 uF into "B". Depressing "C" tells us that the capacitive reactance of that .02 uF coupling capacitor is 11417.14 Ohms.

Gee, no wonder those guys on the autopatch can't hear the low frequency tone. Suppose we increase the capacitor value to .05 uF. What's the Xc value then? Returning to our miracle of miracles, we enter into "B" the new value .05 and once again press "C". Out spits 4566.86. Well, that's better, but not really good enough for the autopatch operation, so we try another capacitor value of .33 uF into the computer and out spits 691.95. I'll bet that works. Suddenly, after changing the capacitor to the new value of .33 uF, we find the autopatch swallowing our signal and keying up the dial tone.

If you have followed me through this exercise, you will now begin to appreciate this beautiful little handful of plastic and electrons. Loading some of the other programs that come with the instrument will truly open your eyes to the reason I, for one, will never be without my wondrous mental crutch. ■



...de W2NSD/1

NEVER SAY DIE

EDITORIAL BY WAYNE GREEN

from page 190

and on for much of my life, it wouldn't have been much trouble to get a W1NSD call back when the getting was good. Goofed.

The current frenzy over two letter calls is fun. When I suggested to the FCC that they offer special calls as an incentive to get an Extra class license (in 1963), they said that hams identified with their calls and would never go for it. Instead, they opted to punish hams for not upgrading their licenses rather than offering an incentive such as a special call. They called it "incentive licensing."

At any rate, while most of us were tied to our calls, a few found ways around the red tape. The ones involved in the conviction of the FCC chap were K8MM, K8KD, K8RS, and K8RZ, all of which now appear to have been withdrawn. All Ohio boys ... odd, since the last I heard, Ohio wasn't yet officially one the United States. They really should be issuing their own calls out there and stop voting in our elections. But that's another story, and an interesting one. It seems the Ohio legislature never actually got around to ratifying the joining of the Union, and by the time this was discovered, everyone felt it was better to shut up and not make waves.

Getting back to those licenses ... I have noticed others have managed to get counterpart calls, while I'm still living out the remainder of my existence as W2NSD instead of W1NSD.

The newspaper article made a big deal out of one of the FCC officials getting his own initials for his call. Big deal. The FCC's answer to that was that they tried to make officials more visible when they operated. That's not a bad answer. Perhaps something even more visible ... like W3A ... would have been even more satisfactory. Those one letter calls do stand out!

THE NEW "REPEATER" BAND

Apparently there are a few amateurs who have noticed that while the FCC deregulated the 144.5-145.5 MHz band so repeaters could be used there, the FCC made no mention that repeaters *had* to be used there.

With only a small percentage of the currently operational repeaters being used much, it seems counterproductive (dumb?) to start allocating a whole new bunch of channels for repeaters. Yes, I know that every red-blooded ham will not be happy until he has found out how difficult it is to set up and run a repeater of his own. Yes, I know that few of us are able to learn from the experiences of others and that most of us prefer to make our own mistakes, no matter the expense in time and money.

As the past setter-upper and maintainer of some repeaters, I can testify as to the trouble and expense. As a matter of fact, I suppose I should write up some of the adventures in repeatering as a humor article for *73* — the wading through four feet of snow to get to a locked-up repeater — the two snowmobiles in the barn just to get to the repeater site — all so a small group of misfits who had been chased off every other repeater in New England would have a place to spend the remaining days of their unproductive lives.

Should I mention the purchase of the duplexer? It seems that when you use a duplexer there is a little problem which gets kind of glossed over in the literature ... temperature. Temperature is something of which there is a great lack on top of a New Hampshire mountain during the winter. So this chap (a *73* staffer), who shall have to go unnamed, figured out a fix for that problem ... he set up a heater near the duplexer and I just about had heart failure when the electric bill came the next spring ... $350 to heat that damned duplexer. Let me know if you want to buy a duplexer cheap ... very cheap. I gave away the repeater.

So, do we need a whole new raft of unused repeaters in the newly deregulated MHz, complete with the usual wars between SSBers, CW DXers, AMers, and all the groups who have already announced that they are ready and willing to go to war? Why is it that the very first reaction to any change is to threaten war? I get the feeling that a lot of hams are excited over the prospects of getting back to war ... it's more fun. Cooperation has led to very dull repeaters and a big loss of interest. Now, a good hot war ... ?

Well, you do what you like. I really don't care if the repeater fans (and I'm one) have terrible battles over whether to go 20 kHz splits, or 30 kHz with 15 kHz unusable splinters (who *ever* learns from experience?). And I'll cheer on the sidewinders and their forays against the terrible repeater groups ... and the AMers leaping out to do battle with any repeater which dares to set foot inside the new band ... etc.

If people want to be foolish and waste their time and energy fighting instead of inventing and pioneering and trying to move things ahead, I'll do what I can to ignore them. It's a pity ... just think of all the new things we could develop if we would spend our time in a positive manner. We could develop some fantastic repeater systems — with automatic calling and message handling — with microcomputer interface — perhaps as an adjunct to burglar, fire, water, etc., alarm systems in hams' houses — tied in with ELT for locating planes which are down ... etc.

Just why the FCC didn't open the rest of two meters to Techs is one of those mysteries. Frankly, I think that was dumb. If the lack of a full MHz hasn't forced Techs to get a General license in all these years, why will the lack of a half meg do it?

WARC PROPOSALS

A reader sent along a copy of some of the foreign proposals for band changes which might interest you ... particularly if you have been worrying about whether to buy a new rig now or wait for one which will include those promised new ham bands which we will be getting after the ITU meeting in 1979.

The BBC proposals (remember, that is the British government) are to resolve the sharing of the 7100-7300 kHz broadcast band with amateurs by re-allocation (moving out the amateurs). They further point out that it is necessary to at least double each of the shortwave broadcasting bands below 20 MHz. Guess whose bands would be affected?

The BBC also wants to use up most of the ham 220 MHz band with added television allocations ... up to at least 223 MHz. Whoops, there goes 220!

The BBC will not have things all their own way with this TV plan, for the C.E.P.T. (Central Europe governments) wants to allocate 174-235 MHz for mobile service. They also are proposing 41-68 MHz for mobile (there goes six meters!) and a mobile service in the 430-432 and 438-440 MHz bands, replacing amateur use of those bands. These decisions were reached at a meeting in Puerto de la Cruz in 1974 and revised at Malaga-Torremolinos in 1975. They will probably stick.

Obviously we may lose more than just our low bands at WARC.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, 73 Magazine. 2. Date of filing, [illegible] Sept 1977. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $15.00. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor, and managing editor. Publisher (Name and Address) Wayne Green, Peterborough, N.H. 03458. Editor (Name and Address) Wayne Green, Peterborough, N.H. 03458. Managing Editor (Name and Address) Jack Burnett, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Name, 73 Inc., Peterborough, N.H. 03458. Wayne Green, Peterborough, N.H. 03458. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM) The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 100,416 (Y) 102,341. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales, none. 2. Mail subscriptions (X) 93,880 (Y) 95,744. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 93,880 (Y) 95,744. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 1,786 (Y) 1,860. E. Total distribution (Sum of C and D) (X) 95,666 (Y) 97,604. F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 4,300 (Y) 4,737. 2. Return from news agents (X) 450 (Y) 0. G. Total (Sum of E, F1 and 2 — should equal net press run shown in A) (X) 100,416 (Y) 102,341. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. [illegible] Smythe, Business Manager.

Boost Your TR22!

-- with a mini rock crusher

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My TR22 is a very nice rig, but it is a little short on the power output side to reach some of the more distant repeaters full quieting. There have been several modifications published that would increase the power output of this rig, but they all have common drawbacks: 1) There is barely enough drive for the final that is in there now, so the drivers have to be reworked to give more power. 2) The increased power means increased battery drain for the times that I want to use it on battery power. And, 3) the increased power doesn't help my other HT, when I want to use that at the QTH or mobile.

The easiest and most flexible solution is to build an outboard power amp, which will connect to either HT and can be used in the car as well as the house. (Actually, given the price and effort to build these, you could build an extra and leave it in the car.) The cost for construction is under $15, and it takes less than an hour to build.

Depending upon the transistor used and the rig driving it, you will get 9 or 10 Watts out with a 2N5590. If you have a higher-powered HT or base rig, you could substitute a 2N6081 (1.5-2 W drive, 15 W out), a 2N6082 (3-5 W drive, 25 W out), or a 2N6083 (30 W out), or, if you have 7-10 W available, you might try a 2N6084 (40 W out) or 2N6097 (40 W).

These would all use the same basic amplifier circuit. The 2N5590 and most of the others listed are available from CeCo Communications, 2115 Avenue X, Brooklyn NY 11235 (a *73* advertiser), and are reasonably priced (the 2N5590 is about $6, the 2N6081 is about $7, currently, and the others are comparably priced).

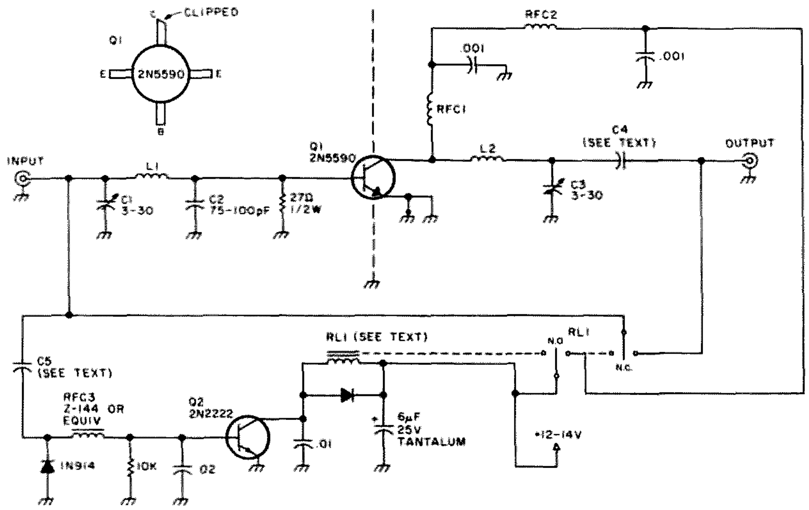

Fig. 1.

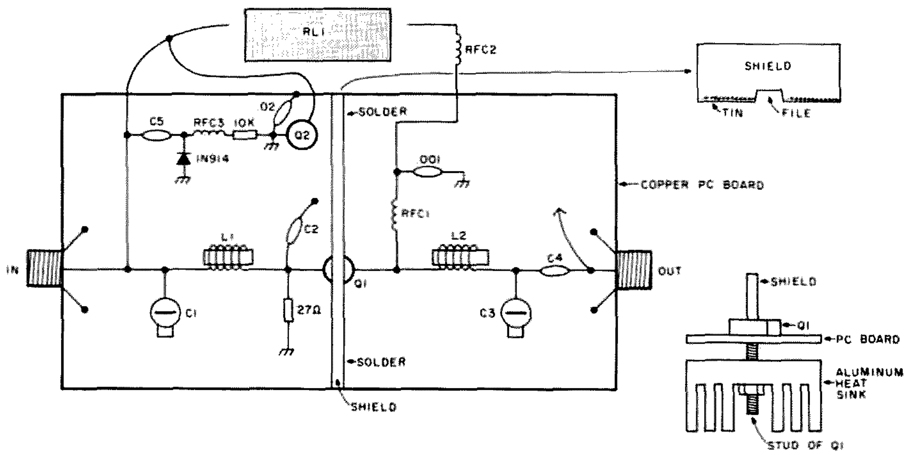

Fig. 2. L1 — 2½ turns #22 solid wire; L2 — same as L1, ¼" diameter spaced ¾"; RFC1-2 — approximately 6 turns #22 solid wire (insulated), ¼" diameter close spaced.

Construction

The amplifier is constructed on a piece of copper PC board, mounted on a finned aluminum heat sink. The stud of Q1 is used to mount the board to the heat sink. A scrap piece of PC board is filed to clear the case of Q1, and soldered to the

main board after the transistor is mounted and the emitter tabs are soldered to the main board. This acts as a shield between the input and output circuits. Layout is simple (see Fig. 2) straight-line construction. RL1 is a DPDT 12 V relay, with 25-50 mA coil current. (A relay with a higher coil current could be used, but the 2N2222 type transistor should be replaced with one having a higher current rating. The cheap plastic TO-220 type audio transistors should work fine for this application.) Radio Shack stocks a relay with the right current, available for a few dollars.

L1 and L2 should be dipped, with a few feet of coax connected. C4 can be a disc ceramic, about 40 pF. If really fine tuning is desired, it could be replaced with a 50 or 60 pF trimmer. C5 is a 1.5-7 pF trimmer. It could be replaced with a fixed value cap, if desired. 2-3 pF should work for a small hand-held HT or TR22 (1-2 W range), or a gimmick could be used for the higher power rigs (when used with the higher power transistors). In either case, the minimum capacitance that will give reliable keying should be used.

Tune-up/Operation

Connect the amplifier to a power source, and connect a wattmeter to the output with a dummy load. Tune C1 and C3 (also C4, if variable) for maximum output. Now back down C5 until the relay drops out, and increase it slightly until it keys reliably.

You might now connect the wattmeter to the input and check swr. C2 may be varied to get the lowest swr (with retuning C1), if the swr is high. Connect the wattmeter to the output, connect an antenna, and repeak for maximum. This completes the tune-up. A switch may be added in the power lead, so the booster may be shut off if not needed. ■

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QRM on the Moon?

-- yep, on all bands

A while back, I had occasion to do some design work to determine the best frequency to be used by an explorer using a handie-talkie on the moon's surface. In that work, I had to calculate the signal levels arriving on the moon from all known Earth transmitters, to determine which frequencies were so QRMed that they would be a bad choice. The results were quite interesting in that they showed that most frequencies are already "occupied" on the moon by Earth QRM.

It may surprise you kilowatters to learn that your idle chatter bombards the moon with readable signal levels. If there had been moon people, they would have had little problem knowing all about Earthlings, since they could have merely turned on their radios and TV sets to monitor just about any station in the world broadcasting on frequencies above the broadcast band. Many persons will kind of suspect that TV signals with their 1 megawatt effective radiated power (ERP) might reach the moon, but few hams whom I have talked to even suspected that their QSOs regularly reached the moon.

Ham signals above 80 meters frequently reach the moon at enough strength to be quite readable, if a receiver up there using a decent antenna was tuned to the frequency. Most moderately powered transmitters that use dipoles, which radiate appreciable power straight up, reach the moon when it is high in the sky, providing the ionospheric critical frequency is low enough relative to the transmitting frequency to permit the signals to punch through at high radiation angles.

For those hams that may be rusty on their critical frequencies, Fig. 1 gives a typical summer and winter curve showing how these vary versus local time. In using this chart, remember that 12:00 local time is high noon by the sun, regardless of what your clock may indicate. Study of Fig. 1 reveals that the 40 meter signals punch through all the time except for a couple of hours each noon in the winter. Eighty meters punches through only late at night through early morning, and bands above 40 punch through always.

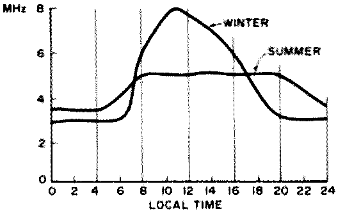

Fig. 1. Typical critical frequencies.

To show the signal levels arriving on the moon, Fig. 2 presents their level when the transmitter is 1 kW, and both the Earth transmitter and the moon receiver use ordinary dipole antennas. Notice that even on the moon one cannot escape static completely, since the galactic noise still prevails much stronger than pure receiver noise. The lower sloping curve on Fig. 2 shows the value of galactic noise versus frequency. To estimate the quality of signals reaching the moon, for example on 40 meters, consult the chart at 40m and read the received signal level as being -97 dB below a milliwatt (dBm). The galactic noise at 40m is about -107 dBm, so the signal to noise ratio will be about 10 dB in a 2 kHz SSB bandwidth, which is the bandwidth the chart is designed for. This 10 dB is not a very hot signal, but it is readable.

If antennas with vertical gain were being used instead of free space dipoles, such as, for instance, ordinary dipoles within a quarter wave of ground, a larger signal would prevail. For example, if a Super Gain[1] antenna was used on each end of the link, 14 dB more gain would result, giving a 24 dB signal to noise ratio, which is quite readable indeed. CW fans may rejoice in the fact that CW truly booms into the moon. This is because the human ear is equivalent to a 50 Hz effective pre-detection bandwidth, when using a receiver with a product detector. Therefore, CW has a bandwidth compression factor of 2000/50, or about 40 times, which amounts to 16 dB more signal to noise ratio over SSB voice. Thus, even a 100 Watt rig is very readable on the moon if CW is used.

Of course, there will still be the usual QRM from other hams on the same frequency, even on the moon. However, since beams and vertical antennas put very little signal straight up, those with such antennas will not QRM the moon, and the net result will be much less congestion on the moon.

The above values of signal levels are given in dBm, which are very familiar to all who do serious work in communications, but dBm may be unfamiliar to many hams whose usual jargon references signals in the notorious S meter system. I cannot convert to S values, since each receiver is different in its indication of S level, and gross differences even exist between similar units on a production run. However, the value of -97 dBm represents

[1] See *73*, Oct., 1970, pg. 8 for description.

3.8 uV in a 50 Ohm line. You will have to calibrate your receiver to determine what that would be in S units on your rig. Anyhow, this is a piddling signal for anyone who would try to communicate on Earth. Earth static and QRM are severe, and would completely mask such a weak signal. However, on the moon, such a signal, small though it is, would be above the noise and static far enough for useful communications.

So, you guys on the UFO net, be advised that the moon is listening, and one would be unwise to bad-mouth saucers, for this might offend some compulsive young saucer captain who may use his laser to ionize a conducting path between the nearest ripe thunderhead and your antenna, thereby delivering a bolt directly into the shack creating much smoke, reverence, and no doubt setting some record for the shortest though loudest digital message ever sent. Also, those who would like a temporary respite from our unresolvable terrestrial problems may want to contemplate what callsign the first moon DX expedition should have. ■

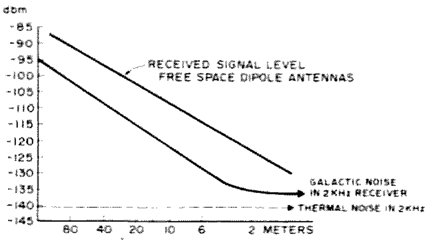

Fig. 2. Received signal levels on the moon in typical SSB receiver.

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Filcher Foiler Car Alarm

-- car door operated

I have been a VHF enthusiast from the time I first knew of the 2m band, and I prefer mobile work most of all. This was to my advantage while in the Navy, as I could take my QTH with me wherever I might be stationed.

Now that I am a civilian, I decided to become more active and help save some of our frequencies. In Montana we had a great group on "two" but nowhere else in the VHF range. So, joined by another ham, I decided to do some work on 450 MHz. Since I own an IC-230, I fell in love with the IC-30a when I saw it. We both bought a unit at a great savings through the local dealer to help get our 450 effort off to a good start.

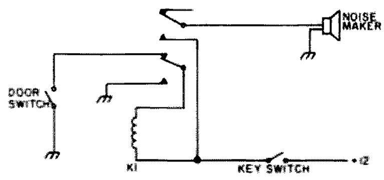
Since I owned a Pinto, I didn't really have the room for both rigs or two antennas, so I was always with one rig or the other. I soon tired of this ordeal (and decided to help the economy too) and bought myself a new Dodge van. Now this was big enough to hold my IC-230, IC-30a and my scanner, with enough roof to make the thing look like a porcupine. After weighing many options, I decided to make a shelf above the sun visors, since none of the rigs were more than two inches thick. I spent one whole weekend drilling holes, filing, sawing and having a great time. I then stood back and was pleased with what I saw. From left to right, the shelf was occupied by the IC-30a, the IC-230, the discriminator meter and, finally, the scanner. I still had plenty of room for a 6 meter or 220 rig in the future. I used the mounting hardware that came with the Icom gear. I put wood screws through the two holes in the clamps and affixed them to the shelf. I thought this way they were solid, but could be taken out if they ever failed (my first mistake).

Having never had any ham gear stolen, even in California, I didn't think about it. But I did always lock all the doors when I was away. Then I came out Saturday morning (one week later) to find my van raped and my IC-30a savagely ripped away from the shelf. The power and speaker cords were cut, but not the antenna, which had a slip on fitting since the SO-239 was metric. Once I got over the shock, I put out a QST (*A general call to hams, not a magazine. — Ed.*) on 2 meters to let them know what happened. In a daze, I then called the police and went through all the paperwork.

I made up my mind right then that this was not going to happen again. I called a few places inquiring about alarm systems. The prices varied from $80 to $150 for a complete job. I then gathered up my ham pride and decided I could build one for less money. After about ten minutes of head scratching, I came up with the circuit in Fig. 1. It is very simple and the total cost of parts came to about $25 to $30. All parts can be bought at Radio Shack except the door switches. They are the "dome light" type and must be bought at an auto parts store for about 79¢ each. If any door is opened the relay energizes and latches, putting plus battery to the noise maker. The only way to turn it off is to come to the vehicle and turn the key switch off. The relay I bought wasn't the best and needed some adjustment before it would quit buzzing and latch like it should. This part should be the best money can buy, as it's the heart of the system.

Since my van was new, it was a simple matter to install the door jam switches. Run all the wires to a common switch bus terminal, wire up the relay and mount the key switch. A mercury switch could be added so that if the vehicle is even bumped the alarm will go off. I now had a system ready to let me know if anyone got in. But how could I slow them down if they did get in?

The best way to come up with a solution is to think like a thief and figure out what would make it hard to take something. First, the nice mounting for the Icom gear had to go. I took the radio apart and found I had a lot of room inside near the front. So, I bought some "stove bolts" and drilled holes through the shelf and the bottom panel of the IC-230 case. With this bolted to the shelf, I put the radio back together around this bottom panel. This way, the thief would have to take the time to take the radio apart and, if he wanted the bottom panel, he would have to unbolt it. To do this, he would have to take the shelf down from the six flat iron brackets that hold it in place, with three screws through each of those. I did the same



with my discriminator meter, but my scanner was another problem. There wasn't any room for stove bolts, so I put four wood screws through the bottom panel into the shelf with huge washers (2 inches across) under the counter-sunk screw head. I then put the scanner back together around this bottom panel.

It took me a half an hour to assemble the radios onto the shelf and put the shelf back into the van. I am sure that if they want them badly enough there is a way, but my arrangement should certainly slow them down.

As someone once said, "an ounce of prevention is better than a pound of cure," so naturally I had the van insured for everything. I found out that I should get all but the $25 deductible back from my insurance company. I had had the IC-230 individually insured but hadn't yet done so for the IC-30a. If so, I would be getting the total value back. I found out from my agent that, with the measures I had taken, there was no question about insuring against theft with a blanket policy "covering everything that's in the van at the time." This is at about the same cost as the single policy I now have on the IC-230.

Since there are a few of us who would rather run these "rice box rigs" instead of commercial gear, and since the rigs look a lot like CB rigs, we must do what we can to keep these nice rigs from being borrowed by our "break in" brothers. I hope what I have done might help at least one fellow ham hold onto what he has saved for years to buy and enjoy. ■

Be sure to include a mercury switch attached to the hood if your vehicle's battery is accessible without entering the passenger compartment. Thieves have been known to clip battery leads to disable alarm systems. — Ed.

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Quick Deviation Meter

-- for the IC-22A

Sooner or later a 2m FMer will find a need for a fairly reliable deviation meter. As is the case with most test gear, the cost of a commercially-prepared deviation meter doesn't make it a justifiable expense for the casual user.

However, being strong on need, yet weak in resources, an inexpensive deviation meter became a must for me. Going on the philosophy that a deviation meter is nothing more than a stable FM receiver with a visual readout, I took my trusty IC-22A and a VTVM and experimented. As a result, here's a quick and easy modification to an IC-22A which will allow for deviation measurement of other 2m FM transmitters.

Connect one end of a 9-inch length of #22 insulated wire to the junction of D2 and R43, located in the ratio detector circuit. Connect the other end of the wire to any open terminal on the accessory plug (Fig. 1).

Obtain, through any legitimate means, a VTVM with a 1 volt range and an rf probe (I used a Hewlett-Packard 410B and had excellent results). Attach the common lead to any ground point on the IC-22A. Plug the tip of the rf probe into the slot in the accessory plug which matches to the terminal now connected to the D2/R43 junction (Fig. 2). Turn on the IC-22A, and tune to any reasonably active frequency. Engage the squelch, so no noise is heard when no signal is present.

Now, turn on your VTVM, let it warm up, and set it for ac, 3 volt range. You'll notice that, when no signal is present, a fairly stable voltage of approximately 1.2 volts will be present. When an unmodulated signal is received, the voltage dips to roughly 0.8 volts. As modulation is applied to the signal, the voltage may then vary from approximately 0.8 to 1.0 volts.

In order to observe the variable voltage better, change the VTVM range control to its 1 volt position. Now, during a period of unmodulated signal input, adjust the meter setting to "0" or "center," whichever suits you best. As a result, when modulation is applied to the input signal, a meter movement following the pattern of the modulation will be observed. The observed modulation pattern will conform to the deviation of the input signal.

It is now necessary to compare meter readings to known deviations. I have found that on my IC-22A, utilizing a regulated 13.6 V dc supply, a peak deviation of 5 kHz will cause a peak voltage reading of 0.2 volts from my adjusted "0" setting. However, this may vary slightly on different IC-22As, depending on power supply stability, component accuracy, etc.

When using this quickie deviation meter, make sure that the input signal is not strong enough to desense the IC-22A. Also, be sure to measure deviation on a simplex frequency, not through a repeater. ■

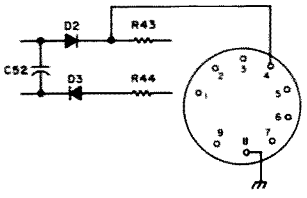

Fig. 1.

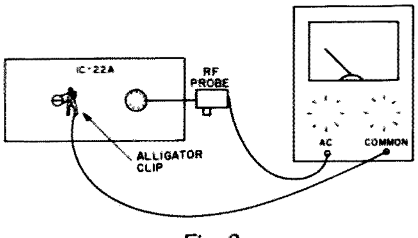

Fig. 2.

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Build a Noise-free Power Supply

-- avoid spikes with sine waves

I've been doing a lot of experimenting with miniature solid state receivers the last few years and in most cases have stuck with single 12 volt power supplies just in case I should want to use batteries at some time. Most of the ICs I use are designed for nominal 12 volt operation, and when a few op amps are sprinkled into the circuit, I generally offset the output to 6 volts by biasing the non-inverting input with a couple of resistors and ac coupling everything. This is common practice and in most cases quite satisfactory.

Then I became intrigued with the idea of using a PLL in one of my designs, but the NE561 needed at least 13 volts for satisfactory operation. Besides the PLL, I had several 741 op amps in the audio and agc circuits whose performance could be improved by the use of dual polarity supplies. An ac supply capable of providing 3 voltages was no problem, but battery operation would call for a converter of some kind.

In the past I've built my share of dc to dc converters using saturating cores and switching transistors, but it seemed I always had a terrible time taming these beasts. Tremendous spikes would show up on the output and cause all kinds of problems in the equipment being powered by this pulse generator. This time I decided to cut out the problem rather than try to cure it. Instead of the customary square waves, I thought I'd start with a pure sine wave and use an audio amplifier to build up the level to a value suitable for feeding into a power transformer.

The idea worked quite nicely and a schematic for the converter is shown in Fig. 1. The majority of the receiver circuits operated from 12 volts and were fed directly from the battery. The NE561 was run off the +15 output and the op amps from both outputs. My circuit drew about 5 mA from each output, but as much as 10 mA should be possible.

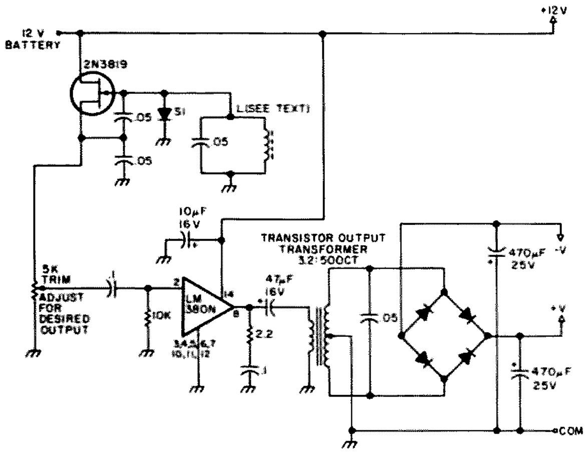

Fig. 1. Schematic for the spike-free power supply.

All kinds of chokes and transformers were tried in the oscillator tank circuit, but eventually it was found that a hand wound pot core inductor worked best. The pot cores I used were obsolete Ferroxcube parts, but similar units should work as well. Mine are about 3/8" in diameter and 5/16" thick with both halves assembled. Material is Ferroxcube 3C. The bobbin was wound with 800 turns of #44 magnet wire. On a homemade bridge, the inductance checked out around 700 millihenries. In the power supply the oscillator frequency is around 900 Hz.

An LM380N audio amplifier IC is used to drive the voice coil side of a standard 500 Ohm to 3.2 Ohm output transformer. I used Radio Shack #273-1379. The bridge rectifier is one of the small plastic units about the size of a TO-5 transistor case. The transformer center tap is grounded and the dual polarity voltages taken from either side of the bridge. Output level is set by the 5k vertical trimmer which controls drive to the LM380. This control should be set with the load connected. All decimal value capacitors are 50 volt discs and the rest are electrolytics. Resistors are ¼ Watt carbon. The silicon diode may be a 1N914 or any other type used for switching or general purposes. Other JFETs will work in most cases as the oscillator transistor. Just make sure you get the right pins in the right holes since not all packages have the same pinouts.

Tests made with ±15 volts out and 10 mA load on each supply showed a maximum ripple of 15 mV peak to peak. At 5 mA loads, the ripple dropped to 8 mV peak to peak. Input current from the 12 volt source was 85 mA and 55 mA respectively. This is not particularly good efficiency, but at these low levels it was of no great consequence. The 900 Hz hum was just about audible with the receiver quiet but normally was lost under background noise.

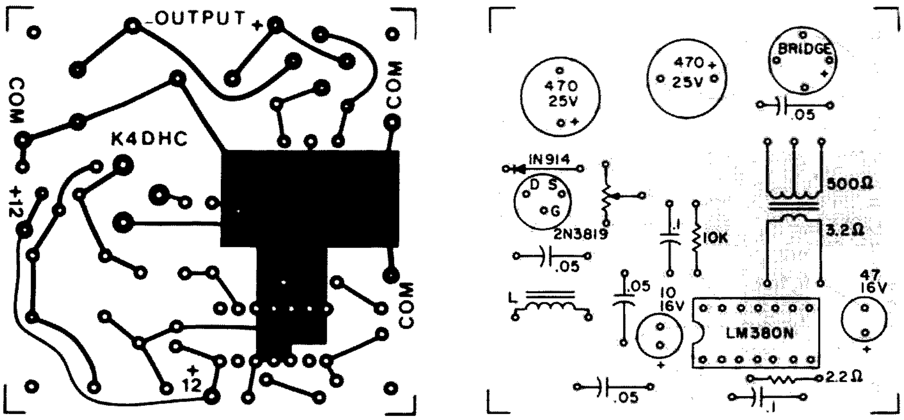

Fig. 2. PC board layout and parts location as viewed from copper side.

The PC board layout and parts placement are shown in Fig. 2. The board is 2.3" square. The pot core inductor was potted in a cylindrical form after winding and provided with 2 radial leads for insertion into the PC board. A finished inductor and undrilled board are available from me for $5 including postage. ■

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Surplus Goodies

- - are they really for you?

The question of whether or not government surplus is for the Novice deserves a simple answer, but an unqualified answer cannot be given. It resembles the question, "Should you build or buy?" The answer depends on the ability of the Novice. Generally, the surplus market is not for the Novice. The best advice is to look, but don't buy. It sounds easy, but surplus is sometimes difficult to leave alone. Many of the new units can't be utilized in their present forms, but they look so pretty that it is normally assumed a useful conversion is possible.

Leave it alone. Especially if you do not have the loot to play with. If you are lucky enough to become a Novice already possessing the knowledge and skills of an electronic technician, the value of the surplus will be apparent.

Another deterrent to buying government surplus is the new Novice regulations governing power and frequency control. Two hundred fifty Watts is unusual in military equipment. Most units are rated much lower in their outputs and are seldom worth the money if any thought is given to upgrading your license in the future. Yet the outlay of several hundred dollars to obtain one of the late model transceivers is not the wisest of moves if you consider the possibility of losing interest in amateur radio before advancing to a higher stage in the license process.

Assuming the interest is there but the money isn't, at least one surplus buy may be in order: a receiver. Check the bank account and see if you have ten or fifteen dollars that can be used for a trip to the nearest surplus or junk dealer that has government surplus materials in stock. Do not be influenced by the prices advertised by the many mail-order houses that dwell on the misinformed nontechnical Novice. Keep in mind that you can spend a bunch of green for a great receiver that will provide features you won't find anyplace else. I would recommend that you do so if it's affordable. There are many available at any price you would like to pay.

One of the most important steps to take before visiting the local surplus house or yard is to familiarize yourself with surplus equipment that has been used in amateur service during the past thirty years. Careful scanning of the catalogs issued by several of the surplus mail-order houses and, if they are available, old copies of various ham magazines can supply a great deal of information. There are a few units still available from World War II that require very little, if any, conversion.

A recent trip to the local surplus dealer to buy a piece of angle iron for a certain project turned up something more and is a common occurrence. Digging through towering piles of so-called junk left out in the weather, I found several old BC 342 receivers and ARR 7 receivers. The covers were in bad shape . . . paint flaking, mildew, and other indignations that had been thrust upon them by the years of bad weather and the rough handling that is apparent in a junk yard. Producing one of the small screwdrivers that I normally carry on my salvage trips, I had one of the receivers open in a flash. Everything was intact and spotless on the inside. The junker wanted ten bucks for the four receivers, two BC 342s and two ARR 7s. I offered him five and he settled on six if I took them all. I did.

The BC 342 is a big piece of reliable iron with tubes. It lacks many refinements but it will get you to 18 MHz, just short of 15 meters. It is better used as a general coverage radio, although many have been used in amateur service. It is one of the few that will operate unconverted.

The ARR 7 is a military version of the old Hallicrafters SX-28 modified to conform with most aircraft equipment of World War II. All the controls were moved to the end of the chassis so that the radio could be inserted lengthwise into the aircraft. The addition of an audio output transformer, a power supply, and a couple of wiring changes can provide an excellent and inexpensive way to listen in on all the activity from the broadcast band to above ten meters (.55-42 MHz). There have been later models but, as with most equipment, the price goes up along with the later release date. And sometimes it isn't as good in quality.

These are just two examples of what you can find if you do a little digging.

If you are like most who develop an interest in amateur radio, one of the first events that takes place is making friends with that guy down the street who has the wires hanging all over his house. If he is a do-it-yourselfer, you will learn something from him and he can give you a big assist in buying, building, or modifying existing equipment.

Besides a telegraph key, you can pick up a low power surplus transmitter that will perform satisfactorily. Contrary to the "power mongers" that are graduating from the CB ranks (if the shoe fits), it really isn't necessary for Novice operators to have a large transmitter output. The increase from a maximum 75 to 250 Watts input was

apparently an attempt at appeasing manufacturers of equipment under the guise of providing an "extra" for the Novice. If the main interest is learning and increasing code speed, power isn't going to help. Fifty Watts more or less will do the job. There are many used commercial models selling for twenty or thirty dollars. Some for less. Most of these are crystal-controlled, which is the biggest drawback. A VFO (variable frequency oscillator) which allows the operator to dial the transmitting frequency is probably the one late improvement that nullifies the increase in power. If your signal is covered by a stronger station, a simple twist of the wrist and you can transmit somewhere else on the band.

With the addition of a transmitter, the one item that remains is an antenna. Several things will determine what your antenna requirements will be. The length of an eighty meter dipole in most cases makes it a difficult antenna to install. Since the main objective is to keep the cost down, the most logical is a dipole. Not only will this be less expensive, but also the results that are obtained are more satisfying. The problems involved are mainly with the area needed to install a piece of wire in the length required. If you intend to operate at night only, then you can eliminate the possibility of ten and fifteen meters and concentrate on putting up a little over sixty feet of wire. I personally preferred fifteen meters due to lack of noise, less crowds, and less room needed for the antenna. Regardless of which band you choose, you still have to have the antenna.

A unit that has been on the surplus market for years and is now obsolete contains the ingredients plus quite a few little odds and ends that you can have fun with. The old CRT-3 (Gibson Girl) survival radio transmitter can be found in almost any junk yard. If you don't know what one looks like, and you missed seeing Robert Taylor use one in the World War II movie, "Bataan," I shall try to describe one. In kit form it comes in a canvas bag with a lot of accessories: balloons, kite, hydrogen generators, telegrapher's key, parachute material, and antennas. Usually the transmitter is found without the accessories, and can be bought as scrap metal. It has a kidney shape with a folded handcrank. There is a door on the front case that contains a fully prepared reel of stranded copper wire. If it is a junk unit, the reel is easily removed. It may cost you two or three dollars at the most.

Any other "buys" of surplus gear would be a waste of money. Many of the items carried by the surplus dealers are truly bargains, but not for the Novice. Some test equipment and other units can save you a bunch of money at a later time when knowledge and experience overtake the desire to proceed to higher goals in amateur radio. This not only applies to the Novice, but also to the older group that is presently migrating into amateur radio.

With the equipment listed or other government surplus units, you can get on the air inexpensively and find out if amateur radio is really for you. There are many ways to equip the Novice station. This has been but one. There are other pieces of surplus that can be utilized without conversion, but the price eliminates the equipment from the bargain category.

The simplest method is to avoid surplus as a Novice. It will save you time and money. ■

Author's note: The December, 1962, issue of *73* featured a conversion article by James M. Stueber W5UOZ. It's one of the most complete ARR 7 conversions available.

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Try A New Mode!

-- don't let boredom strike

I know exactly how it was. You snatched that Gettysburg-postmarked envelope out of the postman's hand, not even giving him a chance to give you the bills and junk mail, lit a streak down the basement steps, and had the filaments warming up while you tore into the thing. And there it was – your own amateur license, complete with totally unpronounceable call letters, indecipherable signature, and of a size so it wouldn't fit your wallet, no matter how you folded it. In short, it was beautiful!

Then you made that first contact, hand jerking spasmodically on the key, sweat dripping off the end of your nose onto the logbook. And from there, you fell deeper and deeper into the euphoria of amateur radio.

It could be now, though, that you've cooled down a bit. Call it the sophomore slump, the child-and-his-new-toy syndrome, or whatever, but you've reached a point where you don't really want to talk about the weather with that guy in California or get another 579 from New Jersey. You find "Starsky and Hutch" more interesting than a dead fifteen meter band. And when the ice storm gets your dipole, you keep forgetting to put it back up.

Recognize your symptoms?

There are two ways you can go now. Sit there, molting, and let your hobby, rig, and license go down the tubes. Or use a little imagination, inject some excitement back into amateur radio, and have the time of your life – even more fun than when you tore into that envelope from Gettysburg.

I'll bet we've all heard about the fellows who dropped out, letting their licenses lapse, blaming it on "twenty meters went to the dogs," or "I couldn't get my code up for the General," or "I was just so busy down at the office." With lame excuses like that, no wonder they couldn't muster up any imaginative ways to get some life back into their hobby.

If you will just stop to think about it, you can probably come up with many ways to perk up your enthusiasm, and most of them can be accomplished sitting right there in front of the rig. Can't think of any? Read on!

Have you ever checked into a traffic net or relayed a message from a homesick serviceman back home to his folks? One of the biggest thrills you can have is to hear a tearful mother's voice on the telephone thanking you for letting her know her son or daughter has survived an earthquake. I know from personal experience what satisfaction it is to allow a missionary in a remote South American jungle speak with his family back home. The day-to-day handling of formal messages on the ham bands involves hundreds of amateurs in a valuable public service activity.

You can find the nets in your area by listening or by sending a self-addressed, stamped envelope, 6" x 9" or larger, to the American Radio Relay League, requesting the net directory. The procedures used can be quickly learned by listening or by reading several ARRL publications which are available. There are also many slow speed or Novice nets, which offer a great introduction to traffic handling (and some super code practice, too).

Phone patching requires listening and volunteering when appropriate (and, of course, a patch!). The Military Affiliate Radio System (MARS) offers many a chance to perform a public service.

There are also plenty of special interest nets and round tables. Some specialize in assisting mobile operators, relaying traffic to missionary personnel or to ships at sea. Some are for physicians to assist in medical problems in remote areas. Whether you're interested in politics, religion, parapsychology, ecology, or a technical discussion, you can find somebody with similar interests, either by simply listening, or by watching for blurbs in the radio magazines. You might even send one in yourself. There are even professional group nets, such as attorneys, post office employees, and the like, who get on the air, not to just talk shop, but to share similar interests and experiences.

Like to play a little chess? There are many games and activities which lend themselves well to amateur radio. It may be a simple game of checkers or the complexity of "Diplomacy." You may practice your stamp collecting or discuss computer science. Practically any other hobby you enjoy can be combined with amateur radio, with the enjoyment multiplied.

Have you thought about experimenting with other modes? RTTY, slow scan or fast scan television, OSCAR, or even CW – all exotic life forms for engineers? Hardly! They are proving to be loads of fun for thousands of us who once thought we could never get the hang of such way-out weirdness. Expensive? Not necessarily. Build,

find used gear, scrounge around – getting there is half the fun. And wait until you see that first SSTV picture from the Middle East or good teletype copy from a station in Japan. There are plenty of books available for the beginner in each of these specialized modes, and you will find that most people already involved like nothing better than to talk about their interests and will be glad to help a newcomer.

And though you probably worked pretty hard to get away from that 5 Watt limitation on the Citizens Band, you are missing a lot of challenging fun if you don't give QRP a try. Several QRP rigs have been featured in the various magazines, and more are available commercially. Sure, it can be frustrating fighting the full gallons with flea power, but when that fellow in Germany gives you a 589 and refuses to believe your 3 Watts input, then you'll know true happiness. QRP is sneaky, too, in that it makes you a better, smarter operator and forces you to learn a little about antennas and propagation.

There are a lot of things you can do off the air to get the fun back into your hobby.

You say you haven't built anything since the code practice oscillator when you were working on 5 words per minute? There are plenty of projects that are not only fun to build, but also are so useful you'll wonder how you ever did without them. Parts are as reasonable now as I can ever remember, with a friendly electronics store on practically every corner. There is no better way to get a firm grasp on the modern technology than to hook some of those funny little things together and see what happens. Even if you only thought a soldering iron was good for burning holes in the carpet, there are kits available that you can put together, get a good idea of how it all works, and have a good piece of gear when you're finished. I have a friend who tries to start a new project every week. He has never finished one, but he has a ball.

You may get out of the house and join a local club. Very few hams bite, and most are friendly sorts. And your club most likely has interesting programs and speakers, worthwhile fun projects, and maybe even coffee and doughnuts. There is also great satisfaction in participating in club projects, like public service activities, helping plan a hamfest, or presenting a program yourself.

I don't know how you got started, but a lot of us attended formal classes. And classes like that need instructors. You? Sure, you can teach! Or maybe set up chairs in the classroom, work on publicizing the classes, or just help passing out books. Or you could do something on a smaller scale, like helping an interested prospect in the neighborhood or teaching a scout troop.

As long as you're volunteering, raise your hand for the work party at the repeater site. It's a great way to get to know the locals, learn a little about VHF by doing it, and do a little toward keeping the machine going. And you could also take part in the next disaster drill, too, or maybe help with communications for the motorcycle races, or man the information booth at the shopping center, or accept an operating assignment for Field Day, or demonstrate the rig for a school science class. You get the idea.

Then, you could even sit down and write an article about some of your projects for *73 Magazine*.

And then, if you can possibly find the time, you could sit down at the rig and have a good old-fashioned rag chew. ■

73 Magazine *Staff*

Build A Useful HF Receiver

-- Novice special

It is interesting to note how events sometimes go around full circle in the amateur radio field. Many years ago, the only way to have an amateur band receiver was to build one yourself. Then later on, as commercial equipment appeared, most amateurs regarded those who "rolled" their own receivers as a group of technical geniuses. Building a transmitter wasn't too difficult, but building a good receiver was another matter. A crude, crystal-controlled transmitter with plug-in coils could be built with a minimum of electrical/mechanical workshop facilities. But to build a good receiver required good test gear and practically machine shop facilities.

Today, with solid state components and PC layout technique, almost any amateur can build a receiver with performance matching commercial units. For those who would like to start to try their hand at receiver building, this article presents a simple HF utility type receiver. It can be used to monitor WWV, to check specific frequencies in the HF bands, or to monitor station transmissions.

As presented, it is crystal-controlled, although one could add a vfo for continuous tuning of its entire range or of just specific bands. With the addition of an audio-type CW filter, it would make an excellent little receiver for portable QRP operation.

The receiver is a single conversion, superheterodyne type, with an FET front end, and is crystal-controlled. No bandswitching is required when it is used over the 6-15 MHz range. Coil usage has been held to a minimum to simplify construction. Construction is also facilitated by the use of a single IC for all audio amplification and the use of a commercial i-f amplifier module.

The schematic for the receiver is shown in Fig. 1, as it would be used for WWV reception. Note that the only switching which has to be done to receive WWV on different frequencies is that necessary to select the appropriate local oscillator crystals. The frequency coverage can be extended below 6 MHz and above 15 MHz, by using a different coil between the MPF 102 (HEP 802) rf amplifier and mixer stages. Or, in the case of just extending coverage below 6 MHz, a 100-200 pF padding capacitor, across the 210 pF variable capacitor shown,

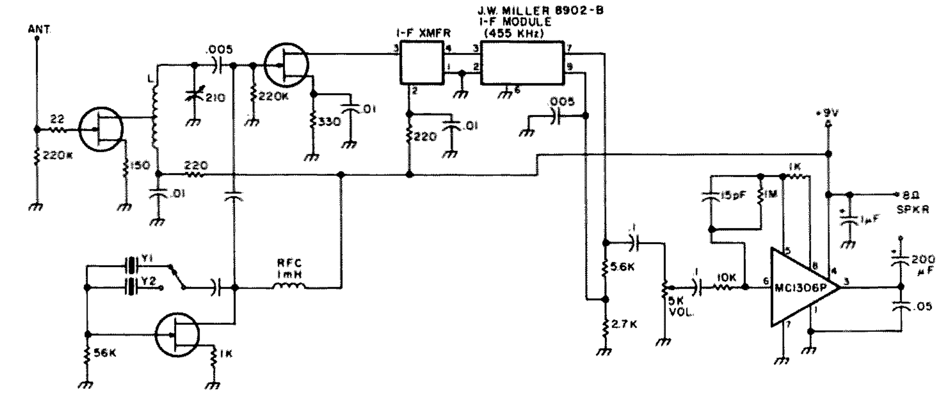


Fig. 1. Complete diagram of the receiver. All transistors are MPF 102 or HEP 802. The i-f transformer comes as part of the J. W. Miller i-f module. L = 26 turns #26 on ¼" form. Tap at 13 turns (for 6-15 MHz). Y1 = 9,545 kHz (10 MHz WWV). Y2 = 14,545 kHz (15 MHz WWV).

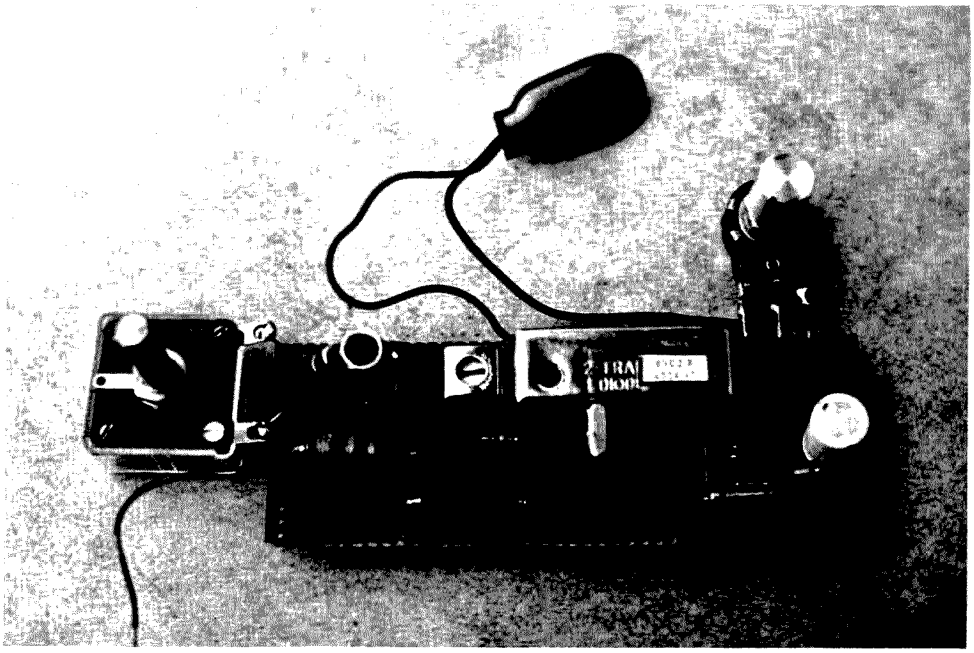
should extend coverage down to the 80 meter band.

The MPF 102 rf amplifier stage is untuned at its input. Its main purpose is to keep the antenna from loading down the tuned circuits between the rf amplifier and mixer stages. This single tuned circuit is sufficient to provide reasonable image rejection. The MPF 102 mixer stage and MPF 102 crystal oscillator stage are conventional. The oscillator stage is untuned. This has proven satisfactory for general reception, using regular miniature HC6/U type crystals. With some sluggish crystals, the rfc shown in this stage may have to be replaced with a tuned circuit.

The i-f amplifier module is a J. W. Miller type 8902-B. This module is just a two-stage i-f amplifier, complete with all necessary i-f transformers, and it also includes an AM diode detector. Its use greatly simplifies construction. If one can't find it readily available, a simple substitute is to cannibalize the i-f section from a small transistor portable radio. But, use an i-f section which has at least two stages. The really cheap $5 portables often use only a single i-f stage, and this will not provide sufficient gain for any sort of reasonably sensitive reception.

The audio amplifier IC is a Motorola MC1306P. This is a neat, inexpensive ($1) IC, which combines a preamplifier and ½ Watt output amplifier in one package. A minimum of external components are needed to make it function. If you did "borrow" the i-f strip from a cheap AM portable to build this receiver, *don't* be tempted to "borrow" the audio section of the AM portable, also. Generally, the quality of such audio sections is horrible, when compared with the clean sound of the MC1306P used with any small, but decent, 8 Ohm speaker.

The photo shows how the receiver was initially laid out



This is the complete receiver, as assembled on an approximately 4" x 2" piece of perforated board stock.

on a piece of perforated board stock. Simple point-to-point wiring was used. The layout wasn't planned, but, rather, construction started on a slightly larger piece of board stock. Starting with the rf amplifier stage, the components were simply grouped together as closely as possible, as I worked from left to right. The rf and mixer stages were grouped around the interstage coil. The crystal oscillator stage is below the i-f amplifier module, and the af amplifier IC is just to the left of the electrolytic capacitor, shown at the extreme right middle side of the board. When the receiver had been assembled, the oversize perforated board was carefully cut down to its final size.

The tuning capacitor used is a regular BC type and is temporarily shown attached at the left side of the board. The receiver should be mounted in a metal enclosure, and the ground leads used in the receiver should be carefully grounded to the enclosure at several points. Although the receiver did work fine wired as shown in the photo, it probably would be safer, from the viewpoint of avoiding possible spurious oscillations, to utilize an isolated pad type of component mounting/soldering technique. The relatively new Stamp-It, Etch-It kit, sold by Rainbow Electronics (see *73* ads), is a pretty handy way of developing an easy do-it-yourself PC layout for the receiver, if you like to take a bit more time but end up with a more professional-looking PC board.

To use the receiver to monitor SSB transmissions, a product detector and bfo have to be added. The circuit for a suitable product detector/bfo is shown in Fig. 2. It is relatively simple and inexpensive. If the product detector circuit is added to the receiver using the J. W. Miller i-f module, you have to remove the shield can from the module and take the i-f signal off the first 1N67A, *before* the diode detector is built into the module. This operation is fairly simple and obvious, if one uses the module, since a diagram comes with it, illustrating the modification. The diode AM detector need not be disconnected, however. So, one can, if desired, add a switch at the volume control to choose either the output of the product detector or the output of the AM diode detector.

With a mixture of some parts from one's junk box and newly-bought main components, the receiver can be constructed for about $20. This represents a rather modest cost for a utility-type HF receiver, for which one can find many applications around the shack or in portable use. ■

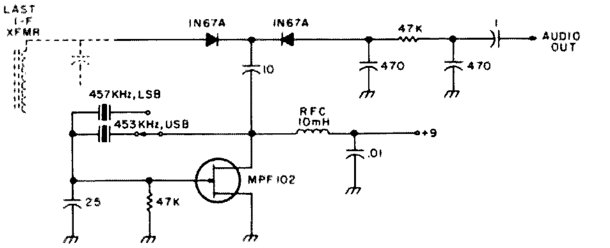


Fig. 2. Product detector/bfo, which can be added for SSB reception.

Wake Up A Dead Repeater!

-- with these new Q signals

Guy Slaughter K9AZG
753 W. Elizabeth Dr.
Crown Point IN 46307

Because the sophistication of state-of-the-art radio gear hasn't been matched by improved ham operating practices, it is often essential for an amateur to vent his spleen over the air in one or another of a patterned program of careful comments.

And no such comments, despite the need for their frequent repetition and the necessity of avoiding actual profanity, are the subjects of any of the "Q" signals on the traditional list.

I have developed, therefore, a suggested list of updated state-of-the-operating-art "Q" signals intended to lower the blood pressure and restore tranquillity without violating the FCC "no obscenities" regulation.

There undoubtedly will be others recommended by other hams.

My suggested list, therefore, is open to amendments, revisions, additions and modifications by fellow hams also frustrated by the shortcomings of other operators and the traditional list of "Q" signals.

Welcome to recommend such amendments or revisions are all who have within the past year sat in for even a few minutes on a DX contest, a sweepstakes, or a band opening to a rare call area.

Because the purpose of the proposed list is to help vent the emotions sure to be seething in the modern ham handicapped by others' operating techniques, most of the suggested "Q" signals are assertions, not the bland and polite question-and-response types of the outmoded traditional list.

They are most useful when delivered as commands or comments, with feeling. ■

QXA	Hey, dolt, tune up someplace else.
QXB	Drop dead, oaf, my dummy load is busted.
QXC	Quit calling through his comeback, jerky.
QXD	I gotta call long, because I'm running low power to a poor antenna with a lousy fist.
QXE	He's listening up two, but you'd better go down five.
QXF	Buzz off, buster. I got here first.
QXG	Slow down, finkie. Your dits sound like ignition noise.
QXH	Speed it up, nipsie. Code practice is over and the band is going out.
QXI	You're working the wrong street, friend. They only use AM on 27 now.
QXJ	Sign, for goodness sakes. I've been waiting 20 minutes to put your call in the log.
QXK	Quit calling through his comeback, dummies.
QXL	Don't expect a card, OM. I don't keep a log.
QXM	Don't gimme that exotic call from Illinois, Mac. I could care less about your state fair station.
QXN	Boy, you gotta lousy fist.
QXO	I worked him before, anyway.
QXP	That ain't hum on me. I'm just blocking your receiver.
QXQ	(Expletive deleted — this is the biggy, the quick tension releaser. It's bad, nasty and very helpful in a crisis. But it should be saved for true crises.)
QXR	I told you before, dang it — quit calling through the rare cat's comeback.
QXS	I copied you solid, 100 per cent, OM, but I can't remember what you said.
QXT	I'm not working for my Extra, cuz I don't believe in that incentive jazz.
QXU	All solid state here. Someday I'm gonna lift the lid and see what's inside.
QXV	I wish to QXQ you QXQers would quit calling through the rare guy's comeback.
QXW	Nil copy, cuz them QXQers keep calling through your comeback.
QXX	I'm reporting you blind, cuz them QXQers keep calling through your comeback.
QXY	I distinctly heard a "G," so I'm gonna put you in the log — even though them QXQers keep calling through your comeback.
QXZ	Where'd everybody go?

Social Events

HAZEL PARK MI
DEC 4

The Hazel Park Amateur Radio Club is holding their 12th annual Swap & Shop on December 4, 1977, at the Hazel Park High School. Admission is $1.00 at the door. Main prize tickets are available from Robert Numerick WB8ZPN, 23737 Couzens, Hazel Park MI 48030. Reserve table space is available from WB8ZPN.

NORTH POLE
DEC 6-17

The Calgary Amateur Radio Association is pleased to announce "Operation Santa Claus" will be activated again this year. Commencing December 6 until December 17 inclusive. CARA will be operating between 0200Z and 0300Z on 3790 kHz and between 0300Z and 0400Z on 3910 kHz. These frequencies are plus or minus QRM. At that time there will be two stations on frequency, a net control station and a Santa Claus station. All calls, from amateur stations with children wishing to speak to Saint Nick at the North Pole, will be accepted. Merry Christmas.

ROYAL OAK MI
JAN 8

The Oak Park Amateur Radio Club's Ninth Annual Swap n' Shop will be Sunday, January 8, 1978, at the Frost Junior High School in Oak Park (north of Nine Mile on Scotia). Talk-in on 52/52. Admission is $2 — ample table space. Hours are from 8 am to 3 pm. Prizes and refreshments. For further info, write to: Lee Ricelli WA8RNB, 118 South Pleasant, Royal Oak MI 48067.

SOUTH BEND IN
JAN 8

A Swap & Shop will be held January 8, 1978, at the New Century Center in downtown South Bend by river on U.S. 31 Oneway North across from St. Joseph Bank Building. Half acre in one large room at ground level of entrances and loading dock. Four lane highways to door from all directions. Talk in on 52-52 and area repeaters.

RICHMOND VA
JAN 15

The Richmond, Virginia, Winterfest will be held on January 15, 1978, at the Bon Air Community Center, sponsored by the Richmond Amateur Telecommunications Society. ARRL coordinated. Technical symposium, drawing, home brewers contest — 2 divisions, over 18 and under — with framed certificate to winners with Most Original Idea, Best Mechanical and Best Electrical Construction. FCC exams will be administered, starting at 10 am — to take exam, mail Form 610 at least five days prior to Fest to address below. Send SASE if you need Form 610. Commercial exhibits, indoor flea market, $2.00 (table included), outdoor frostbite tailgate flea market, $1.00. Admission $2, children under 12 free. RATS members excluded from contest and drawing. Talk-in on 28-88 and 52 simplex. Richmond Amateur Telecommunications Society, PO Box 1070, Richmond VA 23208.

FORT WAYNE IN
JAN 22

The annual Fort Wayne Winter Hamfest will be held on January 22 at Shiloh Hall, north of Fort Wayne, from 8 am until 4 pm local time. Early parking is available and 28/88 and 52/52 will be monitored. This yearly event is sponsored by the Allen County Amateur Radio Technical Society (AC/ARTS). Admission is $2.00 at the door. Table space is available at $1.50 per half table (about 4 feet).

ST JOSEPH MO
JAN 31-MAR 7

The Missouri Western State College Center for Continuing Education is offering a Novice amateur radio class on Monday evenings, 7 to 9 pm, January 31 through March 7, at the Engineering Tech. Bldg. 110. 6 meetings $5.

DAVENPORT IA
FEB 26

The Davenport Radio Amateur Club hamfest will be held on February 26, 1978, at the Masonic Temple in Davenport, Iowa. Admission is $2.00 advance, $2.50 at door. Talk-in will be on 28/88 and 52 simplex. Tables will be available at $2.00 each. For info and tickets, write: Dick Lane WAØGXC, 116 Park Avenue So., Eldridge IA 52748.

Ham Help

I'm asking the help of anyone who can help me get started on SSTV. Any help, information, and/or tips will be greatly appreciated.

Steve Ketler WA1WFA
85 Columbus Avenue
West Bridgewater MA 02379

I recently purchased a theater projection television system. The problem is that I need a picture tube and service information. The set is built by RCA, model PT-100. The picture tube is a 7NP4 or 7WP4. Neither the tube nor manual are available.

I realize that your magazine is mostly amateur radio, and while I am not yet a ham, I do have a 1st phone and repair commercial equipment for a living. I also service amateur gear as well. This TV system is not the small home-type that was popular years ago and is making a comeback. It is a huge commercial projection set that is often used to present fights and races in movie theaters. This unit is quite old, so there are no parts or info available today. It's a very impressive piece of gear, and I would love to make it work again. I never plan to use it commercially. I feel that some reader of your magazine might be able to help me get this monster going.

Bruce Gentry
624 Plymouth Ave.
Mattydale NY 13211

I am a reader of *73*, am not a ham (yet), but need help. The help I need is the answer to this question: Where can I buy a good, used "pan adapter" — that is, an oscilloscope device which visually displays all signals on a 300-500 kHz band? I would consider a new one, if it wouldn't cost the moon. My receiver is a National HRO 600. Any ideas?

Lawrence J. Gutter
President
Chicagoland Broadcasters, Inc.
2622 W. Peterson Ave.
Chicago IL 60659

1977 Index

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	7	7	3	3	3	3	3	7	14	14A	14
ARGENTINA	7A	7	7	7	7	7	14	14A	14A	21	21	14
AUSTRALIA	14	7B	7B	7B	7	7	7B	7A	14	14	14	14
CANAL ZONE	7A	7	7	7	7	7	7A	14	21	21	21	14
ENGLAND	7	7	7	3A	7	7B	7A	14A	14A	14	7B	7
HAWAII	14	7B	7	7	7	7	3A	3A	7B	14A	21	14A
INDIA	7	7	7B	7B	7B	7B	7B	14B	14B	7B	7B	7
JAPAN	14B	14B	7B	7B	7	7	3A	7	7B	7B	7B	14B
MEXICO	7A	7	7	7	7	7	7	14	14A	21	14A	14
PHILIPPINES	14	7B	7B	7B	7B	7	7	7	7B	7B	7B	7
PUERTO RICO	7	7	3A	3A	3A	3A	7A	14	14A	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7B	14	14A	21	21	14	14
U. S. S. R.	7	7	3A	3A	7	7B	7B	14	14	7B	7B	7
WEST COAST	14	7	7	3A	7	7	7	7A	14	14A	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	3	3	7	14	14	14A
ARGENTINA	14	7	7	7	7	7	7B	14	14A	21	21	14
AUSTRALIA	14	7A	7B	7B	7	7	7B	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	14
ENGLAND	7	7	7	3A	7	7	7B	14A	14A	14	7B	7B
HAWAII	14	7A	7	7	7	7	3A	3A	7B	14A	21	21
INDIA	7	7	7B	7B	7B	7B	3B	7A	7A	7B	7B	7B
JAPAN	14	14B	7B	3A	3A	3A	3	3	7	7B	7B	14
MEXICO	14	7	7	3	3	3	3	7A	14	14	14	14
PHILIPPINES	14	14B	7B	3B	3B	3B	3A	3A	3A	7	7B	14
PUERTO RICO	7A	7	7	7	7	7	7	14	14A	14A	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	14A	21	14A	14
U. S. S. R.	7	7	3A	3A	7	7	7B	14	7B	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14A
ARGENTINA	14	7A	7	7	7	7	7B	14	14	14	21	21
AUSTRALIA	21	14	14	7B	7	7	7B	7B	7A	14	14	14
CANAL ZONE	14	7A	7	7	7	7	7	14	21	21	21	14
ENGLAND	7B	7	7	3A	7	7	3B	7B	14	14	7B	7B
HAWAII	14A	14	7A	7	7	7	7	3A	7	14A	21	21
INDIA	7B	14B	14B	3B	3B	7B	3B	7	7	7	7B	7B
JAPAN	21	14	7B	3A	3A	3A	3	7	7	7	7B	14
MEXICO	14	7A	7	3A	7	7	3A	7	14	21	21	14
PHILIPPINES	14A	14	7B	7B	7B	7B	7	3	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14A	14A	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	7A	14	14A	14	14
U. S. S. R.	7B	7	3A	3	3A	7	3B	7A	7A	7B	7B	7B
EAST COAST	14	7	7	3A	7	7	7	7A	14	14A	14A	14

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
FG = Fair to Good
P = Poor

1977 DECEMBER 1977

SUN	MON	TUE	WED	THU	FRI	SAT
				1 F	2 F	3 P
4 FG	5 FG	6 FG	7 FG	8 FG	9 F	10 F
11 P	12 F	13 F	14 P	15 F	16 F	17 FG
18 FG	19 P	20 F	21 F	22 F	23 F	24 P
25 F	26 FG	27 FG	28 FG	29 F	30 F	31 F